ARIC Manuscript Proposal # 3252

PC Reviewed: 10/9/18  Status: _____  Priority: __
SC Reviewed: _________  Status: _____  Priority: ___

1.a. Full Title: Neighborhood characteristics and hearing aid use in ARIC participants

b. Abbreviated Title (Length 26 characters): Neighborhood, hearing aids

2. Writing Group:
Writing group members: Osama Tarabichi (first author), Carrie Nieman, Jennifer A. Deal, Nicholas Reed, Joshua Betz, Miranda R. Jones, Frank R Lin, Adele Goman (senior author) and other interested ARIC investigators.

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

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3. Timeline:
Data Analysis-6 months, manuscript preparation-3 months

4. Rationale:

Hearing Loss (HL) is a significant public health concern
Age-related HL is a significant health issue that affects approximately two-thirds of adults over 70 years old\(^1\). In the past decade, the impact of HL on the physical, social, cognitive and mental well-being of older adults has been increasingly recognized. HL has been linked to social isolation\(^2\), depression\(^3\), increased hospitalization\(^4\), poor patient-provider communication\(^5\), increased risk of falling\(^6\) and cognitive decline/dementia\(^7,8\) in older adults.

Age-related HL is amenable to treatment with sound amplification, most commonly via hearing aids. Despite their demonstrated efficacy in ameliorating HL\(^9\), hearing aids are severely under-utilized. Studies on hearing aid use in older adults suggest that less than 20\% of older adults in the United States with audiometrically documented HL actually use hearing aids\(^10\). Recent evidence suggests that even amongst adults who eventually adopt hearing aids, the average delay from time of hearing aid candidacy to adoption is about 9 years\(^11\).

Studying factors related to hearing aid uptake is crucial in gaining a better understanding of the determinants of this underutilization. In this proposal, our aim is to study the effect of the characteristics of the neighborhood individuals with HL reside in on use of hearing aids.

**Individual racial and socioeconomic characteristics predict hearing aid use**

Factors related to hearing aid use are likely complex and closely interlinked to the sociodemographic status of individuals with HL. Reasons related to device cost, poor access, lack of education, stigma and time-consuming nature of pursuing hearing care have all been cited as potential contributors to low hearing aid utilization\(^12,13\). Research on the determinants of hearing aid uptake is limited and has been primarily focused on identifying individual factors that are predictive of hearing aid use. These studies have found that persons who self-identify as white, with greater socioeconomic status (SES) and greater income as more likely to report regular hearing aid use\(^14-16\).

**Area-level characteristics impact on hearing health is poorly investigated**

Historically, research on health care disparities focused on identifying individual determinants of access and utilization of care. Over the past two decades there is a growing appreciation that neighborhood level SES, geographic access to health care providers and transportation barriers may impact health care access and use\(^17,18\). Area-level SES measures have been shown to impact health care access independent of individual SES\(^19,20\).

Studies on how these area-level factors impact hearing care however are limited. He et al. reported that in a cohort of older adults with HL in China, subjects residing in rural areas were less likely to adopt hearing aids\(^21\) than individuals residing in urban areas. However, He et al. only investigated rural-urban differences in hearing aid uptake and did not look at indicators of neighborhood disadvantage. Similarly, Chan et al. performed a cross-sectional survey of adults with HL treated at a single tertiary care center in the United States and found that rural residents experienced an additional 8 year delay in hearing aid acquisition when compared to urban residents\(^22\). Scholes et al. demonstrated that men residing in areas with lower SES in England were less likely to report current hearing aid use, with no difference seen in women\(^23\). The applicability of Scholes et al.’s findings to our population of interest (older adults) is limited
because: 1) They did not report or control for the racial/ethnic composition of their cohort and 2) a large portion of their study population (about two-thirds) were <65 years old. Differences in the way hearing aids are delivered and paid for in England also limit the generalizability of Scholes et al.’s findings to the United States. To our knowledge, there are no articles in the literature that have studied the impact of several neighborhood characteristics (e.g. socioeconomic advantage, population density, racial composition) on the impact on hearing care in the United States.

The effects of neighborhood characteristics on hearing care access and use remains understudied. Herein, we propose to study the impact of neighborhood characteristics on the utilization of hearing aids by older adults with HL. We hypothesize that individuals living in more disadvantaged areas will report lower rates of hearing aid use even when individual characteristics are accounted for.

5. Main Hypothesis/Study Questions:

Aim: Investigate the impact of neighborhood characteristics on hearing aid use in older adults with HL. We hypothesize that individuals living in more disadvantaged neighborhoods will report lower rates of hearing aid use after individual differences are adjusted for.

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).

Primary outcome: Hearing aid use
Hearing aid use will be determined by responses elicited from the following two questions in the HNE self-reported hearing and noise exposure form.

- **Q12**: Do you currently use a hearing aid or other device in your right ear?
  - Responses:
    - Yes
    - No
    - Other (Specify other device)

- **Q15**: Do you currently use a hearing aid or other device in your left ear?
  - Responses:
    - Yes
    - No
    - Other (Specify other device)

**Exposures:**
**Hearing ability**
Hearing ability was assessed at ARIC Visit 6 using pure-tone-audiometry in a sound treated booth. Pure-tone-audiometry is the gold standard method for assessing objective hearing ability. We will categorize hearing ability according to World Health Organization criteria using the better-ear four frequency (0.5, 1, 2, 4kHz) pure-tone-average threshold as normal hearing.
(<25dB HL) or hearing loss (≥25dB HL; further categorized as mild: ≥25dB HL & <40dB HL, or moderate or greater: ≥40dB HL).

Neighborhood Characteristics
Baseline home addresses of ARIC participants have previously been geocoded with high accuracy24 and linked to 1990 and 2000 census tract level socioeconomic data25. A co-author on the current proposal (Jones) has also linked the geocodes to 1990, 2000 census tract level neighbourhood demographic data. We will consider geocoding visit 5 addresses (if different from baseline) to link with the 2010 census information. We will utilize these existing data for the current proposed project and will consider the following neighborhood characteristics:

- Neighborhood level socioeconomic status: Defined according to the same methods used in previous neighborhood ARIC analyses26. This measure is a composite index factor score including elements of income (median household income), wealth (median value of owner occupied house, % of houses receiving income), education (% of adults with a high school degree, % of adults with a college degree) and occupation (% of individuals in professional, managerial, executive occupations) at the census tract level. 2010 census tract data will be used.
- Population density in 2010: Will be derived from population size and census tract area.
- Neighborhood racial/ethnic composition: Defined as the percentage of the census tract who self-identify as a racial/ethnic minority (i.e. not non-Hispanic White). 2010 census tract data will be used.

Covariates
- Age
- Sex
- Race-center
- Individual socioeconomic status. We will use a composite variable for individual socioeconomic status used in previous ARIC analyses26 as well as individual components (i.e. education and income). In ARIC individual socioeconomic status was ascertained by interview inquiring about several educational and economic attributes such as: education level, literacy, annual household income, self-reported financial status. Regarding literacy, we will utilize the Wide Range Achievement Test (WRAT) as a proxy for health literacy. The WRAT is a measure of pre-morbid intelligence which has been shown to be correlated with measures of health literacy27,28. It is limited in that it may overestimate the ability for individuals to understand health information but it has been used as an indicator of health literacy in ARIC29 (e.g proposal #2043).
- Health related factors: hypertension, history of stroke, smoking, diabetes27,28,29.

Statistical approach
The analysis will be restricted to participants who have hearing data, geocoded baseline address data (i.e. participants were residing in the states of the ARIC study sites at baseline), and covariate data. We will compare demographic characteristics of the analytic sample to those excluded to assess whether the analytic sample is representative of the ARIC cohort.
The associations between hearing aid use and neighborhood characteristics will be explored using a logistic regression model. The model will be adjusted for demographic and health covariates outlined above. We will calculate cluster robust standard errors to account for site clustering.

Sensitivity analyses will be performed to study the effect of our definition of the exposure “hearing ability” on the outcome of hearing aid use. These analyses will examine effects of adopting two different definitions:

1) Self-rated hearing ability: As determined by HNE Q1 and 2.
   - Q: Which statement best describes your hearing in your right/left ear without hearing aid? Would you say your hearing is excellent, good, that you have a little trouble, moderate trouble, a lot of trouble, or are you deaf?
     Excellent .............................................. 1
     Good ........................................................... 2
     A little trouble .............................................. 3
     Moderate trouble ......................................... 4
     A lot of trouble ............................................. 5
     Deaf ............................................................ 6

2) PTA of 1,2 and 5 kHz: Hearing ability was assessed at ARIC Visit 6 using pure-tone audiometry in a sound treated booth. Pure-tone-audiometry is the gold standard method for assessing objective hearing ability. We will categorize hearing ability using the better-ear 1,2 and 5 kHz pure tone average as above.

7.a. Will the data be used for non-CVD analysis in this manuscript? __X__ Yes   ____ No

   b. If Yes, is the author aware that the file ICTDER03 must be used to exclude persons with a value RES_OTH = “CVD Research” for non-DNA analysis, and for DNA analysis RES_DNA = “CVD Research” would be used? _X___ Yes    ____ No
   (This 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   __X__ No

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the file ICTDER03 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.cscc.unc.edu/aric/mantrack/maintain/search/dtSearch.html

____X__ 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)?

1262: Dray-Spira et al. Pathways of socioeconomic health disparities among persons with type 2 diabetes: the Atherosclerosis Risk in Communities Study

2811: Platz et al. Aging and psychosocial causes of cancer disparities in understudied subpopulations – non-metropolitan/rural residents, those of low SES, and the elderly, including those who are African-American

2851: Jones et al. The impact of neighborhood racial residential segregation on risk for smoking associated cancers in the Atherosclerosis Risk in Communities (ARIC) Study

3136: Reed et al. Analyses of hearing impairment and healthcare satisfaction: A pilot study

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

11.b. If yes, is the proposal

___ A. primarily the result of an ancillary study (list number* __________)
___ 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 at https://www2.cscc.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.cscc.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.
References


