World Journal of Current Medical and Pharmaceutical Research
Content available at www.wjcmpr.com ISSN: 2582-0222

ADDRESSING DISPARITIES IN VISION HEALTH AND EYE CARE IN THE US

Pallav Dave *
Regulatory Compliance Analyst, Louisville, KY, 40223, USA

Article History
Received on: 11-02-2024
Revised on: 02-03-2024
Accepted on: 27-04-2024

Abstract
Health disparities are a prevalent issue that continues to affect health outcomes. In ophthalmology, these disparities affect eye care utilization increasing the burden of eye care disorders and vision impairment/loss. Various factors contribute to disparities in vision care. They include age, gender, socioeconomic status, geographic location, and race and ethnicity. These factors make it difficult for people affected by eye conditions to access care. Addressing these disparities can help to increase eye care utilization and improve patient outcomes. Some measures that can address these disparities and increase utilization are providing patient education, increasing insurance coverage, implementing community-based eye care programs, using teleophthalmology, providing transport services, providing reminder alerts, and creating community centres that are federally funded among others. This review seeks to identify measures that can help to address disparities in vision and eye care in the US. The review also identifies drivers of health disparities in vision health and how they affect the ability to access care.

Keywords: eye disorders, disparities, vision health, eye care, utilization

***Corresponding Author**
Pallav Dave

DOI: https://doi.org/10.37022/wjcmpr.v6i1.321

Introduction

Despite the measures taken over the years to address health disparities in the US, they are a significant challenge and burden that affects health outcomes. Just like any other area in healthcare, vision health is one of the areas where health disparities exist. Health disparity in vision health means differences in health outcomes and the burden of disease that emerge from health inequities and affects the ability of underserved populations to receive eye and vision care [1]. Health inequities are systematic differences that exist between different population segments and which affect their ability to achieve optimal health outcomes [2]. Addressing the health disparities that contribute to inequity is vital to attain positive health outcomes.

When it comes to vision health, addressing health disparities means achieving optimal eye health. It also means addressing the burden of vision loss and eye disorders that affect millions of people in the US. These eye disorders affect millions of people across the US and contribute significantly to the burden of blindness [3, 4]. According to Varma et al.5there were about 1.02 million people with blindness in the US in 2015. The data also revealed that 3.22 million people were affected by some form of vision impairment after correction.5 An additional 8.2 million people were affected by vision impairment attributed to uncorrected refractive error [5].

Addressing disparities in vision health and eye care is vital. Blindness and vision loss contribute to great social and economic burdens with individuals affected finding it difficult to lead a quality and productive life. Vision loss also increases the risk of falls and injuries, morbidity, and premature death [6, 7]. In the US, approximately, $51.4 billion is spent addressing vision-related problems including eye disorders and the resulting blindness.8Recent estimates by Rein et al [7] indicate that the burden of vision loss could be as high as $134.2 billion with direct costs averaging $98.7 billion and indirect costs $35.5 billion. Considering the population is rapidly aging and the number of people with chronic conditions such as diabetes is growing, the number of people living with different eye conditions is likely to continue growing.9 Diabetic retinopathy (DR) is related to diabetes while age-related macular degeneration (AMD) is attributed to age.

The aim of this review is to identify measures and strategies that can be used to address disparities in vision and eye care in the US. The review begins by discussing data on eye health in the US before discussing common eye disorders that affect the population. The review goes ahead to identify significant drivers of health disparities in vision health and how they affect the ability to access care. The review goes ahead to discuss measures that can be used to address these disparities

and why addressing them is important to achieve positive health outcomes.

Epidemiology of Vision Loss and Eye-Related Disorders in the US

Globally, approximately 2.2 billion people live with one type of eye problem or another [10]. Among these, approximately 36 million have total vision loss while another 216.6 million have moderate to severe visual impairment.10In the US, about 12 million people live with one type of visual impairment or another [11]. Of these, 1.02 million live with total vision loss, 3.22 million have visual impairment even after correction, and another 8.2 million have vision impairment because of uncorrected refractive errors [3, 5]. The number of cases of visual impairment and loss is projected to increase significantly by 2050 as the number of people affected by chronic diseases such as diabetes and the aging population rises [11]. Vision loss is also likely to arise from work-related injuries and the increasing number of eye-related disorders.

Several eye-related disorders contribute to the rising number of visual impairment and vision loss experienced in the US. The leading eye-related disorders are refractive errors, DR, AMD, cataracts, and glaucoma.

Refractive Errors

Refractive errors including myopia, hyperopia, astigmatism, and presbyopia are the most common eye problems found in the US. Although the real estimates of people affected by refractive errors are not known, vision impairment and loss resulting from uncorrected refracted errors affect approximately 8.5 million people.5 Globally, this number is even larger with approximately 116.3 million people affected by vision impairment and loss as a result of uncorrected refractive errors [9]. Refractive errors such as myopia, hyperopia, and astigmatism affect people of all ages. Presbyopia is mainly common in people aged between 40 to 50 years. All these conditions can be corrected by prescription glasses or corrective surgery. However, most people with refractive errors are uncorrected which makes it a significant burden across the globe. In the US for instance, the number of people with visual impairment and loss because of uncorrected refractive errors is likely to be 16.4 million by 2050 [5, 12].

Age-related Macular Degeneration

Age-related macular degeneration (AMD) is also common in the US.7 The disorder is mainly associated with aging and is characterized by damaging sharp and central vision.13 Due to the impact the disorder has on central and sharp vision, people affected find it difficult to see objects clearly and do activities such as reading and driving. AMD is among the most common eye disorder that is associated with aging. It mainly presents in people who are 40 years and older.14AMD mainly presents as vision-threatening AMD or non-vision-threatening AMD. Vision-threatening AMD is in advanced stages and is characterized by geographic atrophy and wet-form AMD [7]. Non-vision-threatening AMD is characterized by retinal pigment epithelium abnormalities.7 Approximately, 19.8 million people in the US live with AMD with 1.49 million of these cases being life-threatening.15AMD is also a leading cause of blindness globally accounting for 8.9 million cases of impairment and vision loss [9].

Diabetic Retinopathy

Another eye disorder that is common in the US is diabetic retinopathy. DR is a complication of diabetes and results from progressive damage to the blood vessels of the retina [11]. DR contributes significantly to blindness. In 2021, there were about 9.6 million cases of diabetic retinopathy with 1.84 million of these being vision threatening.16Diabetic retinopathy is more common in people aged 40 years and over. Of the 9.6 million cases of diabetic retinopathy reported in the US, 8.94 million of these cases were reported in people aged 40 years and over [16]. The number of people affected by diabetic retinopathy is likely to continue rising as the number of people affected by diabetes continues to rise. Globally, there were about 103 million cases of diabetes retinopathy in 2020 [17]. Another 28.54 million people globally were reported to have vision-threatening diabetic retinopathy [17]. The cases of DR are projected to rise because the number of people affected by diabetes is rising.

Glaucoma

An additional eye disorder that is common in the US is glaucoma. Glaucoma is a group of eye conditions that progressively damage the eye's optic nerve [13]. The damage results in vision loss and blindness. Glaucoma also presents as elevated intraocular pressure. This occurs when the normal fluid pressure inside the eye increases. Other symptoms that are associated with glaucoma are reduced visual acuity and visual field.18The exact number of people who are affected by glaucoma in the US is not known. However, data between 1996 and 2016 from NHANES established a prevalence of 2.1%.18Globally, the number of people affected by glaucoma is 3.54% [19]. The study reported that approximately 64.3 million people were affected by glaucoma globally in 2013.19 The study projected that this number was likely to rise to 76 million in 2020 and 111.8 million in 2040.19The number of people who reported to have moderate to severe impairment as a result of glaucoma was 4 million [9].

Cataract

Cataract is also another leading cause of vision loss in the US. Although cataracts can develop at any age, in most instances it is associated with older age affecting adults that are 40 years and older. Cataracts mainly present as loss of central vision that occurs as a result of clouding of the lens in the eye.20Cloudiness results from changes to proteins and fibers of the eye lens making one's vision blurry when light reaches the opaque lens.13Other than blurred vision, people who have cataracts experience reduced intensity of colours, more sensitivity to glare, difficulty seeing at night, and changes in refractive error. Although there is treatment for cataracts, about 20.5 million people in the US aged 40 years and older have cataracts.13Treating cataractscan reduce cases of vision loss and impairment. Globally, it accounts for about 12.3 million cases of blindness [9].

Amblyopia

Amblyopia commonly referred to as "lazy eye" mainly occurs in children. It is a common disorder in children and contributes greatly to vision impairment. Amblyopia mainly presents as poor vision in one eye. This occurs as a result of the brain and eye not working properly together. As a result of this, vision is reduced in that particular eye [13]. Amblyopia can occur from

conditions such as strabismus which is an imbalance in the positioning of the eyes. It can also result from refractive errors such as myopia, hyperopia, and astigmatism. Amblyopia can be treated successfully in childhood. However, if it is not treated, it can persist into adulthood and lead to permanent vision impairment in the affected eye. In the use, about 2 to 3% of the population are affected by amblyopia [13]. Globally, the prevalence of amblyopia is 1.36% [21].

The prevalence of common eye disorders in the US is likely to continue to rise. As the number of aging population and people affected by chronic conditions such as diabetes continue to rise, the number of people affected by vision loss and impairment due to these errors is projected to rise.22Although treatment is available for most eye disorders, they remain untreated or uncorrected resulting in a significant burden of vision loss and impairment. Health disparities are one of the main reasons why eye disorders remain uncorrected. Most of these disparities are attributed to a number of factors key among them being social, demographic, and economic factors. Lack of healthcare access still remains a key health disparity affecting people's ability to access healthcare. High healthcare costs, racial and ethnic factors, age, and gender also affect people's ability to access care. Addressing these factors can help to reduce disparities.

Drivers of Disparities and Their Impact on Eye Care Utilization

Disparities by gender, socioeconomic status, age, geographic location, and race and ethnicity are some of the reasons why the prevalence of major eye disorders remains an issue and the use of eye care services is still a problem in the US. Disparities contribute to inequities in care and negatively affect how disease progresses in most instances leading to worse outcomes such as vision loss and impairment [12, 5].

Race and Ethnicity

Race or ethnicity was one of the factors that contributed to disparities in eye care. Racial and ethnic differences were reported in how individuals sought eye care services with people from minority ethnicities less likely to seek care for ophthalmologic conditions.12According to a study by Rasendran et al.23non-Hispanic white patients were more likely to visit an ophthalmologist than non-Hispanic blacks and Hispanic patients. The fewer ophthalmologic visits correspond with the impact of eye disorders among these populations. Research has established that racial and ethnic minority populations are at a high risk of getting different eye disorders, visual impairment and total vision loss [24, 25, 26]. For instance, different population studies have established that Black Americans have a higher prevalence of cataracts than White Americans [27, 28]. Further research has established that the prevalence of cataracts is higher in other racial minority groups such as Hispanics [29]. Glaucoma is another eye disorder where disparities are reported in terms of race and ethnic differences. Just like cataracts, glaucoma is likely to affect minority populations more than white populations [30, 31]. Based on these studies, it is evident that racial and ethnic differences contribute to disparities in vision health and eye care with minority populations being the most affected. Minority populations are also less likely to seek care for eye disorders which contributes to higher rates of vision impairment and loss among these populations. Factors that are likely to make them seek less eye care are limited access, lack of insurance coverage, socioeconomic factors such as income inequality and lower education levels, and less racial and ethnic diversity in ophthalmology [12].

Age

Age is another factor that contributes to disparities in vision health. Studies have established that older people are more affected by vision impairment and blindness than younger people [12]. One of the reasons why this population is more affected is because most eye disorders are degenerative and tend to get worse with age [27]. Visual impairment is prevalent in people aged 40 years and older with those aged 80 years and older being the most affected [5]. A study by Flaxman et al.3 established the national prevalence of blindness to increase with age with the prevalence being 0.74% in people aged 12 years and younger to 0.99% in people aged 50 to 54 years, and 20.73% among people aged 85 years and older. The increase in prevalence based on age corresponds with the fact that some eye disorders are more prevalent in older people than younger people. AMD for example is one of the eye disorders that is common among the elderly population with age being the main risk factor.27Other eye disorders that disproportionately affect the elderly are diabetic retinopathy, glaucoma, and cataracts.32 Lack of regular eye screening and examination also contributes to more cases of visual impairment and blindness. Factors such as poverty, having less than a high school education and being institutionalized made it difficult for this population to access regular screening and examinations.33Addressing disparities in vision health among the elderly is important because vision impairment affects mental and physical health making it difficult to perform activities of daily living. Vision loss and impairment is also a risk factor for physical and functional disability [12, 33].

Geographic Location

Geographic location is also a contributing barrier to access and disparities in vision health. Research has shown that different geographic regions in the US have higher incidences of vision loss and impairment than others [12]. In a study examining the prevalence of vision loss and impairment in the US, three states namely Florida, Hawaii, and Mississippi had a higher prevalence of visual impairment [5]. The study also established states such as Florida, Mississippi, and Louisiana had high per capita prevalence of blindness.5Rural populations and low-income populations are also disproportionately affected by vision problems with factors such as lack of access, availability of ophthalmologists, and delays in referral to eye care professionals being some of the factors that contribute to this disproportion [34, 35]. Lack of transportation, lack of proximity to eye care health professionals, lower rates of health insurance coverage, and lower utilization of eye care services were also risk factors for vision impairment and loss in rural areas [34, 36].

Low-income populations both in rural and urban areas are also disproportionately affected by vision impairment. Different population studies have shown a disproportionately higher level of vision impairment in these populations with factors such as poverty, financial challenges, logistical factors, and lack of awareness being the key contributing factors [27, 37, 38].

From the reviewed studies, proximity to eye care services is a key factor in determining access. Patients who have proximity to eye care professionals are more likely to seek care and greater utilization of healthcare services. Poverty and low income are also a factor that affects the ability of populations to seek care with populations adversely affected by poverty being more likely to report poor health outcomes.

Gender

Gender is also a factor when it comes to disparities and inequities in vision health with women being more likely to be affected by vision impairment and blindness than men.5A study by Vajaranant et al [39], established that women were more likely than men to have glaucoma. AMD was also more prevalent in women than men.12 Different factors account for why women are more likely to be affected by vision impairment and loss than men. A systematic review found that higher life expectancy and being more susceptible to factors that lead to blindness were contributing factors to higher rates of impairment in women [40]. Addressing disparities attributed to gender is important because of the impact it has on health outcomes. The higher rates of vision impairment and loss in women are evidence of the negative effect of gender disparities on visual health.

Socioeconomic Status

Socioeconomic factors such as one's level of education, income level, and occupation are also key determinants when it comes to one's ability to access visual health and care. Different studies have established factors such as unemployment, lower levels of education, and low household income to contribute to a higher risk of impairment and blindness.12,24,41Some of the reasons why a lower level of education was associated with more risk of vision loss and impairment was lower rates of access because of lack of insurance and knowledge on the need for ophthalmologic visits [41,23]. Lower household income was also associated with poor vision outcomes with individuals of lower income quintile being likely to report vision impairment or loss [41]. Rasendran et.23 established that increased household income led to more likelihood of visiting an ophthalmologist while lower-income reduced these odds. Occupation is also a factor in visual health with individuals who are not employed being more likely to experience visual impairment.41Factors such as levels of income and job status also impact care access because they directly or indirectly influence one's ability to access healthcare coverage. Individuals who are unemployed or have no to income levels are less likely to have health insurance. This means that their utilization is also low. Research has shown that having insurance coverage increases the likelihood of healthcare utilization and one's decision to get corrective surgery for different eye disorders [34].

Addressing factors that cause disparities can improve patient outcomes. Access to vision and eye care is still a challenge despite the fact that most eye disorders are correctable. The complexity of addressing disparities in eye care is one of the reasons why access remains a challenge. There is a need to put measures in place to address these disparities.

Addressing Disparities in Vision Health and Care

Identifying the social determinants and other disparities that affect vision and eye care is the first step towards ensuring they are adequately addressed. Several measures can be put in place to address disparities in vision care. One of these is increasing insurance coverage for eye care. Inadequate utilization is one of the factors that contributes to poor health outcomes such as increased risk of vision impairment and loss.34One of the factors that contribute to inadequate utilization is the lack of health insurance coverage [42]. Killeen et al [43]. established that lack of medical insurance coverage was one of the barriers to obtaining eyeglasses and improving coverage could improve outcomes. The authors recommended expanding Medicare and Medicaid to include eye screening and correction for refraction errors [43]. Additionally, programs such as the Affordable Care Act (ACA) can improve access more so for vulnerable populations [34]. As such, to improve eye care utilization and subsequent outcomes, there is a need to increase insurance coverage. Lobbying policymakers is one way that can increase insurance coverage.

Implementing community-based eye care programs can also help to address disparities. They can help to improve access, particularly to rural and low-income populations that find it difficult to access care [34]. For rural populations, one of the barriers that were consistently mentioned when it comes to utilization was geographic barriers [12]. Moving services closer to people can address disparities related to geographic location and improve access and utilization of care. Different studies have established that community-based programs can help to serve underserved populations. Ervin et al.44 established that community-based programs such as federally funded community health centres can help to address disparities across diverse populations. Dotan et al.45 also established that community programs in inner cities can help to improve outcomes for low underserved populations in urban areas. The program had a positive outcome with some children receiving glasses and others surgery for different eye disorders [45]. Community eye care programs can also improve screening, promote education to patients, and facilitate referral to eye care professionals [46].

Disparities in vision health can also be addressed through teleophthalmology. Teleophthalmology is the delivery of eye care services through the use of technology. It is considered aneffective measure of delivering eye care services,particularly to underserved populations that find it difficult to access care [47]. Teleophthalmology provides convenience. It also increases access and improves patient outcomes48Teleophthalmology can also help to address the existing disparities such as those attributed to geographic location and age and increase utilization among these populations [34].

Providing patient education can also address disparities and increase the utilization of vision care services. Research has shown that patient education is vital in improving the utilization of vision care services and improving care outcomes as a result of enhanced self-management [34]. Patient education is particularly vital for patients suffering from eye disorders related to chronic conditions such as diabetic retinopathy [49]. A study by Liu et al.50established that providing education on self-management was vital in increasing routine care and utilization of eye care services for rural patients living with diabetes. Another study also

established that patient education increased examination rates, compliance, and adherence to care [12]. Providing education is associated with better care utilization because patients become more knowledgeable about their eye conditions and how they can access care. For instance, patients who have lower levels of education are less likely to be knowledgeable about their eye conditions and the available services. As a result, they are less likely to utilize care. However, educating them on different eye conditions and available care services can increase utilization. Education programs can be targeted towards the most affected population groups to be more effective. For instance, targeting racial minority groups and the elderly is likely to have improved outcomes in terms of increasing utilization and reducing disparities. When designing patient education programs, it is important to consider factors such as linguistic barriers to ensure the programs are beneficial to all. Designing education programs that are easy to understand for all population groups including the less educated is also likely to have better outcomes.

Other measures that can be implemented to address disparities in vision care are establishing community centers that are federally funded, providing reminders to go for eye examinations and screening, providing van pickup services, using reminder calls to schedule eye examinations, and increasing workforce diversity [12, 34, 51, 52]. Community centers that are federally funded can increase access more so in rural communities.34 Providing mobile van pickup services can work well for underserved populations that have lower income levels. Reminders can be vital in increasing adherence and utilization for older adults. Reminder calls to go for scheduled eye examinations can work well particularly for patients with diabetes and those affected by AMD. It is also important to increase workforce diversity to increase service utilization [12]. Having a more representative workforce where all population groups feel represented and included can increase the utilization of care. For minority groups, for example, a diverse workforce can help to overcome barriers attributed to language and culture.

Strengths and Limitations of the Review

The following review contributes significantly to the existing research on vision health and care. It identifies the existing disparities in vision care and the factors that contribute to these disparities. The review also identifies how disparities affect patient outcomes by disproportionately contributing to vision impairment and blindness. Various factors are identified as being key contributors to disparities in vision care. They include socioeconomic status, age, race and ethnicity, gender, and geographic location. These factors contribute to disparities in care by affecting service utilization and overall patient outcomes. Addressing the existing disparities can improve eye care utilization and improve patient outcomes. Various measures can help to address these disparities including providing patient education, increasing medical insurance coverage, implementing community-based eye care programs, using teleophthalmology, providing transport services, and providing reminder alerts to patients among others. These measures can increase the utilization of care and overall patient outcomes.

Although this paper outlines the existing disparities in vision health, and measures to address them, it has limitations. The scope of the review is mainly in the US which makes generalization of findings to other regions challenging. Rigorous data extraction is also not followed.

Conclusion

Health disparities remain a prevalent issue that contributes to poor health outcomes. In ophthalmology, health disparities affect eye care utilization contributing disproportionately to the burden of eye care disorders. Various factors contribute to disparities in vision care. They include age, gender, socioeconomic status, geographic location, and race and ethnicity. These factors affect the ability of the affected populations to access care and increase the burden of eye disorders significantly. Addressing these disparities is vital in increasing eye care utilization and improving patient outcomes. Some of the measures that can address these disparities are providing patient education, increasing insurance coverage, implementing community-based eye care programs, using teleophthalmology, providing transport services, providing reminder alerts, and creating community centres that are federally funded among others. These measures can increase utilization and improve patient outcomes.

Abbreviations

DR: Diabetic Retinopathy

AMD: Age-related macular degeneration

NHANES: National Health and Nutrition Examination Survey

ACA: Affordable Care Act

References

1. Braveman P. What are health disparities and health equity? We need to be clear. Public Health Reports. 2014;129(1_suppl2):5-8. https://doi.org/10.1177/00333549141291S203PMid:24385658 PMCid:PMC3863701
2. Arcaya MC, Arcaya AL, Subramanian SV. Inequalities in health: definitions, concepts, and theories. Global Health Action. 2015;8(1):27106. https://doi.org/10.3402/gha.v8.27106PMid:26112142 PMCid:PMC4481045
3. Flaxman AD, Wittenborn JS, Robalik T, et al. Prevalence of visual acuity loss or blindness in the US: a Bayesian meta-analysis. JAMA Ophthalmology. 2021;139(7):717-23. https://doi.org/10.1001/jamaophthalmol.2021.0527PMid:33983373 PMCid:PMC8120442
4. Wittenborn JS, Gu Q, Erdem E, et al. The prevalence of diagnosis of major eye diseases and their associated payments in the Medicare fee-for-service program. Ophthalmic Epidemiology. 2023;30(2):129-41. https://doi.org/10.1080/09286586.2021.1968006PMid:34530688
5. Varma R, Vajaranant TS, Burkemper B, Wu S, Torres M, Hsu C, Choudhury F, McKean-Cowdin R. Visual impairment and blindness in adults in the United States: demographic and geographic variations from 2015 to 2050. JAMA Ophthalmology. 2016;134(7):802-9. https://doi.org/10.1001/jamaophthalmol.2016.1284PMid:27197072 PMCid:PMC5116104
6. Zhang X, Cotch MF, Ryskulova A, et al. Vision health disparities in the United States by race/ethnicity, education, and economic status: findings from two nationally representative surveys. American Journal of Ophthalmology. 2012;154(6):S53-62. https://doi.org/10.1016/j.ajo.2011.08.045PMid:23158224 PMCid:PMC4169111

7. Rein DB, Wittenborn JS, Zhang P, et al. The economic burden of vision loss and blindness in the United States. Ophthalmology. 2022;129(4):369-78. https://doi.org/10.1016/j.ophtha.2021.09.010PMid:34560128
8. Vision Health Initiative (VHI). Economic studies. 2022. Accessed 31 March 2024. https://www.cdc.gov/visionhealth/projects/economic_studies.htm#:~:text=Vision%20loss%20and%20blindness%20impose,States%20reaches%20approximately%20%2451.4%20billion.
9. Flaxman SR, Bourne RR, Resnikoff S, et al. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. The Lancet Global Health. 2017;5(12):e1221-34. doi:10.1016/S2214-109X(17)30393-5https://doi.org/10.1016/S2214-109X(17)30393-5PMid:29032195
10. Bourne RR, Flaxman SR, Braithwaite T, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. The Lancet Global Health. 2017;5(9):e888-97.
11. Vision Health Initiative (VHI). Fast facts about vision loss. 2023. Accessed 31 March 2024. https://www.cdc.gov/visionhealth/basics/ced/fastfacts.htm
12. Elam AR, Tseng VL, Rodriguez TM, et al. Disparities in vision health and eye care. Ophthalmology. 2022;129(10):e89-113. https://doi.org/10.1016/j.ophtha.2022.07.010PMid:36058735 PMCid:PMC10109525
13. Vision Health Initiative (VHI). Common eye disorders and diseases. 2023. Accessed 31 March 2024. https://www.cdc.gov/visionhealth/basics/ced/index.html
14. Friedman DS, O'Colmain BJ, Munoz B, Tomany SC, McCarty C, De Jong PT, Nemesure B, Mitchell P, Kempen J. Prevalence of age-related macular degeneration in the United States. Arch Ophthalmol. 2004;122(4):564-72. https://doi.org/10.1001/archopht.122.4.564PMid:15078675
15. Vision and Eye Health Surveillance System (VEHSS). Prevalence of age-related macular degeneration (AMD). Accessed 31 March 2024. https://www.cdc.gov/visionhealth/vehss/estimates/amd-prevalence.html
16. Lundeen EA, Burke-Conte Z, Rein DB, Wittenborn JS, Saaddine J, Lee AY, Flaxman AD. Prevalence of diabetic retinopathy in the US in 2021. JAMA Ophthalmology. 2023;141(8):747-54. https://doi.org/10.1001/jamaophthalmol.2023.2289PMid:37318810
17. Teo ZL, Tham YC, Yu M, et al. Global prevalence of diabetic retinopathy and projection of burden through 2045: systematic review and meta-analysis. Ophthalmology. 2021;128(11):1580-91. https://doi.org/10.1016/j.ophtha.2021.04.027PMid:33940045
18. Dougherty M, Wittenborn J, Phillips E, Swenor B. Published examination-based prevalence of major eye disorders. Vision & eye health surveillance system. 2018.
19. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. 2014;121(11):2081-90.https://doi.org/10.1016/j.ophtha.2014.05.013PMid:24974815
20. Olson RJ, Braga-Mele R, Chen SH, Miller KM, Pineda R, Tweeten JP, Musch DC. Cataract in the adult eye preferred practice pattern®. Ophthalmology. 2017;124(2):P1-19. https://doi.org/10.1016/j.ophtha.2016.09.027PMid:27745902
21. Hu B, Liu Z, Zhao J, Zeng L, Hao G, Shui D, Mao K. The global prevalence of amblyopia in children: A systematic review and meta-analysis. Frontiers in Pediatrics. 2022;10:819998. https://doi.org/10.3389/fped.2022.819998PMid:35601430 PMCid:PMC9114436
22. Abdul Basith Khan M, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of type 2 diabetes-global burden of disease and forecasted trends. Journal of Epidemiology and Global Health. 2020;10(1):107-11. https://doi.org/10.2991/jegh.k.191028.001PMid:32175717 PMCid:PMC7310804
23. Rasendran C, Tye G, Knusel K, Singh RP. Demographic and socioeconomic differences in outpatient ophthalmology utilization in the United States. American Journal of Ophthalmology. 2020;218:156-63. https://doi.org/10.1016/j.ajo.2020.05.022PMid:32446736
24. Fisher DE, Shrager S, Shea SJ, Burke GL, Klein R, Wong TY, Klein BE, Cotch MF. Visual impairment in white, Chinese, black, and Hispanic participants from the Multi-Ethnic Study of Atherosclerosis cohort. Ophthalmic Epidemiology. 2015;22(5):321-32. https://doi.org/10.3109/09286586.2015.1066395PMid:26395659 PMCid:PMC4768912
25. Deng Z, Fuller-Thomson E. Temporal trends over a decade in serious vision impairment in a large, nationally representative population-based sample of older Americans: Gender, cohort and racial/ethnic differences. Ophthalmic Epidemiology. 2022;29(1):39-48. https://doi.org/10.1080/09286586.2021.1889001PMid:33645427
26. Chan T, Friedman DS, Bradley C, Massof R. Estimates of incidence and prevalence of visual impairment, low vision, and blindness in the United States. JAMA Ophthalmology. 2018;136(1):12-9. https://doi.org/10.1001/jamaophthalmol.2017.4655PMid:29098289 PMCid:PMC5833607
27. Zambelli-Weiner A, Crews JE, Friedman DS. Disparities in adult vision health in the United States. American Journal of Ophthalmology. 2012 Dec 1;154(6):S23-30.https://doi.org/10.1016/j.ajo.2012.03.018PMid:22633355
28. Sommer A, Tielsch JM, Katz J, et al. Racial differences in the cause-specific prevalence of blindness in east Baltimore. New England Journal of Medicine. 1991;325(20):1412-7. https://doi.org/10.1056/NEJM199111143252004PMid:1922252
29. Richter GM, Chung J, Azen SP, Varma R, Los Angeles Latino Eye Study Group. Prevalence of visually significant cataract and factors associated with unmet need for cataract surgery: Los Angeles Latino Eye Study. Ophthalmology. 2009;116(12):2327-35. https://doi.org/10.1016/j.ophtha.2009.05.040PMid:19815276 PMCid:PMC2787839
30. Stein JD, Kim DS, Niziol LM, Talwar N, Nan B, Musch DC, Richards JE. Differences in rates of glaucoma among Asian Americans and other racial groups, and among various Asian ethnic groups. Ophthalmology. 2011 Jun;118(6):1031-7. https://doi.org/10.1016/j.ophtha.2010.10.024PMid:21310489 PMCid:PMC3109193
31. Friedman DS, Jampel HD, Munoz B, West SK. The prevalence of open-angle glaucoma among blacks and whites 73 years and older: the Salisbury Eye Evaluation Glaucoma Study. Archives of Ophthalmology. 2006;124(11):1625-30. https://doi.org/10.1001/archopht.124.11.1625PMid:17102012
32. Klein R, Klein BE. The prevalence of age-related eye diseases and visual impairment in aging: current estimates. Investigative Ophthalmology & Visual Science. 2013;54(14):ORSF5-13. https://doi.org/10.1167/iovs.13-12789PMid:24335069 PMCid:PMC4139275
33. Umfress AC, Brantley Jr MA. Eye care disparities and health-related consequences in elderly patients with age-related eye disease. Seminars in Ophthalmology 2016; 31 (4),432-438. https://doi.org/10.3109/08820538.2016.1154171PMid:27116323 PMCid:PMC4990069
34. Solomon SD, Shoge RY, Ervin AM, Contreras M, Harewood J, Aguwa UT, Olivier MM. Improving access to eye care: a systematic review of the literature. Ophthalmology. 2022;129(10):e114-26. https://doi.org/10.1016/j.ophtha.2022.07.012PMid:36058739

35. Kirtland KA, Saaddine JB, Geiss LS, Thompson TJ, Cotch MF, Lee PP. Geographic disparity of severe vision loss-United States, 2009-2013. MMWR Morb Mortal Wkly Rep. 2015;64(19):513-7.
36. Rothman AL, Stoler JB, Vu DM, Chang TC. A geodemographic service coverage analysis of travel time to glaucoma specialists in Florida. Journal of Glaucoma. 2020;29(12):1147-51. https://doi.org/10.1097/IJG.0000000000001648PMid:33264165
37. Tielsch JM, Sommer A, Katz J, Quigley H, Ezrine S. Socioeconomic status and visual impairment among urban Americans. Archives of Ophthalmology. 1991;109(5):637-41. https://doi.org/10.1001/archopht.1991.01080050051027PMid:2025164
38. Goyal A, Richards C, Patel V, Syeda S, Guest JM, Freedman RL, Hall LM, Kim C, Sirajeldin A, Rodriguez T, Arsenault SM. The Vision Detroit Project: visual burden, barriers, and access to eye care in an urban setting. Ophthalmic Epidemiology. 2022;29(1):13-24. https://doi.org/10.1080/09286586.2021.1884264PMid:33576279
39. Vajaranant TS, Nayak S, Wilensky JT, Joslin CE. Gender and glaucoma: what we know and what we need to know. Current opinion in ophthalmology. 2010 Mar 1;21(2):91-9. https://doi.org/10.1097/ICU.0b013e3283360b7ePMid:20051857 PMCid:PMC4326058
40. Abou-Gareeb I, Lewallen S, Bassett K, Courtright P. Gender and blindness: a meta-analysis of population-based prevalence surveys. Ophthalmic Epidemiology. 2001;8(1):39-56. https://doi.org/10.1076/opep.8.1.39.1540PMid:11262681
41. Ulldemolins AR, Lansingh VC, Valencia LG, Carter MJ, Eckert KA. Social inequalities in blindness and visual impairment: a review of social determinants. Indian Journal of Ophthalmology. 2012;60(5):368-75. https://doi.org/10.4103/0301-4738.100529PMid:22944744 PMCid:PMC3491260
42. Elam AR, Lee PP. Barriers to and suggestions on improving utilization of eye care in high-risk individuals: focus group results. International Scholarly Research Notices. 2014; https://doi.org/10.1155/2014/527831PMid:27379302 PMCid:PMC4897391
43. Killeen OJ, Cho J, Newman-Casey PA, Kana L, Woodward MA. Barriers and facilitators to obtaining eyeglasses for vulnerable patients in a Michigan free clinic. Optometry and Vision Science. 2021;98(3):243-9. https://doi.org/10.1001/jamaophthalmol.2015.8PMid:25674781
44. Ervin AM, Solomon SD, Shoge RY. Access to eye care in the United States: evidence-informed decision-making is key to improving access for underserved populations. Ophthalmology. 2022;129(10):1079-80. https://doi.org/10.1016/j.ophtha.2022.07.011PMid:36058738
45. Dotan G, Truong B, Snitzer M, et al. Outcomes of an inner-city vision outreach program: give kids sight day. JAMA Ophthalmology. 2015;133(5):527-32. https://doi.org/10.1001/jamaophthalmol.2015.8PMid:25674781
46. Bhoosnurmath K. Hospital-based community eye health programme: a model for elimination of avoidable blindness on a sustainable basis. Community Eye Health. 2017;30(98):S12.
47. Rathi S, Tsui E, Mehta N, Zahid S, Schuman JS. The current state of teleophthalmology in the United States. Ophthalmology. 2017;124(12):1729-34. https://doi.org/10.1016/j.ophtha.2017.05.026PMid:28647202 PMCid:PMC6020848
48. Sreelatha OK, Ramesh SV. Teleophthalmology: improving patient outcomes?.Clinical Ophthalmology. 2016; 10:285-95.https://doi.org/10.2147/OPTH.S80487PMid:26929592 PMCid:PMC4755429
49. Moinul P, Barbosa J, Qian J, et al. Does patient education improve compliance to routine diabetic retinopathy screening?. Journal of Telemedicine and Telecare. 2020;26(3):161-73. https://doi.org/10.1177/1357633X18804749PMid:30373446
50. Liu Y, Zupan NJ, Shiyanbola OO, et al. Factors influencing patient adherence with diabetic eye screening in rural communities: a qualitative study. PLoS One. 2018;13(11):e0206742. https://doi.org/10.1371/journal.pone.0206742PMid:30388172 PMCid:PMC6214545
51. Callinan CE, Kenney B, Hark LA, et al. Improving follow-up adherence in a primary eye care setting. American Journal of Medical Quality. 2017;32(1):73-9. https://doi.org/10.1177/1062860615616860PMid:26656245
52. Pizzi LT, Tran J, Shafa A, et al. Effectiveness and cost of a personalized reminder intervention to improve adherence to glaucoma care. Applied Health Economics and Health Policy. 2016;14:229-40. https://doi.org/10.1007/s40258-016-0231-8