ARIC Manuscript Proposal # 3256

PC Reviewed: 10/9/18  Status: _____  Priority: 2
SC Reviewed: _________  Status: _____  Priority: ____

1.a. Full Title: Hearing loss, neighborhood characteristics and difficulty obtaining health care in the ARIC cohort

b. Abbreviated Title (Length 26 characters): Hearing, neighborhood, care

2. Writing Group:
   Writing group members:
   Adele Goman (first author), Miranda R. Jones, Nick Reed, Jennifer Deal, Amber Willink, Carrie Nieman (Senior author), Frank Lin, Josh Betz, Anna Kucharska-Newton, Michael Griswold, Osama Tarabichi, Other interested ARIC investigators. We welcome contributions from members of Gerardo Heiss’ group.

I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal. ___AG____ [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:
Poor access to healthcare is associated with poor health outcomes including higher rates of hospitalization for chronic diseases\(^1\). Affordability is a major barrier to obtaining care with an estimated 18.5% of adults citing cost as a reason that led to delayed or unmet health care needs\(^2\). However, access to healthcare extends beyond affordability and includes a multitude of both barriers and facilitators that influence an individual’s ability and willingness to use healthcare\(^3\). Approximately 21% of adults experience non-financial barriers\(^2\) in obtaining care, including both individual and community-level factors. The current proposal seeks to determine the association between hearing loss, an individual-level factor, neighborhood characteristics, a community-level factor, and ease of obtaining health care.

**Hearing and ease of obtaining health care**

Hearing loss is highly prevalent, affecting nearly two-thirds of adults aged seventy and older\(^4\) yet the relationship between hearing loss and difficulties obtaining health care remains understudied. Limited research in this area suggests that individuals with hearing loss are likely to visit physicians more often than normal hearing individuals\(^5,6\) although at least one study\(^7\) found no difference in the number of physician visits. Despite this potentially higher utilization of health care services, over 90% of individuals with self-reported hearing trouble have difficulties when seeking health care\(^8\). These difficulties can arise when trying to make appointments such as communicating over the telephone and when at health care facilities such as hearing their name called when in the waiting room or accurately understanding their health care provider. Indeed, among 6524 participants in the Wisconsin Longitudinal Study those with self-reported hearing difficulty were more likely to have experienced difficulties or delays in care in the past twelve months compared to those with no self-reported hearing difficulty (OR: 1.85, 95% CI: 1.19, 2.88)\(^9\). Furthermore, in a survey of 607 adults with hearing loss in Wales, 36% of respondents needed to travel to their health care clinic in order to simply book an appointment because they were unable to use the telephone\(^10\). Thus, hearing loss is associated with communicative barriers in obtaining health care that may translate to additional barriers in accessing care.

**Neighborhood characteristics and ease of obtaining health care**

Neighborhood characteristics can be indicators of area-level factors that could be related to health and healthcare access irrespective of individual characteristics\(^11-13\). Individuals residing in certain geographic areas can face barriers to care including a lack of nearby health professionals, difficulty scheduling appointments, distance from a health center, travel time, and transportation\(^14,15\). Previous research has shown that after controlling for individual-level factors, individuals residing within neighborhoods of socioeconomic disadvantage have poorer access to health care, including a greater likelihood of unmet care needs and a lower likelihood of obtaining care\(^16\). Gaskin et al\(^17\) found that racial/ethnic disparities in healthcare utilization were related not only to individual-level factors, including one’s own racial/ethnic identity, but also to the racial/ethnic composition of one’s neighborhood, which is a proxy for residential segregation. Gaskin et al\(^17\) found that people living in neighborhoods composed of predominantly Hispanic individuals have lower health care utilization as compared to people living in majority White neighborhoods. The racial/ethnic composition of an area or residential segregation can also impact health care utilization. Gaskin et al\(^18\) demonstrated that while African American adults may have lower levels of health care utilization than Whites on a national level, within integrated geographic areas that are less segregated, African American adults were more likely than Whites to have visited a health care provider within the past year. Other neighborhood-level factors
beyond residential segregation include population density or rurality. Mixed results have been observed when exploring the relationship between population density or rurality and health care access. Pandhi et al.⁹ did not find a significant difference in difficulty obtaining health care between rural and urban residents among adults in the Wisconsin Longitudinal Study survey whereas Chan et al.¹⁹ found rurality in the United States to be associated with less visits to health care specialists. Variations in geographic accessibility to care across neighborhoods could account for some of the observed differences in care access.

Conclusion
Both hearing loss and neighborhood characteristics are associated with challenges in obtaining health care however, the independent association and combined effect of hearing loss and neighborhood characteristics on obtaining health care remains understudied. Barriers associated with hearing loss may impact individuals differently depending upon the neighborhood they reside in. Being aware of and addressing such barriers to obtaining health care may improve health care access and improve health. In this study we will quantify the association between hearing loss, neighborhood characteristics and difficulty obtaining health care.

5. Main Hypothesis/Study Questions:
Aim 1: Determine the independent association and combined effect of hearing ability and neighborhood characteristics on ease of obtaining health care.

Sub-aim: Evaluate differences in reasons for difficulty in obtaining care across hearing ability and neighborhood characteristics.

We hypothesize that:
- Individuals with hearing loss are more likely to experience greater difficulty in obtaining health care compared to normal hearing individuals.
- Neighborhood socioeconomic disadvantage and reduced population density will be associated with increased difficulty in obtaining health care.

Our study population of interest is everyone in the ARIC cohort who has V6 hearing data, V5 data on obtaining health care, geocoded address data (i.e. participants were residing in the states of the ARIC study sites at baseline), and covariate data.

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: Difficulty in obtaining care
Difficulty in obtaining care will be defined based on the following questions asked at visit 5:
- How difficult is it to get appointments with your health care provider on short notice, for example, within one or two days? (Appointment difficulty)
  - Raw responses: Very difficult, Somewhat difficult, Not too difficult, Not at all difficult
○ Difficulty will be considered present if the participant responded ‘Very difficult’ or ‘Somewhat difficult’
○ Difficulty will be considered absent if the participant responded ‘Not too difficult’, ‘Not at all difficult’

- How difficult is it to talk with a medical person/your health care provider over the telephone about a health problem? (Telephone communication difficulty)
  ○ Raw responses: Very difficult, Somewhat difficult, Not too difficult, Not at all difficult
  ○ Difficulty will be considered present if the participant responded ‘Very difficult’ or ‘Somewhat difficult’
  ○ Difficulty will be considered absent if the participant responded ‘Not too difficult’, ‘Not at all difficult’

- In the past 12 months, was there any time when you delayed getting, or did not get, medical care when you needed it? (Delayed/unmet care need)
  ○ Raw responses: Yes, No
  ○ Difficulty will be considered present if the participant responded ‘Yes’
  ○ Difficulty will be considered absent if the participant responded ‘No’

**Secondary outcome: Reasons for difficulty obtaining care**

Differences in reasons for difficulty in obtaining care will be explored across hearing and neighborhood characteristics with the following question.

*Aside from costs, what were the reason(s) for which you delayed getting, or did not get, medical care in the past 12 months when you needed it?*

- You couldn’t get through on the telephone
- You couldn’t get an appointment soon enough
- Once you get there, you had to wait too long to see the doctor
- The clinic/doctor’s office wasn’t open when you could get there
- You didn’t have transportation
- Medical care was too far away.

This question was only answered by participants who indicated “Yes” to the question “*In the past 12 months, was there any time when you delayed getting, or did not get, medical care when you needed it?*”. We will categorize the reasons for difficulty as accommodation, availability, or accessibility difficulties consistent with the Penchansky and Thomas model of access to care.

**Other variables on access to care:**

Insurance coverage (ACQ A) and if the participant has a provider that they usually go to (ACQ4) will be used in sensitivity analyses.

**Exposures:**

**Hearing ability**

Hearing ability was assessed at ARIC Visit 6 (3,625 as of January 2018 in the interim Visit 6 data) 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).

To explore whether the perception of hearing difficulty impacts difficulty obtaining health care we will also conduct secondary analyses with self-reported hearing trouble: “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?”

We will categorize participants as having no hearing trouble if they responded “Excellent” or “Good”. Other responses will be categorized as hearing trouble.

**Neighborhood Characteristics**
Baseline home addresses of ARIC participants have previously been geocoded with high accuracy and linked to 1990 and 2000 census tract level socioeconomic data. A co-author on the current proposal (Jones) has also linked the geocodes to 1990, 2000, and 2010 census-tract level neighbourhood demographics 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 separate neighborhood characteristics:

- Neighborhood level socioeconomic status: Defined according to the same methods used in previous neighborhood ARIC analyses. In brief, 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.
  - NOTE: We will additionally link the geocodes with area deprivation indices at the census block group level. This measure ranks neighborhood socioeconomic advantage on a national and state level based on the 2013 American Community Survey.
- Population density per square mile at census tract level.
- 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).

**Covariates**
- Age
- Sex
- Race-center
- Individual socioeconomic status. We will use a composite variable for individual socioeconomic status used in previous ARIC analyses 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.
- Health related factors: self-rated general health compared to peers of same age, hypertension, stroke, smoking, diabetes.
- Wide Range Achievement Test (WRAT). The WRAT is a measure of pre-morbid intelligence which has been shown to be correlated with measures of health literacy\(^24\). 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 ARIC (e.g proposal #2043).

**Statistical approach**
The analysis will be restricted to participants who have hearing data, geocoded 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, neighborhood characteristics, and difficulty obtaining care will be explored in several logistic regression models (see table below). The models will be adjusted for demographic and health covariates outlined above. We will standardize each continuous variable for use in these regression models so comparisons can be made on what has the larger impact on difficulty obtaining health care. We will calculate cluster robust standard errors to account for site clustering. Separate models will be used for objective hearing loss and subjective hearing difficulty.

Aim: Determine the independent association and combined effect of hearing ability and neighborhood characteristics on ease of obtaining health care.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Logistic regression model</th>
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</thead>
<tbody>
<tr>
<td>Individuals with hearing loss are more likely to experience greater difficulty in obtaining health care compared to normal hearing individuals.</td>
<td>1a. Objective hearing status (based on pure-tone audiometry) + covariates</td>
</tr>
<tr>
<td></td>
<td>1b. Subjective hearing trouble + covariates</td>
</tr>
<tr>
<td>Neighborhood disadvantage and reduced population density will be associated with increased difficulty in obtaining health care.</td>
<td>2a. Neighborhood SES + covariates</td>
</tr>
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<td></td>
<td>2b. Neighborhood population density + covariates</td>
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<tr>
<td></td>
<td>2c. Neighborhood racial/ethnic composition + covariates</td>
</tr>
<tr>
<td>Barriers associated with hearing loss may impact individuals differently depending upon the neighborhood they reside in.</td>
<td>3a. Objective hearing status (based on pure-tone audiometry) + Neighborhood SES + Neighborhood population density + Neighborhood racial composition + covariates</td>
</tr>
<tr>
<td></td>
<td>3b. Subjective hearing trouble + Neighborhood SES + Neighborhood population density + Neighborhood racial/ethnic composition + covariates</td>
</tr>
</tbody>
</table>

We will also descriptively evaluate differences in reasons for difficulty in obtaining care across hearing ability and neighborhood characteristics

**Strengths and limitations**
Hearing data was assessed at V6 and difficulty obtaining health care was assessed at V5. Thus we are assessing the relationship between current hearing status and prior difficulties obtaining health care. However, age-related hearing loss occurs gradually and as such we would not expect hearing status to have changed substantially between these two visits to affect our results. Nevertheless we will examine hearing loss continuously as well as categorically.

One outcome measure asks about telephone communication difficulty. We cannot determine from this measure whether the reason for any difficulty is due to initial difficulty connecting to a provider on the telephone or communication difficulty once through to a provider. For instance individuals in low SES neighborhoods may find it difficult to reach a provider (perhaps because of a low density of providers) but once through may not experience difficulty communicating. Individuals with hearing loss may be able to connect to a provider but may find it difficult to communicate with a provider over the telephone. Thus while we will assess if there is a relationship between hearing status, neighborhood characteristics and telephone communication difficulty we will not be able to directly assess where this difficulty is arising.

Our project will add to current literature. The relationship between hearing loss and difficulty obtaining health care remains understudied. We will extend the current literature by using geocoded data linked to neighborhood demographic characteristics to explore the community level factors that can contribute to health care access. Several ARIC communities were homogenous in terms of race when the study began which has the potential to impact on the racial diversity of areas. However, since the late 1980’s demographic changes have occurred increasing the diversity of these areas. As such, we do not anticipate there to be an issue for our analyses. However, if the racial diversity for neighborhoods of participants at some ARIC sites is too homogeneous then we will restrict our analyses on this measure to sites that have sufficient variation.

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.cscce.unc.edu/ARIC/search.php
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 http://www.cscu.unc.edu/aric/forms/

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.cscu.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


