Review Article

Common causes of visual impairment in the elderly

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ABSTRACT

Background: Aging is not a disease; rather, it is a process. As people age, visual impairment (VI) becomes more common. In 2010, the overall prevalence rate of vision impairment in all races was 25.66% in individuals aged ≥ 80 years, according to the estimate of the National Eye Institute at the National Institutes of Health. This review aimed to address the common causes of VI in the elderly.

Methods: In this narrative review, an electronic search of the PubMed/MEDLINE database was conducted using "visual impairment" and "elderly" for the period between January 2010 and April 2021, to include randomized clinical trials and observational studies concerning VI in the elderly. The selected time period was chosen to provide an updated review.

Results: The search yielded 2955 articles published over the period of more than 11 years. The relevant randomized clinical trials or observational studies were included and reviewed. Cataracts, refractive errors, open-angle glaucoma, age-related macular degeneration, and diabetic retinopathy were the most common age-related ocular disorders leading to VI if untreated in the elderly. The loss of visual acuity can adversely affect quality of life in the elderly. Difficulty with activities of daily living related to VI can lead to social isolation, depression, and anxiety. Loss of vision in the elderly is linked to an increased risk of falls, hip fracture, depression, and poor quality of life.

Conclusions: The most common causes of VI in the elderly are cataracts and refractive errors. VI in most ocular diseases is more prevalent in women than in men due to longer lifespan. The overall prevalence of the main causes of VI in the elderly is expected to increase; therefore, health policymakers should consider this when planning for the health-enhancement program of the population.

KEYWORDS

visual impairment, elderly, cataracts, refractive error, age-related macular degeneration, glaucoma, diabetic retinopathy, policymaker, health-enhancement program

INTRODUCTION

Aging is a process that is not considered as a disease. Individuals aged 65 or more years are considered elderly [1]. Presbyopia, reduced contrast sensitivity, reduced dark/light adaptation, and glare delay recovery are common visual changes that are considered part of normal aging physiology. However, with age, visual impairment (VI) becomes more common [1-5]. VI is classified according to visual acuity of the best-seeing eye into mild (< 20/30 to ≥ 20/60), moderate (< 20/60 to ≥ 20/200), and severe (< 20/200 to ≥ 20/400). Blindness is defined as a visual acuity of < 20/400 in the best-seeing eye [6].

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In 2010, among individuals aged ≥ 80 years, the overall prevalence rates of VI in all races, white Americans, Hispanics, and African Americans (AAs) were 25.66%, 27.17%, 19.11%, and 16.68%, respectively [7]. Additionally, in individuals aged ≥ 80 years, the overall blindness rates among AAs, white Americans, other races, and Hispanics were 9.21%, 8.41%, 6.32%, 3.46%, and 2.15%, respectively [7]. In a systematic review and meta-analysis, the global number of blind individuals in 2020 was estimated at 43.3 million, of whom 23.9 million were female; the number with moderate and severe VI was estimated at 295 million, of whom 163 million were female; and the number with mild VI was estimated at 258 million, of whom 142 million were female. By 2050, the global numbers of individuals with blindness, moderate and severe VI, mild VI, and uncorrected presbyopia are predicted to reach 61.0 million, 474 million, 360 million, and 866 million, respectively [8]. The prevalence of VI differs based on the place of study; for example, the prevalence in individuals aged ≥ 80 years in Yugan County, China, was reported as 56.6% [9].

This review aimed to address common causes of VI in the elderly, including cataracts, refractive errors, open-angle glaucoma, age-related macular degeneration (ARMD), and diabetic retinopathy (DR).

METHODS

In this narrative review, an electronic search of the PubMed/MEDLINE database was conducted using the keywords "visual impairment" and "elderly", including relevant randomized clinical trials and observational studies published between January 2010 and April 2021. The search syntax ("visual impairment" AND elderly) was used to provide an updated comprehensive review with inclusion of the most relevant articles.

RESULTS

The search yielded 2955 articles published over the period of more than 11 years. The relevant randomized clinical trials or observational studies were included and reviewed. Cataracts [6, 9-18], refractive error [6, 10, 14, 16, 18], glaucoma [13], ARMD [6, 12, 13, 17], DR [13], and myopic degeneration [12, 14, 16] were the main causes of age-related ocular disorders in the elderly. Articles concerning the main causes of VI in the elderly are reviewed in the Discussion section below. Table 1 summarizes the most common causes of ocular disorders in the elderly outlined in some included studies.

DISCUSSION

The loss of visual acuity in the elderly can adversely affect their quality of life [21]. VI may cause visual difficulties in activities of daily living, leading to social isolation, depression, and anxiety [22]. Loss of vision in the elderly is associated with an increased risk of falls [23], hip fracture [24], depression [25], and poor quality of life [26].

Cataracts

Table 1. The most common causes of visual impairment in the elderly according to the some included studies

Author (year)	Region	Type of Study	Age and number of participants	First Major Cause	Second Major Cause
Thapa et al., 2018 [15]	Nepal	Cross sectional survey	Age ≥ 60 y; n = 1860	Cataract	Retinal disorders
Gan et al., 2018 [19]	China	Cross sectional survey	Age ≥ 60 y; n = 3789	Cataract	Refractive error
Baldev et al., 2017 [10]	Northern India	A population based cross-sectional	Age > 60 y; n = 450	Cataract	Refractive error
Cypel et al., 2017 [6]	Brazil	Cross-sectional	Age > 80 y; n = 150	Cataract	Refractive error
Pan et al., 2016 [18]	Eastern China	Community-based survey	Age > 60 y; n = 4579	Refractive error	Cataract
Varma et al., 2016 [14]	Chinese-American	Cross-sectional	Age ≥ 50 y; 4582	Refractive error	Cataract
Nowak et al., 2015 [13]	Poland	Cross-sectional	Age ≥ 60 y; n = 1107	ARMD	Cataract
Zhou et al., 2012 [20]	China	Cross-sectional	Age ≥ 60 y; n = 1305	Cataract	Fundus diseases
Chen et al., 2012 [17]	Taiwan	Cross-sectional	Age ≥ 65 y; n = 2316	Cataract	ARMD
Tong et al., 2011 [4]	China	Cross-sectional	Age ≥ 60 y; n = 5199	Cataract	Refractive error

Abbreviations: y, years; n, number of participants; ARMD, age-related macular degeneration.

The main causes of VI in the elderly are reported as cataracts [6, 9-18] and refractive error [6, 10, 14, 16, 18] in most of the included studies (Table 1). According to a meta-analysis of 288 studies involving 3,983,541 participants from 98 countries spanning more than three decades, among adults aged ≥ 50 years, most cases of moderate or severe VI and blindness are due to cataracts and refractive error, which are both reversible [27]. Population growth and aging have contributed to an increase in vision loss [27]. Cataracts (Figure 1) are the primary worldwide cause of visual loss in the elderly [6, 9-16]. Cataracts account for almost half of the world's 37 million cases of blindness [28]. Delaying cataract development by ten years might reduce the need for surgery by 50% [29].

Cataracts reduce performance-based visual function compared with that of unaffected individuals. Ni et al. found that uneventful cataract surgery could result in visual improvement, enhancing both performance-based and self-assessed functional vision [31]. The prevalence of cataract-related visual loss increases with age [6, 31]. Increasing age and impaired visual function are independently linked with loss of independence, including driving difficulties and placement in a nursing facility [6]. There are several modifiable risk factors for cataract development. Smoking is linked to nuclear sclerosis and posterior subcapsular cataracts [32], diabetes to cortical and posterior subcapsular cataracts [33, 34], ultraviolet light exposure to cortical and posterior subcapsular cataracts [35, 36], and myopia to all forms of cataracts. Oral corticosteroids, and to a lesser extent, inhaled corticosteroids, have been associated with posterior subcapsular cataracts [33, 34].

Cataract-associated vision loss is also related to sex and age [13, 33, 37]. Women are more likely than age-matched men to lose vision due to cataracts [13]. The risk of cataracts increases with age; by age ≥ 80 years, 70.38%, 53.48%, 60.66%, 60.86%, and 68.30% of white Americans, AAs, Hispanics, other races, and the overall population in the United States have cataracts, respectively [38].

The prevalence of blindness in men and women is 4.17% and 5.68%, respectively. Women have a 35% higher likelihood of blindness and a 69% greater chance of blindness due to cataracts [39]. Female sex accounts for 35% of the blindness prevalence and 33% of the cataract prevalence [39]. The influences of postmenopausal hormonal changes, genetics, and serum inflammatory markers in cataract development are being studied [32, 40, 41].

Considering that patients aged > 65 years with impaired vision are more likely to fall, fracture bones, and

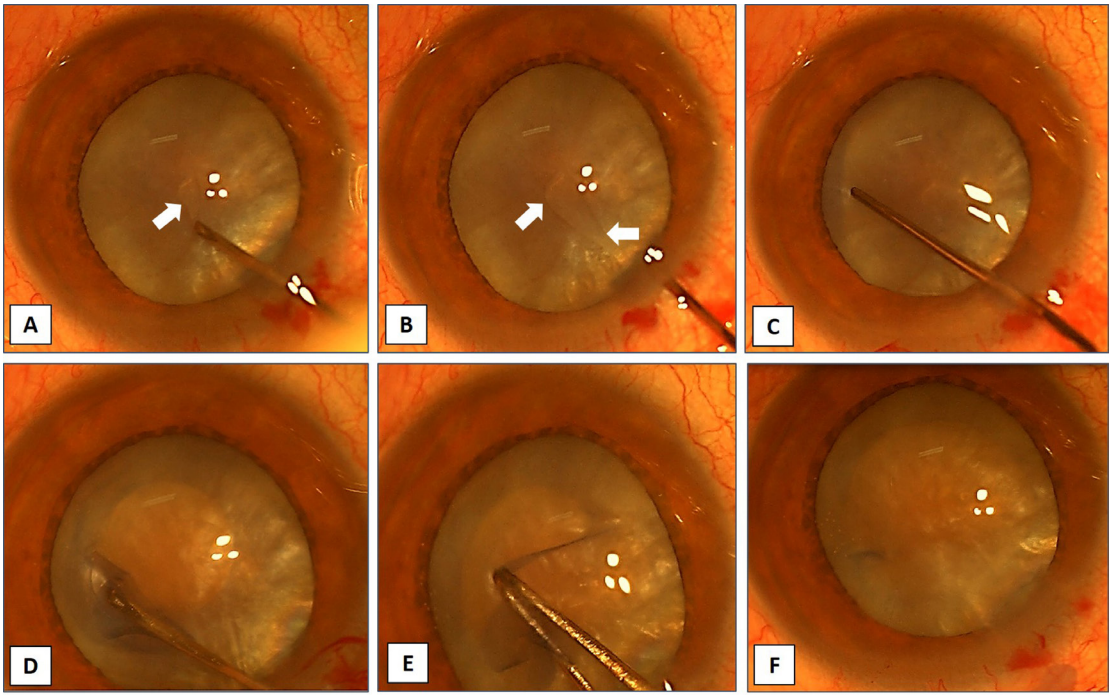

Figure 1. Anterior segment images show surgical steps for capsulorhexis in a dense mature fluid-filled cataract (A-F). This figure has been reused with the permission of *Med Hypothesis Discov Innov Ophthalmol* [30].

require walking aids [42], elimination of the causes of VI, including cataracts, should be emphasized in the elderly. Since the first Rapid Evaluation of Avoidable Blindness (RAAB) Study in 2009 in Bhutan, a country in south-central Asia, blindness has decreased by 33%, from 1.5% in 2009 to 1.0% in 2018 [43].

The prevalence of cataracts in Chinese individuals aged 45–49 years and 85–89 years ranged from 6.71% to 73.0% in men and 8.39% to 77.51% in women, respectively [44]. The number of any cataract cases in individuals aged 45–89 years increased from 50.75 million in 1990 to 111.74 million in 2015 [44]. Between 2000 and 2010, South Central China had the most cataract cases, while Northwest China had the fewest. Because of China's aging population, cataract and cataract blindness prevalence will remain a major public health concern [44].

The Age-Related Eye Disease Study 2 (AREDS2) randomized clinical trial showed that late ARMD, bilateral cataract surgery, and visual acuity < 20/40 were all associated with a lower chance of survival [45]. In contrast, oral supplementation with omega-3 fatty acids, lutein plus zeaxanthin, zinc, or beta-carotene had no statistically significant effect on mortality [45].

Refractive Error

The major cause of VI in the United States is uncorrected refractive error [46]. In the Canadian Longitudinal Study on Aging, the most prevalent cause of vision loss was refractive error [47]. Blindness due to uncorrected refractive error rose from 6.2 million cases in 1990 to 7.4 million cases in 2015; the figures for overall VI were 84.8 million and 116.3 million cases, respectively. By 2020, the estimated number of global cases of moderate or severe VI caused by uncorrected refractive error was 127.7 million (51.0–225.3 million) [27]. It is estimated that by 2050, 866 million people will have uncorrected presbyopia [8]. Geriatric visual acuity screening is still recommended; however, the United States Preventive Services Task Force (USPSTF) found insufficient evidence to recommend screening for impaired visual acuity in adults aged ≥ 65 years. Despite convincing evidence that visual acuity tests can identify individuals with a refractive error, the USPSTF found that screening using only visual acuity testing does not accurately detect early ARMD or cataracts [48, 49]. In addition, Clarke et al. in a recent systematic review and meta-analysis found a comparable risk of poor vision in communities with and without vision screening [50]. More research is required to identify any benefits of vision screening in the elderly. Screening is intended to determine if older individuals require glasses to function normally and to avoid depression or falls that may result from impaired vision.

Although uncorrected refractive error can be as disabling as VI caused by non-correctable causes, it is easily addressed using glasses. The aging process affects several aspects of vision. The elder's vision may decrease considerably as a result of glare. Color vision and contrast sensitivity are known to decrease with age [51, 52].

Increasing time outdoors has been associated with myopia in the elderly [53]. Myopia is more prevalent in individuals aged > 70 years than in other age groups, indicating a nuclear cataract-induced myopic shift in refraction [54]. In 2010, the estimated prevalence rates of myopia in those aged ≥ 80 years among white Americans, Hispanics, other races, and AAs were 18.37%, 17.07%, 15.13%, and 10.25%, respectively [55]. Between ages 55 and 59 years, the estimated prevalence rates in white Americans, other races, Hispanics, and AAs were 22.99%, 16.76%, 14.53%, and 12.21%, respectively [55]. A meta-analysis highlighted the link between myopia and increased risks of myopic macular degeneration, retinal detachment, posterior subcapsular cataract, nuclear cataract, and open-angle glaucoma. Longer axial length, higher degree of myopia, and age ≥ 60 years were all associated with a higher risk of VI. Therefore, the priority of myopia prevention and treatment has been highlighted in the literature [56, 57].

The prevalence of hyperopia increases with age in all races. In 2010, the estimated prevalence rates of hyperopia in individuals aged ≥ 80 years among white Americans, Hispanics, AAs, and other races were 25.12%, 17.50%, 9.66%, and 1.07%, respectively, and were higher in women than in men among all age groups [58].

Glaucoma

Glaucoma increases in prevalence with age [59] (Figure 2). In 2010, 1.9% of people aged > 40 years and 7.89% of people aged > 80 years in the United States were affected by glaucoma [60]. Flaxman et al. reported that in 2015, glaucoma caused moderate or severe VI in 4 million people, and 2.9 million were blind. They predicted that glaucoma would lead to moderate or severe VI in 4.5 million people in 2020, and 3.2 million would be blind [27].

Race, sex, and age can affect the likelihood of glaucoma. Glaucoma is more common among women due to their longer lifespan [60]. AAs have the highest prevalence, and glaucoma is the leading cause of blindness in AAs [60, 61]. Undiagnosed visual disorders affect 10% of the elderly population. One of the most frequently used methods of glaucoma screening is tonometry. A dilated fundus exam is recommended by the United States Centers for Disease Control and Prevention every 1–2 years [18, 62, 63]. Goldmann applanation tonometry

remained the gold standard to which the other devices may underestimate or overestimate the intraocular pressure measurement. However, the central corneal thickness and other factors such as ethnicity could affect the accuracy of intraocular pressure measurement [64].

The prevalence of glaucoma has been reported to increase with age. Glaucoma is diagnosed in approximately 6% of AAs by the age of 69 years, and the proportion increases to 12% after the age of 80 years. Sixty-one percent of glaucoma cases in the United States are in women. It has been predicted that in 2050, 6.3 million people will have a diagnosis of glaucoma [60]. Clinical trials on pharmaceutical treatment of primary open-angle glaucoma have found that medical treatment is effective, safe, and positively affects quality of life [65, 66]. Glaucoma interventions have been summarized in a recently published review article. The novel Rho-kinase inhibitors showed significant intraocular pressure reduction [66].

Age-Related Macular Degeneration

ARMD is a progressive disease of the macula lutea that results in a gradual decline in central vision and leads to severe VI [67] (Figure 3). Among white adults over 50 years of age, the prevalence rate of ARMD was 2.5% in 2010. The prevalence rates of ARMD among people aged ≥ 80 years are 11.73% overall and 13.59% in white Americans, who have the greatest risk of ARMD compared to other races [68]. The burden of disease is predicted to increase by 2050, affecting 5.44 million people. White Americans will account for most cases, and Hispanics will experience the highest growth rate, with an almost six-fold increase in the number of expected ARMD cases from 2010 to 2050. Dietary supplements, such as vitamins and minerals, are recommended [68]. According to AREDS2, a dietary supplement formulation may lessen the likelihood of intermediate ARMD

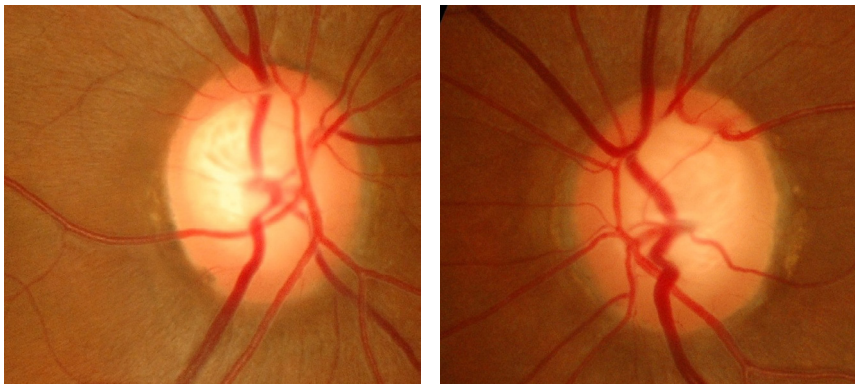

Figure 2. Fundus photographs of the right and left eyes of a patient with glaucoma. Note the large cup-to-disc ratio, bayoneting sign, vessel barring, regional pallor, and subtle retinal nerve fiber layer defect.



Figure 3. Fundus photograph of the right eye of a patient with age-related macular degeneration. Note the hard exudate and significant macular edema caused by choroidal neovascularization.

progressing to the advanced stage [68-70].

Based on a meta-analysis, the global prevalence rate of blindness caused by macular diseases was 6.6% in 2010, accounting for 3.1% of all VI cases worldwide. The prevalence of early ARMD was estimated to be 8.0%, and late ARMD 0.4%, between the ages of 45 and 85 years. The estimated numbers of individuals with ARMD were 196 million in 2020 and 288 million in 2040. Early ARMD was found to be more common in Europeans (11.2%) than in Asians (6.8%) [71, 72]. ARMD was ranked as the fourth most common cause of blindness worldwide in 2015, accounting for an estimated 5.8% of blind people, and as the third most common cause of moderate to severe VI (3.9%) [72]. These data highlight the importance of ARMD as one of the main causes of VI in the elderly. Therefore, policymakers should consider this when planning for health enhancement of the population.

Diabetic Retinopathy

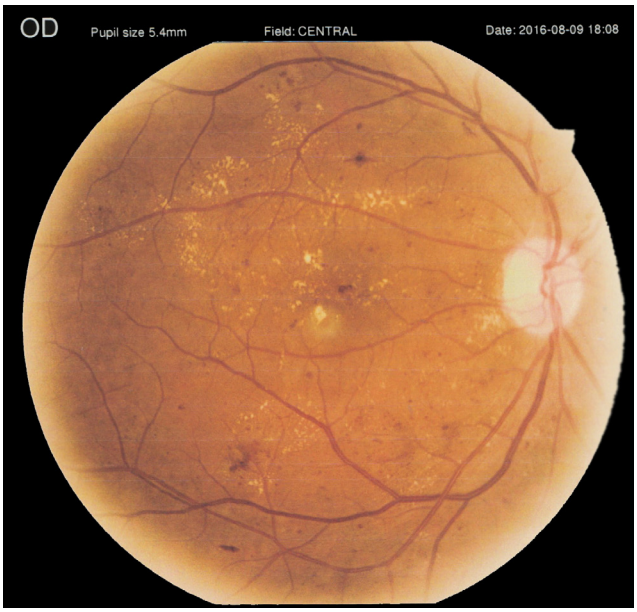

Figure 4. Severe right eye non-proliferative diabetic retinopathy and clinically significant macular edema in a 65-year-old man with corrected distance visual acuity of 40/200 in both eyes. This figure has been reused with the permission of *Med Hypothesis Discov Innov Ophthalmol* [79].

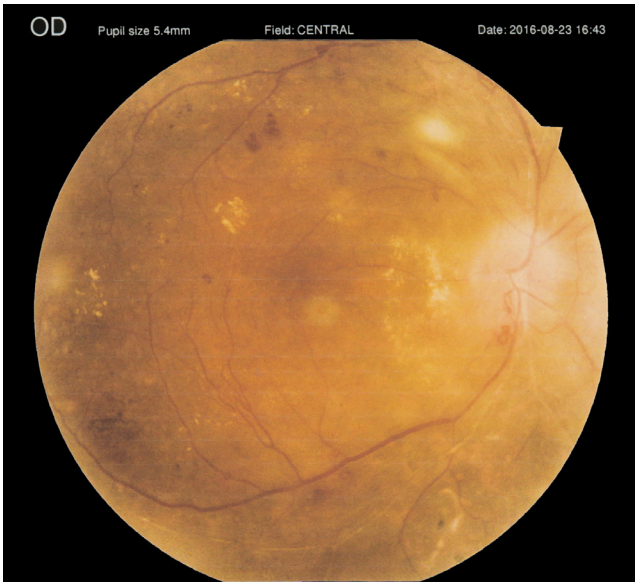

Figure 5. A 68-year-old man with active proliferative diabetic retinopathy and history of previous pan-retinal photocoagulation in his right eye. This figure has been reused with the permission of *Med Hypothesis Discov Innov Ophthalmol* [79].

According to the World Health Organization global report on diabetes published in 2016, one in every 12 adults (8.5%) has diabetes [73]. DR is the fifth leading cause of blindness and moderate to severe VI worldwide, and its prevalence is increasing in the United States. DR is a cause of vision loss in individuals aged 20–74 years [74, 75]. DR causes vision loss predominantly through diabetic macular edema and proliferative diabetic retinopathy (Figures 4 and 5) and is mostly mediated by increased retinal vascular injury and subsequent local ischemia [76-79]. From 2008 to 2010, DR accounted for 6.1% to 8.3% of VI cases in the United Kingdom. The prevalence rate of DR in 2010 for people aged ≥ 75 years was 7% in white Americans and AAs, as compared to 19% in Hispanics, who have a higher risk. In 2010, women had a higher prevalence rate than men (51% versus 49%). The prevalence rate of DR is expected to double by the year 2050, affecting 14.6 million individuals [74, 80].

This literature review included an up-to-date discussion of the most prevalent causes of VI among the elderly and of the practical applications for this pivotal subject. However, the limitations of the study are that it was performed by a single author, and only PubMed/MEDLINE was searched, which might have resulted in bias. A future review article focusing on the most common geriatric syndromes related to VI could provide practical guidelines for health policymakers to confront this globally challenging health issue.

CONCLUSIONS

VI in most ocular diseases is more prevalent in women due to their longer lifespan. Cataracts and uncorrected refractive errors are the leading causes of VI among the elderly. AAs over the age of 80 years have the highest prevalence of glaucoma, and Hispanics over the age of 80 years have the highest prevalence of DR. Depression has been linked to uncorrected refractive error in the elderly. The overall prevalence of the main causes of VI is expected to increase, which should be considered by health policymakers when planning for the health enhancement of the population.

ETHICAL DECLARATIONS

Ethical Approval: This study was a review, and no ethical approval was required.
Conflict of Interest: None

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