1.a. Full Title: Cross-sectional and Prospective Associations between Neighborhood Socioeconomic Status and Incident Diabetes.

b. Abbreviated Title (Length 26 characters): Neighborhoods and Diabetes

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

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3. **Timeline:**

- Submit Proposal to Committee: November 2014
- Analysis: December 2014—April 2015
- JHSPH Masters Thesis Deadline: April 2015
- Draft of Manuscript to ARIC Publication Committee: July 2015

4. **Rationale:**

Previous research suggests that neighborhood disadvantage is an important risk factor for many adverse health outcomes, independent of individual socioeconomic status.\(^1\,^2\) The ARIC cohort has previously been used to demonstrate the associations of neighborhood socioeconomic status with coronary heart disease, mortality, body mass index, metabolic syndrome and other outcomes.\(^1\,^3\,^6\) Since the baseline ARIC cohort visit (1987-1989), the prevalence of type 2 diabetes has increased in the United States.\(^7\) Nearly thirty million people in the US are estimated to have diabetes, including a third of those aged 65 and older.\(^8\) Cross-sectional studies suggest that the prevalence of diabetes is higher among those with low individual-level socioeconomic status, as measured by education, occupation, or income. A few studies about the relationship between diabetes and neighborhood socioeconomic status (SES) suggest that neighborhood SES may be an important risk factor.\(^9\,^11\) The design of the ARIC study allows us to prospectively evaluate these associations between neighborhood SES and incident diabetes.

There are many pathways through which neighborhood characteristics may affect individual health outcomes: availability of health services, physical infrastructure, social support and influence of peer attitudes toward health-related behaviors, segregation, employment opportunities, concentration of poverty, and crime.\(^12\,^14\) For example, availability of fast food outlets, grocery stores, liquor stores, public parks, and advertisements vary by neighborhood and contribute to the quality of the living environment.\(^10\) Previous studies have demonstrated that those living in lower quality neighborhoods are more likely to smoke and consume unhealthy diets, and less likely to perform physical activity, regardless of the level of individual income.\(^12\) These poor behaviors are associated with a higher risk of diabetes.\(^9\) If neighborhood factors are important in the risk of diabetes, data such as those in ARIC can be used to inform neighborhood-level effects and suggest geographical areas to focus preventive efforts. Efforts to address the increase in diabetes across the US at the individual level (i.e., behavior change) may not be successful if larger, structural barriers to health are not identified and mitigated.

5. **Main Hypothesis/Study Questions:**

The purpose of this study is to examine cross-sectional and prospective associations of neighborhood socioeconomic characteristics with incident diabetes.

**Aim 1:** To investigate the cross-sectional association of type 2 diabetes with neighborhood and individual socioeconomic status at visit 1.
• Hypothesis: Both low individual and low neighborhood SES will be associated with a higher prevalence of diabetes.

**Aim 2**: To investigate the prospective relationship between neighborhood-level socioeconomic status at visit 1 and incident diabetes, after adjusting for individual-level socioeconomic status.

• Hypothesis: Participants living in more disadvantaged neighborhoods will be more likely to develop diabetes (at visits 2, 3, 4, and annual telephone follow-ups) than those living in less disadvantage neighborhoods, independent of individual socioeconomic status.

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).

**Aim 1: Cross-sectional analysis**

All white and African-American participants with geocoded address will be included. The primary outcome, diabetes, will be defined using the derived diabetes variable in the ARIC data set (based on blood glucose above 126 mg/dL; self-reported physician diagnosis, and the use of anti-diabetes medications).

Individual SES will be defined by income and education. The primary exposure will be neighborhood socioeconomic status. This will be defined using a z-score that aggregates six indicators of neighborhood advantage at the census-tract level, based on the geocoded address at the baseline visit of each participant: median household income; median housing value, percent of households with interest or rental income; proportion of adults ≥25 years with a high school education; proportion of adults ≥ 25 years with a college education; and proportion of adults ≥ 16 years with executive, managerial or professional occupations. The development of this variable has been described elsewhere. The z-score neighborhood variable will be used to divide the participants into tertiles (high, medium, low) based on the distribution of the z-scores within this sample. Separate models for white and black participants will be performed due to the lack of overlap in SES status. Individual-level SES will be quantified using income and education at visit 1.

Logistic regression models will be used to estimate the prevalence of diabetes comparing participants living in neighborhoods with high versus low neighborhood SES. Results will be examined before and after adjusting for individual socioeconomic status, as measured by income and education at visit 1. Covariates will include risk factors for diabetes such as BMI, age, smoking, percent of calories from fat and sugar, and physical activity.

**Aim 2: Prospective Analysis**
All white or African-American participants with geocoded neighborhood data at visit 1 will be included. Participants with prevalent diabetes at baseline will be excluded. Diabetes is defined as a blood glucose ≥ 126 mg/dL; self-reported physician diagnosis of diabetes or the use of anti-diabetes medications. Additional analysis will be conducted using diagnosed diabetes as outcomes that will include incident cases identified during annual telephone follow-ups after visit 4. The primary exposure will be neighborhood socioeconomic status, as described in aim 1.

Time to event analysis will be carried out using proportional hazards models to evaluate differences in risk of incident diabetes by level of neighborhood socioeconomic disadvantage. The correlation between observations of people living in the same neighborhood will be taken into account by calculating robust standard errors. Covariates will include individual socioeconomic status (measured by income and education) and risk factors for diabetes such as BMI, age, smoking, diet, and physical activity.

7.a. Will the data be used for non-CVD analysis in this manuscript?  ____ Yes  ____ X  ____ 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?  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
   ____ 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)?
• Manuscript Proposal #859: The relationship of neighborhood and individual socioeconomic characteristics to insulin resistance, impaired glucose regulation, and diabetes in the ARIC cohort [Jackson, 2003]
• Manuscript Proposal #1261: Individual and neighborhood SES and health among persons with and without type 2 diabetes: The ARIC Study [Dray-Spira, 2007]
• Manuscript Proposal #455: The Relationship of neighborhood characteristics to trends over time in cardiovascular risk factors in the ARIC cohort [Diez Roux, 1997]
• Manuscript Proposal #864: The effect of neighborhood characteristics on mortality in the ARIC cohort [Borrell]
• Manuscript Proposal #1099: SES Across the Life Course and Metabolic Syndrome [Raymond]

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

11b. 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.cscc.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.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


