STUDY PROTOCOL

The Barriers and Limitations of Conventional Vision Screening Methods in Paediatric Population: A Study Protocol for a Systematic Review

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ABSTRACT

Introduction: Early detection of vision problems in paediatrics is essential, but barriers limit effective screening, including accessibility issues and challenges with conventional methods. This systematic review protocol outlines the approach to identifying and evaluating barriers to paediatric vision screening. The protocol follows PRISMA-P guidelines. **Methods:** Articles will be retrieved from Scopus, Web of Science, and PubMed using the PICo framework. Eligible studies include quantitative, qualitative and observational research (2010–2024) focusing on barriers and limitation to vision screening conducted by trained personnel (optometrists, nurses, or school teachers). The Mixed Methods Appraisal Tool (MMAT) will assess study quality, and thematic analysis will synthesize qualitative data. Quantitative findings will be descriptively summarised and mapped into qualitative themes. **Discussion:** This protocol provides a structured methodology for identifying key challenges in paediatric vision screening. The findings of this review are expected to inform stakeholders such as public health policymakers and school health programs by guiding the future adoption of improved screening tools and early detection strategies. **Trial Registration:** CRD42024625325
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INTRODUCTION

Childhood visual impairment is a significant global health concern, affecting millions of children and substantially impacting their quality of life, cognitive development, and educational attainment. According to the VISION 2020 program, approximately 19 million children aged 15 years and below are visually impaired, with 1.4 million classified as blind and 17.5 million experiencing low vision [1]. The prevalence and causes of childhood visual impairment vary across regions; however, refractive errors, including myopia, hyperopia, and astigmatism, account for over half of all cases globally [2, 3].

Among refractive error types, myopia is the most prevalent, with an estimated global prevalence of 35.8% in 2023. Projections suggest that this figure will increase to 36.6% by 2040 and further escalate to 39.8% by 2050 [4]. Without timely detection and appropriate intervention, myopia progression may lead to complications such as amblyopia and an increased risk of blindness [5]. Moreover, high myopia is associated with a greater susceptibility to sight-threatening ocular pathologies, including glaucoma, retinal detachment, and macular degeneration, which can result in irreversible blindness [6].

To mitigate these risks, eyecare professionals and related have widely implemented vision screening programs as a preventive measure. The United States Preventive Services Task Force (USPSTF) recommended that all children undergo vision screening at least once between the ages of three and five years [7]. Conventional screening modalities include visual acuity (VA) testing and objective refraction assessments using autorefractors or retinoscopes [8]. However,

these methods are resource-intensive, requiring trained personnel and specialized equipment, which pose logistical challenges for large-scale implementation, particularly in underserved populations. Additionally, conventional screening programs primarily focus on detecting refractive errors, often overlooking other critical visual anomalies that may affect children's visual function and academic performance [9].

Beyond refractive errors, there is growing evidence that vergence and accommodative anomalies are common yet frequently undiagnosed in paediatrics. Previous studies reported that between 6% and 28% of children exhibit vergence dysfunctions, while up to 36% present with accommodative anomalies [10-12]. These conditions are strongly associated with increased digital screen exposure, a trend that has intensified in the digital era and was exacerbated by prolonged lockdowns during the COVID-19 pandemic [13]. Despite their prevalence, conventional vision screening programs are not designed to detect these functional visual disorders, further limiting their effectiveness in ensuring comprehensive ocular health in children [14, 15].

While prior reviews have addressed vision screening efficacy, none have systematically synthesized barriers and limitations of the screening methods used across diverse settings. This review distinctively focuses on methodological and logistical barriers and limitations. The narrow scope of conventional vision screening underscores the necessity of a comprehensive evaluation of existing methodologies to identify their barriers and limitations. Therefore, this review protocol aims to gather evidence on the barriers and limitations of conventional vision screening in paediatrics. By synthesizing available evidence, this proposed protocol will systematically assess the barriers and limitations of existing vision screening practices and explore potential improvements to enhance their effectiveness in detecting both refractive and non-refractive visual anomalies in children.

METHODS

Study Design

This systematic review protocol is reported by adapting the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 [16]. This review adheres to selected components of the PRISMA-P checklist, particularly the sections addressing administrative information, the introduction, and methodological specifications presents the adapted section of the PRISMA-P checklist that is being utilized in this review.

The research question guiding this review protocol is structured using the PICo framework:'P' for 'Population','I' for 'Phenomenon of Interest', and 'Co' for 'Context'. Accordingly, this review seeks to address the following question: "*What are the barriers and limitations (Phenomenon of Interest) of conventional vision screening methods (Context) in paediatrics (Population)?*".

This review adopts the PICo framework instead of 'Population', 'Intervention', 'Comparator', 'Outcome', and 'Study Design' (PICOS), as it is better suited for descriptive and qualitative studies. Since the focus for the current review is on the barriers and limitations of vision screening, the most appropriate research approach involves descriptive and qualitative studies. PICo is designed to capture participants' experiences and the context in which they occur, making it ideal for exploring the challenges of the interest population [17]. It provides a flexible structure for developing research questions that effectively capture qualitative insights. Incorporating 'Population', 'Phenomenon of Interest', and 'Context' ensures a comprehensive and relevant framework for this review. This systematic protocol is registered with PROSPERO (CRD42024625325).

Search Strategy

The search will include English-language publications from 2010 to 2024. This timeframe is selected to capture advancements in screening technologies and evolving in the latest practices, ensuring relevance to updated paediatric care. A combination of primary keywords: "barriers," "conventional," "vision screening," and "children", along with related terms namely "challenge," "difficulty," "limitation," "restriction," "constraint," "standard," "traditional," "routine," "established," "vision assessment," "vision examination," "eye screening," "eye examination," "paediatric," "adolescent," "schoolchildren," and "preschool children" will be used. To enhance search accuracy, Boolean operators ('OR' and 'AND'), phrase searching, wildcards, truncation, and field code functions will be applied across the three databases.

Eligibility Criteria for Studies

Studies will be selected based on predefined inclusion and exclusion criteria.

Population

Eligible studies must involve participants under the age of 18, regardless of pre-existing visual impairments or medical conditions. However, studies exclusively involving children with known visual impairment or special needs will be excluded.

Phenomenon of Interest and Study Design

This review will include mainly qualitative studies that provide in-depth insights into the barriers and limitations associated with vision screening in paediatric populations. Additionally, observational studies, such as cross-sectional, cohort, and case-control studies, that descriptively report and discuss these barriers and limitations will be considered. Studies that employ a mixed-methods approach combining both quantitative and qualitative data, will also be included. A separate synthesis approach will be used to analyze quantitative and qualitative data separately before integrating the findings. Review articles, study protocols, case reports, case series, editorial letters, non-peer-reviewed opinions, and non-English articles will be excluded. If the full text of an article is not retrievable, the corresponding author will be contacted to request access.

Context

Vision screening is conducted in the paediatric population to detect vision problems. This review will include only screenings carried out by trained personnel, whether healthcare professionals or non-healthcare practitioners.

Studies Selection

This Systematic Review will adopt the PRISMA 2020 guidelines [18]. The study selection process will follow a systematic approach consisting of three stages: identification, screening, and eligibility, as outlined in the PRISMA flow diagram (Figure 1).

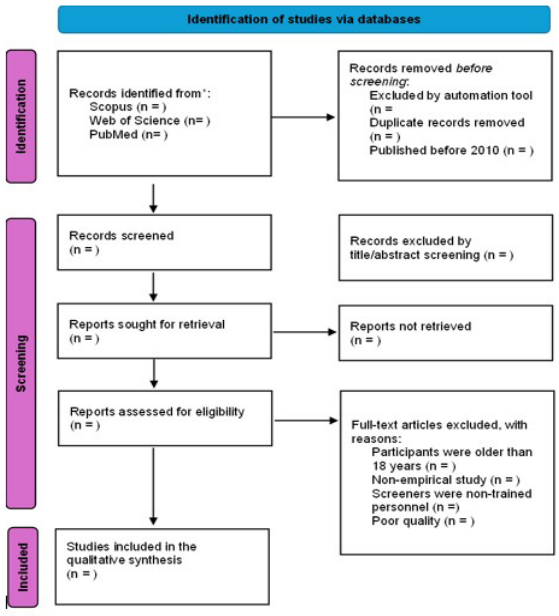

Figure 1: PRISMA 2020 Flow Diagram of the Study Selection Process

Initially, studies retrieved through the search process will be screened for duplicate records, which will be removed using Mendeley referencing software. After duplicate removal, the remaining records will undergo title and abstract screening based on predefined inclusion and exclusion criteria. Studies deemed potentially relevant will be retrieved in full-text format for further evaluation. All full-text copies of selected studies will be stored in a designated cloud-based folder using Mendeley reference software, which will be created to facilitate shared access among the review authors.

Next, two review authors (BSAR and MMMMS) will assess the full text independently to determine eligibility based on the predefined criteria. Any discrepancies between the two review authors will be resolved through discussion, and if a consensus cannot be reached, a third review author (NMN) will be consulted. In order to examine the inter-reviewer reliability during the full-text screening phase, Cohen's kappa (κ) statistic will be computed. A total of (numbers) articles will be reviewed independently by two reviewers, and the reviewer agreement will be reported as a κ value with a 95% confidence interval (lower–upper). The interpretation will follow the standard κ scale ranging from 0.00 (poor agreement) to 1.00 (almost perfect agreement) [19]. of 0.00 (poor agreement) to 1.00 (almost perfect agreement) [19].

The study selection process will be documented in detail to complete the PRISMA flow diagram (Figure 1). To ensure transparency in the selection process, reasons for study exclusions at the full-text screening stage will be recorded in a table of reasons for exclusion.

Quality Assessment

The methodological quality of the selected studies will be evaluated using the Mixed Methods Appraisal Tool (MMAT), version 2018. MMAT is a validated tool designed for the critical appraisal of studies across different methodological designs, including qualitative research, quantitative randomized controlled trials, quantitative non-randomized studies, quantitative descriptive studies, and mixed methods research. Each category consists of five specific methodological quality criteria that assess key aspects such as research design, data collection methods, data analysis, and interpretation. Studies will be appraised using a structured checklist, with each criterion rated as 'Yes,' 'No,' or 'Can't tell.' If applicable, comments will be provided to justify the rating [20].

Two review authors (BSAR and NMN) will conduct the quality assessment independently to ensure objectivity and minimize bias. The assessment process will begin with an initial screening based on two fundamental criteria: (i) whether the research questions are clearly defined and (ii) whether the collected data sufficiently address these questions. Studies that do not meet these screening criteria will not proceed to full appraisal. For studies that pass the screening, the reviewers will assess each methodological component according to the corresponding study design.

To determine whether a study will be included in the qualitative synthesis, it must receive a minimum of three 'Yes' ratings (≥3/5) by consensus between both reviewers. In cases where there is a disagreement regarding the inclusion or exclusion of a study, a third review author (MMMMS) will act as an arbiter to resolve the discrepancy. The inter-reviewer reliability for the quality appraisal will be assessed using κ following the same method described earlier. This rigorous evaluation process will ensure that only high-quality studies are included in the qualitative synthesis, thereby enhancing the credibility and validity of the systematic literature review findings.

Data Extraction and Management

A review author (BSAR) will extract data from each included study using a structured table in Microsoft Word, and the extracted data will be independently verified by another review author (MMMMS). The data extraction process will systematically document the characteristics of the included studies, covering the following sections: i. General information (first author, publication year, funding sources, and authors' conflicts of interest); ii. Study setting, detailing study design, location, country, vision screening method, and the screener; iii. Population, specifying the age range and number of participants; iv. Study aims; and v. Outcomes: Findings relevant to the identified barriers and limitations aligned with the review question.

The extracted data will primarily focus on identifying common barriers and limitations associated with conventional vision screening methods in paediatric populations. Discrepancies during data extraction will be resolved through discussion between reviewers, and if unresolved, a third reviewer will be consulted. This systematic documentation will enable a comprehensive synthesis of the available evidence, ensuring a structured and transparent approach to data management for qualitative synthesis.

Data Analysis

Thematic analysis will be employed for this review, which involves (1) open coding, (2) axial coding to categorize themes, and (3) refinement. The themes' reliability will be assessed via consensus meetings. Quantitative findings will be descriptively summarized and mapped to qualitative themes using a convergent synthesis approach.

Thematic Analysis

The data extracted from the selected articles will undergo a manual thematic analysis to identify, analyze, and report patterns (themes) relevant to the research objectives. This method will be employed to ensure a systematic approach to synthesizing qualitative findings across reviewed studies. The analysis will follow the six-phase process of thematic analysis as outlined by Braun and Clarke (2006) [21].

Initially, data familiarisation will be achieved through repeated reading of the extracted information to immerse researchers in the content. All relevant text from the included studies, particularly findings, results, and discussion, will be read independently by an author. At this level, initial ideas and patterns will be noted. Next, meaningful features within the data will be coded inductively, allowing patterns to emerge using a structured MS Word-based data extraction matrix. These initial codes will then be examined and grouped to form broader, meaningful themes.

Subsequently, the identified themes will be reviewed and refined with all authors to ensure internal consistency and accurate representation of the dataset. This includes checking the theme against the coded data and the full dataset to confirm their relevance and coherence. Each theme will then be clearly defined and named, and an analytic narrative will be developed. Additionally, the quantitative data will be mapped into the relevant themes to enhance the review outcome.

Finally, the findings will be synthesized into a structured report. The analysis will be contextualized to highlight key barriers and provide implications for practice, policy, and future research in paediatric vision screening.

Ethics and Dissemination

Ethical approval is not required for this review protocol, as it does not involve patient data or confidential information. This study's findings will be disseminated through publication in a peer-reviewed specialist journal and/or presentation at relevant academic conferences.

Expected Results

The findings of this systematic review will be reported in accordance with PRISMA 2020[18]. This review is expected to provide a comprehensive evaluation of the barriers and limitations associated with conventional vision screening methods in paediatric populations. A qualitative synthesis of the selected studies will be conducted using thematic analysis to identify key challenges, including issues related to accuracy, accessibility, and implementation. The insights gained from this analysis will enhance understanding of the limitations of current screening approaches and inform future improvements in paediatric vision assessment.

DISCUSSION

Conventional vision screening methods have long been employed in paediatric populations to detect visual impairments at an early stage [22]. However, despite their widespread clinical use, challenges remain in ensuring their accuracy, accessibility, and overall effectiveness in real-world settings [23, 24]. This review will address the barrier and limitation of the current visual impairment detection practice that represents a fundamental gap in the literature where the detection

of refractive error has been predominantly highlighted, although functional visual disorders of children in the era of digitalization have been overlooked.

The synthesis of barriers and limitations of the narrow scope of conventional tools will underscore systemic inequities in paediatric vision care. For instance, in a study done by Gilbert et al. (2017), wherein low- and middle-income countries, vision screening programs often struggle with sustainability and scalability [25]. Moreover, the key strength of this review will be the integration of mixed-methods evidence, which captures both quantitative and qualitative studies, enhancing the efficacy of the findings to design significant solutions. Systematic reviews are considered the highest level of evidence in research. However, the reliability of the evidence generated is often undermined by various biases introduced during the evidence synthesis process [26]. While high-quality systematic reviews provide robust and credible insights to support informed decision-making, low-quality evidence may mislead policymakers and healthcare practitioners, ultimately affecting the development and implementation of effective screening strategies.

Given the current state of evidence, a comprehensive review of existing systematic reviews is essential to synthesize key findings, identify fundamental limitations, and provide more targeted, high-quality information for evidence users. This systematic review protocol outlines a structured approach to evaluating the barriers and limitations of conventional vision screening methods in paediatric care. By making this protocol publicly available, we aim to enhance transparency, facilitate reproducibility, and incorporate valuable feedback from experts in the field. However, this review may have limitations. Such as restricting the search to three databases (Scopus, Web of Science, PubMed) and English-language studies may exclude relevant grey literature or regional studies published in other languages, potentially introducing selection bias. Future updates to this review could expand the search to other databases and collaborate with stakeholders to incorporate unpublished data.

CONCLUSION

This review protocol provides a valuable framework for researchers conducting systematic reviews on vision screening methods that integrate qualitative synthesis. A well-structured protocol ensures a comprehensive exploration of key review questions, offering deeper insights into the barriers and limitations affecting screening accuracy, accessibility, and implementation. The findings will inform the development of more effective, inclusive, and evidence-driven screening strategies, potentially guiding stakeholders such as the Ministry of Health, education departments, and school health programs in revising current vision screening frameworks, enhancing early detection and timely intervention for pediatric visual impairments.

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