Arsiwala-Scheppach L, et al., J Gerontol Geriatr Med 2022, 8: 132
DOI: 10.24966/GGM-8662/100132

HSOA Journal of Gerontology and Geriatric Medicine

Short commentary

An Eye on the Brain: Insights from the Eye Determinants of Cognition Study

Arsiwala-Scheppach L[1], Ramulu PY[1,2] and Abraham AG[2,3,4]*

[1]*Wilmer Eye Institute, Johns Hopkins School of Medicine, Johns Hopkins University, Baltimore, USA*

[2]*Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, USA*

[3]*Department of Epidemiology, School of Public Health, University of Colorado, Denver, USA*

[4]*Department of Ophthalmology, School of Medicine, University of Colorado, Denver, USA*

Blindness and visual impairment are leading causes of disability and reduced quality of life in older adults, affecting more than 11% of people aged 50 years and older in the general population [1]. The global burden will only grow as populations around the world age [1,2]. Visual impairment has also been identified as a risk factor for cognitive decline, another leading cause of disability, dependency and early mortality in older adults [3-5]. There are a number of potential underlying mechanisms that could link visual function to decline in cognition. The common cause theory postulates that systemic disease processes such as diabetes mellitus or hypertension could damage both the retina and the brain resulting in visual and cognitive impairment, respectively. Similarly, behavioral or social factors could contribute to both higher likelihood of uncorrected refractive error or cataract and poorer performance on cognitive testing. On the other hand, the sensory deprivation theory states that loss of vision function could lead to declining engagement in physical and social activities, and depression, which in turn could increase risk of cognitive decline. Understanding the connection between visual impairment and cognitive decline may help identify high risk populations and inform screening and prevention strategies.

The Eye Determinants of Cognition (EyeDOC) study was designed to look at relationships of vision and eye health with cognitive decline, using a thorough battery of vision function and eye health measures, and cognitive performance data spanning a 7-year period in a biracial, community-based cohort of older adults [6]. Studies that have examined vision and cognition relationships have generally assessed only Distance Visual Acuity (DVA) - a single measure of vision function that may not be closely linked to physical or social functioning [7-11]. Unlike these studies, the EyeDOC Study measured several aspects of visual function including presenting DVA, corrected DVA and contrast sensitivity. Presenting DVA is the visual acuity that the participants have using their regular glasses/lenses, if any. It is a function of both vision loss due to disease or refractive error as well as under-correction for refractive error potentially due to poor access to vision care or irregular visits to an eye doctor. Corrected DVA, on the other hand, is the optimal visual acuity that participants could achieve after perfect correction of any refractive error. Contrast sensitivity is the participants' ability to detect subtle differences in shading and patterns. It is important in detecting objects with ill-defined outlines and discriminating objects or details from their background, such as the ability to find a black mobile phone on a dark countertop. Contrast sensitivity has a large impact on daily activities like reading speed and navigating dimly lit spaces, and remains relatively unaffected by uncorrected refractive error [12,13]. In addition to more expansive vision measures, the EyeDOC Study benefitted from a thorough assessment of cognitive status via a comprehensive battery of tests that spanned several cognitive domains, a feature that is not available in many studies.

Results from the EyeDOC Study suggested that worse visual function was associated with greater rates of concurrent decline in global cognition, as well as in the domains of memory and executive function, independent of well-known risk factors for cognitive decline such as diabetes mellitus and hypertension. This pattern of associations was consistent in all the three measures of visual function. The associations between each measure of visual function and cognitive decline may be linked to different mechanistic pathways. Weaker associations in corrected DVA, as compared to presenting DVA, suggest that part of the relationship may arise from unmet vision care needs and social factors that drive them. Hence, treating residual refractive error and encouraging older adults into vision care may be a modifiable risk factor for cognitive decline in older adults. Beyond refractive error, contrast sensitivity, which cannot be corrected in most cases, was also associated with greater decline in cognition. Vascular damage related to underlying diseases such as hypertension and diabetes mellitus can result in damage to the optic nerve that leads to loss of contrast sensitivity, and both diseases are known risk factors for cognitive decline [14-16]. However, the association persisted even after accounting for diabetes mellitus and hypertension, though the possibility of residual and/or unmeasured confounding remains but it was only observed in one of the two community/race groups that were studied - the Washington County/White group.

The results speak to important contextual factors that drive relationships between vision function and cognition. Washington County, Maryland and Jackson, Mississippi represent two distinct communities that differ by geographic location, state level health policy, urbanicity, as well as culture. These factors may influence educational

***Corresponding author:** Abraham AG, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, USA, E-mail: alison.abraham@cuanschutz.edu

Citation: Arsiwala-Scheppach L, Ramulu PY, Abraham AG (2022) An Eye on the Brain: Insights from the Eye Determinants of Cognition Study. J Gerontol Geriatr Med 8: 132.

Received: April 26, 2022; **Accepted:** May 04, 2022; **Published:** May 11, 2022

quality and availability, opportunity for social interactions, access to outdoor physical activities and the risk of depression. Community differences in these potential mediating factors could influence relationships between vision function and cognitive decline. For example, in a community with low access to outdoor physical activities, the loss of vision function may not do much to further limit an individual's physical activity. Research has demonstrated a link between high area-deprivation-index and high disability prevalence in USA, where disability was defined as having limitations in vision, hearing, cognitive, ambulatory, self-care, or independent living [17]. Clearly, additional research is needed into community and individual level factors that may play key roles in ameliorating or exacerbating the impact of vision loss on daily activities, emotional well-being, and quality of life.

While the EyeDOC study examined three aspects of visual function (presenting DVA, corrected DVA and contrast sensitivity), other domains of vision function such as color vision and visual field were not assessed. Visual acuity and color vision have been shown to be correlated. However, the severity of color vision loss in relation to visual acuity differs depending on the cause of visual impairment [18]. In addition, at least for certain etiologies, such as glaucoma and optic nerve disease, visual field tests may be superior to visual acuity in determining functional vision loss [19]. Hence, further studies investigating the association between visual impairment and cognitive decline should expand on the EyeDOC study results, including an even wider range of vision function tests and additional follow-up to better assess the temporality of the relationship between aspects of vision function loss and cognitive decline. Longer follow-up and repeated measures of vision function and cognition over time could elucidate the remaining mechanistic question: is visual impairment the key factor, or are underlying systemic diseases associated with changes in both the retina and brain responsible for the observed associations [20].

In conclusion, results from the EyeDOC study support a functional link between visual impairment and cognitive decline in older adults which, given the high prevalence of vision impairment in this age group, could have substantial public health implications. Since many common causes of vision loss are preventable or treatable, regular visual screening, as well as appropriate treatment, would likely improve the quality of life and promote healthy aging, potentially including better cognitive health. Older adults may benefit from a more aggressive approach to vision loss by clinical care providers including advocating for frequent eye examinations, more awareness of the problem of uncorrected refractive error and encouraging timely cataract surgery when warranted.

References

1. GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study (2021) Trends in prevalence of blindness and distance and near vision impairment over 30 years: An analysis for the global burden of disease study. Lancet Glob Health 9: 130-143.
2. Congdon N, O'Colmain B, Klaver CC, Klein R, Muñoz B, et al. (2004) Causes and prevalence of visual impairment among adults in the united states. Arch Ophthalmol 122: 477-485.
3. Vu TA, Fenwick EK, Gan ATL, Man REK, Tan BKJ, et al. (2021) The bi-directional relationship between vision and cognition: A systematic review and meta-analysis. Ophthalmology 128: 981-992.
4. Schultz-Larsen K, Rahmanfard N, Kreiner S, Avlund K, Holst C (2008) Cognitive impairment as assessed by a short form of MMSE was predictive of mortality. J Clin Epidemiol 61: 1227-1233.
5. Leigh AJ, O'Hanlon K, Sheldrick R, Surr C, Hare DJ (2015) Care mapping in clinical neuroscience settings: Cognitive impairment and dependency. Neuropsychol Rehabil 25: 574-592.
6. Arsiwala LT, Guo X, Ramulu PY, Sharrett AR, Mihailovic A, et al. (2021) Associations of visual function with cognitive performance in community-based older adults: The eye determinants of cognition study. J Gerontol A Biol Sci Med Sci.
7. Elyashiv SM, Shabtai EL, Belkin M (2014) Correlation between visual acuity and cognitive functions. Br J Ophthalmol 98: 129-132.
8. Wettstein M, Wahl HW, Heyl V (2018) Visual acuity and cognition in older adults with and without hearing loss: Evidence for late-life sensory compensation? Ear Hear 39: 746-755.
9. Salthouse TA, Hancock HE, Meinz EJ, Hambrick DZ (1996) Interrelations of age, visual acuity, and cognitive functioning. J Gerontol B Psychol Sci Soc Sci 51: 317-330.
10. Fang IM, Fang YJ, Hu HY, Weng SH (2021) Association of visual impairment with cognitive decline among older adults in taiwan. Sci Rep 11:17593.
11. Zheng DD, Swenor BK, Christ SL, West SK, Lam BL, et al. (2018) Longitudinal associations between visual impairment and cognitive functioning: The salisbury eye evaluation study. JAMA Ophthalmol 136: 989-995.
12. Clay OJ, Edwards JD, Ross LA, Okonkwo O, Wadley VG, et al. (2009) Visual function and cognitive speed of processing mediate age-related decline in memory span and fluid intelligence. J Aging Health 21: 547-566.
13. Rubin GS, West SK, Munoz B, Bandeen-Roche A, Zeger S, et al. (1997) A comprehensive assessment of visual impairment in a population of older Americans. The SEE study. Salisbury eye evaluation project. Invest Ophthalmol Vis Sci 38: 557-568.
14. Dosso AA, Bonvin ER, Morel Y, Golay A, Assal JP, et al. (1996) Risk factors associated with contrast sensitivity loss in diabetic patients. Graefes Arch Clin Exp Ophthalmol 234: 300-305.
15. Baumgart M, Snyder HM, Carrillo MC, Fazio S, Kim H, et al. (2015) Summary of the evidence on modifiable risk factors for cognitive decline and dementia: A population-based perspective. Alzheimers Dement 11: 718-726.
16. Gella L, Raman R, Pal SS, Ganesan S, Sharma T (2017) Contrast sensitivity and its determinants in people with diabetes: SN-DREAMS-II, report no 6. Eye (Lond) 31: 460-466.
17. Li H (2016) Disability, insurance coverage, area deprivation and health care: Using spatial analysis to inform policy decisions. Procedia Environmental Sciences 36: 20-25.
18. Almog Y, Nemet A (2010) The correlation between visual acuity and color vision as an indicator of the cause of visual loss. Am J Ophthalmol 149: 1000-1004.
19. Bengtsson B, Heijl A, Agardh E (2005) Visual fields correlate better than visual acuity to severity of diabetic retinopathy. Diabetologi 48: 2494-2500.
20. Oster C (1976) Sensory deprivation in geriatric patients. J Am Geriatr Soc 24: 461-464.

HERALD

Advances In Industrial Biotechnology | ISSN: 2639-5665

Advances In Microbiology Research | ISSN: 2689-694X

Archives Of Surgery And Surgical Education | ISSN: 2689-3126

Archives Of Urology

Archives Of Zoological Studies | ISSN: 2640-7779

Current Trends Medical And Biological Engineering

International Journal Of Case Reports And Therapeutic Studies | ISSN: 2689-310X

Journal Of Addiction & Addictive Disorders | ISSN: 2578-7276

Journal Of Agronomy & Agricultural Science | ISSN: 2689-8292

Journal Of AIDS Clinical Research & STDs | ISSN: 2572-7370

Journal Of Alcoholism Drug Abuse & Substance Dependence | ISSN: 2572-9594

Journal Of Allergy Disorders & Therapy | ISSN: 2470-749X

Journal Of Alternative Complementary & Integrative Medicine | ISSN: 2470-7562

Journal Of Alzheimers & Neurodegenerative Diseases | ISSN: 2572-9608

Journal Of Anesthesia & Clinical Care | ISSN: 2378-8879

Journal Of Angiology & Vascular Surgery | ISSN: 2572-7397

Journal Of Animal Research & Veterinary Science | ISSN: 2639-3751

Journal Of Aquaculture & Fisheries | ISSN: 2576-5523

Journal Of Atmospheric & Earth Sciences | ISSN: 2689-8780

Journal Of Biotech Research & Biochemistry

Journal Of Brain & Neuroscience Research

Journal Of Cancer Biology & Treatment | ISSN: 2470-7546

Journal Of Cardiology Study & Research | ISSN: 2640-768X

Journal Of Cell Biology & Cell Metabolism | ISSN: 2381-1943

Journal Of Clinical Dermatology & Therapy | ISSN: 2378-8771

Journal Of Clinical Immunology & Immunotherapy | ISSN: 2378-8844

Journal Of Clinical Studies & Medical Case Reports | ISSN: 2378-8801

Journal Of Community Medicine & Public Health Care | ISSN: 2381-1978

Journal Of Cytology & Tissue Biology | ISSN: 2378-9107

Journal Of Dairy Research & Technology | ISSN: 2688-9315

Journal Of Dentistry Oral Health & Cosmesis | ISSN: 2473-6783

Journal Of Diabetes & Metabolic Disorders | ISSN: 2381-201X

Journal Of Emergency Medicine Trauma & Surgical Care | ISSN: 2378-8798

Journal Of Environmental Science Current Research | ISSN: 2643-5020

Journal Of Food Science & Nutrition | ISSN: 2470-1076

Journal Of Forensic Legal & Investigative Sciences | ISSN: 2473-733X

Journal Of Gastroenterology & Hepatology Research | ISSN: 2574-2566

Journal Of Genetics & Genomic Sciences | ISSN: 2574-2485

Journal Of Gerontology & Geriatric Medicine | ISSN: 2381-8662

Journal Of Hematology Blood Transfusion & Disorders | ISSN: 2572-2999

Journal Of Hospice & Palliative Medical Care

Journal Of Human Endocrinology | ISSN: 2572-9640

Journal Of Infectious & Non Infectious Diseases | ISSN: 2381-8654

Journal Of Internal Medicine & Primary Healthcare | ISSN: 2574-2493

Journal Of Light & Laser Current Trends

Journal Of Medicine Study & Research | ISSN: 2639-5657

Journal Of Modern Chemical Sciences

Journal Of Nanotechnology Nanomedicine & Nanobiotechnology | ISSN: 2381-2044

Journal Of Neonatology & Clinical Pediatrics | ISSN: 2378-878X

Journal Of Nephrology & Renal Therapy | ISSN: 2473-7313

Journal Of Non Invasive Vascular Investigation | ISSN: 2572-7400

Journal Of Nuclear Medicine Radiology & Radiation Therapy | ISSN: 2572-7419

Journal Of Obesity & Weight Loss | ISSN: 2473-7372

Journal Of Ophthalmology & Clinical Research | ISSN: 2378-8887

Journal Of Orthopedic Research & Physiotherapy | ISSN: 2381-2052

Journal Of Otolaryngology Head & Neck Surgery | ISSN: 2573-010X

Journal Of Pathology Clinical & Medical Research

Journal Of Pharmacology Pharmaceutics & Pharmacovigilance | ISSN: 2639-5649

Journal Of Physical Medicine Rehabilitation & Disabilities | ISSN: 2381-8670

Journal Of Plant Science Current Research | ISSN: 2639-3743

Journal Of Practical & Professional Nursing | ISSN: 2639-5681

Journal Of Protein Research & Bioinformatics

Journal Of Psychiatry Depression & Anxiety | ISSN: 2573-0150

Journal Of Pulmonary Medicine & Respiratory Research | ISSN: 2573-0177

Journal Of Reproductive Medicine Gynaecology & Obstetrics | ISSN: 2574-2574

Journal Of Stem Cells Research Development & Therapy | ISSN: 2381-2060

Journal Of Surgery Current Trends & Innovations | ISSN: 2578-7284

Journal Of Toxicology Current Research | ISSN: 2639-3735

Journal Of Translational Science And Research

Journal Of Vaccines Research & Vaccination | ISSN: 2573-0193

Journal Of Virology & Antivirals

Sports Medicine And Injury Care Journal | ISSN: 2689-8829

Trends In Anatomy & Physiology | ISSN: 2640-7752