

# Association Between Vision Impairment And Traffic Safety Outcomes In Low And Middle-Income Countries: Protocol For A Systematic Review

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## Protocol

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# Abstract

**Background:** Road traffic injuries are a major public health concern. The burden and road traffic fatality rate are especially high in low-and middle-income countries and the socioeconomic impact is profound. Although many authors have studied the correlation between vision and traffic safety, there is no robust evidence base that could be used in advocacy. This systematic review will test the hypothesis that interventions to improve vision function are associated with good traffic safety outcomes.

**Methods:** Cochrane guidance on conducting a systematic review and Preferred Reporting Items for Systematic Review and Meta-Analysis - Protocols (PRISMA-P) were used to inform the preparation of this protocol and the Cochrane guidance and the main PRISMA guidance will inform the conduct and reporting of the review. We will search MEDLINE (Ovid), EMBASE (Ovid), PsycINFO (Ovid), CINAHL (EBSCO host), Web of Science, Cochrane Database of Systematic Reviews (CDSR) and The Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library. We will include studies of any design which either attempt to assess traffic safety outcomes of any kind among persons with any vision deficit or examine vision among persons who use roads. The primary outcome for this review is any measure of traffic safety or surrogate outcomes. Study selection, data extraction and evaluation of risk of bias will be done by two reviewers. A meta-analysis or narrative data synthesis will be conducted, depending on study quality and homogeneity.

**Discussion:** The results of this review will include summary estimates of vision and the effects of interventions to improve vision function, that are associated with traffic safety outcomes in LMICs. This systematic review will fill a gap in the evidence base with policy implications that will be useful for a wide audience and may improve vision of the drivers in LMICs, leading to better traffic safety outcomes.

## Background

Road traffic injuries are a major public health concern, which require concerted efforts for prevention. They are the leading global cause of death among people aged 5 to 29 years, and without sustained action could become the seventh-leading global cause of death for all ages by 2030.(1)(2) The World Health Organization reported that road traffic injuries caused 1.25 million deaths world-wide in 2013.(3) The burden and road traffic fatality rate are especially high in low-and middle-income countries (LMICs) with annual fatality rates per 100,000 population of 24.1 in low-income, 18.4 in middle-income and 9.2 in high-income countries.(3) In LMICs, studies have found that between 30% and 86% of trauma hospital admissions are due to road crashes.(4) Furthermore, the continuous expansion of cities and rapid urban migrations, will mean that urban traffic safety problems will be even more prominent, adding to the challenges faced in LMICs.(5)

The socioeconomic impact of road traffic injuries is profound. According to a survey by the Transport Research Laboratory, between 40% and 75% of motor vehicle crash victims in LMICs were the principal

earners in a family group.(6) Road traffic crashes cost LMICs 1–2% of their gross national product (GNP), more than the total development aid received by these countries.(7)

The main domains of visual functions that are necessary for safe driving are visual acuity, static acuity, dynamic acuity, visual fields, depth perception and contrast sensitivity. Evidence suggests that vision problems such as glare and visual field loss are associated with increased risk of crashes in high-income countries among older drivers.(8)(9) Furthermore, any association between visual acuity and traffic safety cannot be adequately considered without evaluating other aspects of visual functioning.(9) However, the impact of poor vision on the safety of road users in LMICs, where many drivers do not undergo vision testing, is poorly understood.(10) Although it is known that uncorrected vision problems are common among drivers in LMICs, and that reduced visual acuity appears to be associated with crash risk, the difficulty in establishing reliable measures of crash outcomes has been a major barrier to inference of cause and effect.(11) The currently available published literature shows that the association between vision and traffic safety is weakly described for LMICs.

Although many authors have studied the correlation between vision and traffic safety, there is no robust evidence base that could be used in advocacy.(12) The scientific community has yet to gather the necessary evidence to prove to policy makers that modest investments to improve vision would save lives on the road. Consequently, there is a lack of evidence to inform policies with regard to the vision requirements for drivers that might reduce the burden of mortality and morbidity due to road traffic injuries and information on licensure requirements and rates of compliance in LMICs remains scarce. This systematic review will help to fill this gap in the evidence base. It will test the hypothesis that interventions to improve vision function are associated with good traffic safety outcomes. We will seek to answer the research question: how does vision impairment impact driver and traffic safety in LMIC settings?

## **Methods**

Cochrane guidance on conducting a systematic review (13) and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis - Protocols (PRISMA-P 2015) (14) were used to inform the preparation of this protocol and the Cochrane guidance and main PRISMA statement (15) will inform the conduct and reporting of the review (PRISMA-P checklist - Additional file 1). This systematic review protocol will be registered in the international prospective register of systematic reviews, PROSPERO (Registration number - submitted).

### **Objective**

Our main objective is to review published studies to determine whether any aspect of vision, and particularly interventions to improve vision function, are associated with traffic safety outcomes in LMICs.

### **Criteria for considering studies for this review**

## **Type of studies**

We will include any study (interventional or observational) which aimed to assess whether vision is associated with traffic safety outcomes in LMICs. Motor vehicle collisions or motor vehicle crash or road traffic injuries are rarely reported in LMICs and reliable data on crashes are rare. Therefore, we aim to include studies that report poor vision among drivers and any measure of traffic safety or surrogate outcomes.

## **Type of participants**

Eligible participants for these studies will be any person driving a vehicle (e.g., motorcycle, car, bus, truck or other commercial vehicle) with special attention on persons whose income derives in whole or in part from driving a vehicle in a LMIC, where this information is available.

## **Type of outcome measures**

The primary outcome of this review is any measure of traffic safety or a surrogate outcome (e.g., hard braking, accelerometer-measured events, etc.) proven or expected to be associated with traffic safety. We will also collect data on the quality of the vision of drivers as a secondary outcome measure.

## **Search methods**

A comprehensive search strategy has been developed in consultation with an information specialist. We will search MEDLINE (Ovid), EMBASE (Ovid), PsycINFO (Ovid), CINAHL (EBSCO host), Web of Science, Cochrane Database of Systematic Reviews (CDSR) and The Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library. These sources will be searched from the year of inception to April 2020. A list of search terms for LMICs (as recommended by the Cochrane Library) will be applied in each strategy to identify studies from LMICs.(16) The search strategy is shown in Additional file 2. We will also check the reference lists of eligible studies, to identify additional studies for the review and efforts will be made to translate publications not in English.(17)

## **Data collection and analysis**

### **Selection of studies**

We will include eligible studies of any design which either attempt to assess traffic safety outcomes of any kind among persons with any vision deficit or examine vision among persons who use roads. Two reviewers (PP, VO) will use the eligibility criteria to independently check the titles and abstracts retrieved by the searches to identify potentially eligible articles. Any disagreements will be adjudicated by a third reviewer (NC). The full text of the potentially eligible articles will be retrieved, and their eligibility confirmed. Data extraction will be done for the eligible articles by the co-reviewers. The study authors will be contacted for any relevant data that are not in their article. The extracted data and data collected from authors will be used in data synthesis of the review.

## **Assessment of methodological quality**

The risk of bias and quality of the included studies will be assessed according to the guidelines of the critical appraisal of skills program (CASP) tool and National Institute of Health (USA) quality assessment tool (NIH-QAT) for the relevant study design. Study characteristics will be tabulated according to the domains described in these tools. We will assess risk of bias of each included study using a tool appropriate to the study design.

## **Data items and extraction**

We will extract data from each study into a specially prepared MS Excel spreadsheet. This will include country, year, study design, setting, sample size, participant characteristics, type of vehicle / driver, measure of visual acuity/other vision related domains and reported outcomes. One reviewer will extract the data and a second reviewer will verify it.

## **Data synthesis**

We will first describe the study characteristics, such as study design, country and setting, type of driver, category of vehicle. In the next stage, we will provide quantitative synthesis of the findings for the reported outcomes. We will use odds ratio for binary outcomes and mean differences for continuous variables.

Heterogeneity will be assessed across the studies. If meta-analyses are appropriate, we will use a random effect model, with a fixed effect model used in a sensitivity analysis. We will also conduct sensitivity analyses to assess the impact of unmeasured confounding and study assumptions, such as experience of the driver, underlying other visual pathologies other than primary cause measured, different driving environments that will affect the primary outcome, time to event data, different exposure definitions and different outcome definitions.

Where the necessary data are available, we will conduct subgroup analysis for persons whose income derives in whole or in part from driving a vehicle in a LMIC and other drivers who drives commercial vehicles. We will also conduct subgroup analyses based on the type of vehicle, and demographic characteristics of the driver (sex and age). We also hope to conduct a subgroup analysis of adherence to vision related licensure requirements and rates of compliance.

## **Results**

We will present the result of our search using the PRISMA study flow diagram (Additional file 3). We will report the quality and risk of bias of each included study based on the use of appropriate tools for the study design (as described above). The systematic review will assess the association of vision and traffic safety in LMIC settings and pooled data tables and graphs will be presented for traffic crashes or near crashes or surrogate events per 10, 000 miles or 100,000 miles based on the outcomes reported in each study. Results of any meta-analyses will be presented using forest plots as appropriate. If we identify a

high level of heterogeneity among the studies, we will present the results using narrative synthesis methods.

## Discussion

The results of this review will provide summary estimates of vision, and of the effects of interventions to improve vision function, that are associated with traffic safety outcomes in LMICs. To our knowledge, this will be the first review of the impact of vision on traffic safety in LMICs, filling a gap in the evidence base which has many policy implications in these countries. Our comprehensive search strategy will help to ensure the identification of as many articles as possible from LMICs. However, this might still yield a relatively small number of studies from LMICs with high level of heterogeneity, minimising the opportunities for meta-analyses. Nevertheless, the results should be useful for a wide audience and should help identify strategies to improve vision of drivers in LMICs, leading to improvements in traffic safety.

### Strengths and limitations of this review

- This systematic review protocol follows Cochrane guidance and Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines.
- This systematic review will address a gap in current evidence base and be the first review to explore the association of vision and traffic safety outcomes in low-and middle-income countries.
- The inclusion of any study design without a time limit, will support the capture of a wide range of studies, but there may be few studies, especially controlled trials from low-and middle-income countries.
- This systematic review may find heterogeneous studies, minimising the opportunities for meta-analyses.

## Declarations

### Ethics and Dissemination

There will be no requirement for ethical approval for conducting this systematic review, because it will be based on published articles only. We will disseminate our findings through publication in a high impact, global health, peer-reviewed journal and presentations at international conferences, and will use the evidence in advocacy in relevant countries.

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**Author's contributors** - NC, MK, GM, VC, and PP contributed to the conception of this research, design of the protocol and manuscript preparation. NC, MK, GM, VC, PP and VO provided revisions and approved the final version of the manuscript for submission. PP and VO will conduct the review as co-reviewers.

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**Data statement section** - The extracted relevant data of this systematic review will be uploaded to a suitable data repository after extraction and data analysis. The data will be available upon a reasonable request.

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## Supplementary Files

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