Self-Reported Medication Use and On-Road Driving Performance of Older Drivers

MRJ Baldock¹,²
JL Mathias²
A Berndt³
AJ McLean¹

Contact address Matthew Baldock ¹Centre for Automotive Safety Research, University of Adelaide South Australia, 5005; ²Department of Psychology, University of Adelaide; ³School of Occupational Therapy, University of South Australia, Australia

Background
A great deal of attention has recently been devoted to the older driver (> 65 years), largely because older drivers have a greater crash rate per kilometre driven [1-4] and also because of the substantial projected increases in the number of older drivers in the next half a century [e.g. 5]. It has been suggested that the higher crash rate of older drivers is due to high risk subgroups within the older driver population rather than to a general decline associated with ageing [6]. For example, the increased crash risk of older drivers may, in part, be attributable to the fact that increasing age is associated with a greater prevalence of medical conditions that affect driving ability [7].

Associated with this higher prevalence of medical conditions is greater use of medications [8]. This has implications for road safety because many medications have side-effects that impair central nervous system functioning, and which may be detrimental to driving ability. There is also greater sensitivity with increasing age to anything that affects the central nervous system [8, 9], leading to an increased likelihood with age of adverse reactions to medication [7]. Older drivers are also more likely to be taking more than one medication at a time, known as ‘polypharmacy’ [8, 10]. Medications taken concurrently could have additive or synergistic effects, which could further impair central nervous system functioning.

Objectives
This study examined the relationship between self-reported medication use and performance on an on-road driving test in a sample of older drivers. Specifically, the aim was to ascertain whether older drivers who were taking a higher number of prescription medications demonstrated poorer driving performance. This study was conducted as part of a larger study investigating the self-regulation of driving habits by older drivers.

Methodology
A group of 104 older drivers (aged 60 years or more) were recruited from two sources: the general community and the Driver Assessment Rehabilitation Service (DARS) at the University of South Australia. Community participants were recruited through Senior Citizens’ clubs and Australian Retired Persons Association clubs in metropolitan Adelaide. The group of drivers from the DARS client pool were referred, mostly by general practitioners, for an assessment of their ability to drive and their right to hold a driver’s licence.

The total sample consisted of 104 adults (65 females, 39 males), 93 of whom were recruited from the general community and 11 of whom were recruited from the DARS
client pool. Their ages ranged from 60 to 92 ($M = 74.2, SD = 6.3$) and they had completed an average of 10.9 years of formal education ($SD = 3.0$).

All participants were required to be fluent in English, in possession of a full driver's licence for non-commercial motor vehicles, and have been driving for over ten years. The latter requirement was imposed to ensure that all participants were experienced drivers. Participants were excluded if they had suffered a cerebrovascular accident (stroke), traumatic brain injury, or other event causing a sudden loss of functioning, in the past year.

Participants completed a questionnaire about their health and medication use, in which they indicated whether they had been diagnosed with any of 14 listed medical conditions and to nominate any other conditions they had. For each such medical condition, participants reported the extent to which it affected their daily functioning on a three point scale (1 = not at all, 2 = a bit, 3 = a lot). These scores were summed to provide an index of participants' general health. Additionally, participants provided a list of any prescription medication that they took at least once a month. Details of these medications were obtained from the Monthly Index of Medical Specialties (MIMS) annual [11] to identify medications that may be hazardous to driving. The MIMS annual is a publication providing details about currently available medications, including likely and possible side-effects. All medications described as commonly causing drowsiness, dizziness, or disturbance of central nervous system functioning were classified as being "potentially hazardous to driving".

The driving assessments consisted of standardised on-road driving tests conducted by an occupational therapist from DARS with postgraduate training in driver assessment and rehabilitation, and a professional driving instructor. The driving instructor directed the participant through the driving route and used dual brakes to maintain safety, while the occupational therapist scored the participant's driving performance. A set test route based on testing procedures used in other studies [12-14] was designed specifically for this study. The test was broken into four sections: familiarisation, low demand, moderate demand, and high demand. The familiarisation section involved familiarising the driver with the vehicle, and assessing whether the driver could perform basic vehicle control tasks (e.g. starting a car, moving off). The low demand section was conducted on low traffic roads and mainly involved negotiating roundabouts. The moderate demand section involved driving on main roads but did not require complex manoeuvres. In this section, all intersections were negotiated by driving straight through or turning with a dedicated turning arrow. In the high demand section, drivers had to perform unprotected right turns at intersections on main roads, as well as merging manoeuvres on multi-lane roads and driving in areas featuring high pedestrian activity. The driving test, therefore, involved progressively more difficult manoeuvres completed in the presence of increasingly more complex traffic conditions. It took from 40 minutes to an hour to complete.

The on-road driving tests were all conducted in dual-controlled, medium-sized sedans (1997 Toyota Corollas), fitted with power steering and manual or automatic transmission, depending on the participant's preference. Two occupational therapists were employed for the study, and completed 57 and 43% of the assessments, respectively. The same driving instructor was available for 95% of the assessments. Assessments were conducted at 9:30am, 11:00am or 1:00pm, so that drivers were not assessed during peak hour traffic.

As is standard practice for DARS, test failure was based on agreement between the occupational therapist and driving instructor about the safety risk posed by the driver, given the types of errors they made and the level of active intervention required on the part of the driving instructor to ensure safety during the test (applying brakes, taking hold of the
steering wheel, explicit verbal guidance). Errors that posed a greater safety risk, such as speeding, disregarding traffic signals and Stop or Give Way signs, drifting into other lanes, and stopping unexpectedly without reason, were most likely to lead to failure of the test.

In keeping with other studies of driving performance and aging [15-17] in which different weightings were given for different road test errors, a scoring system was developed that assigned different weightings to different errors in order to produce an overall score that more closely matched the outcomes of the assessments (i.e. pass or fail). Greater weightings were assigned to errors requiring the intervention of the driving instructor, with lesser weightings given to what were termed “hazardous” errors (exceeding the speed limit, inappropriate high speed, unsafe gap selection, unsafe positioning, disobeying Stop signs or traffic lights) and no extra weightings given for what were termed “habitual” errors (e.g. failure to check mirrors or blind spots, failure to indicate, inappropriate lane selection, poor parking ability). It was found that, using a weighting of 10 for driving instructor interventions, five for hazardous errors and one for habitual errors, it was possible to accurately predict test outcomes in 94% of cases, with 79% sensitivity (correctly identified failures) and 97% specificity (correctly identified passes). This weighted error score was used as the outcome measure for the driving assessment.

Results and Analysis
It was found that 83% of participants reported having at least one medical condition but few (less than 13%) had more than three. The most commonly reported medical conditions were arthritis (45%), hypertension (31%), and heart disease (15%). A variable was calculated that took into account self-reports of the extent to which each medical condition affected daily functioning, and this variable ranged from 0 to 12 (\(M = 2.57, \text{SD} = 2.03\)). This suggests that the drivers in the sample were not strongly affected by the medical conditions they reported having. This variable (“general health”) was used as an index of the degree to which the participants were affected by medical complaints.

The number of medications used by the participants is shown in Table 1, where it can be seen that over 60% of participants reported using at least one prescription medication each month. The most commonly used medications were those used to treat hypertension, heart problems, cholesterol, and arthritis.

Given that many medications were unlikely to affect driving, the medications listed by participants were categorised according to whether or not they could negatively impact on driving. Table 1 shows that the majority of participants did not regularly use a medication that could adversely affect driving. Furthermore, the majority (30 out of 44) who did use a medication that could affect driving used only one. In total, there were 44 drivers who were taking 67 medications that may affect driving, the most common being medications to treat hypertension, heart problems, acid reflux or ulcers, and depression.

| Table 1 |
|---|---|---|
| **Number of medications used regularly by participants** | | |
| Number of medications | All medications | Potentially hazardous medications |
| 0 | 39.4 (41) | 57.7 (60) |
| 1 | 18.3 (19) | 28.8 (30) |
| 2 | 12.5 (13) | 5.8 (6) |
| 3 | 6.7 (7) | 6.7 (7) |
| 4 | 13.5 (14) | 1.0 (1) |
| 5 | 7.7 (8) | - |
| 6 | 1.0 (1) | - |
| 7 | 1.0 (1) | - |
| Total | 100.0 (104) | 100.0 (104) |
Of the 104 participants, 90 completed the on-road driving test (82 from the general community, eight referrals). Sixty eight (76%) of these passed the test, eight (9%) passed but were recommended to have lessons and 14 (16%) failed. On average, there were 1.1 (SD = 1.7) driving instructor interventions, 10.5 (SD = 10.9) hazardous errors and 54.0 (SD = 17.5) habitual errors per driving assessment. The mean weighted error scores for the driving test, using these different error types, was 117.6 (SD = 78.3).

The relationship between prescription medication use (overall use and use of medications potentially hazardous for driving) and driving performance was assessed using Pearson’s Correlation Coefficients. Although the correlation between overall medication use and the weighted error score for the driving test was not significant ($r = .19$, $p = .075$), use of medications potentially hazardous to driving correlated significantly with the weighted error score for the driving test ($r = .22$, $p = .038$). As ageing may be associated with greater medication use and susceptibility to side-effects, a hierarchical regression analysis was conducted to determine whether medications potentially hazardous to driving made a significant contribution to the prediction of driving performance beyond that of age. The weighted error score was the dependent variable, and age (entered at step 1) and medications potentially hazardous to driving (entered at step 2) were the predictor variables. After controlling for the effects of age, the contribution of potentially hazardous medications to the prediction of driving performance only approached significance, with a partial correlation of .20 ($p = .067$). This suggests that potentially hazardous medications may be only weakly related to driving performance independently of age (refer to Table 2).

In order to determine whether potentially hazardous medications made a significant contribution to the prediction of driving performance beyond that of the medical conditions they were prescribed to treat, a second hierarchical regression analysis was conducted. Again, the weighted error score on the driving test was the dependent variable, with general health (entered at step 1) and medications potentially hazardous to driving (entered at step 2) being the predictor variables. After controlling for the effects of general health, medications potentially hazardous to driving did not make a significant contribution to the prediction of driving performance, with a partial correlation of .15 ($p = .172$). Thus, medications were not significantly related to driving performance independently of the effects of the medical conditions they were prescribed to treat (refer to Table 2).

### Table 2

**Details of hierarchical regressions examining the effects of age and general health on the relationship between medications potentially hazardous to driving and driving performance (n=90)**

<table>
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<th>$B$</th>
<th>Adj $R^2$</th>
<th>$\Delta R^2$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
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<td>.000</td>
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<td>.03</td>
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<td>1.38</td>
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</table>

### Discussion

The number of medications used by older drivers was not significantly correlated with driving performance, consistent with a previous study by Foley, Wallace and Eberhard [18], which found no relationship between medication use and crash involvement among older drivers. In contrast, use of medications potentially hazardous to driving (those that can cause central nervous system impairment, drowsiness, or dizziness) was found in the present study to be related to driving performance. However, the relationship was only
small and use of such medications was not found to make a significant contribution to the prediction of driving performance after controlling for the effects of general health. This latter finding does not mean that use of such medications does not affect driving but merely that any effects of medication use on driving performance cannot be separated from the effects of the medical conditions that they were prescribed to treat. This difficulty is likely to be encountered in any epidemiological study of driving and medication use [19]. The appropriate conclusion appears to be that attention should be given to the medications taken by older drivers but that it also needs to be remembered that untreated medical conditions may have a greater effect on driving than the medications used to treat them [9]. The inter-relationships between medical conditions, medication use, driver age and driving performance comprise a complex issue in need of further study.

**Possible Next Steps**
A limitation of the present study is that the accuracy of the self-reported data on medication use cannot be guaranteed. It may be that the relationships reported in the present study underestimate the true effects of medication use on driving. Any future study into the medication use and driving performance of older drivers should use a more objective source of information, such as medical records. Use of medical records may also provide information about the dosing schedule, allowing a better assessment of which medications are likely to affect driving.

**References**


