ARIC Manuscript Proposal #4281

PC Reviewed: 6/13/23 **Status: _____** **Priority: 2**
SC Reviewed: _____ **Status: _____** **Priority: ____**

1.a. Full Title: Effects of Hearing Intervention with Hearing Aids on Physical Function: Findings from the ACHIEVE Study

b. Abbreviated Title (Length 26 characters): ACHIEVE SPPB

2. Writing Group:
Writing group members:

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I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal.
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3. Timeline:

Proposal timeline	June 2023	June-July 2023	August 2023
Proposal approval	X		
Data Analysis		X	
Manuscript preparation and submission			X

4. Rationale:

Maintaining physical function a public health priority for an aging society. Hearing loss is an underrecognized risk factor for physical function decline that may be amenable to rehabilitative interventions and devices. A small but growing body of observational epidemiologic studies suggests an association between hearing loss and gait speed [1,2], and poorer lower mobility function [3-7]. These observed associations could be explained through a common underlying pathology, such as inflammation or concomitant vestibular dysfunction [8,9]. However, in a recent study in the Baltimore Longitiduanl Study on Aging, one of the few studies with both audiometric hearing and vestibular function measured, moderate or greater impairment versus normal hearing was associated with poorer lower extremity function and slower walking speed and baseline and with faster rates of decline over 6 years in 831 adults aged 40-92 years, independent of vestibular function [4]. Alternatively, hearing loss may cause physical function decline through mechanisms including cognitive decline, increased cognitive load, reduced auditory awareness of the environment, or increased social isolation and loneliness [10,11]. However, few studies have investigated if hearing aids can mitigate this association. In the above-referenced study in the BLSA, hearing aid users walked 400 m an average of 24 seconds faster than nonusers with hearing loss ($p = 0.001$) [4]. However, other studies, including one in the Atherosclerosis Risk in Communities Study, failed to find a difference in physical function outcomes by hearing aid use [7]. To date, there has never been a large-scale randomized study to determine if hearing rehabilitation intervention can slow physical function decline in older adults with hearing loss.

5. Main Hypothesis/Study Questions:

Study Question:

To determine the effect of a hearing intervention versus a successful aging health education control intervention on the primary outcome of 3-year change in physical function as measured by the Short Physical Performance Battery and grip strength in well-functioning, cognitively-normal participants with hearing loss aged 70-84 years.

Main Hypotheses:

Compared to a successful aging health education control intervention, hearing intervention is associated with higher SPPB scores and grip strength over 3 years of follow-up.

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).

Study design: Randomized trial of 977 participants enrolled in the Aging and Cognitive Health Evaluation in Elders (ACHIEVE) trial from 2018-2019 and followed for 3 years. Participants were from four U.S. sites (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD). 238 participants were recruited from the ongoing Atherosclerosis Risk in Communities Neurocognitive (ARIC-NCS) Study and the remaining 739 participants were recruited de novo from the community.

Inclusion/exclusion criteria for ACHIEVE: All eligible participants enrolled at baseline in the ACHIEVE study.

- Inclusion criteria: 1) age 70-84 years, 2) community-dwelling adults, 3) mild–to-moderate audiometric hearing impairment, defined as a better-hearing ear pure tone average (PTA) ≥30 and <70 dB hearing level, 4) MMSE ≥23 for those with high school degree or less, and ≥25 for those with some college education or more, 5) Word Recognition in Quiet score ≥60% correct in the better-hearing ear, 6) fluent English-speaker, 7) older adults who plan to remain in the area during the study period.
- Exclusion criteria: 1) self-reported difficulty in ≥2 activities of daily living, 2) prior dementia diagnosis, 3) vision impairment, 4) medical contraindication to hearing treatment, 5) untreatable

conductive hearing impairment, 6) unwillingness to regularly wear hearing aids; 7) self-reported hearing aid use in the past year.

Outcome Variables: Primary outcomes will include total **Short Physical Performance Battery (SPPB)** score and **grip strength**. In secondary analysis, we will estimate the association between intervention assignment and components of the SPPB, including chair stand speed, balance, and 4-m walking speed.

The **Short Physical Performance Battery (SPPB)** is a series of physical performance tests designed to assess lower extremity function in older adults, ranging in score from 0-12; higher scores indicate better function. The total score is the sum of 3 component scores: chair stands, balance and 4-meter walk; each component score ranges from 0-4. The SPPB and its components predict mortality [12], falls [13], hospitalization [14] and incident disability [15,16].

SPPB Components:

- Chair stands. Participants were asked to fold arms over chest, and rise to standing from a seated position in a chair. If able to complete one chair stand, participants were then timed as they completed five chair stands in a row, as quickly as possible without stopping, keeping arms folded over chest. Participants were assigned a score ranging from 0-4 based on the ability and time to complete
- Balance. Each participant was scored for standing static balance based on his/her ability to balance for 10 seconds with feet side-by-side, in semi-tandem, and in full tandem position.
- 4-meter walk. Participants were asked to complete a 4 meter walk at their normal pace in two trials. Participants were encouraged to complete each walk without a walking aid (e.g., walker, cane) if possible, but allowed to use a walking aid if they chose to do so.

Proposed SPPB scoring from the National Institute on Aging [12] shows ceiling effects in high functioning populations. In order to discriminate physical function in a high-functioning population, SPPB component scores can be rescaled according to published guidelines developed in the Health Aging and Body Composition (Health ABC) study [17].

Grip strength was measured with a hand held dynamometer. After one practice trial, participants were asked to complete two trials, squeezing as hard as possible, with a 15-20 second rest between trials. We will average the two trials for analysis.

Exposure Variables: Intervention group (hearing intervention vs. successful aging interventoin) assigned at baseline randomization.

Other Variables: The primary analysis may include adjustments for the baseline hearing loss, ARIC vs de novo status, center, age (years), sex (male/female), and education (less than high school/ high school or equivalent/ greater than high school).

Analytic Plan : *A statistical analysis plan (SAP) has previously been developed by the CC in conjunction with ACHIEVE investigators and was approved by the NIA and ACHIEVE DSMB in June 2022. Complete details of the primary data analysis, and with planned sensitivity and exploratory analyses and analyses of secondary outcomes, are in the SAP. Mr. Wuyang Zhang will be the analysis lead for this manuscript.*

We will examine physical function decline within each condition using mixed effects models that account for the correlation among repeated measures as well as the correlation between spouses or cohabitating partners. If a linear trend appears reasonable, we will fit a model with a linear slope. If a nonlinear trend is observed, the model will be adapted to include time splines. Continuous time in years from the baseline will be the time scale. An interaction term between treatment assignment and time will be used to test if

rates of physical function change differ by treatment assignment. Model fit will be assessed with residual plots and other statistics (Akaike Information Criterion, Bayesian Information Criterion, etc.). The primary analysis may include adjustments for the baseline hearing loss, ARIC vs de novo status, center, age, sex, and education. We will consider advanced statistical techniques to account for informative attrition as outlined in the SAP.

References

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7.a. Will the data be used for non-ARIC analysis or by a for-profit organization in this manuscript? ____ Yes _X___ 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? __X__ 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"? _X___ 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)?

Main results of the ACHIEVE trial (no manuscript number yet assigned).

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

11.b. If yes, is the proposal

_X_ A. primarily the result of an ancillary study (list number* _2016.03_)

___ 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.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.