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Age-Based Testing for Driver's License Renewal: Potential Implications for Older Australians

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Grants/Funds		X		X		X		X		X
Honoraria		X		X		X		X		X
Speaker Forum		X		X		X		X		X
Consultant		X		X		X		X		X
Stocks		X		X		X		X		X
Royalties		X		X		X		X		X
Expert Testimony		X		X		X		X		X
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Abstract

OBJECTIVES—To investigate the effect of age-based testing (ABT) for driver's license renewal policies among older Australians.

DESIGN—Secondary data analysis of a pooled dataset

SETTING—Community-based samples drawn from three Australian States.

PARTICIPANTS—5206 older adults aged 65 to 103 from the Dynamic Analyses to Optimise Ageing (DYNOPTA) project.

MEASUREMENTS—Included were: self-reported driving status, ABT for driver's license renewal status, demographics, medical conditions, Mini Mental State Exam (MMSE), and visual acuity.

RESULTS—After accounting for significant demographic and health covariates, logistic regression analyses revealed that older adults required to undergo ABT were between 2.22 (95% CI= 1.35–3.57, $P < .01$) and 1.52 (95% CI=1.18–1.92, $P < .01$) times more likely to report *not* driving. Similar proportions of drivers with cognitive or visual impairments were found regardless of ABT status.

CONCLUSIONS—Required ABT for license renewal was associated with lower rates of driving. The proportion of drivers with probable cognitive or visual impairments was similar in those who had ABT and those who did not. Future investigation of the impact of current ABT policies on crash rates and the potential to use other scientifically designed ABT strategies, is therefore needed.

Keywords

Older drivers; Driver's license testing; Age-based testing (ABT); DYNOPTA

INTRODUCTION

Crash statistics clearly show that older drivers are over-represented in crashes and have greater associated morbidity and mortality^{1–2}. For example, per miles driven, drivers aged 80 years and over have the greatest risk of being involved in a fatal crash². Frailty, cognitive impairment, poor physical functioning and poor health have all been demonstrated to reduce the safety of older drivers^{3–4}. In an effort to reduce accidents and improve road safety, some jurisdictions mandate age-based testing (ABT) before renewal of a driver's license. ABT typically is comprised of a visual function and/or health status assessment via a doctor's report. The effects of visually-based and/or health-based ABT on driving safety, however, are not conclusive^{5–11}.

Mandatory ABT has been associated with lower licensure rates among older adults^{6–7}, with jurisdictions varying in the age at which they introduce ABT (usually between 70 and 80 years of age). However, licensure rates may not be an accurate measure of driving status¹² given that many older adults may keep their licenses for identification, psychological, and social reasons even though they may no longer drive. Additionally, some older adults may continue to drive even without a license. The distinction between licensure rates and self-reported driving participation is therefore a significant one, not only due to these possible inaccuracies, but also given the importance of driving for maintaining independence and mobility.

The *Dynamic Analyses to Optimise Ageing* (DYNOPTA)¹³ project provides a unique opportunity to study the association of ABT, self-reported driving status and demographic and health variables in older Australians. The DYNOPTA project is a harmonized pooled dataset across nine Australian longitudinal studies of aging collected between 1990 and 2007 (N=50661). As such, DYNOPTA encompasses a broad range of variables, including demographics, health, and cognitive status, as well as self-reported driving status for a large sample of older Australians. This study is also distinctive as it assesses self-reported driving, differing from several other studies relying upon licensure rates as indicative of driving status 6–10.

The current study sought to investigate the impact of ABT on actual self-reported driving status across three Australian states, two of which employ ABT. Two questions were the focus of this investigation: (1) is ABT associated with self-reported driving among older adults? (2) is ABT associated with the rates of visual and cognitive deficits among individuals who report themselves as drivers? Whilst the findings from this study are specific to states within Australia, evaluation of licensing regulations may inform other jurisdictions and contribute to the development of social policy relating to screening of older drivers and consequential changes in mobility or independence.

METHODS

Participants and Procedure

DYNPOTA participants (N=5206) with data on driving status who were 65 years and older were selected. The sample used in this study has been previously described¹⁴. Briefly, participants were included from the states of *New South Wales* (NSW, composed of Sydney Metropolitan area and the Blue Mountains, mean age 75.9 ± 6.6 , 43.9% men), *South Australia* (SA, composed of Adelaide Metropolitan area, mean age 78.2 ± 6.7 , 50.1% men), and *Victoria* (VIC, composed of Melbourne Metropolitan area, mean age 73.4 ± 5.9 , 46.5% men). Data for the present analyses were obtained between August 1991 and January 2000 either by participant questionnaire completion or interview. Each original contributing study was approved by the respective home institution's ethics committee, and DYNOPTA was approved by the Australian National University's Human Research Ethics Committee. For further information on DYNOPTA, please see <http://dynopta.anu.edu.au> and Anstey and colleagues¹³.

Materials

Demographic and health factors previously found to be associated with driving status and safety were included as covariates^{14–16}.

Driving Status was assessed by self-reports, resulting in a binary measure of currently driving (1) or not currently driving (0). Participants were classified as drivers if they reported any driving.

Age-Based Testing (ABT) was coded as a dichotomous variable which indicated if the participant would have received testing (visual acuity or medical report) prior to license renewal due to his or her age and state of residence. In accordance with Australian mandatory age-based license testing practices¹⁷, persons living in NSW and over the age of 80 years and those living in SA and over age 70 years were coded as '1', indicating a mandatory vision test and medical report. All persons under these ages and those living in VIC, where there is no age-based mandatory testing, were coded as '0'.

Visual Functioning. Far visual acuity was measured with either a 3 meter (m) Snellen chart or a 2.4 m LogMar chart. A binary variable was created indicating if participants had vision

equal to, or better than, 6/12 m (or a LogMar of 0.30) or worse than 6/12 m (or a LogMar of 0.30) in at least one eye. This cut-off (6/12 m and 0.30 LogMar) was chosen as it is the minimum requirement for licensed driving in Australia¹⁸ and it was consistent across the contributing studies.

Demographic Information included participant age, sex, education and marital status. *Education* was assessed through a binary variable indicating if the participant reported leaving school at age 14 years or younger or 15 years of age or older¹⁹. *Marital status* was harmonized into a binary variable indicating if the participant was married/partnered or not.

Cognitive Status was assessed using the Mini Mental State Examination (MMSE) with higher scores indicating better cognitive functioning. MMSE was scored as a categorical variable consisting of possible dementia (MMSE total < 24), possible cognitive impairment (MMSE total $\geq$ 24 and $\leq$ 26), and no or minimal cognitive impairment (MMSE total > 26). MMSE data were not available for participants from VIC, and could not be included in the main regression analyses. However, cognitive status was investigated in analyses on a subsample of participants in NSW and SA.

Self-reported Medical Conditions of arthritis, diabetes, stroke, heart attack, or hypertension were investigated individually to assess the impact of specific reported medical conditions on driving status. Participants were classified as having one of these conditions if they either reported having had it in the past or were currently diagnosed with such condition.

Analyses

Differences between drivers and nondrivers for demographic, cognitive, visual and medical health and ABT status were investigated in the total sample by univariate t-tests for continuous variables and chi-square tests for categorical variables. Logistic regressions were conducted in order to investigate odds ratios (OR) with 95% confidence intervals (95% CI) for driving status and significant predictors in two subsample analyses. As there was no ABT in VIC, it was the comparison group in logistic regressions comparing (1) NSW and VIC and (2) SA and VIC.

For (1), participants residing in NSW and 80 years of age or younger and those living in VIC (where no ABT for license renewal exists) were coded as receiving no ABT (n=2684). NSW residents who were 81 years or older were coded as receiving ABT (n=555). This ABT variable was added to the logistic regression model that also adjusted for the significant effects of age, sex, visual acuity, education, marital/partner status, and any significant self-reported medical condition.

This procedure was repeated for again for participants from SA and VIC. SA participants aged 71 and older were coded as receiving ABT (n=1818), while SA participants younger than 71 and those from VIC were coded as not receiving ABT (n=1267).

RESULTS

Total Sample Descriptives between Drivers and Non-drivers

Unless otherwise indicated, all *P*-values are < .001. Drivers were younger in age (drivers: mean 74.13($\pm$ 5.74); non-drivers: 78.90($\pm$ 6.89); $t(4623.80)=26.80$) and had higher MMSE scores (drivers: mean 28.10($\pm$ 2.18); non-drivers: 26.67($\pm$ 3.51); $t(2858.51)=-14.89$) compared to non-drivers. Drivers also had significantly better visual acuity (64.6% versus 35.4% of non-drivers; $\chi^2(1, N=4238)=202.95$) and fewer reported strokes (56.3% versus 43.7% of non-drivers; $\chi^2(1, N=5096)=45.51$). Drivers were also more likely to be male (drivers: 73%; non-drivers: 27%; $\chi^2(1, N=5206)=658.72$), married or partnered (drivers:

65.8%; non-drivers:34.2%; $\chi^2(1,N=5203)=368.75$), and to report education past 14 years of age (driver: 56.7%; non-driver: 43.3%; $\chi^2(1,N=3659)=58.14$). A higher proportion of drivers were not eligible for ABT (no ABT: 64.2%; ABT: 35.8%; $\chi^2(1,N=5206)=210.43$). Finally, as there were no significant differences between drivers and non-drivers on reports of diabetes, hypertension, arthritis, or heart attacks, these conditions were not included in the subsequent regression analyses.

Age-based Licensure Renewal Testing

NSW versus VIC—Table 1 shows the results of multivariate logistic regression models of driving status for states with (NSW, SA) and without (VIC) ABT requirements. In the adjusted models, drivers were more likely to be male, married/partnered, to report no previous or current stroke, to report remaining in school through age 15 or older, and to have normal vision. Additionally, after accounting for significant demographic and health covariates, participants required to undergo ABT for license renewal were less likely (OR=.045, 95% CI 0.28–0.74) to report driving.

SA versus VIC—Other than partner status, which was removed from the model due to nonsignificance, there were similar findings for the second subsample analysis. After accounting for significant demographic and health covariates, participants required to undergo ABT for license renewal were less likely (OR=0.66, 95% CI 0.52–0.85) to report driving (Table 1).

In order to allow for a more conclusive investigation of ABT while reducing the possible impact of an ‘age effect’ inherent in defining the groups, the above two analyses [(1)NSW versus VIC and (2) SA versus VIC] were repeated while restricting the sample to the same age range between groups in both sets of analyses. Analyses for (1) NSW (n=546) versus VIC (n=139) were repeated as above with the age range restriction of 81–94 years. After accounting for covariates (Table 1), results indicated that older adults who were required to undergo ABT were less likely to report driving (OR=0.21, 95% CI=0.11–0.42, $P<.001$). Analyses for (1) SA (n=1798) versus VIC (n=613) were repeated as above with the age range restriction of 71–94 years. After accounting for covariates (Table 1), results indicated that older adults who were required to undergo ABT were less likely to report driving (OR=0.51, 95% CI=0.39–0.67, $P<.001$).

Association of ABT and Driving Status among Drivers with Cognitive and Visual Impairments—Subsequent descriptive analyses compared MMSE and visual acuity by ABT and driving status categories to investigate the proportion of these impairments by ABT and driving status (see Table 2). As MMSE was not available for participants from VIC, cognitive status analyses only included participants from SA between 71 and 80 years of age (ABT required, n=966) and participants from NSW between 71 and 80 years of age (no ABT required, n=1045). Descriptive analyses revealed that amongst drivers, 4.7% required to undergo ABT had MMSE levels suggesting possible dementia (versus 4.0% of drivers without ABT), and 14.7% undergoing ABT were classified as having possible dementia (versus 10.7% of drivers not undergoing ABT). Fewer cognitively intact older adults reported driving (80.6%) when ABT was required, compared with 85.3% when ABT was not required. There was little difference in visual acuity between drivers required to undergo ABT and those not required to undergo ABT (Table 2).

DISCUSSION

To the authors’ knowledge, this is the first study to investigate the impact of ABT on self-reported driving rather than licensure. This study also addresses gaps within the literature as

the unique association of ABT was examined after accounting for demographic, health and functional factors related to driving. The results provide clear empirical evidence that ABT is associated with driving status (Table 1). Second, the proportion of drivers with cognitive or visual impairments was similar in those who had ABT and those who did not (Table 2). This finding warrants further investigation in studies that examine the functional cognitive (via neuropsychological and daily activity assessments) and visual abilities of older adults who have and have not undergone ABT for licensing renewal. Generally, persons with poorer cognitive functioning tend to reduce, limit or cease driving, possibly indicating an awareness of their impaired functioning^{16, 20}. However, research has indicated that this awareness may not occur in persons with very severe cognitive impairments who sometimes continue to drive²¹.

Although there is an association between ABT and driving status, the impact of ABT on driving safety remains unclear. Grabowski and colleagues⁹ used the US based Fatality Analysis Reporting System (FARS) and found that most stringent license renewal policies, such as more frequent renewals, vision tests and road tests were not predictive of fewer road crash fatalities; however, in-person renewal was predictive of fewer such fatalities among persons 85 and older. Levy⁸ also used the FARS and found that after adjusting for license renewal periods, visual acuity assessments were associated with lower fatal crash risk for older drivers. Similarly, McGwin and colleagues¹¹ found that a vision screening law for persons 80 and older resulted in lower fatal crash rates among such drivers. Two Australian studies by Langford and colleagues concluded that mandated testing was not associated with state recorded crash rates among older adults^{6, 10}. However, other research has shown that Australian state recorded crash records may not be reliable, calling into question their use as a means of evaluating the efficacy of licensing to improve road safety²². A comparison of road accident and fatality rates in Sweden (no ABT) and Finland (where ABT is used) found no differences in the rates for older drivers between the two countries²³. Finally, in terms of currently used medical reporting and visual testing, research has indicated that, although mandatory, physicians rarely report unsafe drivers to licensing authorities^{23–24}, and that there is currently insufficient evidence to evaluate the impact of vision screening on subsequent crash reduction rates²⁵.

Although our results are important and add to the current driving, aging, and ABT literature, there are several limitations. First, we did not have crash data to assess the effectiveness of ABT; although we did attempt to investigate this issue through our secondary descriptive analyses of visual and cognitive impairment. Second, we did not have data on which, if any, Victorian participants who may have been reported or volunteered for testing. As such, our analyses can only speak to mandatory ABT and driving status. Crash rates and referral or volunteering for testing are beyond the scope of this study. Third, we were also limited with the use of self-reported medical conditions rather than more extensive medical reviews or a general measure of health status. Fourth, our investigation of MMSE, driving status, and ABT did not use education adjustments. The available education variable was binary and hence lacked sensitivity. In addition, further stratification of the sample with MMSE < 24 would reduce cell sizes and statistical power. Education cutoffs are not validated in this population. For these reasons we decided to use the single measure, but suggest that future work should consider a more fine-grained analysis of the association between education-adjusted cognitive function and driving status. Fifth, we relied on self-reported driving status which, as discussed above, offers benefits to use of licensure data, does not provide information on the actual frequency and exposure of driving. Finally, our results do not speak to other promising scientifically-based screening measures currently under development that have been validated with driving outcomes^{3, 26}. These are important areas for future investigations of the impact of ABT on older adults' driving, driving behaviors, and crashes.

It is clear that additional research into the impact and validity of license renewal practices, as well as the cost-benefit in terms of crash rate reduction, is needed. Ideally, any new research should be prospective longitudinal research that includes demographic, health, cognitive and functional information. Detailed information on driving habits, such as driving avoidance/exposure and accidents (type, fault and severity) should also be included so that the complex relationships and effectiveness of different ABT methods on future crashes and driving habits can be better addressed. It is also important to keep in mind that the majority of ABT effectiveness research has dealt solely with traditional vision (such as visual acuity) and medical report based assessments, both of which have demonstrated problems in terms of preventing crashes^{24–25}.

Conclusions from the current study should not be extended to other cognitive, physical or multifaceted screening protocols. Further research is needed into the development of new technological advances, retraining, and intervention programs that could assist certain older adults to remain safe drivers for longer periods²⁷. Alternative transportation programs and interventions to offset the negative consequences of reduced licensure are also needed for those no longer able to drive safely²⁸. These issues are of great importance to all of society as the ramifications of driving cessation extend well beyond transport issues, with the potential to undermine ones autonomy and sense of independence.

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Table 1**Final Logistic Regression Models for Self-reported Driving**

Predictors	Driving OR	95% CI for OR	P
New South Wales vs Victoria			
Age	0.89	0.87–0.92	<.001
Male Sex	4.25	3.24–5.56	<.001
Left school after the age of 15	1.97	1.53–2.52	<.001
Married	1.83	1.40–2.38	<.001
Normal Visual Acuity	1.71	1.33–2.20	<.001
No report of stroke	3.40	2.04–5.67	<.001
ABT required	0.45	0.28–0.74	<.02
South Australia vs Victoria			
Age	0.90	0.88–0.92	<.001
Male Sex	10.06	7.99–12.67	<.001
Left school after the age of 15	1.94	1.58–2.38	<.001
Normal Visual Acuity	2.00	1.59–2.52	<.001
No report of stroke	4.19	2.51–6.97	<.001
ABT required	0.66	0.52–0.85	<.01

Note: DV=Driving=1 ; OR=Odds Ratio; CI=95% confidence interval; ABT= Age-based Testing; There is no ABT for license renewal in the state of Victoria. There is ABT for license renewal for adults over the age of 70 in South Australian and adults over the age of 80 in New South Wales.

Table 2

MMSE, Visual Acuity and ABT Categories by Driving Status

	DRIVER		NON-DRIVER	
	No ABT, n(%)	ABT required, n(%)	No ABT, n(%)	ABT required, n(%)
<i>Cognitive Status</i>				
Possible Dementia	24(4.0)	28(4.7)	66(14.5)	27(7.2)
Possible Dementia	63(10.7)	87(14.7)	97(21.4)	55(14.8)
No or minimal	504(85.3)	478(80.6)	291(64.1)	291(78.0)
Cognitive Impairment				
<i>Total, n(%)</i>	591(100.0)	593 (100.0)	454(100.0)	373(100.0)
<i>Visual Status</i>				
Normal Visual Acuity	346(80.3)	130(81.5)	360(61.8)	339(59.6)
Poor Visual Acuity	1406(19.7)	574(18.5)	583(38.2)	500(40.4)
<i>Total</i>	1752(100.0)	704(100.0)	943(100.0)	8390(100.0)
				4238

Note. MMSE is the Mini-Mental State Exam; ABT is Age-based Testing; *Cognitive State* Possible Dementia= MMSE < 24; Possible Cognitive Impairment= MMSE =>24 & =< 26; No or Minimal Cognitive Impairment= MMSE > 26; Included participants between the ages of 71 and 80 from NSW (no ABT) and SA (ABT required); *Visual Acuity*: Normal Vision=visual acuity of better than or equal to 6/12 m or a LogMar of 0.30; Impaired Vision= visual acuity of worse than 6/12 (m) or a LogMar of 0.30; included all participants.