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Abstract

Background: Childhood visual impairment has a significant effect on social life, educational performance, and professional choices, and can lead to poverty.

Aims: To review the prevalence and causes of visual impairment among children aged 5–17 years in the Eastern Mediterranean Region (EMR).

Methods: This study was conducted in 2021 using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) method. We searched Google Scholar, PubMed, Web of Science, Scopus, Index Medicus for the Eastern Mediterranean Region, and Medline for studies published between January 2000 and April 2020. The articles included were epidemiological studies of prevalence and causes of childhood visual impairment published in peer-reviewed journals.

Results: Of the 12 705 articles screened, 23 from 9 countries met the inclusion criteria. The pooled prevalence of uncorrected, presenting, and best-corrected childhood visual impairment was 11.57%, 8.34% and 1.21%, respectively. The most common causes of childhood visual impairment were refractive error (51.89%), amblyopia (11.15%), retinal disorders (3.90%), corneal opacity (3.0%), and cataract (1.88%). There was a highly significant heterogeneity between the studies (P

Conclusion: The prevalence of visual impairment among children in the EMR was high, and the leading causes were uncorrected refractive error and amblyopia, which were avoidable.

Access to eyecare services may help improve early diagnosis and treatment of preventable causes of childhood visual impairment.

Keywords: childhood visual impairment, refractive error, amblyopia, corneal opacity, retinal disorders

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Introduction

Visual impairment is defined as significant limitation of visual functions, such as visual acuity, contrast sensitivity, visual field, colour vision, and dark adaptation, resulting from disease, trauma, or congenital or degenerative conditions that can be treated or not (1,2). Visual impairment ranges in severity from mild visual loss to total absence of light perception (3,4). According to the International Classification of Diseases 11th revision, 2018, mild visual impairment is defined as visual acuity worse than 6/12 to 6/18 of the best-corrected eye; moderate visual impairment is visual acuity worse than 6/18 to 6/60; severe visual impairment is defined as visual acuity worse than 6/60 to 3/60; and blindness is defined as visual acuity worse than 3/60 in the better eye with the best correction possible (3). In 2020, an estimated 596 million people worldwide had visual impairment; 43.3 million were blind, and most of those affected (90%) lived in poor countries (5). Most causes of visual impairment are avoidable or treatable with highly cost-effective interventions (5,6). The latest prevalence figures for 2020 estimated that visual impairment resulted in annual global productivity loss of US$410.7 billion (5).

Universal estimations show that there are ~19 million children worldwide with visual impairment; 1.4 million are blind, 17.5 million have low vision, and most are in poor countries (6). The Lancet

Commission Report on Global Eye Health predicted that the prevalence of childhood blindness would be 1.02 million by 2020; representing a global prevalence of 4.8 per 10 000 children (5). Visual impairment has a significant negative impact on the lifespan of children, with an estimated 60% dying within 1 year of becoming blind from preventable or treatable causes (7,8).

A recent estimation revealed that the leading causes of blindness globally were cataract in 15.2 million cases, followed by glaucoma in 3.6 million, uncorrected refractive error in 2.3 million, age-related macular degeneration in 1.8 million, and diabetic retinopathy in 0.86 million. However, the leading causes of mild visual impairment were uncorrected refractive error in 86.1 million cases and cataract in 78.8 million (1). Globally, it is estimated that 90% of paediatric visual impairment is treatable by early intervention at primary, secondary, and tertiary levels of eye care (1,9). The condition affects academic performance, career choice, and social life, with defective near vision affecting the ability to perform various tasks that involve reading and writing (10,11). Timely detection and effective treatment of underlying causes at the sensitive period of visual development are important for preventing childhood visual impairment (12,13).

In 2010, the estimated prevalence of visual impairment, blindness, and low vision in the World Health Organization Eastern Mediterranean Region (EMR) was 8.2%, 12.5%, and 7.6%, respectively (14). Khandekar et al. reported that ~238 500 children with bilateral blindness were found in the EMR in 2012 (13). Accurate information on the prevalence and causes of childhood visual impairment could lead to the development of a systematic eye care plan for early detection and successful treatment of possible causes (15). Therefore, the purpose of this systemic review and meta-analysis was to assess the prevalence and causes of childhood visual impairment in the EMR.

Methods

Search strategy and selection criteria

The study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (16). We searched Google Scholar, PubMed, Web of Science, Scopus, Index Medicus for the Eastern Mediterranean Region, and Medline for studies published between January 2000 and April 2020 that assessed the prevalence and causes of childhood visual impairment in the EMR. The search keywords were: (prevalence OR incidence OR rate OR frequency OR proportion OR epidemiology OR distribution) OR (major risk OR influencing factors) OR (cause OR reasons) OR (effect OR impact) and childhood visual impairment (paediatric visual impairment OR childhood low vision OR paediatric low vison). We also searched for 21 countries in the EMR: Afghanistan, Bahrain, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait Lebanon, Libya, Morocco, Oman, Palestine, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, and United Arab Emirates. The review was restricted to articles published in the English language and in peer-reviewed journals. Only epidemiological studies that reported the prevalence and causes of visual

impairment among children aged 5–17 years were included. Articles were excluded if the research was not conducted in the EMR, or if they did not assess the prevalence and causes of childhood visual impairment. The study also excluded meeting abstracts, editorial discussions, conference papers, and studies without basic data collection.

Data extraction

The title and abstract of each article were evaluated by the reviewer, and data such as the first author's name, publication date, study location (country), and participants' characteristics (age and sample size) were extracted. In each study, patients with visual acuity ≤ 6/12 were used to calculate the pooled prevalence of uncorrected, presenting, and best-corrected visual impairment, and the causes of childhood visual impairment were determined. We used the threshold definition of the International Classification of Diseases 10th revision, H54 for prevalence and cause of childhood visual impairment: (1) uncorrected visual impairment, defined as visual acuity ≤ 6/12 in the better eye without refractive correction (to assess the extent of visual impairment caused by uncorrected refractive errors); (2) presenting visual impairment, defined as visual acuity ≤ 6/12 in the better eye, obtained with currently available refractive correction; and (3) best-corrected visual impairment, defined as visual acuity ≤ 6/12 in the better eye, obtained with the best-possible refractive correction.

Data analysis

The data from the included studies were entered separately in a predesigned format that recorded information about the first author's name, country of study, date of publication, mean age, sample size, number of children with visual impairment, and different causes of childhood visual impairment. After extraction, all related data were entered into Microsoft Excel for compilation. The data were analysed with MedCalc version 19.6.1 (MedCalc Software, Mariakerke, Belgium). Heterogeneity among studies was assessed using Q statistics that were distributed as $\chi 2$ under the assumption of homogeneity of effect sizes and I2 values of 0–75%, which represented none to high heterogeneity. The overall pooled prevalence of uncorrected, presenting, best-corrected, and causes of childhood visual impairment was estimated using a random-effect model. P

Results

Study characteristics

We identified 12 711 articles (Figure 1). After excluding duplicate studies, we reviewed the titles or abstracts of 6457 articles. Then, we excluded 6350 articles after reading their abstracts because they did not meet the inclusion criteria, and we excluded 84 articles after reading their full texts because the required data could not be extracted. The final meta-analysis included 23 articles from 9 countries (Table 1). Publication years were 2007–2020, and the overall sample size of the studies was 63 814 children with a mean age of 10.03 (1.96) years. The visual acuity threshold for the definition of childhood visual impairment varied from

Prevalence of childhood visual impairment

The pooled prevalence of uncorrected visual impairment among children using the random-effect model was 11.57% [95% confidence interval (CI): 8.37–15.33%, Q = 2759.9, I2 = 99.35%] (Table 2). Heterogeneity between studies showed a highly significant difference (P **C**

auses of childhood visual impairment

We assessed the causes of childhood visual impairment (Table 3). Refractive error was the main cause with a pooled proportion of 51.89% (95% CI: 20.39–82.56%). The pooled proportion of amblyopia was 11.15% (95% CI: 5.24–18.91%), retinal disorder 3.90% (95% CI: 1.49–7.40%), corneal opacity 3.0% (95% CI: 0.0–11.49%), and cataract 1.88% (95% CI: 0.27–4.91%). The pooled prevalence of other causes of childhood visual impairment was 11.3% (95% CI: 3.49–22.82%). Heterogeneity between studies showed a highly significant difference (P

Discussion

The prevalence of childhood visual impairment varies between countries and is influenced by socioeconomic status and childhood mortality rate. Posterior eye lesions are the leading causes of childhood visual impairment in developed countries, whereas corneal scarring caused by measles and vitamin A deficiency, and uncorrected refractive error are the main causes in less developed countries (40). This review attempted to provide information about the prevalence and causes of childhood visual impairment in the EMR. The pooled prevalence of uncorrected, presenting, and best-corrected childhood visual impairment was 11.57%, 8.34%, and 1.21%, respectively. Refractive error was the main cause (51.89%), followed by amblyopia (11.15%), retinal disorder (3.9%), corneal opacity (3.0%), and cataract (1.88%). There was high heterogeneity among reported estimates for each of these disorders, which showed a highly significant difference (P

Our results revealed that the prevalence of presenting childhood visual impairment was 8.3% lower than that reported globally for children around the same age (18.9%) (14). The prevalence of childhood visual impairment was comparable with the estimation for all ages in 6 WHO regions, which was 9.2%, 9.3%, 8.2%, 9.9%, 9.8%, and 5.2% in the African Region, Region of the Americas, EMR, European Region, South-East Asia Region, and Western Pacific Region, respectively (14). We found that the prevalence of uncorrected visual impairment was 11.57% when tested without correction, which was reduced to 8.34% with presenting correction, and only 1.21% with best correction of the refractive error. These findings indicate that childhood visual impairment can be improved by correction of refractive error, which agrees with previous studies conducted among children in different countries with various environments and ethnic groups (41–42).

In our meta-analysis, uncorrected refractive error was the leading cause of childhood visual impairment and was responsible for 51.89% of cases. This was lower than in countries outside

the study region, such as Ethiopia (77.3%) (43), India (77%) (44), and Malaysia (87.0%) (45). However, some studies within the EMR showed a high percentage of childhood visual impairment caused by uncorrected refractive error, such as Saudi Arabia (94.0%) (17), Libya (90.7%), and Pakistan (89.3%) (26). Our analysis showed a wide variation in the prevalence and causes of childhood visual impairment, which reflected the heterogeneity among the studies. This could have resulted from racial and environmental diversity, as well as poor accessibility, availability, affordability, and awareness of paediatric eye care services in some countries. The high proportion of cases of childhood visual impairment resulting from uncorrected refractive error may have been related to the recent increase in myopia caused by young people spending a lot of time studying and reading, and more recently, increased use of smart devices. This agreed with Morgan and Rose (46), who reported convincing evidence for the rapid, environmentally induced change in the prevalence of refractive error associated with increased education and urbanization. Geographical distribution was considered a risk factor for the development of childhood refractive errors. The second most frequent cause of childhood visual impairment in the EMR overall was amblyopia (11.15%), with higher levels in Somalia (22.0%) (39), Sudan (32.5%) (24), and Pakistan (35.8%) (35). This could have resulted from the high rate of poverty and illiteracy, as well as poor accessibility to paediatric eye care services and the absence of annual school visual examinations. We found that corneal opacity was responsible for 3.0% of the cases of childhood visual impairment in the EMR. This may have been associated with the low prevalence of active trachoma in the EMR, or with implementation of a strategy for the prevention of avoidable childhood visual impairment. Corneal opacity caused by trachomatous trichiasis was reported as the cause of 3.0% of cases of visual impairment in a previous study in Cambodia (47).

This study had some limitations. It was a review of articles that had variations in study methods, such as the use of different definitions of visual impairment threshold, and different methods for gathering and analysing data, as well as different sample sizes. Many articles were excluded from the final meta-analysis because they used different methods or different age groups, which reduced the number of articles included and may have affected the accuracy of the estimates. The study estimated the prevalence and causes of childhood visual impairment for both sexes but did not calculate sex differences. There was an unequal geographic distribution of studies included in this review; some countries had several studies, whereas others had no studies about childhood visual impairment, which may have created bias in the final results. Regardless of these limitations, this meta-analysis estimated the overall prevalence and causes of uncorrected, presenting, and best-corrected childhood visual impairment in the EMR, and included different environments and racial groups.

Conclusion

The prevalence of visual impairment among children in the EMR was high, and the leading causes were uncorrected refractive error, amblyopia, and retinal disorders. These causes are avoidable; therefore, access to eye care services may lead to early diagnosis and treatment of preventable causes of childhood visual impairment.

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Analyse systématique et méta-analyse des déficiences visuelles chez les enfants dans la Région de la Méditerranée orientale

Résumé

Contexte : La déficience visuelle chez les enfants a un effet significatif sur la vie sociale, les résultats scolaires et les choix professionnels, et peut mener à la pauvreté.

Objectifs : Examiner la prévalence et les causes des déficiences visuelles chez les enfants âgés de 5 à 17 ans dans la Région de la Méditerranée orientale.

Méthodes : L'étude a été menée en 2021 à l'aide des directives PRISMA (Éléments de notification préférés à des fins d'examens et de méta-analyse systématique). Nous avons recherché les études publiées entre janvier 2000 et avril 2020 dans Google Scholar, PubMed, Web of Science, Scopus, Index Medicus pour la Région de la Méditerranée orientale et Medline. Les articles retenus étaient des études épidémiologiques sur la prévalence et les causes de la déficience visuelle chez les enfants, publiées dans des revues à comité de lecture.

Résultats : Sur les 12 705 articles examinés, 23 provenant de neuf pays répondaient aux critères d'inclusion. La prévalence globale des déficiences visuelles infantiles non corrigées, détectées et les mieux corrigées était respectivement de 11,57 %, 8,34 %, et 1,21 %. Les causes les plus fréquentes de déficience visuelle infantile étaient le vice de réfraction (51,89 %), l'amblyopie (11,15 %), les troubles de la rétine (3,90 %), l'opacité cornéenne (3,0 %) et la cataracte (1,88 %). L'hétérogénéité entre les études était très significative (p