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A validation study comparing self-reported travel diaries and objective data obtained from in-vehicle monitoring devices in older drivers with bilateral cataract

Seraina Agramunt (MSc, MAS)[a,b], Lynn Meuleners (PhD) (Professor)[a,b,*], Kyle Chi Chow (PhD) (Dr.)[a,b], Jonathon Q. Ng (MBBS, FRANZCO, PhD) (Dr.)[b,c], Nigel Morlet (MBBS, FRANZCO, FRACS) (Professor)[b,c]

[a] Curtin-Monash Accident Research Centre (C-MARC), Curtin University, Perth, Australia
[b] Eye & Vision Epidemiology Research (EVER) Group, Perth, Australia
[c] School of Population Health, The University of Western Australia, Perth, Australia

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ABSTRACT

Background: Advances in technology have made it possible to examine real-world driving using naturalistic data obtained from in-vehicle monitoring devices. These devices overcome the weaknesses of self-report methods and can provide comprehensive insights into driving exposure, habits and practices of older drivers.
Aim: The aim of this study is to compare self-reported and objectively measured driving exposure, habits and practices using a travel diary and an in-vehicle driver monitoring device in older drivers with bilateral cataract.
Methods: A cross-sectional study was undertaken. Forty seven participants aged 58–89 years old (mean = 74.1; S.D. = 7.73) were recruited from three eye clinics over a one year period. Data collection consisted of a cognitive test, a researcher-administered questionnaire, a travel diary and an in-vehicle monitoring device. Participants' driving exposure and patterns were recorded for one week using in-vehicle monitoring devices. They also completed a travel diary each time they drove a motor vehicle as the driver. Paired *t*-tests were used to examine differences/agreement between the two instruments under different driving circumstances.
Results: The data from the older drivers' travel diaries significantly underestimated the number of overall trips ($p < 0.001$), weekend trips ($p = 0.002$) and trips during peak hour ($p = 0.004$). The travel diaries also significantly overestimated overall driving duration ($p < 0.001$) and weekend driving duration ($p = 0.003$), compared to the data obtained from the in-vehicle monitoring devices. No significant differences were found between instruments for kilometres travelled under any of the driving circumstances.
Conclusions: The results of this study found that relying solely on self-reported travel diaries to assess driving outcomes may not be accurate, particularly for estimates of the number of trips made and duration of trips. The clear advantages of using in-vehicle monitoring devices over travel diaries to monitor driving habits and exposure among an older population are evident.

1. Introduction

The population of the world is ageing and this trend is expected to continue for several decades (United Nations, 2015). It has been estimated that at least a quarter of the population globally, will be aged 60 years or over by 2050 (United Nations, 2015). In Australia, for example, older adults are living longer, healthier lives (Australian Institute of Health and Welfare, 2015). This has led to an increase in the number of older drivers on the road with driving licence counts increasing by 44% for the 65+ age group in the decade ending in 2013 (Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2014).

In Australia, driving is the most common form of transport for people aged over 65 years (Australian Bureau of Statistics, 2004). Driving enables an ageing population to maintain their independence, mobility and flexibility (Gwyther and Holland, 2012) and is strongly associated with older adults' social participation

* Corresponding author at: Curtin-Monash Accident Research Centre (C-MARC), GPO BOX U1987, Perth, WA 6845, Australia.
E-mail address: l.meuleners@curtin.edu.au (L. Meuleners).

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(Pristavec, 2016). In contrast, driving cessation has been linked to poorer health, social, cognitive and physical function and an increased risk of depressive symptomatology (Chihuri et al., 2016). However, as people age, sensory, motor and cognitive declines as well as medical conditions common in older adults such as cataract, can affect the ability to safely operate a motor vehicle.

Cataract is an opacification of the crystalline lens of the eye (Iroku-Malize and Kirsch, 2016) which causes a gradual decline in visual function and is one of the leading causes of vision impairment globally (Pascolini and Mariotti, 2011). By age 70, almost everyone will have developed some degree of cataract (Taylor et al., 2005). There is evidence to suggest that cataract patients may modify their driving exposure, habits and practices while waiting for surgery (Fraser et al., 2013; Owsley et al., 1999). An early study from the USA found that cataract patients reported reductions in the number of days and destinations driven, driving slower than the general traffic flow and preferring someone else to drive as a result of their visual impairment (Owsley et al., 1999). More recently, Australian cataract patients reported avoiding driving at night, on freeways, in the rain and parallel parking due to their visual impairment (Fraser et al., 2013). However, it should be noted that these studies only used self-report questionnaires to measure the driving exposure, habits and practices of drivers with cataract. These sources however, may be limited in the depth and accuracy of information they can provide about driver behaviour and may be affected by recall and social desirability bias.

Recent research has found that self-reported measures of driving exposure (driving distance) among older adults may be inaccurate (Blanchard et al., 2010; Porter et al., 2015). This raises questions concerning the validity of other self-reported driving practices. In addition, recent naturalistic driving studies found that older drivers in general may not restrict their driving as much as they report on questionnaires (Blanchard and Myers, 2010; Myers et al., 2011). For example, older drivers with Parkinson's Disease were found to accurately report their number of days driving in morning/afternoon driving and residential/city area driving when compared to data collected from an in-vehicle driver monitoring device (Crizzle et al., 2013). However, they drove more at night, in bad weather, in peak hour traffic and on highways than they self-reported (Crizzle et al., 2013). Similarly, an Australian study of 156 older drivers found that participants tended to underreport their average number of days per week and kilometres per week driven. However, participants accurately reported avoidance of driving at night, in unfamiliar areas and on high speed roads (Molnar et al., 2013). It has also been reported that participants prefer to use in-vehicle monitoring devices over self-reported travel diaries or questionnaires (Blanchard et al., 2010). Indeed, travel diaries may lead to high dropout rates among participants and are seen as an encumbrance when required to be filled in daily (Marshall et al., 2013). However naturalistic driving research overcomes the weaknesses of self-report methods, providing objective measures of real-world driving and allowing comprehensive insights into the driving exposure, habits and practices of older adults. In-vehicle driving monitoring devices are small electronic devices that can be attached to a participant's own car and record electronic, time-tagged GPS data on location and speed which allows naturalistic examination of real life driving patterns.

Older adults with cataract are a unique group of older drivers. Since cataract, unlike other conditions of ageing, can be quite easily corrected by surgery, it is important to determine whether these patients temporarily modify their driving exposure, habits and patterns while waiting for surgery, potentially reducing their crash risk. To date however, the limited investigations of driving patterns among cataract patients have used self-report measures only (Fraser et al., 2013; Owsley et al., 1999). Before further research is undertaken among cataract patients, it is essential to determine the accuracy of self-reported measures (including travel diaries) of driving exposure, habits and patterns, as compared to data obtained from more costly in-vehicle monitoring devices. Current evidence suggests that self-report methods are often inaccurate among general older drivers, however findings are inconsistent on which driving measures older adults are able to accurately report or record, for example, night driving exposure (Crizzle et al., 2013; Molnar et al., 2013). In addition, the majority of these studies sampled from the general older population. Since those awaiting cataract surgery are more likely to be actively and temporarily modifying their driving exposure, habits and patterns than general older drivers, it is essential to determine whether this group are able to accurately report these driving outcomes using a travel diary, as compared to data obtained from in-vehicle monitoring devices.

Therefore, the aim of this study is to compare self-reported information obtained from a travel diary and objectively measured data using an in-vehicle driver monitoring device on driving exposure, habits and practices in older drivers with bilateral cataract as they await first eye cataract surgery.

2. Methods

2.1. Research design and participants

A cross-sectional study was undertaken. Participants with bilateral cataract who were scheduled for first eye cataract surgery within one month were recruited from three eye clinics in Perth, Western Australia (WA). Inclusion criteria stipulated that participants were aged 55 years or older, possessed a current WA driver's licence, drove at least twice a week, had access to a motor vehicle, and lived in the Perth metropolitan area. Participants were excluded from the study if they had a diagnosis of dementia, Alzheimer's disease, Parkinson's disease, were wheelchair bound, colour-blind, did not speak English or had any other ocular conditions that would limit visual outcome. Patients with diagnoses of refractive error or dry eye were acceptable for inclusion in the study.

2.2. Data collection

Participants were recruited and data collected over a one year period in 2015. They were provided with a Participant Information Sheet and informed consent was obtained before any information was collected by a trained researcher. Data collection consisted of three visual tests (under the guidance of an ophthalmologist), a cognitive test, a researcher-administered questionnaire, travel diary and use of an in-vehicle monitoring device. It took approximately 50 min to complete the questionnaire, cognitive and visual tests for each participant. The travel diary and in-vehicle driver monitoring device were provided to each participant at the assessment. The results of the visual tests are not presented as part of this paper. Medical records were also accessed to validate information on co-morbid medical conditions, and current and previous treatments and medication(s). Ethics approval was obtained from Curtin University as well as the three public hospital eye clinics.

2.2.1. Questionnaires/instruments

Socio-demographic data, such as age, gender, level of education, marital and employment status, country of birth, living situation, medications, co-morbid conditions and years of driving experience was collected using a researcher administered questionnaire. Each participant was also asked about their driving experience and confidence when driving. All participants were also assessed to determine their cognitive status using the Mini-Mental Status Examination (MMSE) (Folstein et al., 1975).

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