Vision screening of older drivers for preventing road traffic injuries and fatalities (Review)

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[Intervention Review]

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Editorial group: Cochrane Injuries Group.
Publication status and date: New, published in Issue 1, 2009.
Review content assessed as up-to-date: 27 June 2007.

Citation: Subzwari S, Desapriya E, Babul-Wellar S, Pike I, Turcotte K, Rajabali F, Kinney J. Vision screening of older drivers for preventing road traffic injuries and fatalities. *Cochrane Database of Systematic Reviews* 2009, Issue 1. Art. No.: CD006252. DOI: 10.1002/14651858.CD006252.pub2.

ABSTRACT

Background

Demographic data in North America, Europe, Asia, Australia and New Zealand suggest a rapid growth in the number of persons over the age of 65 years as the baby boomer generation passes retirement age. As older adults make up an increasing proportion of the population, they are an important consideration when designing future evidence-based traffic safety policies, particularly those that lead to restrictions or cessation of driving. Research has shown that cessation of driving among older drivers can lead to negative emotional consequences such as loss of independence and depression. Those older adults who continue to drive tend to do so less frequently than other demographic groups and are more likely to be involved in a road traffic crash, probably due to what is termed the 'low mileage bias'. There is universal agreement among researchers that vision plays a significant role in driving performance, and that there are age-related visual changes. Vision testing of all drivers, and in particular of older drivers, is therefore an important road safety issue. The components of visual function essential for driving are acuity, field, depth perception and contrast sensitivity, which are currently not fully measured by licensing agencies. Furthermore, it is not known how effective vision screening tools are, and current vision screening regulations and cut-off values required to pass a licensing test vary from country to country. There is, therefore, a need to develop evidence-based tools for vision screening for driving, thereby increasing road safety.

Objectives

To assess the effects of vision screening interventions for older drivers to prevent road traffic injuries and fatalities.

Search strategy

We searched the Cochrane Injuries Group Specialized Register, the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2006, issue 3), MEDLINE, EMBASE, TRANSPORT, AgeInfo, AgeLine, the National Research Register, the Science (and Social Science) Citation Index, IBSS (International Bibliography of Social Sciences), PsycINFO, and Zetoc. We also searched the Internet and checked the reference lists of relevant papers to identify any further studies. The searches were conducted up to September 2006.

Selection criteria

Randomized controlled trials (RCTs) and controlled before and after studies comparing vision screening to non-screening of drivers aged 55 years and older, and which assessed the effect on road traffic crashes, injuries, fatalities and any involvement in traffic law violations, were included.

Data collection and analysis

Two authors independently screened the reference lists for eligible articles and independently assessed the articles for inclusion against the criteria. Two authors independently extracted data using a standardized extraction form.

Main results

No studies were found which met the inclusion criteria for this review.

Authors' conclusions

Most countries require a vision screening test for the renewal of an individual's driver's license. There is, however, insufficient evidence to assess the effect of vision screening tests on subsequent motor vehicle crash reduction. There is a need to develop valid and reliable tools of vision screening that can predict driving performance.

PLAIN LANGUAGE SUMMARY

Vision screening of older drivers to prevent road traffic injuries and deaths

Good vision is critical for safe driving performance. Because vision declines with age and the percentage of older adults in the population is increasing, it has become more important to consider the vision screening needs of older adults when designing evidence-based traffic safety policy. Mandatory vision screening for the issue or renewal of a driver's licence helps to ensure that older drivers are fit to safely operate vehicles.

To date, there has been no trial to demonstrate the impact of vision screening on the prevention of older driver-related crashes. However, given the importance of good vision for safe driving, vision testing remains a relevant issue for all licensed drivers.

BACKGROUND

In the early 1990s, the 'Global Burden of Disease Study' predicted that traffic-related injuries would become the third largest contributor to global death and disability by the year 2020 (Murray 1996). Treatment of people with road traffic injuries has a substantial impact on the healthcare system, and crashes represent a significant and unnecessary drain on medical resources. In low and middle-income countries, between 30% and 85% of trauma hospital admissions are road crash victims. According to a survey completed by the Transport Research Laboratory, between 40% and 75% of the motor vehicle crash victims in developing countries were the principal earners in a family group (Silcock 1997). This has a direct impact on the gross national product, to the extent that injuries due to crashes cost low and middle-income countries between 1% and 2% of their gross national product; more than the total development aid received by these countries (Murray 1996; WHO 2005).

The number of older drivers has and will increase dramatically as populations worldwide continue to age. In the next three decades it is expected that there will be a huge increase in both the number of older people and the proportion of the population that they represent in almost all European countries as well as North America, Asia and Australia (Rosenbloom 2001). Data from the USA, Australia, Germany, New Zealand, Norway, and the United Kingdom demonstrate that, in spite of cultural and policy differences, older people today are more likely to have a driver's licence and will take more trips than a comparable group 10 years ago (Rosenbloom 2001).

People over the age of 65 years have more fatal crashes per mile driven than any other demographic group, except teenage males (NCIPC 2002). Earlier research maintained that older drivers do not have a higher risk per capita or per driver's licence, but their increased crash proneness is reflected in higher crash rates per driven distance (Blomqvist 2005). This claim has been contested and it has been argued that older drivers, a group that drive small annual distances, have a higher crash risk per kilometer than other population groups with larger annual driving distances (Janke 2001).

Finnish, French, and Dutch motor vehicle crash data have shown, when compared across age groups, that older drivers had higher crash rates per distance driven. However, the age effect disappeared when the comparison was made in groups matched for yearly driving distance (Fontaine 2003; Langford 2006; Raitanen 2002). Recently, this effect was termed the 'low mileage bias'. This bias has been empirically demonstrated and shows that increased crash rates are due to driving exposure rather than age.

Driving cessation has been shown to induce depression (Azad 2002; Marottoli 1997; Ragland 2005; Siren 2002) through a loss of independence (Fonda 2001); therefore self-regulation is a better option to enhance quality of life and to facilitate safe driving for a greater number of years. Self-regulation helps older drivers modify their driving habits to suit their limitations, such as avoiding rush hour, daytime driving only and driving for essential trips only (groceries, doctors appointments) (Ragland 2005). However, self-regulation cannot occur if a person is unaware that their actions require regulating. If older drivers are not screened, they may not be aware of their functional limitations. Proper valid screening, therefore, targets both road safety injury prevention as well as self awareness.

Many types of interventions have been proposed to decrease the risk of motor vehicle crashes among older drivers, targeted toward the vehicle, the roadway, and the driver. In many countries, the primary driver-related intervention focuses on relicensing requirements for older drivers, which may involve reassessment. Government policy employs a variety of methods for increasing the stringency of the licensure process for older drivers, including the adoption of in-person renewal requirements, road tests, implementation of a shorter renewal period, and vision screening tests (Grabowski 2004).

New vision screening methodologies based on evidence-based practice and standards for fitness to drive are now urgently required to predict visual impairment and promote road safety (Hales 1982). Promising strategies to improve older adults' driving performance to acceptable levels include: education, remediation of physical or mental disabilities, self-regulation, or regulation by licensing authorities (Adler 2003; Dobbs 1997; Fox 1997; Shope 1998; Tuokko 1995). In particular, self-regulation of driving has been proposed as a viable means of balancing older adults' autonomy against the competing demand of public safety (Ball 1998; Shope 1998).

As most individuals age, they experience some level of functional decline in sensory, physical, and cognitive function (OECD 2001). It has been suggested that the deterioration in vision that results from the normal aging process, as well as from eye disease, is likely to be a major contributing factor to the increased crash rates of older people (Wood 2001).

Vision is the most important source of information during driving and many driving-related injuries have been associated with visual problems. Therefore, visual assessment for driving is paramount to the reduction of crash-related injuries. Visual tasks that are involved in driving include selective and divided attention and cognition. Researchers also believe that colour vision and glare sensitivity is important in driving. In addition, research has indicated that poor depth perception is also associated with poor driving performance (Javitt 2002; Shope 1998; West 2003). Further, studies have shown that many eye diseases affect vision and driving, for example cataract, macular degeneration, diabetic retinopathy, glaucoma, retinitis pigmentosa, corneal scarring, and eye movement disorders (Fishman 1981; Gutierrez 1997; Mangione 1998; McCloskey 1994; Owsley 1999). These conditions affect many aspects of vision including acuity, contrast sensitivity, visual field sensitivity, and increased disability glare.

Vision screening is a complex issue. While licensing authorities in many jurisdictions throughout the world use simple strategies to measure driving fitness, utilizing simple visual acuity tests, it is not clear that the vision tests used actually assess the visual skills necessary to drive safely (Sivak 1996). Furthermore, research has shown that visual acuity alone is not an appropriate method for assessing full visual function, which includes other vision components such as visual field and contrast sensitivity to name a few. Therefore, it is necessary that more comprehensive vision testing, together with an evaluation of continuing competency for driving, is essential (Christie 2000). New vision screening methodologies and standards for fitness to drive are now urgently required in order to promote road safety (Desapriya 2008). Evidence shows that visual field, body coordination, and reaction time influence fitness to drive. A recent prospective cohort study conducted by the Motor Vehicle Administration (MVA) in Maryland, USA demonstrated a relationship between performance-based risk factors and subsequent at-fault crashes among older drivers (Ball 2006). The study concluded that a driver had to be physically, mentally, medically, and functionally fit in order to operate an automobile. Currently, these factors are not evaluated by licensing authorities.

The common standard threshold used for visual acuity is 20/40 (0.50, 6/12) and this is an accepted requirement for driving in many countries. However, this criterion varies from country to country, although most agree that visual acuity in the better eye of 20/40 (0.50; 6/12) is acceptable. For example, USA jurisdictions differ on the required minimum visual acuity and minimum visual field necessary to pass a screening test. Furthermore, some states assess colour vision, depth perception, contrast sensitivity, and disability glare, while others do not. It is interesting to note that the way in which visual acuity itself is measured differs among countries. For example, in North America visual acuity is measured by a Snellen's chart in the driving license office, while UK authorities simply ask a driver to read a number plate for visual acuity.

With respect to the renewal of a driver's licence, there is also considerable variation. For example, jurisdictions across the USA differ in requiring road tests, vision screening, renewal in person, by mail or by the internet (McGwin 2008). In Florida, drivers must demonstrate visual acuity of 20/70 in either eye, with or without corrective lenses, whereas drivers in Connecticut must have 20/40 in the better eye, with or without corrective lenses. In some states, drivers who do not meet the vision requirement may be eligible for a restricted driver's licence (Levy 1995). There is also variation among states with respect to the field of vision required to operate a motor vehicle. For instance, in Arizona the field of vision must be 60°, plus 35° on the opposite side of the nose, in at least one eye. The field of vision for Connecticut drivers must be 140° for a person with two eyes and 100° for a person with one eye (Owsley 1999). The age at which a vision test is required at renewal ranges from 40 years (Maryland) to 80 years (Virginia). Illinois and New Hampshire require a road test at renewal for drivers age 75 and older (McGwin 2008). This evidence illustrates that practices in the USA and many other countries that govern required vision screening and licensing of older drivers vary significantly. Given the extent of this variation, it is understandable that evidence relating to the effectiveness of vision screening is inconclusive.

Researchers agree that the assessment of the driver's ability should be a fundamental part of the solution for maintaining safe, older driver mobility (Eby 2007; Shope 1998; Staplin 1999). However, the tools that are currently available for licensing authorities to assess fitness-to-drive tend not to be scientifically derived or validated and rely heavily on subjective rather than objective conclusions (Eby 2007; Molnar 2007). There is a need, therefore, for the development of valid, evidence-based instruments to aid licensing authorities in determining fitness to drive (Desapriya 2008). Clinically sensible screening and assessment tools are required in order that licensing agencies can assess fitness to drive, and promote and facilitate safe licensing of older drivers (Eby 2007; Molnar 2007).

Why it is important to do this review

The aim of this review is to evaluate the effectiveness of vision screening tests for the prevention of motor vehicle crashes involving older drivers. While vision screening assessments have generally been tested against on-road driving performance, their impact on traffic crashes, road traffic law violation, fatalities, or injury reduction has not been evaluated. The effectiveness of vision screening for older drivers has been evaluated in retrospective cohort studies (see 'Characteristics of excluded studies'); however, the results are inconclusive as retrospective cohort studies are prone to bias. We therefore propose a randomized control trial (RCT) to evaluate the efficacy of vision screening in reducing crashes among older drivers.

OBJECTIVES

To critically assess the effects of vision screening interventions on the prevention of older driver-related motor vehicle crashes, in particular:

- traffic violations;
- motor vehicle crash-related injuries; and
- motor vehicle crash-related fatalities among older drivers.

METHODS

Criteria for considering studies for this review

Types of studies

All randomized controlled trials (RCTs) comparing crash rates among older drivers before and after vision screening interventions were included. Studies must have included one or more of the primary outcomes of interest: traffic violations, motor vehicle crashes, injuries or fatalities. In the absence of RCTs evaluating the effectiveness of vision screening, controlled before and after (CBA) studies were considered for inclusion.

Types of participants

Trials with older individuals (aged 55 years or over) of either sex, who were current drivers, were included in this review.

Types of interventions

Any screening method, including road and vision testing, compared with controls without screening. This included tests such as 'useful field of view' (UFOV), contrast sensitivity, visual fields (central or peripheral), visual acuity, and any other automated vision screening measures.

Types of outcome measures

- Reduction in traffic violations.
- Reduction in motor vehicle crashes.
- Reduction in motor vehicle injuries.
- Reduction in motor vehicle fatalities.

Search methods for identification of studies

We did not employ language restrictions and both published and unpublished research were considered for inclusion (according to the methodology and quality of the study). We obtained full copies of those articles identified by the search, which were considered to have met the inclusion criteria based on title, abstract, and subject descriptors. We searched the reference lists of the identified studies and reviewed articles for further potentially eligible studies.

Electronic searches

We searched the following electronic databases:

- the Cochrane Injuries Group Specialized Register (September 2, 2006);
- CENTRAL (*The Cochrane Library* 2006, issue 3);
- MEDLINE (1950 to week 4 August 2006);
- EMBASE (1980 to August 2006);
- TRANSPORT (to 2006, issue 12);
- AgeInfo (searched 6 September 2006);
- AgeLine (searched 6 September 2006);
- National Research Register (to issue 3, 2006);
- Science (and Social Science) Citation Index (searched 9 September 2006);
- IBSS (International Bibliography of Social Sciences) (1951 to August 2006);
- PsycINFO (1806 to week 3 September 2006);
- Zetoc (searched 2 September 2006).

The detailed search strategies are reported in Appendix 1.

Searching other resources

Handsearching

We handsearched the following journals for relevant articles:

- Injury Prevention;
- Accident Analysis and Prevention;
- International Journal of Injury Control and Safety Promotion;
- The Journal of Safety Research.

Grey literature and unpublished studies

We searched websites relating to traffic and road crash research bodies, government agencies, and injury prevention organizations for any grey literature. In addition, reference lists of the selected papers or topic reviews were scanned for potentially relevant papers.
We reviewed a published abstract from the seventh World Conference on Injury Prevention and Control for potentially relevant studies. We also contacted experts from national and international injury prevention organizations for help in identifying further studies.
We sought relevant dissertation abstracts, grey literature, and conference proceedings by a general Internet search using a combination of terms taken from the electronic search strategies.

Data collection and analysis

Selection of studies

Two authors (SS, ED) independently reviewed titles (and abstracts where available) from the search outputs to identify potentially relevant studies. The same two authors independently reviewed the full text of studies identified, using a standardized inclusion criteria form. We resolved discrepancies through discussions between the authors, with the involvement of a third party (KT) where necessary. A list of excluded studies, together with details regarding the reasons for exclusion, has been provided in the table 'Characteristics of excluded studies'.

Assessment of risk of bias in included studies

The quality of individual components, such as randomization, allocation, concealment methods, blinding, and patient follow up were to be assessed. Key definitions derived from the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2008) were to be used to assess the quality of selected studies. The elements inherent in a carefully designed and conducted RCT are intended to minimize bias, balance confounders, and produce the most reliable estimate of treatment effect. We planned to assess each included trial against a comprehensive checklist provided in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2008). Four authors (SS, ED, SB, KT) were to perform quality assessment independently, with disagreements being resolved by further discussion.
In the event of an absence of RCTs, we planned to consider controlled before and after (CBA) studies for inclusion. The following methodological criteria would have been used to assess CBA studies:

1. study design;
2. data collection methods;
3. assessment of comparability of groups on potential confounders;
4. sound method of ascertaining exposure (should be valid, reproducible, and blinded);
5. sound case definition (should be valid, reproducible, and blinded);
6. sound outcome assessment (should be valid, reproducible, and blinded);
7. completeness of follow up.

Data synthesis

Where possible, we planned to calculate odds ratios (for categorical outcome data) or standardized mean differences (for continuous data) and their 95% confidence intervals (CI) from the data generated by each included RCT. If appropriate, and with available data, we planned to pool results from comparable groups of studies into a statistical meta-analysis using the RevMan 5.0 software provided by The Cochrane Collaboration (RevMan 2008). We intended to test heterogeneity between combined studies using the standard Chi^2 test. Where statistical pooling was not appropriate or possible, we planned to provide a narrative summary of the findings.

Four review authors (SS, ED, FR, JK) planned to extract data independently using a standardized form. The following information was to be extracted.

- Type of study: RCT or CBA study.
- Study setting: road, time of year, and day when outcomes were measured.
- Type of screening: useful field of view (UFOV), contrast sensitivity, visual fields (central or peripheral), visual acuity, and any other automated vision screening measures.
- Follow up: duration of follow up from vision screening testing.
- Outcomes: number and types of older drivers committing traffic violations; involved in motor vehicle crashes; and sustaining minor, severe, or fatal injury.
- Cost: information about the cost of implementing vision screening.

Two authors (SS, ED) were to perform the applicable data analysis of the extracted data. The data were to be analyzed as follows.

- Meta-analysis: a random-effects meta-analysis would have been performed.
- Continuous data would have been analyzed if means and standard deviations were available and there was no evidence of skew in the data (defined as mean > standard deviation). If scales measured the same outcome in different ways, standardized mean differences would have been combined across studies.
- Binary data: for studies with binary outcome data, the association between intervention and outcome would have been quantified using the odds ratio along with the 95% CI.
- Heterogeneity: investigation of the heterogeneity of the odds ratios across studies would have been assessed using a standard Chi^2 test.
- Funnel plots: odds ratios were to be determined and represented on a funnel plot, which describes the relationship between effect size and study precision. The reasons for any relationship identified (sample size, publication bias, diversity of interventions and populations) were to be examined.
- Sensitivity analysis: the primary analysis involved all studies. The robustness of the findings was to be assessed by subgroup analysis based on sample size, study quality, and setting. Where possible, we planned to conduct high versus low and middle-income areas, and rural versus urban setting subgroup analyses, according to study context.

RESULTS

Description of studies

See: Characteristics of excluded studies.

We screened 4589 citations for eligibility. Three relevant studies were identified but they did not meet the pre-defined study design criteria.

Risk of bias in included studies

No studies met the inclusion criteria.

Effects of interventions

No studies were identified which satisfied the inclusion criteria.

DISCUSSION

We found no studies that met the inclusion criteria, and no studies were included in the review.

The major limitation of this review is that we were unable to find high quality studies, such as randomized controlled trials or controlled before and after studies, to include in the review. Therefore, there is no evidence in support of, or against, the hypothesis that vision screening leads to a reduction in motor vehicle crashes involving older drivers. A strength of this review is that it has identified a gap in the literature by demonstrating a lack of trials studying older driver vision screening and motor vehicle crashes.

AUTHORS' CONCLUSIONS

Implications for practice

At present, there is insufficient evidence to support the efficacy of the vision screening test as a preventive strategy to reduce motor vehicle crashes among older drivers. In addition, the use of driving assessments tools, such as visual acuity, on road driving tests, simulator tests, and others vary among jurisdictions and their validity has been questioned in the research literature. Hence, further research is required to fully examine their reliability. In addition to licensing authorities, physicians also play a vital role in the safety of older drivers as they typically have the first encounter with older drivers experiencing vision problems. There is a serious need for research to develop a battery of tests with proven sensitivity and specificity for identifying high-risk drivers so that physicians and ophthalmologists can provide guidance to their patients, and also to medical advisory boards working with licensing offices (Hales 1982). Not only does research have the challenge of developing tests of high sensitivity and specificity for identifying unsafe drivers, these tests must also be cost-effective and acceptable to the public. In the interim, physicians should refer visually impaired drivers to driver re-education programs that are designed to reinforce safe driving practices and caution on the road.

Implications for research

There are no randomized controlled trials to demonstrate that vision screening for older drivers reduces the risk of motor vehicle crashes. However, most countries require vision screening for driver licence renewal and this seems a reasonable and sensible approach. Good vision at all ages is important for safe driving. A case can be made, based on the existing literature, that more high quality trials are needed to evaluate the efficacy of vision screening in reducing motor vehicle crashes. Future trials would ideally utilize a randomized control trial design.

There is a need to develop effective vision screening tools that are valid predictors of fitness to drive. Vision standards established for driving licences have been criticized for being arbitrary and not adequate to screen all potential visual components for safe driving (Ball 1988; Ball 1991; Levy 1995; Owsley 1998). Owsley 1991 and colleagues were the first to provide significant evidence that demonstrated a relationship between useful field of view (UFOV) and motor vehicle crashes. Performance-based functional assessments, including the use of driving simulators and road tests, may facilitate this task by providing information that is useful for the evaluation and rehabilitation of possibly impaired older drivers (Boegner 2004; Shope 1998; Underwood 1992).

UFOV is the area over which a person can extract information in a single glance without moving his or her head or eyes. The UFOV is shown to adequately predict driving performance. It provides a rapid and effective measure of visual information processing speed in approximately five minutes. It identifies examinees whose performance is associated with a significant increase in collision risk. UFOV also measures skills in selective and divided attention (Rizzo 1997) and how rapidly one can process multiple stimuli in the visual field. This measure is economically valid in that it has been shown to be an excellent predictor of both motor vehicle crashes and mobility outcomes among older adults (Ball 1998). Rinalducci 2002 showed that UFOV adequately predicted driving performance on a low-fidelity simulation task. Therefore, the UFOV may also serve as a useful method of identifying at-risk drivers that may not be easily screened through other techniques. Recent prospective studies have confirmed a relationship between UFOV performance and future crashes, further supporting the use of this instrument as a potential screening measure for at-risk older drivers (Rubin 2007). A recent meta-analysis conducted with numerous studies that included various methodologies confirms the importance of the UFOV assessment as both valid and reliable for indicating driving performance and for ensuring road safety (Clay 2005). This study clearly demonstrated the association between poorer UFOV and poorer driving performance in older adults. Recent prospective studies have confirmed a relationship between UFOV performance and future crashes, supporting the use of this instrument as a potential screening measure for at-risk older drivers (Clay 2005).

ACKNOWLEDGEMENTS

We are grateful to the Cochrane Injuries Group editorial base for their technical support. We also thank the Cochrane Eyes and Vision Group for input on the manuscript.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Grabowski 2004	(i) Study design - retrospective cohort study. (ii) Interventions were in-person renewal of driving license, road test, and vision test.
Levy 1995	(i) Study design - retrospective cohort study. (ii) Interventions were a combination of vision test, knowledge test, and on-road driving test.
Shipp 1998	Study design - retrospective cohort study.

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. Search strategy

Cochrane Injuries Group's Specialized Register (searched September 9, 2006)
(vision or visual or sight* or eyesight* or eye*) AND (exam* or test* or screen* or assessment*) AND (driver* or driving or crash* or accident* or motor* or vehicle* or automobile*)
TRANSPORT (to issue 12, 2006)
1. Vehicle-driver
2. Vehicle-driving
3. Automobile-drivers
4. Automobile-driving
5. Crash
6. Accident
7. Accidents
8. Accidents-and-the-human-factor
9. Accidents-et-facteur-humain
10. Driver
11. Driving
12. Driving-ability
13. Driving-age
14. Driving-aptitude
15. Driving-safety
16. Driving-veh
17. OR/1-16
18. Aged
19. Aged-
20. Aged-automobile-drivers
21. Aged-drivers
22. Elderly
23. Elderly-people
24. Elders
25. Old
26. Old-age
27. Old-people
28. Older
29. Older-driver
30. Older-driver-handbook
31. Older-driver-involved
32. Older-people
33. Older-person
34. Senior
35. Seniors
36. OR/18-35
37. Vision

38. Vision-disorders
39. Vision-impaired
40. Vision-tests
41. Sight
42. Sight-distance
43. Sight-distances
44. Sight-restricting
45. Sighted
46. Screening
47. Eye-movement
48. Eye-movements
49. Eyecare
50. Eyesight
51. Eyes
52. OR/37-51
53. 17 AND 36 AND 52

AgeInfo (http://ageinfo.cpa.org.uk/scripts/ageinfo/) **(searched September 6, 2006)**

(vision or visual or sight* or eyesight* or eye*) AND (exam* or test* or screen* or assessment) AND (driver* or driving or crash* or accident* or motor* or vehicle* or automobile*)

Ageline (http://www.aarp.org/research/ageline/) **(searched September 6, 2006)**

(vision test*or sight test*or eyesight test*or eye testor eye exam*or sight exam*or vision exam*or eyesight exam*or visual screen*) AND (driver*or drivingor crash*or accident*or motor*or vehicle*or automobile*) NOT (fall*)

CENTRAL (to issue 3, 2006)

#1 Vision next test*
#2 Sight next test*
#3 Eyesight next test*
#4 Eye* next test*
#5 Eye next exam*
#6 Sight next exam*
#7 Vision next exam*
#8 Eyesight next exam*
#9 Visual near screen*
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9
#11 Driver* or driving or crash* or accident* or motor* or vehicle* or automobile*
#12 #10 and #11

MEDLINE 1950 to 2006/August week 4

1. exp Vision-Screening/
2. exp Vision-Tests/
3. exp Mass-Screening/
4. exp Vision/
5. (vision or visual or field of view or contrast sensitivity or visual field or driving capabilit$).ab,ti.
6. 4 or 5
7. 3 and 6
8. ((vision or visual or sight$ or eyesight$ or eye$) adj3 (exam$ or test$ or screen$ or assessment$)).ab,ti.
9. 1 or 2 or 7 or 8
10. exp Motor-Vehicles/
11. exp Automobile-Driving/
12. exp Accidents-Traffic/
13. (drive or driver$ or driving or crash$ or accident$ or motor$ or vehicle$ or automobile$).ab,ti.
14. exp geriatric assessment/
15. exp aged/
16. exp “aged 80 and over”/
17. exp age factors/

18. 10 or 11 or 12 or 13
19. 14 or 15 or 16 or 17
20. 18 and 19
21. ((aged or senior$ or elder$ or older) adj3 (driver$ or driving)).ab,ti.
22. 20 or 21
23. 9 and 22

National Research Register (to issue 3, 2006)

1. ((vision and test*) or (sight and test*) or (eyesight and test*) or (eye and test*) or (eye and exam*) or (sight and exam*) or (vision and exam*) or (eyesight and exam*) or (visual and screen*) or (vision and screen*))
2. (driver* or driving or crash* or accident* or motor* or vehicle* or automobile*)
3. (#1 and #2)

Science Citation Index/Social Science Citation Index (searched September 28, 2006)

((vision and test*) or (sight and test*) or (eyesight and test*) or (eye and test*) or (eye and exam*) or (sight and exam*) or (vision and exam*) or (eyesight and exam*) or (visual and screen*) or (vision and screen*)) and (driver* or driving or crash* or accident* or motor* or vehicle* or automobile*)

EMBASE (1980 to 2006/August)

1. exp Automobiles/ or exp Automobile Driving/ or exp Accidents, Traffic/ or exp Vehicle Emissions/ or exp Motor Vehicles/
2. exp Automobile Driving/
3. exp Aged/ or exp Accidents, Traffic/ or exp Automobile Driving/
4. 1 or 2 or 3
5. exp Vision Tests/ or exp Vision Screening/ or exp Visual Acuity/
6. 4 and 5
7. exp Licensure/ or exp Automobile Driver Examination/
8. 6 and 7

International Bibliography of the Social Sciences 1951 to 2006/08 and PsycINFO 1806 to 2006/09 Week 3

1. ((aged or senior$ or elder$ or older) adj3 (driver$ or driving)).ab,ti.
2. (drive or driver$ or driving or crash$ or accident$ or motor$ or vehicle$ or automobile$).ab,ti.
3. ((vision or visual or sight$ or eyesight$ or eye$) adj3 (exam$ or test$ or screen$ or assessment$)).ab,ti.
4. trial$ or study or studies or group$ or control$ or random$
5. 1 and 2 and 3 and 4

ZETOC searched September 2, 2006

driver* vision* screen* older

HISTORY

Protocol first published: Issue 4, 2006

Review first published: Issue 1, 2009

CONTRIBUTIONS OF AUTHORS

Dr Sayed Subzwari contributed significantly to the protocol development, concept and design, data acquisition, data analysis, and interpretation of the data. He also wrote the first draft of the manuscript with the help of Dr Ediriweera Desapriya. Dr Ediriweera Deaspriya, Dr Shelina Babul and Dr Ian Pike contributed significantly to the systematic review's concept and design, protocol development, data analysis, and interpretation of the data. Ms Fahra Rajabali and Ms Kate Turcotte contributed significantly to the literature search, quality assessment, data analysis, and interpretation of the data. Ms Jacqueline Kinney contributed significantly to the systematic review's data acquisition and interpretation of the data. All authors provided critical revisions to the manuscript and gave final approval of the submitted manuscript.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- BC Injury Research & Prevention Unit, Canada.
- Department of Pediatrics, University of British Columbia, Vancouver, Canada.

External sources

- BC Ministry of Health, Canada.

INDEX TERMS

Medical Subject Headings (MeSH)

*Automobile Driving; *Vision Screening; Accidents, Traffic [*prevention & control]

MeSH check words

Aged; Humans