

## Short commentary

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

Arsiwala-Scheppach L<sup>1</sup>, Ramulu PY<sup>1,2</sup> and Abraham AG<sup>2,3,4\*</sup>

<sup>1</sup>Wilmer Eye Institute, Johns Hopkins School of Medicine, Johns Hopkins University, Baltimore, USA

<sup>2</sup>Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, USA

<sup>3</sup>Department of Epidemiology, School of Public Health, University of Colorado, Denver, USA

<sup>4</sup>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

**\*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

**Copyright:** © 2022 Arsiwala-Scheppach L, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

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

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.



- 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

Submit Your Manuscript: <https://www.heraldoopenaccess.us/submit-manuscript>