

ARIC Manuscript Proposal #4174

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Priority: _____

1.a. Full Title:

b. Abbreviated Title (Length 26 characters): Social Determinants of Uncorrected Refractive Error, Vision Impairment, and Ocular Pathology

2. Writing Group [please provide a middle name if available; EX: Adam Lee Williams]:

Writing group members: Alison G Abraham, Xinxing Guo, Adrienne Tin, Pradeep Ramulu, Aleks Mihailovic

I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal. X **[please confirm with your initials electronically or in writing]**

First author [please provide a middle name if available; EX: Adam Lee Williams]: Alison Abraham

Address: 13001 East 17 Place, Mail Stop B119
Aurora, CO 80045
Office number: W3143

Phone: 303-724-8378 Fax:
E-mail: alison.abraham@cuanschutz.edu

ARIC author to be contacted if there are questions about the manuscript and the first author does not respond or cannot be located (this must be an ARIC investigator).

Name: **Alison Abraham**
Address: 13001 East 17 Place, Mail Stop B119
Aurora, CO 80045
Office number: W3143

Phone: 303-724-8378 Fax:
E-mail: alison.abraham@cuanschutz.edu

3. Timeline:

Analysis and manuscript draft will be completed in 18 months

4. Rationale:

Disparities in Vision Impairment and Eye Disease

There is substantial evidence documenting disparities in vision and eye health linked to key SDOH to vision and eye health. A primary source of data for research on the social determinants of vision and eye health is the National Health and Nutrition Examination Survey (NHANES) collected from 2005–2008, as this is the only nationally representative, measured data on the prevalence of vision impairment and eye disease in the U.S. A study by Vitale et al. using NHANES data found that visual impairment (presenting distance visual acuity of 20/50 or worse in the better-seeing eye) was more prevalent in persons who were Black (8.4%), Hispanic (10.7%) or another race or ethnicity (11.2%) compared to White persons (5.0%) as well as higher among those with a high school education or less (compared to those who received some college education), incomes <2 times the federal poverty level (compared to those with incomes ≥ 2 times the poverty level) and those who were uninsured or had some form of public insurance like Medicaid or Medicare (compared to those with private insurance) (Vitale, 2006).

There are documented disparities in the prevalence of major eye diseases across population groups. A nationally representative study using NHANES data from 2005-2008 found that non-Hispanic White adults ≥ 40 years of age had a higher prevalence than non-Hispanic Black adults of age-related macular degeneration (8.3% and 3.1%, respectively) and cataract surgery (18.4% and 13.5%), but a significantly lower prevalence of diabetic retinopathy (3.2% and 8.7%) and glaucoma (6.9% and 11.5%) (Zhang, 2012). A recent study used Medicare Part B fee-for-service claims data to examine trends in the annual prevalence of having a claim for diabetic macular edema or vision-threatening diabetic retinopathy among beneficiaries ≥ 65 years with diabetes (Lundeen, 2022). The prevalence of diabetic macular edema or vision-threatening diabetic retinopathy was highest among beneficiaries who were Hispanic (7.0%), Black (6.2%), and American Indian or Alaska Natives (6.0%) and lowest among non-Hispanic White beneficiaries (3.8%); however, despite having the lowest annual prevalence of vision-threatening diabetes-related eye disease, non-Hispanic White beneficiaries had the highest annual prevalence of receiving anti-vascular endothelial growth factor injections, the contemporary first-line treatment.

SDOH Drivers of Vision Health Disparities

Employment status is an important determinant of health, and there is an established link between employment and vision status that is likely bidirectional. Sherrod et al. found that decreased vision is associated with a significantly higher likelihood of not working as vision impairment that affects a person's functioning likely decreases employment opportunities. Visually impaired individuals with diabetes, women, and those younger than 55 years have a particularly high risk of not working (Sherrod, 2014). Conversely, unemployment and having a low income can exacerbate health conditions like diabetes that may cause or worsen vision impairment.

Food insecurity is another vitally important determinant of health, particularly for cardiometabolic diseases like diabetes, as consistent access to healthy foods enables long-term management of chronic disease and may contribute to the prevention of serious complications like diabetic retinopathy (Seligman, 2010). Data from two nationally representative surveys

show that those with food insecurity have greater odds of having vision impairment (Kolli, 2022; Su, 2020), and one of the studies found that in a dose-response manner, the prevalence of vision impairment increased with increasingly severe food insecurity (Kolli, 2022).

Research has also documented differences in access to and utilization of vision care by SDOH factors like education and income. For example, Zhang et al. found that among adults with self-reported visual impairment, those with lower educational attainment were less likely to receive an annual eye care exam (35.4% in those with less than a high school education vs. 59.0% among those with a high school education or more; $p < 0.001$) and more likely to report an inability to afford eyeglasses (25.8% in those with less than a high school education vs. 12.6% among those with a high school education or more; $p < 0.001$). Findings were similar for adults with lower incomes (33.3% had eye exams among those with a poverty-to-income ratio [PIR] < 1.00 vs. 65.7% among those with a $PIR \geq 4.00$; $p < 0.001$; 23.7% couldn't afford eyeglasses among those with a $PIR < 1.00$ vs. 5.4% among those with a $PIR \geq 4.00$; $p < 0.001$) (Zhang, 2012). Another study using data from the Behavioral Risk Factor Surveillance System examined barriers to eye care in people with diabetes and found that nearly a quarter of adults with diabetes reported that they had not sought eye care in the last 12 months, with the most common reasons being cost of eye care or a lack of insurance (Chou, 2014). Furthermore, cost of or lack of insurance was most frequently reported by women, people 40–64 years old, Hispanic persons, those with an income less than \$35,000, and those with less than a high school education.

Using data from the ARIC study and the ancillary EyeDOC study, we propose to evaluate the burden of eye disease and vision loss across populations defined by social factors and indicators of disadvantage. We will explore relationships between eye disease and vision loss with SDOH, looking at both individual and independent contributions to burden and joint contributions to burden. Specifically, we will focus on vision loss and blindness, diabetic retinopathy, glaucoma, AMD and uncorrected refractive error.

- Kolli A, Mozaffarian RS, Kenney EL. Food Insecurity and Vision Impairment Among Adults Age 50 and Older in the United States. *Am J Ophthalmol.* 2022;236:69–78.
- Seligman HK, Schillinger D. Hunger and socioeconomic disparities in chronic disease. *N Engl J Med.* 2010;363(1):6–9.
- Sherrod CE, Vitale S, Frick KD, Ramulu PY. Association of vision loss and work status in the United States. *JAMA Ophthalmol.* 2014;132(10):1239–42.
- Lundeen EA, Andes LJ, Rein DB, et al. Trends in Prevalence and Treatment of Diabetic Macular Edema and Vision-Threatening Diabetic Retinopathy among Medicare Part B Fee-for-Service Beneficiaries. *JAMA Ophthalmol.* 2022;30341:1-9.
- Vitale S, Cotch MF, Sperduto RD. Prevalence of visual impairment in the United States. *JAMA.* 2006;295(18):2158-6.
- 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. *Am J Ophthalmol.* 2012;154(6 SUPPL.):S53-S62.e1.

5. Main Hypothesis/Study Questions:

Aim 1: Quantify the relationship between SDOH collected in the ARIC study and the magnitude and degree of visual impairment in two communities (Washington County and Jackson participants) of older adults.

Aim 2: Quantify the relationship between SDOH and the prevalence and severity of uncorrected refractive error in two communities of older adults.

Aim 3: Quantify the relationship between SDOH and the prevalence and types of ocular pathology in two communities of older adults.

6. Design and analysis (study design, inclusion/exclusion, outcome and other variables of interest with specific reference to the time of their collection, summary of data analysis, and any anticipated methodologic limitations or challenges if present).

This is an observational study using vision data from the nested EyeDOC study visit and indicators of SDOH drawn from mostly ARIC visit 6 or visit 7 (depending upon the closest proximity to the EyeDOC exam), but also with the potential to look at longer term histories for some factors reported over several visits. We will choose the time frame most appropriate given best available data on the relevant time period for health impact based on expert opinion and the literature.

Inclusion/Exclusion criteria: ARIC participants recruited in the EyeDOC ancillary study will be included. These include ~500 participants with Mini-Mental State Examination (MMSE) scores no less than 22 from the Jackson study site and ~500 participants with MMSE scores no less than 24 from the Hagerstown study site.

Participants will be excluded if they did not have complete data on SDOH. Participants will be further excluded from the respective analysis if they did not have data on:

1. Distance presenting, corrected, or near presenting visual acuity (Aim 1)
2. Refraction or visual acuity (distance presenting, corrected, near presenting) (Aim 2)
3. Retinal image grading outcomes (Aim 3)

Primary outcome: The primary outcomes will be visual impairment, uncorrected refractive error, and ocular pathology. Definitions and vision variables include the following:

- Visual impairment: worse than 20/40 in the better-eye (World Health Organization)
 - Presenting visual impairment: distance presenting visual acuity in the right eye and left eye
 - Corrected visual impairment: distance corrected visual acuity in the right eye and left eye
 - Near visual impairment: near presenting visual acuity in both eyes
- Uncorrected refractive error
 - Distance uncorrected refractive error: distance presenting vision worse than 20/40 where corrected distance visual acuity 20/40 or better
 - Refractive error of myopia, hyperopia, and astigmatism will be determined using autorefraction data in the right eye and left eye

- Uncorrected presbyopia: near presenting vision worse than 20/40 where corrected distance visual acuity 20/40 or better
- Ocular pathology will be identified based on the retinal image grading and self-reported medical history
 - Age-related macular degeneration
 - Glaucoma
 - Retinopathy (diabetic retinopathy, other retinopathy)

Variables related to social determinants of health: We will look at indicators of Social Determinants of Health (SDOH) as defined by Healthy People 2030

(<https://health.gov/healthypeople/priority-areas/social-determinants-health>): SDOH are the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks.

SDOH can be grouped into 5 domains:



Variables collected during the ARIC visit 4- 7 follow-up that speak to these domains include:

- health literacy (WRAT)
- geocoding data to link to census tract indicators of community level SDOH including area deprivation index
- education level
- Access to medical care (ARIC visit 4)
- household income
- health insurance, Medicaid status

Life course SDOH exposures

- Following George et al (AJE, 2020), we will also explore individual- and neighborhood-level life-course (LC) socioeconomic status (SES) as a cumulative SDOH exposure

Other variables of interest include:

- Demographics: age, gender
- Life style: smoking and alcohol history
- Medical history: diabetes, hyperlipidemia, hypertension
- social support

Proposed analysis: Based on the definitions of the primary outcomes outlined above, we will further compare across groups defined by visual impairment and uncorrected refractive error:

none, distance, near, both; on demographics, socioeconomics, and medical history. We will also compare across groups defined by ocular pathology: age-related macular degeneration, glaucoma, any other retinal pathology; on demographics, socioeconomics, and medical history. Overall visual impairment, uncorrected refractive error (near and distance), and ocular pathology prevalence will be estimated across categories of age, sex and community as well as across groups defined by social factors or disadvantage.

Logistic or Poisson regression models will be used to estimate the associations of the vision outcomes (prevalence of visual impairment, uncorrected refractive error, and ocular pathology) with social determinants of health (SDOH), adjusting for age and sex, looking both at each SDOH individually and combined (independent effects). We will also explore interactions across domain of SDOH to look for synergistic effects that increase prevalence and explore difference in the impact of SDOH factors on vision outcomes across subgroups characterized by community and social support.

Limitations:

- 1) We are limited to a single assessment of vision outcome from the EyeDOC study and thus cannot look at SDOH that speak to incident visual impairment, URE, or ocular pathology
- 2) The ARIC study does not have comprehensive measures of SDOH, including measures of structural racism.
- 3) We are limited to two communities – Washington Co and Jackson MS – which have refractive error data.
- 4) There is potential that SDOH act differently on risk of URE across strata of other contextual or individual factors. We will look for interactions across community (as a surrogate for built environment and other access differences) and social support (representing resiliency that may protect against the harms of SDOH).

7.a. Will the data be used for non-ARIC analysis or by a for-profit organization in this manuscript? ___ Yes ___ **No**

b. If Yes, is the author aware that the current derived consent file ICTDER05 must be used to exclude persons with a value RES_OTH and/or RES_DNA = “ARIC only” and/or “Not for Profit” ? ___ Yes ___ **No**

(The file ICTDER has been distributed to ARIC PIs, and contains the responses to consent updates related to stored sample use for research.)

8.a. Will the DNA data be used in this manuscript? ___ Yes ___ **No**

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the current derived consent file ICTDER05 must be used to exclude those with value RES_DNA = “No use/storage DNA”? ___ Yes ___ **No**

9. The lead author of this manuscript proposal has reviewed the list of existing ARIC Study manuscript proposals and has found no overlap between this proposal and previously approved manuscript proposals either published or still in active status.

ARIC Investigators have access to the publications lists under the Study Members Area of the web site at: <http://www.csc.unc.edu/aric/mantrack/maintain/search/dtSearch.html>

Yes No

10. What are the most related manuscript proposals in ARIC (authors are encouraged to contact lead authors of these proposals for comments on the new proposal or collaboration)?

ARIC Manuscript Proposal #3919; Full Title: Social determinants of health and incident dementia

ARIC Manuscript Proposal #3967; Full Title: Social Determinants of Health and Prediction of Incident Heart Failure

ARIC Manuscript Proposal #3156; Full Title: Visual Function, Retinal Pathology, OCT Measures, and Associations with Quality of Life in a Bi-community Population 75 Years and Older: The Eye Determinants of Cognition Study

11.a. Is this manuscript proposal associated with any ARIC ancillary studies or use any ancillary study data? Yes No

11.b. If yes, is the proposal

- A. primarily the result of an ancillary study (list number* 2014.38)**
 B. primarily based on ARIC data with ancillary data playing a minor role (usually control variables; list number(s)* _____)

*ancillary studies are listed by number <https://sites.csc.unc.edu/aric/approved-ancillary-studies>

12a. Manuscript preparation is expected to be completed in one to three years. If a manuscript is not submitted for ARIC review at the end of the 3-years from the date of the approval, the manuscript proposal will expire.

12b. The NIH instituted a Public Access Policy in April, 2008 which ensures that the public has access to the published results of NIH funded research. It is **your responsibility to upload manuscripts to PubMed Central** whenever the journal does not and be in compliance with this policy. Four files about the public access policy from <http://publicaccess.nih.gov/> are posted in <http://www.csc.unc.edu/aric/index.php>, under Publications, Policies & Forms. http://publicaccess.nih.gov/submit_process_journals.htm shows you which journals automatically upload articles to PubMed central.