Inequities in Stroke among Women of Color in the Women’s Health Initiative

Disclosures/Conflict of Interest

- None
Sex

Race/ethnicity
Where real people live

Sex

Race/ethnicity
Overview

- Background
- Results work in WHI
- Implications
- Gaps WHI can fill
Inequities in Stroke - Sex

- Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS)
  Madsen et al. 2017
Age-adjusted incidence of total stroke by race across cohorts

- REGARDS: 45+ years
- ARIC cohort: 45-64 years
- GCNKS: 20+ years
- CHS: 65+ years

Howard et al. 2011
Inequities in stroke: Race/ethnicity

- Reasons for Geographic and Racial Differences in Stroke
  - Black women compared to white women
    Howard et al. 2018
  - Also observed for other racial/ethnic groups but data limited

![Bar chart showing Ischemic stroke incidence]
Racial Variation in Stroke Risk Among Women by Stroke Risk Factors

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Background and Purpose—in the United States, black Americans exhibit a greater risk of stroke and burden of stroke risk factors than whites; however, it is unclear whether these stroke risk factors influence stroke risk differently across racial groups.
Objective

- We examined:
  1) Racial inequities in stroke risk
  2) Interactions between race, stroke risk factors and total stroke

- Utilizing data from observational arm, dietary modification and control arms of HT - through Extension study 1
Methods: Independent variables

Race: Self-reported black/African-American or white

Stroke risk factors/indicators:

- Age: 50-<60, 60-<70, >70
- Smoking status: Never, former, current
- Hypertension: No hypertension, hypertensive non-treated, hypertensive treated
- Antihypertensive medication
- Diabetes
- Family history of stroke
Methods: Analysis

Cox models

**Model 1:** Adjusted for age, time-varying enrollment in Extension Study 1 and stratified by treatment arm.

**Model 2:** Additionally adjusted for socioeconomic factors:
- Marital/partnered status
- Highest level of attained education
- Physician visit within last year
- Household income
- Region of residence

**Model 3:** Additionally adjusted for stroke risk factors:
- Smoking
- Systolic blood pressure and diastolic blood pressure
- Hypertension status
- Anti-hypertensive medication
- Hyperlipidemia medication
- History of diabetes
- Atrial fibrillation
- Cancer
- BMI
- Hormone therapy use
- Alcohol consumption
- Physical activity
- Family history of stroke
Assessment of Effect Modification

- **Race-specific relationships between stroke risk factors and total stroke**
  - Adjusted for covariates in model 3
  - Rationale:
    - Minimizes residual confounding by using race-specific comparisons
    - P-value for interaction assessed by likelihood ratio test

- **Association between race and total stroke stratified by stroke risk factors**
  - Adjusted for covariates in model 1, all other covariates may be intermediates on the causal pathway
  - Rationale:
    - Allows for the ascertainment of how racial inequities may differ across stroke risk factors
    - P-value for interaction assessed by likelihood ratio test, wald test for age-at-event
### Results:
Baseline characteristics of women by race

<table>
<thead>
<tr>
<th></th>
<th>White women</th>
<th>Black women</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>114,629</td>
<td>11,389</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td>63 ± 7.2</td>
<td>61 ± 7.1</td>
</tr>
<tr>
<td><strong>Current smokers, %</strong></td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td><strong>Alcohol (g/day)</strong></td>
<td>0.4 [0-3.2]</td>
<td>0 [0-0.4]</td>
</tr>
<tr>
<td><strong>Physical Activity (mins/week)</strong></td>
<td>60 [0-170]</td>
<td>10 [0-100]</td>
</tr>
<tr>
<td><strong>History of hypertension, %</strong></td>
<td>34</td>
<td>56</td>
</tr>
<tr>
<td><strong>Current antihypertensive medication, %</strong></td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td><strong>Atrial fibrillation, %</strong></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td><strong>Family History of Stroke, %</strong></td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td><strong>Region of residence in the South, %</strong></td>
<td>23</td>
<td>47</td>
</tr>
<tr>
<td><strong>College or Postgrad education, %</strong></td>
<td>43</td>
<td>37</td>
</tr>
<tr>
<td><strong>Treatment Arm, %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observational study only</td>
<td>63</td>
<td>54</td>
</tr>
<tr>
<td>Dietary modification trial only</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>Hormone therapy controls only</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Hormone therapy controls and dietary modification trial</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Incidence rates of stroke by type and race

- Total: 383 (Black women) / 295 (White women)
- Ischemic: 261 (Black women) / 213 (White women)
- Hemorrhagic: 57 (Black women) / 48 (White women)
Incidence rates of total stroke by race and age
Multivariable association between race and risk of stroke

- Model 1: Adjusted for age and time-varying effects for enrollment in extended follow-up and stratified by treatment arm.
- Model 2: Model 1 and socioeconomic factors
- Model 3: Model 2 and stroke risk factors
Multivariable association between race and risk of stroke

- Model 1: Adjusted for age and time-varying effects for enrollment in extended follow-up and stratified by treatment arm.
- Model 2: Model 1 and socioeconomic factors
- Model 3: Model 2 and stroke risk factors
Multivariable association between race and risk of stroke

- Model 1: Adjusted for age and time-varying effects for enrollment in extended follow-up and stratified by treatment arm.
- Model 2: Model 1 and socioeconomic factors
- Model 3: Model 2 and stroke risk factors
Race specific multivariable associations between stroke risk factors and total stroke risk in Black and White women:

<table>
<thead>
<tr>
<th>Stroke Risk Factors</th>
<th>Black Women HR (95% CI)</th>
<th>White Women HR (95% CI)</th>
<th>P_{interaction}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-&lt;60</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>60-&lt;70</td>
<td>1.38 (0.94-2.04)</td>
<td>2.56 (2.01-3.26)</td>
<td></td>
</tr>
<tr>
<td>≥70</td>
<td>2.74 (2.26-4.12)</td>
<td>7.07 (5.56-8.99)</td>
<td></td>
</tr>
<tr>
<td><strong>Family history of stroke</strong></td>
<td>0.90 (0.74-1.11)</td>
<td>1.16 (1.09-1.24)</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Multivariable association between race and total stroke stratified by stroke risk factors

<table>
<thead>
<tr>
<th>Stratification Factor</th>
<th>Events white women</th>
<th>Events black women</th>
<th>Model 1*</th>
<th>$P_{interaction}$</th>
<th>Model 3†</th>
<th>$P_{interaction}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-&lt;60</td>
<td>1961</td>
<td>199</td>
<td>3.48 (2.31-5.26)</td>
<td>1.76 (1.09-2.83)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-&lt;70</td>
<td>1634</td>
<td>148</td>
<td>1.80 (1.50-2.16)</td>
<td>&lt;0.05</td>
<td>1.09 (0.89-1.33)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>≥70</td>
<td>286</td>
<td>57</td>
<td>1.26 (1.10-1.43)</td>
<td>&lt;0.05</td>
<td>0.98 (0.85-1.12)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Family History of stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2048</td>
<td>229</td>
<td>1.69 (1.47-1.94)</td>
<td></td>
<td>1.21 (1.04-1.40)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1665</td>
<td>157</td>
<td>1.29 (1.09-1.52)</td>
<td></td>
<td>0.92 (0.77-1.10)</td>
<td></td>
</tr>
<tr>
<td>Antihypertensive Medication‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>336</td>
<td>40</td>
<td>1.55 (1.11-2.16)</td>
<td></td>
<td>1.42 (1.00-2.02)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1367</td>
<td>213</td>
<td>1.11 (0.96-1.29)</td>
<td></td>
<td>0.96 (0.82-1.12)</td>
<td></td>
</tr>
</tbody>
</table>
Strengths

- The long follow and ample events
- **Standardized clinical measurements** of blood pressure and anthropometrics and medication inventories
- **Comparisons of inequities across stroke risk factors** – help us identify targets of intervention
- **Within racial group comparisons** – allow for relevant reference groups
Limitations

- **Residual confounding** of across racial group comparisons
  - Unmeasured confounders
  - Inequities in the comparability of socioeconomic measures, quality or access to care or compliance to medication

- **Limitations of education and income** to fully capture SES by race

- **Limited power to examine stroke types**: few hemorrhagic strokes

- Potential limited generalizability, but expected to be towards the null
Conclusion

- We observed a moderate, increased risk of stroke among black compared to white women
  - No longer significant after adjustment for traditional stroke risk factors

- Significant variation by race of the association between time-varying age and total stroke:
  - In all age groups, black women had a higher incidence rate of stroke than white women
  - Age-related risk of stroke stronger among white women than black women due to the higher baseline risk among younger black women

- Racial inequities greater among women without a family history of stroke
Implications

- Importance of examining inequities across multiple dimensions
- The attenuated magnitude of racial inequities compared to previous findings: key role of SES factors underlying racial inequities in stroke
  - Both black and white women on average healthier than those in REGARDS

- Role of structural racism in shaping inequities in stroke and other chronic disease across the life course
  - Deleterious exposures at the individual, neighborhood and institutional levels across the life course
Gaps that WHI can fill

- Ability to examine other racial/ethnic groups
  - Present the data, even descriptive data is informative

- Consideration of race-specific analyses

- Exploration of race-specific confounding
Special Thanks

- Co-authors:
  - Kathryn M. Rexrode, MD MPH
  - JoAnn E. Manson, MD PhD
  - Nancy R. Cook, ScD
  - Ichiro Kawachi, MD PhD
  - Sylvia Wassertheil-Smoller, PhD
  - Bernhard Haring, MD, MPH
  - Rami Nassir, PhD
  - Jinnie J. Rhee, ScD
  - Shawnita Sealy-Jefferson, PhD

- WHI participants
  - Mary Pettinger, MS
  - Rimma Dushkes, MS
FACE
Ask the person to smile. Does one side of the face droop?

ARMS
Ask the person to raise both arms. Does one arm drift downward?

SPEECH
Ask the person to repeat a simple phrase. Is their speech slurred or strange?

TIME
If you observe any of these signs, call 9-1-1 immediately.
Inequities in Stroke: Sex

- Women have a lower age adjusted incidence of stroke at younger ages
  - Reverses at >85 years

- Annually, ~ 55,000 more women have a stroke than men

- Women have a higher lifetime risk of stroke
  - ~20% for women and 14% for men
INEQUITIES IN STROKE: Age at Stroke Death

- American Indian/Alaskan Native, black and Hispanic/Latino populations have exhibited a lower mean age at stroke death than non-Hispanic whites.
Inequities in Stroke: Race/ethnicity
Trends in incidence of stroke by race

- Greater Cincinnati/Northern Kentucky Stroke Study
  Kleindorfer et al. 2010

![Graph showing trends in incidence of stroke by race, with data points for Black adults and White adults for the years 1993, 1999, and 2005. The graph indicates a decrease in incidence over time.]
Incidence rate by sex and race/ethnicity:

- Northern Manhattan Stroke Study
The association between race and stroke has been shown to vary by blood pressure (systolic [SBP] & diastolic [DBP]).

- Prevalence of hypertension is higher among black adults and varies by sex and age.
  - Black women aged ≥75 years exhibit the highest prevalence of hypertension (> 70%).

In REGARDS, each 10mmHg increase in SBP was associated with a 24% greater risk of stroke in blacks compared to an 8% in whites ($P_{int}=0.02$).

- Among those with SBP<140 mmHg, the risk of stroke among black adults was not significantly different from that of whites.
- Among adults 45-64 yr, SBP 140-159 mmHg: Black adults exhibited a 2.14 significantly greater risk of stroke compared to whites (95% CI: 1.07-4.30) in fully adjusted models.
- Among adults >65 yr, SBP 140-159: The association between race and stroke was not statistically significant.
Defining terms

- Inequities:
  - Specific focus on the differences in health between groups that are “avoidable, unfair, and unjust”
Inequities in stroke: Race/ethnicity

- Brain Attack Surveillance in Corpus Christi
- Mexican American compared to white adults

![Relative Risk Chart]

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-59 y</td>
<td>2.04</td>
</tr>
<tr>
<td>60-74 y</td>
<td>1.58</td>
</tr>
<tr>
<td>&gt;=75 y</td>
<td>1.12</td>
</tr>
</tbody>
</table>