



Eye Health Needs of Older Adults Literature Review



EYE HEALTH NEEDS OF OLDER ADULTS LITERATURE REVIEW

I. INTRODUCTION

The purpose of this literature review is to provide information about the eye health care needs of older adults. Age-related eye diseases and conditions are the most important drivers for the various types of eye health care required by older adults. The most common age-related eye diseases or conditions are cataract, age-related macular degeneration (AMD), primary open-angle glaucoma, diabetic retinopathy, and presbyopia. For each, we provide a definition, describe the prevalence in the older adult population, and briefly summarize current prevention and treatment practices. The impact of vision loss from these diseases and the public health implications are also discussed. A brief description of the older adult population is provided in terms of demographic and cultural characteristics, as well as communication strategies that may be effective in delivering eye health care messages to this audience.

II. EYE DISEASES AND CONDITIONS IN OLDER ADULTS

As people advance in age, normal functions of the eye tissues decrease and blinding disorders increase in frequency. Age-related eye diseases and visual loss are common in the older adult population. In 2003, it was reported that almost half of more than 20,000 Medicare recipients developed at least one of three eye diseases (i.e., diabetic retinopathy, glaucoma, or macular degeneration) over a 9-year period.¹ Although age-related eye diseases are prevalent in older adults, some blindness and low vision resulting from these diseases may be prevented or treated.

On the basis of demographics from the 2000 U.S. Census, an estimated 937,000 Americans aged 40 and older are blind and another 2.4 million suffer from low vision.² The specific causes of blindness and other visual impairments are substantially different by race and ethnicity. Regardless of the cause, the number of people who are blind or who have low vision is expected to nearly double by the year 2020, largely because of the aging of the U.S. population.

CATARACT

Cataract is defined as opacity in the lens, which interferes with vision.³ Cataract is the most common age-related eye disease and is also the most treatable cause of vision loss in older adults.⁴

It is estimated that more than 17 percent of Americans aged 40 and older have cataract in either eye, and 5 percent of Americans aged 40 and older report having surgery to remove cataract from one or both eyes.⁵ Cataract is more prevalent in women than in men. In the United States, cataract causes about 50 percent of the cases of vision loss among White, African American, and Hispanics/Latinos. African American men are more likely to be blind from cataract than White men.² A recent study among Hispanics/Latinos found that cataract occurred in 20 percent of this population and approximately 3.9 percent had cataract extractions in at least one eye.⁶

Although there is no proven primary prevention for cataract, it has been suggested that reducing sunlight exposure may slow the pace of eye deterioration and delay the development of cataract.⁷ The risk of developing cataract has been found to be highest among individuals with high sun exposure at younger ages.⁸ A diet rich in fruits and vegetables may reduce the risk of developing cataract and several studies have been conducted to test these theories. One study found that adherence to the *Dietary Guidelines for Americans* protects against cataract in women.⁹ A high intake of fruits and vegetables also has been found to have a modest protective effect on cataract in women.¹⁰

While there are no effective medical interventions for cataract, surgical treatment is highly effective. Modern cataract surgery is very safe and can be performed as an outpatient procedure under local anesthesia. Cataract surgery can be used as treatment when daily activities and quality of life are affected or when changes in eyeglasses are no longer effective. Treatment also is indicated when cataract interferes with the treatment of other eye diseases, such as diabetic retinopathy, macular degeneration, or glaucoma.^{3,4} Cataract surgery can generate improvement in visual functional status and result in a better quality of life for older adults.

AGE-RELATED MACULAR DEGENERATION

Age-related macular degeneration (AMD) is the leading cause of irreversible vision loss in the industrialized world. Two forms of AMD exist. Exudative AMD, also known as neovascular or wet AMD, causes central vision loss. Nonexudative AMD, the most common form, is known as dry AMD and progresses more slowly than exudative AMD.

The overall prevalence of AMD in the U.S. population aged 40 and older is estimated at 1.47 percent, with 1.75 million individuals affected.¹¹ Owing to the rapid aging of the U.S. population, this number is projected to increase to almost 3 million by 2020. Another 7 million individuals have large drusen in one or both eyes and are at an increased risk for developing advanced AMD. The disease is more common in Whites than in African Americans and is a leading cause of blindness (54 percent of the cases) among White Americans.² The incidence of AMD increases dramatically with age among both men and women: 16 percent of White women over 80 years of age are affected with advanced AMD, while 12 percent of White men over 80 years of age are affected with advanced AMD¹¹.

Lifestyle modifications may reduce the risk of developing AMD. These changes include refraining from smoking, preventing high blood pressure, reducing body mass index, increasing intake of the carotenoids found in dark green leafy vegetables, and wearing sunglasses that block ultraviolet and high-energy radiation.^{11,12} Moderate wine consumption has also been found to be associated with decreased odds of developing AMD.¹³

High-dose supplements of vitamins C and E, beta-carotene, and zinc can be effective in treating AMD. These supplements have been shown to slow the rate of progressive vision loss over a 5-year period, but only when the condition is not extremely advanced.¹⁴ It also has been suggested that these supplements may lower the risk of developing AMD.^{3,15} Two other nutritional supplements, lutein and zeaxanthin, have been shown to improve visual function in AMD patients.¹⁶ If supplementation were in widespread use among individuals at risk for

developing AMD, vision loss could be prevented in more than 300,000 people over age 55 during a 5-year period.¹⁷

In addition to dietary supplementation, laser and photodynamic therapy have both been used in the treatment of exudative AMD.^{18,19} These treatments may reduce the risk of severe vision loss and limit the extent of damage associated with AMD. However, AMD is complex and challenging to treat.

GLAUCOMA

Glaucoma describes a number of disorders that result in optic nerve damage due in part to elevated intraocular pressure. Glaucoma produces gradual and progressive visual field loss that results from a progressive loss of optic nerve fibers. Glaucoma is the third most common cause of vision loss and is a significant cause of blindness in the world.

The prevalence of primary open-angle glaucoma among Americans aged 40 and older is estimated at 1.86 percent, affecting 2.22 million Americans.²⁰ These prevalence estimates do not include those diagnosed with elevated intraocular pressure only, often a precursor to the development of glaucoma. The incidence of glaucoma increases with age but the disease is more prevalent among individuals with a family history of glaucoma, those of African American descent, and people with diabetes. The age-adjusted prevalence among African Americans is three times that of Whites. The prevalence of glaucoma among Hispanics/Latinos is highest among those of Mexican descent.²¹

Although glaucoma cannot be prevented, early detection and treatment can reduce the progression of the disease. An early symptom of glaucoma is peripheral field loss, which occurs before central vision is affected. Patients who notice changes in their peripheral vision should be evaluated immediately. When intraocular pressure is present, several drug interventions are available to delay the onset of glaucoma.

Glaucoma treatments include medicines, laser trabeculoplasty (draining of fluid), conventional surgery, or a combination of any of these. Although these treatments may help to save remaining vision, they do not improve sight already lost from glaucoma. The goal of glaucoma treatment is to reduce intraocular pressure by 20 to 50 percent.²² The most common treatments for early glaucoma are medicines in the form of eye drops or pills that cause the eye to make less fluid or help fluid drain from the eye. Topical beta-blockers or systemic agents can be used to medically lower intraocular pressure. Laser trabeculoplasty and conventional surgery also reduce intraocular pressure by draining fluid from the eye.²³

DIABETIC RETINOPATHY

Diabetic retinopathy causes vision loss due to various diabetes-related changes in the eye. These changes can lead to proliferative diabetic retinopathy or macular edema. The development of retinopathy depends on the length of time a person has diabetes rather than his or her age. People with type 1 (insulin-dependent) are at a higher risk for developing vision-threatening diabetic retinopathy.

The prevalence of retinopathy increases with age to a point, reflecting higher rates of diabetes in older individuals, but prevalence drops in the highest age groups (>75 years of age), most likely due to decreased survival of individuals with diabetes.²⁴ Diabetic retinopathy is the fourth most common cause of vision loss in older adults.²⁵ Some form of retinopathy affects 40 percent of the adult population with diabetes, while vision-threatening retinopathy develops in 8 percent of the adult population with diabetes. In the general U.S. population, retinopathy and vision-threatening retinopathy occur in 3.4 percent (4.1 million persons) and 0.75 percent (899,000 persons) of people, respectively.²⁴

The early detection and treatment of diabetic retinopathy can prevent blindness. Therefore, a comprehensive eye exam is recommended shortly after diagnosis of diabetes and annual exams should be obtained thereafter. Good control of blood glucose levels is important in delaying the onset and progression of diabetic retinopathy, and can reduce its severity.^{25,26,27} Other associated medical conditions known to worsen diabetic retinopathy, such as high blood pressure and high cholesterol, should also be controlled appropriately.^{25,26}

Laser treatment can reduce the onset and severity of vision loss and blindness due to diabetic retinopathy and macular edema. In particular, pan retinal laser photocoagulation has been shown to reduce the risk of visual loss by 50 percent. Another form of laser treatment, focal laser therapy, can reduce the risk of visual loss when used in patients with significant macular edema.³

PRESBYOPIA

Presbyopia literally means “aging eye” and usually begins to manifest itself in people aged 40 and older. Although it may lead to significant visual loss, it usually does not cause blindness. The most common symptom is the inability to read comfortably at close distances. Presbyopia is very prevalent among the older adult population, ultimately affecting 100 percent of the population.²⁸

Presbyopia is usually treated with glasses or lenses, including reading glasses, bifocal glasses, multifocal glasses, multifocal contact lenses, or intraocular lenses. Changes continue over time and stronger correction is needed with advancing age. New surgical options, such as conductive keratoplasty, are already available in many countries.²⁹

III. DILATED EYE EXAMS AND THE PREVENTION OF VISION LOSS

Age-related eye diseases are often asymptomatic at early stages. Therefore, an annual eye exam can help in the detection of age-related eye disease before obvious symptoms develop and prevent vision loss. The general public must be made aware that regular eye exams are necessary even in the absence of symptoms. The public must also be made aware that a test for visual acuity, such as for glasses or a driver’s license, will not detect sight-threatening conditions. Instead, people must see an optometrist or an ophthalmologist for a comprehensive dilated eye examination.

Although data are limited as to the benefits and cost-effectiveness of vision screening in older adults, the American Academy of Ophthalmology recommends an eye exam every 1 to 2 years for patients aged 65 and older. These recommendations are based on the high prevalence of

common, asymptomatic vision problems in older adults. However, a recent meta-analysis of the benefits of vision screening in people aged 65 and older found no evidence that community-based screening of asymptomatic older people results in improvements in vision.³⁰ Further research is warranted to determine the efficacy of annual eye screenings in older adults.

IV. IMPACT OF VISION LOSS IN OLDER ADULTS

PHYSICAL AND MENTAL HEALTH

Visual impairment is closely associated with fair or poor health status and restricted activity.³¹ Age-related eye diseases increase the risk for accidents, falls, and hip fractures.³² In 1998, it was reported that 11 percent of older patients with reduced vision had a history of falls compared to 4.4 percent of older patients with normal vision.⁴

Individuals with age-related eye diseases also suffer psychologically, experiencing grief, anxiety, social isolation, and depression.^{32,33} Since depression may exacerbate functional impairment of vision problems, treating depression may reduce excess disability resulting from impaired vision.³³ AMD patients, in particular, experience significant emotional distress and a profoundly reduced quality of life.³⁴ Low vision can be a significant psychological loss.³⁵ Vision loss also produces stress for the family members of affected patients.³²

DEPENDENCY

Age-related eye diseases can threaten the ability of older adults to live independently, thus profoundly affecting their lifestyle. There exists an association between loss of vision and loss of overall function.^{36,37,38,39} Visual impairment can also interfere with daily activities.⁴⁰ AMD patients often require assistance with daily living activities.³⁴ Vision loss impairs driving ability of older adults, which poses a safety risk for both drivers and passengers.⁴¹

V. PUBLIC HEALTH IMPLICATIONS

PUBLIC EDUCATION

The *Healthy People 2010* vision goal is to “improve the visual health of the Nation through prevention, early detection, treatment, and rehabilitation,” and it includes objectives to reduce visual impairment due to glaucoma, cataract, and diabetic retinopathy.⁴² Well-designed community and public health programs can have a great impact on the prevention and treatment of vision problems.⁴³ However, few communities have enough resources to expand efforts beyond diabetes-related eye diseases.⁴⁴ It is imperative that public education messages be distributed regarding all eye diseases and conditions that affect older adults.

Public health education messages for older adults must take health literacy into consideration. Health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions. The impact of low health literacy on health care is a concern that spans all racial/ethnic groups, but is of particular importance in populations where low literacy levels are more prevalent.⁴⁵ Studies have shown that health literacy is a considerable problem among the older adult

population. The prevalence of inadequate and marginal health literacy is higher among persons aged 85 and older compared with younger persons.⁴⁶ Public education programs and materials must address health literacy in order to effectively reach their target populations.

VARIABLE ACCESS TO EYE CARE

Variable access to eye care can lead to variations in the prevalence of age-related eye diseases and loss of visual function in different populations. The geographical distribution of eye care professionals is not known. Rural and medically underserved areas may have shortages that lead to an inability for some individuals to obtain necessary eye care. Furthermore, people living in rural locations are more likely to be uninsured and are less likely to use preventive care services than those living in urban areas.⁴⁷

Another factor affecting variable access to appropriate eye care services is lack of adequate health insurance coverage. Those who have no health insurance coverage are less likely to receive needed care.⁴⁸ For those who do have health insurance coverage, although eye exams are usually covered, glasses and other vision improvement aids are not consistently covered.⁴⁴ By law, regular fee-for-service Medicare may not cover refractive services (eye exams for eyeglasses) although some Medicare+Choice managed care plans may offer them. Medicare also only covers annual dilated eye exams for high-risk beneficiaries: people with diabetes, people with a family history of glaucoma, and African Americans aged 50 and older. The 2006 CMS Medicare Physician Fee proposal does include a provision for free glaucoma screenings for Hispanics/Latinos aged 65 and older, but it has not yet been approved by Congress.

People covered by Medicaid, which is seen by providers as less desirable because of low reimbursement rates, often do not receive the care they need simply because they are Medicaid recipients. Many providers restrict the number of Medicaid patients seen, and, in some cases, refuse to see Medicaid patients entirely. It has also been shown that minorities who do have insurance are nearly three times more likely to be covered by publicly funded programs, such as Medicaid, and are less likely to have employment-based coverage than Whites.⁴⁹

The type of health insurance model may affect the coordination of primary and specialty care and may affect access to appropriate eye care.⁵⁰ It was found that older persons with diabetes in a managed care organization were more likely to have had a dilated eye exam when compared with fee-for-service enrollees.⁵¹ Contrarily, Southern California Medicare beneficiaries in managed care received cataract surgery at rates that were 50 percent lower than those in fee-for-service plans.⁵² In another study, a high rate of untreated eye disease was found among both managed care and fee-for-service Medicare beneficiaries, although managed care participants exhibited a greater need for future eye care services within 6 months than fee-for-service participants.⁵⁰

COORDINATION OF SCREENING, EXAMINATION, AND TREATMENT

The detection and treatment of serious eye diseases are not integrated with quality-of-life services. For instance, rehabilitation services that help people return to work are not linked with public health services or home health services for older adults. Additionally, given the growing number of older adults with low vision, rehabilitation services that help older adults to function

independently are either already overburdened or will become so in the near future.⁴⁴ Incorporating vision screening and treatment into quality-of-life services and public health and community programs could aid in getting older adults to receive eye examinations.

Primary care physicians (PCPs) can play an important role in influencing the eye health care of older adults. Because older adults may not be forthcoming about vision problems when consulting PCPs about other medical concerns, PCPs should question patients about their vision. PCPs should recommend or encourage patients to obtain regular comprehensive dilated eye exams and can ensure that appropriate patients are examined for vision problems. PCPs can also refer patients with low vision to rehabilitative services and support groups.⁵³ Some researchers even suggest that for eye diseases to be detected, eye exams should take place in primary care settings, particularly for patients who are older than 65, in poor health, report poor vision, have had infrequent eye examinations, or have inadequate insurance coverage for eye care.⁵⁴

REHABILITATION SERVICES

Once vision has been lost, rehabilitation services are important. Comprehensive low vision rehabilitation programs include clinical assessments, training, counseling, and other support services for persons with visual impairments. These programs aim to increase independence and productivity, improve the performance of daily activities, and improve quality of life.³⁵ Vision rehabilitation can help a person with a visual impairment cope with vision loss, travel safely, take care of his or her home, meet career objectives, and enjoy leisure activities.

A recent study of patients with AMD found that patients in a low vision clinic who received an intensive, group health education program experienced an improved sense of security in performing daily activities.⁴⁰ On the other hand, patients who received minimal individual intervention tended to deteriorate. For AMD patients in their 80s and 90s, rehabilitation can be challenging, but quality of life can be improved.⁵⁵

VI. PROFILE OF THE OLDER ADULT POPULATION

DEMOGRAPHIC PROFILE

The NEHEP target audience profile analysis of adults aged 60 years and older revealed that 56 percent of the population are women and 44 percent are men. Approximately 85 percent are White, 8 percent African American, 5 percent Hispanic/Latino, 1 percent American Indian or Alaska Native, and 1 percent Asian. About 60 percent of adults aged 60 and older are married and 58 percent reside in two-person households. Additionally, approximately 28 percent live alone, 11 percent live in three- to four-person households, and 4 percent live with five or more people. Seven percent have children living with them.

In terms of geographic location, 37 percent of adults aged 60 and older reside in the South, 21 percent in the West, 19 percent in the North Central region, and 18 percent in the Northeast. Among older adults, 78 percent are not employed or are retired, while 14 percent are employed full-time and 7 percent are employed part-time. Twenty-two percent of adults aged 60 and older have a household income of \$60,000 or more, while 28 percent have an income of less than \$20,000.

CULTURAL ISSUES

Cultural issues that arise as a result of the aging process are significant factors affecting delivery of health care to the aging population. Older people may unwittingly assume the stereotypes of old age. Expectations regarding health diminish with age, sometimes realistically, but often not. Older people with treatable symptoms tend to dismiss their problems as an inevitable part of aging. As a result, they may not seek medical care and may suffer needless discomfort and disability. They may not even seek treatment for serious conditions including vision loss and visual impairments. A recent study documents that a significant number of older adult patients had not seen an optometrist for more than 3 years and only 16 percent of patients with treatable visual impairments were under ophthalmic care.⁵⁶

The process of aging may be troubling for older adults who once recovered quickly from an illness or who were generally healthy. Patients may be afraid that their complaints will be dismissed as trivial or that if they complain too much about minor issues, they will not be taken seriously in the future. Some older patients do not mention symptoms because they are afraid of the diagnosis or treatment. They may worry that the physician will recommend surgery, suggest costly diagnostic tests or medications, or tell them to stop driving. There is a pervasive fear of blindness among older adults and limited knowledge about age-related vision loss.⁵⁷

Aging baby boomers bring different expectations, experiences, and preferences to aging than did previous generations. Their needs vary from their parents' generation. People between the ages of 50 and 64, for example, are more likely than those over the age of 65 to want to participate actively in health care treatments and decisions, use complementary or alternative medicine, and search the Internet for health information.

CHANNELS OF COMMUNICATION

The NEHEP target audience profile analysis revealed that among adults aged 60 and older, 57 percent are heavy television viewers and about 58 percent are heavy newspaper readers. Additionally, 29 percent of older adults are heavy magazine readers and 51 percent are medium to light magazine readers. About 27 percent of older adults are heavy radio listeners and 58 percent are light radio listeners.

The number of adults over the age of 65 who use the Internet nearly doubled between 2000 and 2004 to 22 percent, which translates to about 8 million Americans aged 65 and older.⁵⁸ Although the Internet is increasingly being used to gain knowledge about health-related topics, many older adults are not computer literate and cannot imagine why they should spend money and time learning how to use a computer. However, Internet usage continues to increase among this population and should not be dismissed as an effective tool to reach older adults. Internet materials developed for older adults should be designed to address health literacy levels, cognitive abilities, and vision problems that may affect this population.

NEI conducted focus groups and interviews in 1997 among people with low vision ranging in age from 45 to 75 and older.⁵⁹ Participants indicated that the eye care professional's office is the most logical and efficient place to distribute information about low vision. However, many older adults are not already part of the eye care system. Other channels of communication to reach this

population include health care settings, low vision clinics, pharmacies, the clergy, nonprofit vision organizations, the American Association of Retired Persons (AARP), senior centers, television, and state governments. Older adults with low vision preferred messages in the form of large-print brochures, videos, a toll-free number, and transit advertising. They also expressed the need for a script that they could use in the doctor's office with specific questions they should ask regarding low vision symptoms and eye health care.

VII. CONCLUSIONS

The issues surrounding age-related eye diseases are growing challenges for public health professionals. The leading causes of visual impairment and blindness in older adults include cataract, age-related macular degeneration, glaucoma, diabetic retinopathy, and presbyopia. The prevalence of these diseases is expected to increase with the aging of the U.S. population. To reduce visual impairment and blindness due to these diseases, the public must be educated about each condition, its symptoms, and the potential for loss of vision and blindness without proper preventive care and treatment. The importance of regular eye exams as a preventive measure in healthy adults prior to vision loss must be stressed in educational campaigns. General awareness of the importance of regular dilated eye exams must be increased in the older adult population and among their health care providers. Dietary lifestyle changes and reduced exposure to sunlight are additional preventive measures that should be stressed.

Obtaining access to appropriate eye care services is an important health need for older adults. Access to appropriate surgical treatment for cataract and corrective lens for presbyopia can substantially reduce visual impairment in older adults. Disparities in the prevalence of low vision and blindness due to the inability of minorities to access appropriate eye health services must be addressed. The detection and treatment of eye diseases must also be incorporated into quality-of-life services. PCPs should be trained to recommend that older patients see an eye care professional regularly and immediately report any signs of impaired visual function. Preventing and treating visual loss can have a positive impact on the physical and mental health of patients, can reduce dependency, and can have a significant impact on their quality of life.

Lay knowledge and the subjective assessment of risk have been identified as important motivators for influencing older people's health care decisions. Referrals for eye health care from physicians or health care professionals are critical because many older adults are not aware of guidelines with respect to eye exams. The involvement of family members in health information dissemination and medical decisionmaking is important for older patients. Intergenerational programs that allow the participation of family members may help to provide support and address issues such as transportation, which can be a significant barrier to the receipt of preventive services and health care. Education programs and materials targeting older adults should be health literate and culturally appropriate with respect to the unique issues that older adults face, such as worries about the loss of independence, unwillingness to seek medical attention, and fears of the medical system.

LIMITATIONS OF RESEARCH

The magnitude of vision problems in the older adult population is not completely understood. Current estimates of blindness and vision loss are based on best-corrected visual acuity and do

not reflect the burden of low vision and blindness due to uncorrected refractive error, potentially an important cause of visual impairment in the United States. People with limited eyesight may also be less likely to have the necessary eye exams, thus affecting the accuracy of prevalence estimates. Furthermore, state-based blindness registries have not been successful in documenting prevalence, risk factors, or trends in vision loss.⁶⁰

There are limited prevalence data for older adult minority populations in the United States. Estimates for African Americans and Hispanics/Latinos are based on only a few population-based eye studies, and no information is currently available on the prevalence of eye disease and vision loss in American Indians, Alaska Natives or Asian Americans. Additional research needs to be conducted for these minority populations to more fully understand the prevalence of age-related eye diseases and low vision.

REFERENCES

-
- ¹ Lee, P. P., et al. “Longitudinal Prevalence of Major Eye Diseases.” Archives of Ophthalmology 121.9 (2003): 1303-10.
- ² Congdon, N., et al. “Eye Diseases Prevalence Research Group. Causes and Prevalence of Visual Impairment Among Adults in the United States.” Archives of Ophthalmology 122.4 (2004): 477-85.
- ³ Quillen, D. A. “Common Causes of Vision Loss in Elderly Patients.” American Family Physician 60.1 (1999): 99-108.
- ⁴ Trudo, E. W., and W. J. Stark. “Cataracts. Lifting the Clouds on an Age-old Problem.” Postgraduate Medicine 1035 (1998): 114-16, 123-26.
- ⁵ Congdon, N., et al. “Prevalence of Cataract and Pseudophakia/Aphakia Among Adults in the United States.” Archives of Ophthalmology 122.4 (2004): 487-94.
- ⁶ Varma, R., and M. Torres. “Los Angeles Latino Eye Study Group. Prevalence of Lens Opacities in Latinos: The Los Angeles Latino Eye Study.” Ophthalmology 111.8 (2004): 1449-56.
- ⁷ Javitt, J. C., F. Wang, and S. K. West. “Blindness Due to Cataract: Epidemiology and Prevention.” Annual Review of Public Health 17 (1996): 159-77.
- ⁸ Neale, R. E., et al. “Sun Exposure as a Risk Factor for Nuclear Cataract.” Epidemiology 14.6 (2003): 707-12.
- ⁹ Moeller, S. M., et al. “Overall Adherence to the Dietary Guidelines for Americans Is Associated with Reduced Prevalence of Early Age-related Nuclear Lens Opacities in Women.” The Journal of Nutrition 134.7 (2004): 1812–1819.
- ¹⁰ Christen, W.G., et al. “Age-related Cataract in a Randomized Trial of Beta-carotene in Women.” Ophthalmic Epidemiology 11.5 (2004): 401-12.
- ¹¹ Age-Related Eye Disease Study Research Group. “Risk Factors Associated with Age-related Macular Degeneration. A Case-control Study in the Age-related Eye Disease Study: AREDS Report no. 3.” Ophthalmology 107.12 (2000): 2224-32.
- ¹² Chaine, G., et al. “France-DMLA Study Group. Case-control Study of the Risk Factors for Age-related Macular Degeneration.” The British Journal of Ophthalmology 82.9 (1998): 996-1002.

-
- ¹³ Obisesan, T. O., et al. “Moderate Wine Consumption is Associated with Decreased Odds of Developing Age-related Macular Degeneration in NHANES-1.” Journal of the American Geriatrics Society 46.1 (1998): 1-7.
- ¹⁴ Age-Related Eye Disease Study Research Group. “A Randomized, Placebo-Controlled, Clinical Trial of High-dose Supplementation with Vitamins C and E and Beta Carotene, and Zinc for Age-related Macular Degeneration and Vision Loss: AREDS Report no. 8.” Archives of Ophthalmology 119.10 (2001): 1417-36.
- ¹⁵ Starr, C. E., D. R. Guyer, and L. A. Yannuzzi. “Age-related Macular Degeneration. Can We Stem This Worldwide Public Health Crisis?” Postgraduate Medicine 103.5 (1998): 153-56, 161-64.
- ¹⁶ Bartlett, H., and F. Eperjesi. “An Ideal Ocular Nutritional Supplement?” Ophthalmic and Physiological Optics 24.4 (2004): 339-49.
- ¹⁷ Bressler, N. M., et. al. “Potential Public Health Impact of Age-related Eye Disease Study Results: AREDS Report no 11.” Archives of Ophthalmology 121.11 (2003): 1621-24.
- ¹⁸ Treatment of Age-related Macular Degeneration with Photodynamic Therapy (TAP) Study Group. “Photodynamic Therapy of Subfoveal Choroidal Neovascularization in Age-related Macular Degeneration with Verteporfin: One-year Results of 2 Randomized Clinical Trials—TAP Report.” Archives of Ophthalmology 117.10 (1999): 1329-45.
- ¹⁹ Bressler, N. M. “Photodynamic Therapy of Subfoveal Choroidal Neovascularization in Age-related Macular Degeneration with Verteporfin: Two-year Results of 2 Randomized Clinical Trials—TAP Report 2.” Archives of Ophthalmology 119.2 (2001): 198-207.
- ²⁰ Friedman, D. S., et al. “Prevalence of Open-angle Glaucoma Among Adults in the United States.” Archives of Ophthalmology 122.4 (2004): 532-38.
- ²¹ Varma, R., et al. “Los Angeles Latino Eye Study Group. Prevalence of Open-angle Glaucoma and Ocular Hypertension in Latinos: The Los Angeles Latino Eye Study.” Ophthalmology 111.8 (2004): 1439-48.
- ²² Podolsky, M. M. “Exposing Glaucoma: Primary Care Physicians are Instrumental in Early Detection.” Postgraduate Medicine 103.5 (1998): 131-36, 142-43, 147-48.
- ²³ Juzych, M. S., et al. “Comparison of Long-term Outcomes of Selective Laser Trabeculoplasty Versus Argon Laser Trabeculoplasty in Open-angle Glaucoma.” Ophthalmology 111.10 (2004): 1853-59.
- ²⁴ Kempen, J. H. et al. “The Prevalence of Diabetic Retinopathy Among Adults in the United States.” Archives of Ophthalmology 122.4 (2004): 552-63.

-
- ²⁵ The Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. "Retinopathy and Nephropathy in Patients with Type 1 Diabetes Four Years After a Trial of Intensive Therapy." New England Journal of Medicine 342 (2000): 381-89.
- ²⁶ Fong, D. S., et al. "American Diabetes Association. Retinopathy in Diabetes." Diabetes Care 27 suppl. 1 (2004): S4-87.
- ²⁷ Moss, S. E., R. Klein, and B. E. Klein. "The 14-year Incidence of Visual Loss in a Diabetic Population." Ophthalmology 105.6 (1998): 998-1003.
- ²⁸ Glasser, A., and P. Kaufman. "Presbyopia: a view." E-Medicine. 2005. 31 May 2006 <<http://www.emedicine.com/oph/byname/presbyopia--a-view.htm>>.
- ²⁹ Loh, K. Y., and J. Ogle. "Age-related Visual Impairment in the Elderly." The Medical Journal of Malaysia 59.4 (2004): 562-68.
- ³⁰ Smeeth, L., and S. Iliffe. "Community Screening for Visual Impairment in the Elderly." Cochrane Database of Systematic Reviews 2 (2000): CD001054.
- ³¹ Lee, D. J., et al. "Visual Impairment and Morbidity in Community-residing Adults: The National Health Interview Survey 1986-1996." Ophthalmic Epidemiology 12.1 (2005): 13-17.
- ³² Crews, J. E., and V. A. Campbell. "Vision Impairment and Hearing Loss Among Community-dwelling Older Americans: Implications for Health and Functioning." American Journal of Public Health 94.5 (2004): 823-29.
- ³³ Rovner, B. W., and M. Ganguli. "Depression and Disability Associated with Impaired Vision: The MoVies Project." Journal of the American Geriatrics Society 46.5 (1998): 617-19.
- ³⁴ Williams, R. A., et al. "The Psychosocial Impact of Macular Degeneration." Archives of Ophthalmology 116.4 (1998): 514-20.
- ³⁵ Scott, I. U., et al. "Quality of Life of Low-vision Patients and the Impact of Low-vision Services." American Journal of Ophthalmology 128.1 (1999): 54-62.
- ³⁶ Keeffe, J. E., et al. "Impact of Vision Impairment on Functioning." Australian and New Zealand Journal of Ophthalmology 26.suppl. 1 (1998): S16-S18.
- ³⁷ Lee, P. P., K. Spritzer, and R. Hays. "The Impact of Blurred Vision on Function and Wellbeing." Ophthalmology 104 (1997): 390-96.
- ³⁸ Swagerty, D. L. "The Impact of Age-related Visual Impairment on Functional Independence in the Elderly." Kansas Medicine: The Journal of the Kansas Medical Society 96.1 (1995): 24-26.
- ³⁹ Keller, B.K., et al. "The Effect of Visual and Hearing Impairments on Functional Status." Journal of the American Geriatrics Society 47.11 (1999): 1319-25.

-
- ⁴⁰ Eklund, K., U. Sonn, and S. Dahlin-Ivanoff. "Long-term Evaluation of a Health Education Program for Elderly Persons with Visual Impairment: A Randomized Study." Disability and Rehabilitation 26.7 (2004): 401-09.
- ⁴¹ Rizzo, M., and I. L. Kellison. "Eyes, Brains, and Autos." Archives of Ophthalmology 122.4 (2004): 641-47.
- ⁴² U.S. Department of Health and Human Services. Healthy People 2010. Washington, DC: U.S. Government Printing Office, 2000.
- ⁴³ Odom, J. V. "Vision, Visual Needs, and Quality of Life of Older People in Rural Environments: A Report and Synthesis of a Meeting." The Journal of Rural Health 17.4 (2001): 360-63.
- ⁴⁴ Gohdes, D. M., et al. "Age-related Eye Diseases: An Emerging Challenge for Public Health Professionals." Preventing Chronic Disease. July 2005. 31 May 2006 <http://www.cdc.gov/pcd/issues/2005/jul/04_0121.htm>.
- ⁴⁵ Schillinger, D., et al. "Association of Health Literacy with Diabetes Outcomes." Journal of the American Medical Association 288.4 (2002):475-82.
- ⁴⁶ Gazmararian, J. A., et al. "Health Literacy Among Medicare Enrollees in a Managed Care Organization." Journal of the American Medical Association 281.6 (1999): 545-551.
- ⁴⁷ Bowyer, N. K., and R. N. Kleinstein. "Healthy People 2010: Vision Objectives for the Nation." Optometry 71 (2000): 569-78.
- ⁴⁸ National Academy of Sciences. The Consequences of Being Uninsured. Washington, DC: The National Academies Press, 2003.
- ⁴⁹ Alliance for Health Reform. "Closing the Gap: Racial and Ethnic Disparities in Healthcare." Journal of the National Medical Association 96.4 (2004): 436-40.
- ⁵⁰ Brown, A. F., et al. "Need for Eye Care Among Older Adults with Diabetes Mellitus in Fee-for-Service and Managed Medicare." Archives of Ophthalmology 123.5 (2005): 669-75.
- ⁵¹ Retchin, S. M., and J. Preston. "Effects of Cost Containment on the Care of Elderly Diabetics." Archives of Internal Medicine 151.11 (1991): 2244-48.
- ⁵² Goldzweig, C. L., et al. "Variations in Cataract Extraction Rates in Medicare Prepaid and Fee-for-Service Settings." Journal of the American Medical Association 277.22 (1997): 1765-68.
- ⁵³ Goldzweig, C. L., et al. "Preventing and Managing Visual Disability in Primary Care: Clinical Applications." Journal of the American Medical Association 291.12 (2004): 1497-1502.
- ⁵⁴ Wang, F., et al. "Undetected Eye Disease in a Primary Care Clinic Population." Archives of Internal Medicine 154.16 (1994): 1821-28.

-
- ⁵⁵ Tasman, W., and B. Rovner. "Age-related Macular Degeneration: Treating the Whole Patient." Canadian Journal of Ophthalmology 40.3 (2005): 389-91.
- ⁵⁶ Cox, A., et al. "Optometric and Ophthalmic Contact in Elderly Hip Fracture Patients with Visual Impairment." Ophthalmic and Physiological Optics 25.4 (2005): 357-62.
- ⁵⁷ The Lighthouse, Inc. The Lighthouse National Survey on Vision Loss: The Experience, Attitudes and Knowledge of Middle-aged and Older Americans. New York: The Lighthouse Inc, 1995.
- ⁵⁸ Fox, S. Older Americans and the Internet. Washington, DC: Pew Internet and American Life Project 2004. 31 May 2006 <http://www.pewinternet.org/PPF/r/117/report_display.asp>.
- ⁵⁹ National Eye Institute, National Institutes of Health. Life with Low Vision: A Report on Qualitative Research Among People with Low Vision and Their Caregivers. Washington, DC: U.S. Government Printing Office, 1997. 31 May 2006 <<http://www.nei.nih.gov/nehep/execsum.asp>>.
- ⁶⁰ Ferris 3rd, F. L., and J. M. Tielsch. "Blindness and Visual Impairment: A Public Health Issue for the Future as Well as Today." Archives of Ophthalmology 122.4 (2004): 451-52.