Educational attainment and self-rated health among African-Americans in Pitt County, NC

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ABSTRACT
Background: To help fill the knowledge gap regarding relationships between educational attainment and self-rated health (SRH) in minority populations, we analyzed the data of a community-based cohort of African-Americans residing in Pitt County, NC, between 1988 and 2001.

Methods: Data from the Pitt County Study (a community-based, longitudinal survey of risk factors for hypertension and related disorders disproportionately affecting African-Americans) were used to explore associations between educational attainment and SRH, stratified by sex, in a cohort of individuals from 1988 (n=1,773), 1993 (n=1,195), and 2001 (n=1,117) using continuous, ordinal, and binary correlated data analyses.

Results: For males and females with less than a high school education, the odds of reporting poor or fair health (compared to excellent, very good, or good health) were 2.75 (95% CI: 1.54-4.91) and 1.78 (95% CI: 1.15-2.75) times greater, respectively, than among those who completed a college degree or higher.

Conclusions: Across all analyses, individuals with lower educational attainment reported lower SRH scores, and the association differed by sex. Social support may be a factor in these differences. More research is needed, however, to assess relationships between educational attainment, social support, and SRH for African-Americans and other minority populations.

Key words: Education, Pitt County Study, Self-rated health, African-American, Health Disparities

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INTRODUCTION
Self-rated health (SRH) is a predictor of health utilization and all-cause mortality (Benjamins et al., 2004; Idler et al., 1997). Although education is a predictor of biological health, there is a dearth of evidence about how it affects motivations to seek routine health care services, and whether social support affects this relationship (Caetano et al., 2013). Further literature on this topic from US racial/ethnic minority cohorts is scarce. By exploring relationships between educational attainment, social support, and SRH, we identified opportunities to address factors contributing to health disparities and motivations among African-Americans in Pitt County, NC, a community with a high burden of chronic disease.

METHODS
Details regarding participant recruitment, eligibility, study setting, data collection methods, and survey instruments have been previously described (James et al., 2006). This study, declared exempt by the Emory University Institutional Review Board, included 1,773 participants at baseline in 1988, 1,195 in 1993, and 1,177 in 2001. At baseline, participants
ranged from 24 to 51 years old. The average SRH score in 1988 was 26.39 (SD = 6.02), similar to the average of 26.31 (SD = 6.10) in 1993. Table 1 contains demographic factors.


<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Level</th>
<th>1988</th>
<th>1993</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td>Female</td>
<td>1112</td>
<td>62.7</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>661</td>
<td>37.3</td>
<td>415</td>
</tr>
<tr>
<td>Age (years)</td>
<td>&lt;24</td>
<td>18</td>
<td>1.0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>25-29</td>
<td>391</td>
<td>22.1</td>
<td>18</td>
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<tr>
<td></td>
<td>30-34</td>
<td>426</td>
<td>24.0</td>
<td>301</td>
</tr>
<tr>
<td></td>
<td>35-39</td>
<td>382</td>
<td>21.6</td>
<td>323</td>
</tr>
<tr>
<td></td>
<td>40-44</td>
<td>276</td>
<td>15.6</td>
<td>239</td>
</tr>
<tr>
<td></td>
<td>45+</td>
<td>280</td>
<td>15.8</td>
<td>314</td>
</tr>
<tr>
<td>Education</td>
<td>Less than HS</td>
<td>547</td>
<td>30.9</td>
<td>345</td>
</tr>
<tr>
<td></td>
<td>HS or GED</td>
<td>709</td>
<td>40.0</td>
<td>484</td>
</tr>
<tr>
<td></td>
<td>Vocational</td>
<td>181</td>
<td>10.2</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>Some College</td>
<td>190</td>
<td>10.7</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>4-Year Degree+</td>
<td>146</td>
<td>8.2</td>
<td>100</td>
</tr>
<tr>
<td>Self-Rated Health</td>
<td>Poor</td>
<td>78</td>
<td>4.4</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>151</td>
<td>8.5</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>518</td>
<td>29.3</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>Very Good</td>
<td>545</td>
<td>30.8</td>
<td>374</td>
</tr>
<tr>
<td></td>
<td>Excellent</td>
<td>477</td>
<td>27.0</td>
<td>325</td>
</tr>
<tr>
<td>Social Support</td>
<td>1 Low</td>
<td>37</td>
<td>2.1</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>352</td>
<td>19.9</td>
<td>238</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>880</td>
<td>49.6</td>
<td>521</td>
</tr>
<tr>
<td></td>
<td>4 High</td>
<td>504</td>
<td>28.4</td>
<td>402</td>
</tr>
</tbody>
</table>

Abbreviations: HS= High School; GED= General Educational Development

As educational attainment was not measured in 2001, analyses were conducted with the five-category baseline measure ranging from (1) less than high school education (LTHSE) to (5) college degree or higher (CDH). Since SRH was assessed by use of 9 questions in only 1988 and 1993, aggregate measure was used to convert the data into the five-category Likert scale used to measure SRH in 2001. For analyses with a dichotomous SRH outcome, an overall good health category was created by combining excellent, very good, or good categories; an overall bad health category was created by combining the fair or poor categories.

After assessing covariates for temporality and evaluating unstructured, AR-1, and Toeplitz correlation structures, we tested for model convergence with and without random effects and subsequently conducted tests for independence. To assess goodness-of-fit of the different correlation structures, the pseudo-Hannan and Quinn information criterion (pseudo-HQIC), pseudo-Akaike information criterion (pseudo-AIC), and the pseudo-Bayesian...
information criterion (pseudo-BIC) were utilized. After assessing for collinearity, interaction, and confounding, the final models considered age, education, and social support. With an unbalanced dataset, linear, categorical, and ordinal binomial models were analyzed with SAS 9.4 (Cary, NC). Confidence intervals were calculated with alpha of 0.05, unless otherwise noted.

RESULTS

In the continuous outcome analyses, male and female participants with LTHSE reported SRH scores that were 1.94 and 1.41 units lower than their counterparts with CDH, respectively. For both sexes, significant differences existed only between the lowest and highest education categories. For each 1-unit increase in social support score, the average SRH score increased by 0.22 units for males and 0.19 units for females. For each additional year in age, the average estimated SRH score decreased by 0.14 units for males and 0.19 units for females.

In the ordinal outcome analyses, males and females with LTHSE had 2.75 (1.54 - 4.91) and 1.78 (1.15 - 2.75) times the odds of reporting poor or fair health (relative to excellent, very good, or good health) compared to those with CDH, respectively. The results show that, for both sexes, any education level greater than or equal to high school completion increased the odds of higher SRH.

For the binary outcome analyses, the odds of reporting good health (relative to bad health) for males with LTHSE were 0.31 (0.14 - 0.69) times the odds of males with CDH. Among males, odds ratios for other education levels compared to those with CDH were not statistically significant. The odds of reporting good health for females with LTHSE were 0.37 (0.21 - 0.66) times the odds for females with CDH. Additionally, the odds of reporting good health for females who completed high school or a GED were 0.55 (0.31 - 0.98) times the odds for females with CDH. Among females, odds ratios comparing the other levels of education to CDH were not statistically significant.
DISCUSSION/CONCLUSIONS

This study is one of the first to explore the gender-specific effects of education on SRH in a longitudinal cohort of African-Americans. The analyses suggest that higher educational attainment is associated with higher SRH and that these results differ by sex. In addition, the findings suggest that social support increases SRH; however, due to collinearity, we were unable to explore its interaction with education. A possible mechanism that explains the findings is that higher educational attainment increases economic stability, financial resources, and perceived sense of control, all of which can lead to greater SRH. These factors may be involved in decision-making regarding seeking routine and preventive healthcare services. However, the strength of associations between education and SRH varied by sex across modeling strategies. Therefore, additional research is necessary to understand these relationships.

The analyses were limited by inconsistencies in the survey instrument across all three waves of data. Moreover, due to temporality concerns, we could not control for the complete set of covariates initially considered. As in most investigations collecting self-reported data, the results may be subject to self-report bias, recall bias, or social desirability bias. However, the study has several strengths. Primarily, the methodology involved three distinct modeling strategies to analyze a relationship in a longitudinal dataset; current practice in epidemiology often includes only one. The

Table 2. Results of continuous, ordinal, and binary logistic analyses for participants in Pitt County, NC study (1988, 1993, 2001).†

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Estimate</td>
</tr>
<tr>
<td>Continuous [estimate, (SE)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>-1.94 (0.79)*</td>
<td>-1.41 (0.62)*</td>
</tr>
<tr>
<td>Social Support</td>
<td>0.22 (0.03)*</td>
<td>0.19 (0.03)*</td>
</tr>
<tr>
<td>Age</td>
<td>-0.14 (0.03)*</td>
<td>-0.19 (0.02)*</td>
</tr>
<tr>
<td>Ordinal [OR, (95% CI)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Less than high school compared to college degree or higher</td>
<td>2.75 (1.54-4.91)*</td>
</tr>
<tr>
<td></td>
<td>Less than high school compared to some college</td>
<td>1.47 (0.90-2.40)</td>
</tr>
<tr>
<td></td>
<td>Less than high school compared to vocational school</td>
<td>1.81 (1.03-3.17)*</td>
</tr>
<tr>
<td></td>
<td>Less than high school compared to high school or GED</td>
<td>1.69 (1.19-2.41)*</td>
</tr>
<tr>
<td>Binary Logistic [OR, (95% CI)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Less than high school compared to completed college or higher</td>
<td>0.31 (0.14-0.69)*</td>
</tr>
<tr>
<td></td>
<td>High school or a GED compared to completed college or higher</td>
<td>0.54 (0.24-1.22)</td>
</tr>
</tbody>
</table>

Abbreviations: SE= standard error; OR= odds ratio; 95% CI= 95% confidence interval; * p-value < 0.05
† Additional results in appendix.
results differed between the modeling approaches, providing evidence supporting the use of multiple modeling strategies in analysis of longitudinal data. Additionally, an unbalanced dataset was used, allowing us to use all observations in this large, 13-year longitudinal study. Future studies could consider controlling for a fuller set of health-related influences, including biological factors and interactions with social support, which may further elucidate the relationship between education and SRH.

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References


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APPENDIX
Detailed Results

**Continuous Outcome**

The final model selected for the continuous analysis was:

\[
SRH = \beta_0 + \sum_{a=1}^{4} \beta_a Edu_a + \gamma_1 Age + \gamma_2 SS + E_{ij}
\]

where  
- \( i = 1, 2 \ldots, K \) (number of subjects)  
- \( j = 1, 2 \) (timepoint)  
- \( Edu_a: a = 1, 2, 3, 4 \), where:  
  - \( Edu_1: 1 = \text{participant completed high school}, 0 \text{ otherwise} \)  
  - \( Edu_2: 1 = \text{participant completed vocational school}, 0 \text{ otherwise} \)  
  - \( Edu_3: 1 = \text{participant completed some college}, 0 \text{ otherwise} \)  
  - \( Edu_4: 1 = \text{participant completed college or above}, 0 \text{ otherwise} \)  
  (Note: referent group was participant completed less than high school)  
- \( Age: \) continuous age of participant, in years  
- \( SS: \) continuous social support score, (9-36, where 9 was the worst social support and 36 was the best social support)  
- \( E_{ij}: \) error term

Figure 1a. Continuous analysis results for males.

![Solution for Fixed Effects Table](image)

Among males, participants who completed less than high school education reported an SRH score that was, on average, 1.94 units lower compared to participants who completed college or above (Figure 1a). There were no significant differences between participants who completed college or greater and any other education level. Average SRH score increased by 0.22 units for every 1-unit increase in the continuous social support score. For every additional year in age, the average estimated SRH score decreased by 0.14 units.
Among females, individuals who had completed less than high school reported an SRH score that was, on average, 1.41 units lower when compared to individuals who had completed college or above (Figure 1b). All other education categories did not significantly differ when compared to the “college degree or above” stratum. A single-unit increase in social support score was associated with an estimated 0.19 unit increase in SRH score. With every one-year increase in age, there was an estimated 0.19 unit decrease in SRH score.

**Ordinal Outcome**

The final model selected for the ordinal analysis was:

\[
\ln \left( \frac{P(SRH \geq g | Edu, SS, Age)}{P(SRH < g | Edu, SS, Age)} \right) = \alpha_g + \sum_{a=1}^{4} \beta_a Edu_a + \gamma_1 Age + \gamma_2 SS + b_{i0} + E_{ij}
\]

where

- \( g = 1, 2, 3, 4; \alpha_1 > \alpha_2 > \alpha_3 > \alpha_4 \)
- \( i = 1, 2, \ldots, K \) (number of subjects)
- \( j = 1, 2, 3 \) (timepoint)
- \( Edu_a: a = 1, 2, 3, 4, \) where:
  - Edu1: 1 = participant completed high school, 0 otherwise
  - Edu2: 1 = participant completed vocational school, 0 otherwise
  - Edu3: 1 = participant completed some college, 0 otherwise
  - Edu4: 1 = participant completed college or above, 0 otherwise
- (Note: referent group was participant completed less than high school)
- Age: continuous age of participant, in years
- SS: continuous social support score, (9-36, where 9 was the worst social support and 36 was the best social support)
- \( b_{i0} \): random intercept (subject-specific)
- \( E_{ij} \): error term
SAS modeled the probabilities of levels of SRH having lower ordered values (poorer health) in the numerator. Therefore, the OR interpretations estimate the odds of poorer health vs. better health.

Among males, those with less than high school education had 2.75 (95% CI: 1.54 - 4.91) times the odds of reporting poor or fair health (compared to excellent, very good, or good health) compared to those who had completed a college degree or higher (Figure 2a). The OR was lower when comparing education levels that were not as far apart. Those with less than high school education has 1.69 (95% CI: 1.19 - 2.41) times the odds of reporting poor or fair health (compared to excellent, very good, or good health) compared to those who had completed high school/GED, and 1.81 (95% CI: 1.03 - 3.17) times the odds of reporting poor or fair health (compared to excellent, very good, or good health) compared to those who had completed vocational school. All other comparisons between other education levels were not statistically significant.

Among females, those with less than high school education had 1.78 times the odds of self-reporting poor or fair health (compared to excellent, very good, or good health) compared to both those who completed a college degree or higher (95% CI: 1.15 - 2.75) and those who completed vocational school (95% CI: 1.20 - 2.62) (Figure 2b). Those with less than high school education had 1.66 (95% CI: 1.10 - 2.50) times the odds of reporting poor or fair health (compared to excellent, very good, or good health) compared to those who completed some college. Those with less than high school education had 1.56 (95% CI: 1.19 - 2.05) times the odds of reporting poor or fair health (compared to excellent, very good, or good health) compared to those who had completed high school or a GED. Since the ORs for all education levels were significant, yet similar, it appears that any education level greater than or equal to high school completion increased the odds of higher SRH.

**Binary Outcome**
The final model selected for the binary analysis, using a Toeplitz correlation structure, was:

\[
\text{logit}(\text{SRH}|\text{Edu}, \text{SS}, \text{Age}) = \beta_0 + \sum_{a=1}^{4} \beta_a \text{Edu}_a + \gamma_1 \text{Age} + \gamma_2 \text{SS} + E_{ij}
\]

where \( i = 1, 2, \ldots, K \) (number of subjects)
\( j = 1, 2, 3 \) (timepoint)
\( \text{Edu}_a: a = 1, 2, 3, 4 \), where:
- Edu1: 1 = participant completed high school, 0 otherwise
- Edu2: 1 = participant completed vocational school, 0 otherwise
- Edu3: 1 = participant completed some college, 0 otherwise
- Edu4: 1 = participant completed college or above, 0 otherwise
(Note: referent group was participant completed less than high school)

Age: continuous age of participant, in years

SS: continuous social support score (9-36, where 9 was the worst social support and 36 was the best social support)

\( E_{ij} \): error term

Figure 3a. Binary results analysis for males.

The odds of reporting good health (vs. bad health) for men who completed less than high school education were 0.31 (95% CI: 0.14, 0.69) times the odds of males who completed college or higher (Figure 3a). ORs for all other education levels compared to those who completed college or greater were not statistically significant.

Figure 3b. Binary results analysis for females.

The odds of reporting good health (vs. bad health) for women who completed less than high school education were 0.37 (95% CI: 0.21, 0.66) times the odds of women who had completed college or higher (Figure 3b). Additionally, the odds of reporting good health (vs. bad health) for women who completed high school or GED were 0.55 (95% CI: 0.31, 0.98) times the odds of women who completed college or higher. ORs comparing the other levels of education to the completion of college or higher were not statistically significant.