

The Analysis Study of Association of Myopia and Age-Related Cataract: A Comprehensive Systematic Review

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ABSTRACT

Background: Cataract is a major burden for health-care providers around the world. From a public health perspective, it is important to know the prevalence of undiagnosed lens opacities. Myopia a refractive error where distant objects appear blurred due to the elongation of the eyeball is seeing a rise in prevalence worldwide, with a particular increase in Asian populations. **The aim:** The aim of this study to show about association of myopia and age-related cataract. **Methods:** By the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. This search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, SagePub, and Sciondirect were used to do this. **Result:** Eight publications were found to be directly related to our ongoing systematic examination after a rigorous three-level screening approach. Subsequently, a comprehensive analysis of the complete text was conducted, and additional scrutiny was given to these articles. **Conclusion:** Low and moderate myopes are less likely to develop such a severe visual outcome; nevertheless, they are at significant risk to develop cataract.

Keyword: Myopia, cataract, lens opacities.

INTRODUCTION

Cataract is the leading cause of blindness in the world, accounting for half of blindness and affecting about 20 million people. Although cataract surgery is an effective method for restoring vision, individuals in developing countries have limited access to cataract surgery services. In addition, cataract is also one of the major socioeconomic and public health burdens, even in developed countries.^{1,2}

Cataract, defined as any opacity of the crystalline lens in the eye that affects clear vision, is a common condition in later life. If left untreated, cataract can eventually progress to severe visual impairment or even blindness. Compared to the general population, people with cataract are more likely to have substantially reduced vision-related quality of life and increased risk of comorbidity and mortality. Surgery is cost-effective and successful in restoring cataract-related vision loss. Pathological myopia has been known to be associated with posterior subcapsular

lens opacities and early onset nuclear sclerosis, which adds up to the myopic refractive error.³⁻⁵

Myopia brings further vision challenges because high myopia increases the risk of pathologic ocular changes such as cataract, glaucoma, retinal detachment, and myopic macular degeneration, all of which can cause irreversible vision loss. In some communities with a high prevalence of myopia, myopic macular degeneration has been found to be the most frequent cause of irreversible blindness. Myopic macular degeneration has been found to cause 12.2% of vision impairment in Japan (approximately 200 000 people).^{6,7}

Myopia is the most prevalent ocular condition in young children worldwide, with the highest prevalence rates in East Asian countries (affecting up to 83% of Singaporean teenagers). Excessive axial elongation of the eye in high myopia can cause mechanical stretching of the outer coats of the eye ball resulting in various pathologic

changes such as staphyloma, chorio-retinal atrophic lesions, lacquer cracks and choroidal neovascularization, etc. Pathologic myopia, defined variably across studies i.e. either based on degenerative changes in posterior eye or pathologic axial elongation or by using definitions based on myopic retinopathy/maculopathy, represents the most severe form of high myopia.⁸⁻¹⁰

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast association of myopia and age-related cataract. It is possible to accomplish this by researching of association of myopia and age-related cataract. As

the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about association of myopia and age-related cataract. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "association of myopia and age-related cataract." as keywords. The search for studies to be

included in the systematic review was carried out using the PubMed, SagePub, and Sciencedirect databases.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The

following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

Table 1. Search Strategy

Database Search Strategy		Hits
Pubmed	((("Myopia"[MeSH Subheading] OR "Risk factor"[All Fields] OR "Etiology" [All Fields]) AND ("Diagnostic"[All Fields] OR "Prognostic"[All Fields]) AND ("Cataract"[All Fields]) OR ("Age-related cataract" [All Fields]))	17
Science Direct	((("Myopia"[MeSH Subheading] OR "Risk factor"[All Fields] OR "Etiology" [All Fields]) AND ("Diagnostic"[All Fields] OR "Prognostic"[All Fields]) AND ("Cataract"[All Fields]) OR ("Age-related cataract" [All Fields]))	47
Sagepub	((("Myopia"[MeSH Subheading] OR "Risk factor"[All Fields] OR "Etiology" [All Fields]) AND ("Diagnostic"[All Fields] OR "Prognostic"[All Fields]) AND ("Cataract"[All Fields]) OR ("Age-related cataract" [All Fields]))	1831

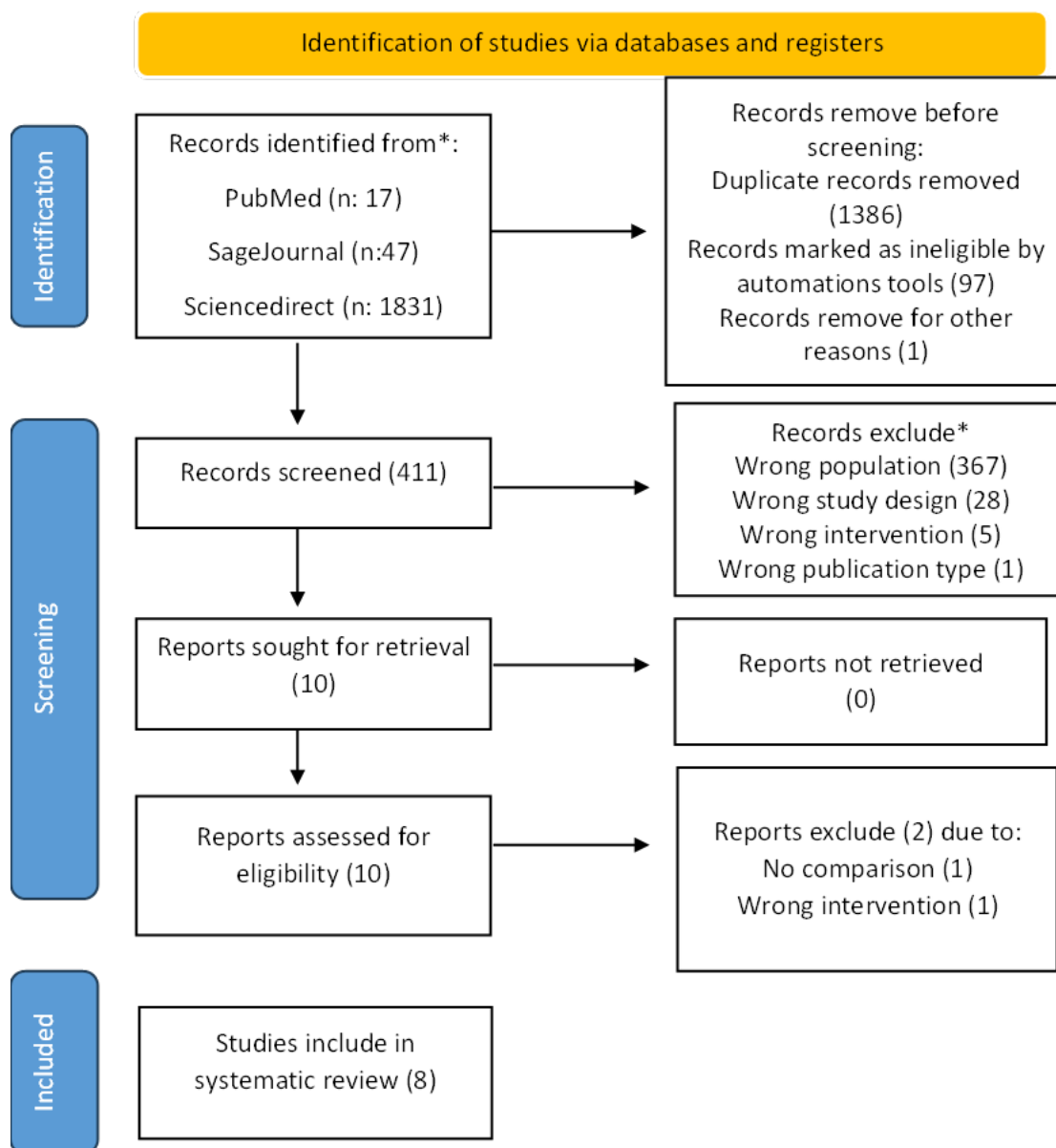


Figure 1. Article search flowchart

RESULT

Using reputable resources like Science Direct, PubMed, and SagePub, our research team first gathered 1895 publications. A thorough three-level screening strategy was used to identify only eight papers as directly relevant to our ongoing systematic evaluation. Next, a thorough study of the entire text and further examination of these articles were selected. Table 2 compiles the literature that was analyzed for this analysis in order to make it easier to view.

Table 2. The literature include in this study

Author	Origin	Method	Sample	Result
Hugosson, M & Ekstrom, C., 2020 ¹¹	Sweden	The Tierp Glaucoma Survey was conducted in the municipality of Tierp, Sweden, including 760 subjects aged 65–74 years. The presence of cataract was determined based on retroillumination, with lens opacities evident on slit-lamp examination. To assess risk factors for cataract, odds ratios (ORs) were calculated, adjusted for age and gender.	234	A total of 234 individuals were found to have cataract, 12 of whom had undergone cataract surgery. The prevalence adjusted for nonparticipation was 31.5% (95% confidence interval [CI] 29.4–33.6), 35.2% (95% CI 28.7–41.8) in females and 26.2% (95% CI 19.8–32.6) in males. Cataract was associated with age ≥ 70 years (OR 1.93; 95% CI 1.41–2.64), female gender (OR 1.54; 95% CI 1.12–2.11), and myopia (OR 2.3; 95% CI 1.16–3.56), while pseudoexfoliation, smoking, diabetes, hypertension, and ischaemic heart disease were not.
Kim, JM & Choi, YJ., 2024 ¹²	Republic of Korea	We analyzed 204,973 adults (44% men, 56% women; mean age 58.70 ± 10.75 years), exploring the association between myopia and these eye diseases through multivariate logistic regression, adjusting for confounders and calculating adjusted odds ratios (ORs) with 95% confidence intervals (CIs).	204973	Results showed a myopia prevalence of 44.6%, cataracts at 19.4%, macular degeneration at 16.2%, and glaucoma at 2.3%, with significant differences across ages and genders. A potential link was found between myopia and an increased risk of cataracts and macular degeneration, but not with glaucoma. Additionally, a higher dietary intake of carbohydrates, polyunsaturated and n-6 fatty acids, vitamins, and minerals correlated with lower risks of

				these diseases, underscoring the importance of the diet in managing and preventing age-related eye conditions.
Bullimore, MA & Brennan, NA., 2023¹³	USA	The broad approach is to apply the risk of visual impairment as a function of age and myopia to the projected United States population in 2050.	379 million	For a projected myopia prevalence of 58.4%, 222 million are projected to be myopic and 48 million will have high myopia (– 5 D or worse). The projected total number with uncorrectable visual impairment is 11.4 million of which 4.9 million cases (43%) of visual impairment will be directly attributed to increased risk of eye disease associated with myopia. For a projected myopia prevalence of 33.1%, 8.9 million are projected to have uncorrectable visual impairment of which 2.4 million cases (27%) will be directly attributed to myopia. It is predicted that between 27 and 43% of uncorrectable visual impairment in the US population in 2050 will be directly attributable to myopia. Failure to account for the increasing prevalence of myopia among the aging population leads to a substantial underestimate of the prevalence of visual impairment.
Sumeer, S et al., 2019¹⁴	India	A total of 6617 subjects were recruited from both rural and urban areas. A detailed history including data on demographic, socioeconomic and ocular history was obtained. Lens opacity was graded according to the Lens Opacity Classification System III (LOCS III).	6617	Cataract was present in 1094 of the rural and 649 subjects in the urban population. Monotype subtype cataracts were found in 32% and 25% in rural and urban population and 12.68% and 18.6% were mixed cataracts in the rural and urban groups. In baseline characteristics history of diabetes, alcohol intake and presence of age-related macular degeneration were the risk factors in urban group. On multivariate analysis, the only

				significant risk factors for any cataract in subjects ≥ 60 years were increasing age in both rural [odds ratio (OR), 1.07] and urban (OR, 1.08) population, and HbA1c (OR, 1.14) in rural population. Overweight (OR, 0.6) was found to be a protective factor, and lower social economic status (OR, 1.52) a risk factor for cataract in urban population. A significant urban-rural difference was found in the prevalence of cataract and its subtypes ($P \leq 0.05$).
Nowak, MS & Smigielski, J., 2015¹⁵	Poland	The study design was cross-sectional and observational study. A total of 1107 women and men of predominantly Caucasian origin were successfully enumerated and recruited for the study. All selected subjects were interviewed and underwent detailed ophthalmic examinations.	1107	Overall 8.04% (95% CI 6.44–9.64) subjects had cataract surgery in either eye. After excluding subjects with bilateral cataract surgery, the prevalence of cataract was 12.10% (95% CI 10.18–14.03). AMD was found in 4.33% (95% CI 3.14–5.54) of all subjects. Of them 3.25% (95% CI 2.21–4.30) had early AMD and 1.08% (95% CI 0.47–1.69) had late AMD. Various types of glaucoma were diagnosed in 5.51% (95% CI 4.17–6.85) of subjects and 2.62% (95% CI 1.68–3.56) had OHT. The prevalence rates of DR and myopic macular degeneration were 1.72% (95% CI 0.95–2.48) and 0.45% (95% CI 0.06–0.85), respectively. All multiple logistic regression models were only significantly associated with older age. The highest rate of visual impairment was observed among subjects with retinal diseases.
Xu, C et al., 2017¹⁶	China	A community-based, cross-sectional survey was conducted in the Weitang town located in	5613	Among the 5613 participating individuals, 4795 (85.4%) complete refraction data of phakic right eye was included for

		Suzhou, an urban metropolis in East China.		analysis. The age-adjusted prevalence was 21.1% (95% confidence interval [CI], 19.9-22.2) for myopia and 2.5% (95% CI, 2.1-2.9) for high myopia. The prevalence of myopia tended to increase significantly with age($p < 0.001$), and women had a higher rate of myopia than men ($p < 0.001$). According to multivariate logistic regression analysis, adults who were older (odds ratio[OR]:1.05; 95% CI:1.04-1.07), spent more time for sleeping at night (OR:1.12;95% CI: 1.06-1.18), or had cataract (OR:1.60;95% CI:1.36-1.88) and family history of myopia (OR:1.47;95% CI:1.23-1.77), are more susceptible to myopia ($p < 0.001$). People who had older age, family history, cataract and specially longer night-time sleep duration, would have a higher risk of myopia.
Hsiao, YT et al., 2021 ¹⁷	Taiwan	A retrospective cohort study examined 960 adults who underwent cataract surgery at the Kaohsiung Chang Gung Memorial Hospital in year 2008 and year 2018. Axial length was assessed with the ultrasound biometry and/or the Zeiss IOLMaster.	960	Axial length showed an age-related elongation in 10-year cross-sectional data, from a mean of 23.65 ± 1.80 mm in year 2008 to a mean of 24.30 ± 1.90 mm in year 2018 ($p = 0.003$). Patients with high myopia (axial length > 26 mm) increased significantly over the 10-year period from 8.1 to 16 % ($p < 0.001$). A birth cohort effect on axial length was evident as the axial lengths of year 2008 cohort were shorter than the 2018 cohort when they were in the same operation age group. In particular, persons born after the 1960s demonstrated a predominant increase in axial length in both cohorts.

Hong, Y et al., 2022 ¹⁸	China	From March to June 2010, a population-based, cross-sectional study was conducted in a community selected by stratified cluster sampling in the Jingan district of Shanghai.	2894	A total of 2894 subjects aged 40 years and above were included in our study. Nine hundred forty-eight people (32.8%) were diagnosed with cataract, including 845 with bilateral cataracts (29.2%) and 292 with moderate and severe visual impairment (low vision, 10.1%). There were significant differences in low vision among different age groups and gender ($X^2_{age} = 84.420, P_{age} < 0.001$, $X^2_{gender} = 7.696, P_{gender} = 0.021$). For any cataract, we found age (OR = 1.107, 95% CI: 1.094–1.120) and refractive error (OR = 1.352, 95% CI: 1.127–1.622) were independent risk factors.
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Table 3. Critical appraisal of Study

Parameters	(Hugosson, M & Ekström, C., 2020)	(Kim, JM & Choi, YJ., 2024)	(Bullimore, MA & Brennan, NA., 2023)	(Sumer, S et al., 2019)	(Nowak, MS & Smigielski, J., 2015)	(Xu, C et al., 2017)	(Hsiao, YT et al., 2021)	(Hara, Y et al., 2022)
1. Bias related to temporal precedence								
Is it clear in the study what is the “cause” and what is the “effect” (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation								
Was there a control group?	No	No	No	No	No	No	No	No
3. Bias related to confounding factors								
Were participants included in any comparisons similar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Bias related to administration of intervention/exposure								
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	No.	No.	No.	No.	No.	No.	No.	No.
5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

DISCUSSION

High myopia is said to occur when a person's myopia progresses until they need -5 dioptres (D) or more of spherical correction, although the definitions used to grade myopia are variable. The prevalence of myopia is increasing globally. It has been predicted that, by the year 2050, high myopia will affect 9.8% of the global population; a total of 938 million people. The highest prevalence of myopia is seen in younger adults, particularly in urbanised East and Southeast Asian countries.^{5,19}

Even when appropriate refractive correction is provided, myopia continues to place an individual at an increased risk of sight-threatening diseases, including:^{5,20}

- Glaucoma (open-angle)
- Cataract (nuclear, cortical and posterior subcapsular)
- Retinal tears which may lead to a retinal detachment
- Myopic maculopathy or myopic macular degeneration

Although cataract is almost always a curable disease, it is still one

of the most common causes of visual impairment around the world. This disease, which can significantly reduce patients' quality of life, is still one of the main ophthalmological public health problems in developed and developing countries, and it is known as the main cause of blindness in many countries. Studies indicate that 36 million people are blind worldwide, and over 12 million of them are due to cataract. It is projected that this estimate will reach 13.5 million people in 2020. The importance of cataract blindness is that more than 90% of the total disability-adjusted life years lost due to cataract is in developing countries.^{21,22}

For cataract, the relationship with myopia is less evident. In particular, nuclear cataract may result in a myopic shift, which hampers determination of the original refractive error. Considering OAG, Perkins et al. already published in 1982 about a higher percentage of myopic patients in the OAG population. A meta-analysis performed on 11 population-based studies also identified an increased

risk of OAG for myopic persons. Whether visual field progression in myopes is similar to other OAG patients is still unclear.^{23,24}

The meta-analysis identified a strong association between myopia, PSC, and nuclear cataract, but not between myopia and cortical cataract. Three mechanisms have been proposed to explain the relationship between myopia and cataract. First, myopic eyes may be exposed to a higher level of oxidative stress caused by faster vitreous liquefaction, or by a decreased level of glutathione, an antioxidative agent in the lens of myopic eyes leading to cataract formation. Second, the higher level of byproducts of lipid peroxidation in myopia may increase cataract formation. Third, longer AL may lead to diminished diffusion of nutrients from the posterior chamber to the lens causing cataract. This mechanism seems less plausible because the aqueous humor also provides nutrients to the lens.^{23,25,26}

CONCLUSION

In conclusion, one in three high myopes is at risk of bilateral low vision with age. Low and moderate myopes are less likely to develop such a severe visual outcome; nevertheless, they are at significant risk to develop cataract.

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