

1 Appendices

1.1 Appendix 1: Search string

**Ovid MEDLINE(R) and In-Process & Other Non-Indexed Citations and Daily
<1946 to November 01, 2019> Amended 2-3rd Nov 2019**

1 automobile driving/ or automobile driver examination/ or distracted driving/ or licensure/ (25110)

2 (((car or cars or vehicle* or vehicular or automobile* or automotive or truck or trucks or lorry or lorries or bus or buses or coach or coaches or minibus* or autobus* or van or vans or "heavy goods" or cab or cabs or taxi or taxis or motorcycl* or "motor cycl*" or motorbike* or "motor bike*") adj3 (drive or driving or driver*)) or motorist* or motorcyclist* or "motor cyclist*" or chauffeur* or cabbies or "road user*").ti,ab,kw. (9612)

3 ((automobile* or driving or driver* or car or cars or vehicle* or motorcycl* or "motor cycl*" or motorbike* or "motor bike*") adj2 (test* or exam* or assess* or screen* or licenc* or licens*)).ti,ab,kw. (7136)

4 or/1-3 (34263)

5 exp Eye Diseases/ (551334)

6 visual acuity/ or contrast sensitivity/ or emmetropia/ (79284)

7 ((vision or visual* or eye or eyesight or sight* or (field* adj2 (vision* or visual or view))) adj2 (impair* or disab* or disease* or hinder* or hindrance or acuity or loss or imperfect or damage* or deteriorat* or fail* or worse* or declin*)).ti,ab,kw. (107866)

8 Visual Fields/ or Visual Perception/ or Disability Evaluation/ (132904)

9 Vision Tests/ or Color Perception Tests/ or Refraction, Ocular/ or Vision Screening/ (26564)

10 ((vision or visual* or eye or eyesight or sight* or (field* adj2 (vision* or visual or view))) adj2 (test* or screen* or assess* or evaluat*)).ti,ab,kw. (33967)

11 or/5-10 (726465)

- 12 4 and 11 (2494)
- 13 exp United Kingdom/ or ("united kingdom" or UK or britain or british or english or scottish or scots or welsh or england or scotland or wales or "northern ireland" or ulster).ti,ab,kw. (628755)
- 14 (australia or belgium or canada or denmark or finland or france or germany or italy or japan or netherlands or norway or spain or sweden or switzerland or usa or "united states").ti,ab,kw. (944549)
- 15 exp canada/ or exp united states/ or exp japan/ or belgium/ or exp france/ or exp germany/ or exp italy/ or netherlands/ or exp denmark/ or finland/ or exp norway/ or sweden/ or spain/ or switzerland/ or exp australia/ (2347949)
- 16 14 or 15 (2760454)
- 17 12 and 13 (131)
- 18 limit 17 to (english language and yr="2010 -Current") (40)
- 19 12 and 16 (567)
- 20 limit 19 to (english language and yr="2010 -Current") (162)
- 21 Accidents, Traffic/ (42126)
- 22 Mortality/ (42453)
- 23 exp "Wounds and Injuries"/ (879831)
- 24 risk/ or risk factors/ or risk-taking/ (926028)
- 25 (((traffic or car or cars or motor or automobile* or road* or vehicle* or motorcycl* or "motor cycl*" or motorbike* or "motor bike*") adj3 (accident* or crash* or smash* or collision* or death* or mortality or injur* or trauma*)) or risk*).ti,ab,kw. (2083123)
- 26 or/21-25 (3178908)
- 27 18 and 26 (14)
- 28 20 and 26 (95)

1.2 Appendix 2: Online repositories searched

Website name	Link	Date Searched
CIHT - Chartered Institute of Highways and Transportation	https://www.ciht.org.uk/about-us/about-ciht/	06/11/19
Safety Cube DSS	https://www.roadsafety-dss.eu/#/	06/11/19
Urban Transport Group	www.urbantransportgroup.org	06/11/19
International Transport Forum	https://www.itf-oecd.org/	06/11/19
Transport Studies Unit, Oxford University	https://www.tsu.ox.ac.uk/pubs/wpapers.html	06/11/19
Institute for Transport Studies, Leeds University	https://environment.leeds.ac.uk/publications/101/economics-and-appraisal	06/11/19
Transport and Environment	https://www.transportenvironment.org	06/11/19
What Work Centre for Local Economic Growth	http://www.whatworksgrowth.org/policy-reviews/transport/	06/11/19
TRL: the future of transport	https://trl.co.uk/about-us	06/11/19
Vias Institute	https://www.vias.be/en/research/	06/11/19
TfL	https://tfl.gov.uk/corporate/publications-and-reports/	06/11/19
Highways England	https://highwaysengland.co.uk/research-publications/	06/11/19
Royal College of Ophthalmologists	https://www.rcophth.ac.uk/standards-publications-research/	06/11/19
Association of Optometrists	https://www.aop.org.uk/	06/11/19
European Council of Optometry and Optics	https://www.ecoo.info/professional-guidelines/	06/11/19

1.3 Appendix 3: International Department for Transport Websites Searched

Department name	Link	Date searched
UK: Department for Transport	https://www.gov.uk/government/publications?departments%5B%5D=department-for-transport	06/11/19
Australia: Department for Infrastructure, Transport, Cities and Regional Development	https://www.infrastructure.gov.au/utilities/publications.aspx	06/11/19
Canada: Transport Canada	https://www.tc.gc.ca/eng/motorvehiclesafety/tp-index-45.htm	06/11/19
Denmark: Ministry for Transport and Housing	https://www.trm.dk/en/publications/	06/11/19
Finland: Ministry for Transport and Communications	https://www.trm.dk/en/publications/	06/11/19
Germany: Federal Ministry of Transport and Digital Infrastructure	https://www.bmvi.de/EN/Services/Publications/publications.html	06/11/19
Japan: Ministry of Land, Infrastructure, Transport and Tourism	http://www.mlit.go.jp/en/statistics/white-paper-mlit-index.html	06/11/19
The Netherlands: The Ministry of Infrastructure and Water Management	https://www.government.nl/ministries/ministry-of-infrastructure-and-water-management/documents	06/11/19
Norway: Ministry of Transport	https://www.regjeringen.no/en/find-document/reports-and-plans/id438817/?ownerid=791&term	06/11/19
USA: Department for Transportation	https://www.transportation.gov/research-technology	06/11/19

1.4 Appendix 4: Bibliography of all studies included at full text but not prioritised

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1.5 Appendix 5: Prioritisation tool

[illegible]

1.6 Appendix 6: Data extraction template

	Code	
	Coder	Coder initials (JS, CE, AS)
	Citation	Amend to full citation
	Year	
	Country	
	Research questions	1
		2
		3
		4
		5
		6
	Brief summary of study	Briefly summarise study/intervention
	Headline findings	Briefly summarise the key/headline finding or conclusion
	Population	Describe any target groups that the study focuses on e.g. older adults, professional drivers, general population
Quality assurance: primary studies	Study design	An overview of the study design e.g. secondary data analysis
	Methodology	This should focus on the rigour and reliability of the methods used: do they accurately report population/sample size, data sources, are variables described fully, justify statistical techniques?
Quality assurance: reviews	Study design	Choose from list: * systematic review (SR) * rapid evidence assessment * rapid review * literature review * meta-analysis * SR with meta-analysis * other synthesis

	Systematic search	This should focus on the rigour and reliability of the methods used: Do they list the resources (databases and websites) searched? Do they provide a search string for databases?
	Weight of evidence	Rate WoE following instructions and assign rating low/medium/high
Research question 1	Visual impairment conditions	List eye conditions/visual impairments
	Association road collision or casualty	Briefly describe the association between visual impairment and risk of road collision or casualty
	Outcome measures	Briefly describe measure of road safety/collision risk e.g. population-based actual collisions, on road/closed road driving safety evaluation, driving simulator, UFOV
	Comparator	Give a brief description of the comparator group (control group, age matched etc)
	Outcome	Rate or relative risk of collision or casualty
	Moderating conditions (eye driving conditions, driver characteristics or behaviour)	List moderating conditions
	Impact of moderating conditions	Briefly the describe the extent to which moderating conditions affect association between VI and road collisions and their impact
	Evidence of international differences in VI and risk of road collision	Briefly describe the relationship between VI and risk of road collision, giving names of comparison country or countries and a brief description of the testing regime
Research question 2	Type of test discussed	National vision standards or number plate test
	Proportion of drivers	Give proportion of drivers who would not meet test standards
	Reporting to DVLA	Give proportion of drivers who declare this to the DVLA
Research question 3	List of visual impairments	List any VIs which are associated with road collision and cannot be

		identified by national vision standards or number plate test
	<i>Testing for VIs</i>	Briefly describe how this condition can be identified through testing
Research question 4	<i>Eyesight testing in other countries</i>	Briefly describe any comparisons made with driving eyesight rules in non-UK countries and rates of road collision
	<i>Author opinion</i>	Briefly describe any discussion, conclusions or author opinion given regarding eye testing regimes including changes, additions etc
Research question 5	<i>Non-visual conditions</i>	List non-visual conditions which moderate the relationship between visual impairment and the risk of road traffic collision
	<i>Moderating influence of non-visual conditions</i>	Briefly describe how non-visual conditions moderate relationship between visual impairment and the risk of road traffic collision
	<i>Impact of moderating conditions</i>	Any impact on relative risk or prevalence of road collision or casualty
	<i>Impact on eyesight requirements</i>	Briefly describe any discussion of eyesight requirements for drivers with other non-visual conditions
Research question 6	<i>List of visual impairments</i>	List any VIs which are referred to as changing in prevalence
	<i>Change in VI rates</i>	Briefly describe change in prevalence and in which groups
	<i>List of non-visual conditions</i>	List any non-visual conditions co-occurring with VIs which are referred to as changing in prevalence
	<i>Change in VI and non-visual condition rates</i>	Briefly describe change in prevalence and in which groups

1.7 Appendix 7: Weight of Evidence tool

Area	Quality assessment	Methodology	Relevance
Questions to consider	-Does the article address the research questions outlined? -How well is it written? E.g. does it have an academic/formal tone? Is it clear? Are there spelling mistakes? Is it peer-reviewed?	-Do the research methods map onto the aims and objectives? - Are the methods and the rationale discussed? E.g. quantitative methods are used, is this justified? - Is there a section on sampling and ethics? -Are the limitations of the respective approaches discussed?	- To what extent does the question address our research questions? E.g. does it speak directly to one or more research questions or only indirectly?

The Weight of Evidence tool is designed to guide reviewers in assessing the quality and relevance of evidence. During the data extraction phase, a single reviewer assessed each paper against each category and gave a rating of low, medium or high. This was used to give an overall rating for the paper. Due to the low number of papers which were judged to be highly relevant to the study, a category of medium-low was developed to differentiate those papers which were of medium quality and methodology and low relevance from those of low quality and relevance.

Process

- With the questions in mind, rate each category low/medium/high and then determine the final score
- When deciding on the final score, consider that each area is weighted equally, i.e. low/medium/high

Examples of elements of studies which would receive a higher or lower rating for each category include:

- **Quality assessment** – an evidence review which includes details of a search string and strategy and inclusion criteria would be judged to be of high quality whereas a literature review which does not include details of a search string and strategy and inclusion criteria would be judged to be of low quality.
- **Methodology** – studies which use appropriate methods to determine relative crash rate ratios using well defined clinical measures of visual impairment and controlling for factors such as age, gender, and distance travelled would be assigned a rating of high for methodology, while a study which relies on self-reported visual impairment would be given a lower rating for methodology.
- **Relevance** – studies which compared relative crash risk in drivers with a visual impairment with drivers without a visual impairment were judged to be highly relevant to this study, while those which compared self-reported driving difficulty were judged to be of lower relevance.

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1.9 Appendix 9: Coverage of eye conditions

Condition	What is it and how does it affect vision?	Is it more common in older adults?	How can it be detected?	How is it treated?	Is there a requirement for it to be reported to the DVLA?
<i>Cataract</i>	A clouding of the eye lens which reduces vision. Symptoms include; blurry or double vision, trouble seeing at night and with bright lights.	Yes	Initially a visual acuity exam known as a dilated eye exam.	In early stages stronger glasses are used. Surgery where the lens is replaced is the only long-term treatment.	No requirement to inform DVLA if national vision standards for driving are met
<i>Monocular vision</i>	Vision loss in one eye. Symptoms may include difficulty judging distances accurately and loss of partial field of view.			There is no cure although adaptive behaviours are recommended.	No requirement to inform the DVLA if driver is still able to meet the national vision standards for driving.
<i>Macular degeneration</i>	An age-related central vision loss condition. Symptoms include dimming of colours, objects looking smaller than they are and hallucinations. Can either be dry (more common, less drastic vision loss) or wet (less common, more drastic vision loss).	Yes	MD is often found during a routine eye test before patients are symptomatic. The optometrist will conduct a central vision assessment with a magnifying class.	There is no treatment for dry MD but adaptive vision aids help. Wet MD requires regular eye injections and often photodynamic therapy to prevent further vision loss.	The DVLA must be informed if the condition affects both eyes. No requirement to inform the DVLA if condition only affects one eye and driver is still able to meet the national vision standards for driving.

<i>Visual field loss</i>	The visual field is the portion of the subject's surroundings that can be seen at any one time. Visual field loss or visual field impairment refers to a loss of part of the usual field of vision. General visual field defects including hemianopia and quadrant can also affect ability to drive. Hemianopia and quadrantanopia is decreased vision in half or quarter of the visual field in one or both eyes. It is most commonly caused by stroke, brain tumour and trauma. Symptoms include distorted sight, double vision, difficulty seeing at night and assorted head/neck issues.	Yes	A routine eye exam will test for this using a visual field test. Other visual tests will be conducted to rule out other possible causes of vision loss.	Dependent upon the cause. In some cases, vision loss never improves. In this instance symptomatic cures can help such as wearing prismatic correction glasses or undergoing vision restoration therapy.	Yes
<i>Glaucoma</i>	A condition where the optic nerve connecting the eye to the brain becomes damaged. Symptoms include peripheral visual field loss, blurred vision and difficulty seeing bright lights.	Yes	During routine eye tests, through eye pressure tests and visual field tests.	To prevent the condition from becoming worse eye drops are used to reduce pressure. In more advanced cases laser treatment and surgery are used.	If the condition only affects one eye and driver is still able to meet the national vision standards for driving, then there is no requirement to tell the DVLA. The DVLA must be informed if it affects both eyes or if it affects one eye and the driver has a medical condition in the other eye.
<i>Retinitis pigmentosa</i>	A rare, inherited visual field disease in which the light sensitivity of the retina slowly deteriorates, eventually causing blindness. Symptoms include difficulty seeing at night and tunnel vision.	No	A visual field test will be conducted by an optometrist followed by referral to an ophthalmologist.	There is no cure although patients with early stage RP can be give electrical stimulation therapy to prevent further vision loss.	The DVLA must be informed even if the driver meets the national vision standards for driving.

<i>Presbyopia</i>	An age-related process whereby the natural lens inside the eye gradually thickens and the lens becomes less flexible. Symptoms include difficulty focusing on close objects and blurred vision.	Yes	Through routine site testing with a refraction assessment.	Stronger glasses or multifocals.	No requirement to inform DVLA if national vision standards for driving are met
<i>Diabetic retinopathy</i>	Caused by diabetes by damages to the blood vessels at the back of the retina, results in patches of vision loss and a lack of sharpness across the visual field usually in both eyes. Symptoms include floaters, blurred vision and impaired colour vision.		During a sight test, optometrists will dilate pupils and conduct a pressure test to rule out other visual impairments.	In early stages good blood sugar management slows the progression of the disease. In advanced cases laser treatment and vitreous surgery are treatments.	For drivers who have had retinopathy in both eyes, the DVLA must be informed. However, if drivers with retinopathy in one eye meet the national vision standards for driving there is no requirement to inform the DVLA. Group 2 drivers need to inform the DVLA in any case.
<i>Macular oedema</i>	Occurs when a build-up of fluid behind the eye causes it to stop functioning properly and blurs vision. Symptoms include blurred or cloudy vision and dimmed colours. Diabetic macular oedema is the most common cause of sight loss in diabetics and is a complication of diabetic retinopathy.	Yes	During a sight test, optometrists will dilate pupils and conduct a pressure test to rule out other visual impairments.	As MO is often caused by other conditions (e.g. diabetes, high blood pressure) treating these is key. Thereafter treatment for MO includes eye drops, injections and in severe cases surgery.	Yes

<i>Impaired contrast sensitivity</i>	Impaired ability to distinguish between objects and their backgrounds, especially challenging in situations of low light, such as fog, glare, or at night. Symptoms include difficulty seeing at night and easily tired eyes while focusing. Itself is a symptom of several eye conditions such as cataracts, glaucoma, PD or DR.	Yes	This isn't included in the routine sight test. A Pelli Robson contrast sensitivity chart is the most widely used device.	For low contrast sensitivity, drivers can wear corrective lenses with a yellow filter. Laser treatment has also been used as well as intraocular lenses.	No requirement to inform DVLA if national vision standards for driving are met.
<i>Amblyopia</i>	A vision development disorder where one or both eyes fail to achieve normal visual acuity even with corrective lenses, known as a lazy eye. Symptoms include a misalignment of the eyes and blurred vision.	No	Screening test followed by a comprehensive eye exam.	Glasses and patching of the good eye. In some cases, surgery is used in combination with vision therapy.	No requirement to inform DVLA if national vision standards for driving are met.

Source: Author's own

1.10 Descriptive table for prioritised texts

Reference	Country	Research Question						Methodology	Type of study	Weight of evidence
		1	2	3	4	5	6			
Agramunt et al (2016)	Multi-country	1		1				Literature review	Review	High
Baker et al (2019)	USA	1						Retrospective cohort study	Primary	Medium
Blane (2016)	Multi-country	1						Literature review	Review	High
Bohensky et al (2008)	Multi-country			1	1			Evidence review*	Review	Medium
Boot et al (2013)	USA						1	Literature review	Review	Low
Braitman et al (2010)	USA				1		1	Population cohort study	Primary	Medium
Crabb et al (2010)	UK	1			1			Case-control study	Primary	High
Crizzle et al (2012)	Multi-country	1						Other synthesis	Review	High
Goldenbeld and van Schagen (2016)	Multi-country	1						Literature review	Review	High
Green et al (2013)	USA	1			1	1		Retrospective cohort study	Primary	High
Hawley et al (2015)	UK				1		1	Secondary data analysis	Primary	High
Hill et al (2012)	USA				1			Population cohort study	Primary	Medium
Huisinigh et al (2015)	USA	1						Population cohort study	Primary	High
Huisinigh et al (2017)	USA	1						Population cohort study	Primary	Medium
Kaido et al (2013)	Japan						1	Off-road driving assessment	Primary	Medium-Low
Keay et al (2009)	USA					1		Population cohort study	Primary	Medium
Kotecha et al (2008)	Multi-country	1		1	1		1	Literature review	Review	Medium
Kwon et al (2016)	USA	1						Population cohort study	Primary	High
Little (2018)	Multi-country		1		1			Evidence review	Review	Low
Martensen (2017)	Multi-country				1			Rapid review	Review	Medium
McGwin et al (2015)	USA	1						Retrospective cohort study	Primary	Medium
Meulenens et al (2012)	Australia	1						Population cohort study	Primary	High
Muir et al (2016)	Australia	1			1			Secondary data analysis	Primary	High

Noyce et al (2017)	Multi-country	1			1		1	Literature review	Review	Low
Okamura et al (2019)	Japan	1						Population cohort study	Primary	Medium
Owsley and McGwin (2010)	Multi-country	1			1		1	Evidence review	Review	High
Patterson et al (2019)	Multi-country	1						Systematic review	Review	High
Rathore et al (2012)	UK			1	1			Population cohort study	Primary	High
Road Safety Observatory (2013)	Multi-country	1	1		1		1	Other synthesis	Review	High
Road Safety Observatory (2016a)	UK				1			Evidence review	Review	Medium
Road Safety Observatory (2016b)	UK		1		1	1		Evidence review	Review	Medium
Sandin and Strang (2016)	Multi-country	1						Rapid review	Review	Low
Schlenker et al (2018)	Canada	1						Population cohort study	Primary	Medium
Seland et al (2011)	Multi-country						1	Population cohort study	Primary	High
Tanabe et al (2011)	Japan	1			1			Cross-sectional study	Primary	High
Tefft (2014)	USA				1			Secondary data review	Primary	High
U.S Department of Transportation (2005)	USA	1			1			Evidence review	Review	Medium-Low
Wood and Black (2016)	Multi-country	1						Literature review	Review	Medium-Low
Woolnough et al (2013)	Multi-country	1			1			Retrospective cohort study	Primary	High
Yan et al (2019)	Multi-country				1			Evidence review	Review	Medium
Zhang et al 2007	USA			1				Simulator	Primary	Medium-Low

*An evidence review will be taken to mean a study which has a systematic literature search but without a clearly defined search strategy.