Social Determinants of Cigarette Smoking among American Women during Pregnancy

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Abstract: Educational attainment is among the most substantial protective factors against cigarette smoking, including during pregnancy. Although Minorities' Diminished Returns (MDRs) of educational attainment, defined as weaker protective effect of education for racial and ethnic minority groups compared to Non-Hispanic Whites, has been demonstrated in previous studies; such MDRs are not tested for cigarette smoking during pregnancy. To better understand the relevance of MDRs to tobacco use during pregnancy, this study had three aims: firstly, to investigate the association between educational attainment and cigarette smoking in pregnant women; secondly, to compare racial and ethnic groups for the association between educational attainment and cigarette smoking; and thirdly, to explore the mediating effect of poverty status on such MDRs, among American adults during pregnancy. This cross-sectional study explored a nationally representative sample of pregnant American women (n = 338), which was taken from the Population Assessment of Tobacco and Health (PATH; 2013). Current smoking was the outcome. Educational attainment was the independent variable. Region and age were the covariates. Poverty status was the mediator. Race and ethnicity were the effect modifiers. Overall, a higher level of educational attainment (OR = 0.54, \( p < 0.05 \)) was associated with lower odds of current smoking among pregnant women. Race (OR = 2.04, \( p < 0.05 \)) and ethnicity (OR = 2.12, \( p < 0.05 \)) both showed significant interactions with educational attainment on smoking, suggesting that the protective effect of educational attainment against smoking during pregnancy is smaller for Blacks and Hispanics than Non-Hispanic Whites. Poverty status fully mediated the above interactions. In the United States, highly educated pregnant Black and Hispanic women remain at higher risk of smoking cigarettes, possibly because they are more likely to live in poverty, compared to their White counterparts. The results suggest the role that labor market discrimination has in explaining lower returns of educational attainment in terms of less cigarette smoking by racial and ethnic minority pregnant women.

Keywords: social determinants of health; ethnicity; race; Hispanics; population groups; poverty; socioeconomic status; tobacco use; smoking

1. Background

Smoking cigarettes during pregnancy is probably the single most important preventable cause of adverse outcomes for pregnant woman [1,2] and the unborn child [3–5]. Studies that have compared various risk factors in the perinatal period have suggested that exposure to tobacco smoke should be regarded as one of the most harmful exposures that increase short- and long-term morbidity and mortality for both mothers and children [6,7]. Smoking cigarettes during pregnancy increases the risks of developing congenital disabilities and poor pregnancy outcomes [6,7].
Smoking cigarettes during pregnancy is linked to a variety of adverse pregnancy and birth outcomes [8–10]. Prenatal cigarette smoking disturbs the equilibrium between the oxidant and the antioxidant systems, resulting in several adverse effects at the genetic and cellular levels linked to a large number of diseases in the unborn child [11]. The tobacco-induced harm to the unborn offspring manifests itself at various times in life, from birth to death; many harmful consequences do not have known treatments [12].

Similar to the social inequalities in health [13,14], and tobacco use [15], racial/ethnic minority status [16–20] and socioeconomic status (SES) [21–25] are strong social determinants of smoking during pregnancy. Black and Hispanic women may also be at high risk of smoking during pregnancy [1,8,26]. High educational attainment is a robust protective factor against smoking for pregnant women [3,21,23,27–30]. Poverty status is also another determinant of smoking during pregnancy [16,18,26,31]. Correlates of smoking during pregnancy, however, differ between Whites and Non-Whites [1,26,32].

Recent research on the Minorities’ Diminished Returns (MDRs) phenomenon has proposed diminished returns of educational attainment [33] as an essential but historically neglected mechanism for racial and ethnic disparities in tobacco burden in the United States [34,35]. Accordingly, at least some of the racial/ethnic tobacco use disparities are because of “less than expected” protective effects of SES indicators on tobacco use for minority populations [34,35]. This model suggests that: (a) tobacco racial/ethnic disparities are not all due to SES gaps, but are, in part, due to smaller effects of SES indicators for Black and Hispanic populations; and (b) the racial and ethnic gap in tobacco use widens, rather than narrows, at the highest SES levels. As a result, this model suggests that there is a need to study racial/ethnic disparities in tobacco use across all SES levels, and the solution to tobacco disparities is beyond equal SES [34,35].

This study had two aims: firstly, to compare racial and ethnic groups for the associations between educational attainment and poverty status with cigarette smoking among American adults during pregnancy; and secondly, to explore the mediating effect of poverty status on such MDRs. Our hypotheses included: (1) educational attainment would be inversely associated with cigarette smoking in pregnant American women; (2) we expect a smaller protective effect of educational attainment on smoking during pregnancy for Black and Hispanic than Non-Hispanic White Americans, however; and (3) we expected the differential effect of educational attainment on smoking of pregnant women to be due to poverty status.

2. Methods
2.1. Study Design

This cross-sectional study is a secondary analysis of existing data. Data came from wave 1 of the Population Assessment of Tobacco and Health (PATH) adult data [36–38]. Wave 1 of the PATH data used here were collected between 2013 and 2014.

2.2. Sample and Sampling of the PATH Study

Participants were eligible for the PATH study if they were: (1) civilian; (2) non-institutionalized; (3) a U.S. citizen; and (4) 18 years of age and older. We also limited this sample to those who reported that they were pregnant at the time of the survey. The PATH study sample was drawn with a four-stage probability sampling design [36–38].

2.3. Analytical Sample of Pregnant Women in the Current Report

The current analysis was limited to pregnant women at the time of the survey; therefore, the final analytical sample was 338 individuals.

2.4. Variables

The outcome was current smoking of cigarettes, measured with a self-reported assessment [39]. Confounders were age and region. Race and ethnicity were self-identified and operationalized as binary variables: Race (Black vs. White) and Ethnicity (Hispanic
vs. Non-Hispanic). Age, a continuous variable, ranged from 1 to 7: 1 for 18–24 years old, 2 for 25–34 years old, 3 for 35–44 years old, 4 for 45–54 years old, 5 for 55–64 years old, 6 for 65–74 years old, and 7 for 75+ years old. Education was a six-level categorical variable: 1 for Less than High School, 2 for GED, 3 for High School Graduate, 4 for Some College (no degree) or associates degree, 5 for Bachelor’s Degree, and 6 for Advanced Degree. The moderator was poverty status, measured as a dichotomous variable: (0) below the 200% federal poverty line, and (1) above the 200% federal poverty line.

Our outcome was current smoking (smoked 100 cigarettes and smokes currently) [39]. Current smoking and lifetime history of smoking 100 cigarettes were used in combination to define current smoking status. Participants were considered current smokers only if the answer to both questions was affirmative. The very same definition is commonly used in tobacco use research [40].

2.5. Statistics and Data Analyses

To analyze wave 1 of the PATH data, we used SPSS 23.0 (IBM Corp, Armonk, NY, USA). For the first step, we described our categorical and continuous variables. For this purpose, we used mean and frequency tables. For multivariable analysis, we applied three nested binary logistic regression models and had identical sample sizes. In our models, current smoking was the outcome, educational attainment was the independent variable, race and ethnicity were the moderators, and poverty status was the mediator. These logistic regression models were run without interactions or mediators (Model 1), with interactions but without the mediator (Model 2), and with interactions and the mediator (Model 3).

2.6. Ethical Approval

All the adults participating in the PATH study provided written informed consent. The study received Institutional Review Board (IRB) approval from Westat.

3. Results

3.1. Descriptive Statistics

This study included 338 pregnant American women. Most participants were Non-Hispanic (n = 273, 80.0%) and White (n = 274, 81.1%) (Table 1).

Table 1. Descriptive statistics.

|               | n  | %   |
|---------------|----|-----|
| Race          |    |     |
| White         | 274| 81.1|
| Black         | 64 | 18.9|
| Ethnicity     |    |     |
| Non-Hispanic  | 273| 80.8|
| Hispanic      | 65 | 19.2|
| Region        |    |     |
| West          | 39 | 11.5|
| Northeast     | 93 | 27.5|
| Midwest       | 127| 37.6|
| South         | 79 | 23.4|
| Poverty Status|    |     |
| Living in poverty | 229| 72.9|
| Living out of poverty | 85 | 27.1|
| Current Smoker|    |     |
| Non-Smoker    | 263| 77.8|
| Smoker        | 75 | 22.2|
| Mean          |    |     |
| SD            |    |     |
| Age (1–7)     | 1.57| 0.67|
| Educational Attainment (1–6) | 3.47| 1.4|
3.2. Pooled Sample Multivariable Models

Table 2 shows the summary of three logistic regressions. Based on Model 1, there was an inverse correlation between education and the odds of current smoking among pregnant women. In this model, Blacks and Hispanics showed lower odds of current smoking, net of covariates. Model 2 showed significant interactions between race and ethnicity with educational attainment on current smoking status, suggesting that high educational attainment is more protective for Whites and Non-Hispanics than Blacks and Hispanics. Model 3, however, suggested that these interaction terms (MDR) are entirely due to poverty status. This was because the interaction terms were no more significant after poverty status was introduced to the model (Table 2).

Table 2. Summary of three logistic regression on current smoking models in the pooled sample.

| Model 1 (All) | B    | SE   | OR   | 95% CI | p    |
|---------------|------|------|------|--------|------|
| Race (Blacks) | -1.10| 0.42 | 0.33 | 0.15   | 0.75 | 0.008 |
| Ethnicity (Hispanics) | -2.08| 0.58 | 0.13 | 0.04   | 0.39 | 0.000 |
| Country Region | | | | | 0.274 |
| South         | 0.35 | 0.51 | 1.41 | 0.52   | 3.81 | 0.494 |
| West          | 0.32 | 0.50 | 1.38 | 0.52   | 3.65 | 0.515 |
| Northeast     | -0.54| 0.61 | 0.58 | 0.18   | 1.92 | 0.372 |
| Midwest       | 1    |      |      |        |      | 0.237 |
| Age (10-Year Intervals) | 0.19 | 0.22 | 1.21 | 0.78   | 1.86 | 0.390 |
| Educational Attainment (1–6) | -0.62| 0.11 | 0.54 | 0.43   | 0.67 | 0.000 |
| Constant      | 0.77 | 0.65 | 2.15 |        |      | 0.237 |

| Model 1 (All + Interaction) | B    | SE   | OR   | 95% CI | p    |
|-----------------------------|------|------|------|--------|------|
| Race (Blacks)               | -3.15| 1.01 | 0.04 | 0.01   | 0.31 | 0.002 |
| Ethnicity (Hispanics)       | -4.11| 1.29 | 0.02 | 0.00   | 0.21 | 0.001 |
| Country Region              | |     | |      | 0.266 |
| South                       | 0.45 | 0.53 | 1.57 | 0.56   | 4.41 | 0.395 |
| West                        | 0.34 | 0.51 | 1.41 | 0.52   | 3.86 | 0.502 |
| Northeast                   | -0.49| 0.63 | 0.51 | 0.18   | 2.10 | 0.435 |
| Midwest                     | 1    |      |      |        |      | 0.397 |
| Age (10-Year Intervals)     | 0.19 | 0.23 | 1.21 | 0.78   | 1.89 | 0.397 |
| Educational Attainment (1–6) | -0.82| 0.14 | 0.44 | 0.34   | 0.58 | 0.000 |
| Black × Educational Attainment | 0.71 | 0.30 | 2.04 | 1.12   | 3.70 | 0.019 |
| Hispanic × Educational Attainment | 0.75 | 0.38 | 2.12 | 1.00   | 4.51 | 0.050 |
| Constant                    | 1.33 | 0.71 | 3.80 |        |      | 0.059 |

| Model 3 (All + Interaction + Mediator) | B    | SE   | OR   | 95% CI | p    |
|---------------------------------------|------|------|------|--------|------|
| Race (Blacks)                         | -2.42| 1.05 | 0.09 | 0.01   | 0.70 | 0.021 |
| Ethnicity (Hispanics)                 | -3.78| 1.37 | 0.02 | 0.00   | 0.33 | 0.006 |
| Country Region                        | |     | |      | 0.253 |
| South                                 | 0.37 | 0.55 | 1.44 | 0.49   | 4.24 | 0.506 |
| West                                  | 0.18 | 0.53 | 1.20 | 0.42   | 3.42 | 0.736 |
| Northeast                             | -0.66| 0.65 | 0.52 | 0.14   | 1.84 | 0.307 |
| Midwest                               | 1    |      |      |        |      | 0.307 |
| Age (10-Year Intervals)               | 0.33 | 0.24 | 1.40 | 0.88   | 2.22 | 0.160 |
| Educational Attainment (1–6)          | -0.56| 0.16 | 0.57 | 0.42   | 0.79 | 0.001 |
| Black × Educational Attainment        | 0.40 | 0.32 | 1.50 | 0.81   | 2.78 | 0.201 |
| Hispanic × Educational Attainment     | 0.66 | 0.41 | 1.94 | 0.86   | 4.35 | 0.110 |
| Living Out of Poverty                 | -2.15| 0.66 | 0.12 | 0.03   | 0.43 | 0.001 |
| Constant                              | 0.80 | 0.78 | 2.22 |        |      | 0.304 |

CI: Confidence Interval; SE: Standard Error; OR: Odds Ratio.

4. Discussion

The current study presents three findings. Firstly, overall, higher educational attainment is associated with lower odds of smoking among pregnant American women. Secondly, high educational attainment has smaller protective effects against Black and Hispanic smoking than pregnant White and Non-Hispanic women. Finally, the reason for this race and ethnic difference is that highly educated pregnant women are more likely to live in poverty, if Black and Hispanic.
Our first finding is in harmony with the very well-established literature on the protective effect of social determinants of health and fundamental cause theory, which suggests that populations and individuals with higher SES, including education, avoid health risk behaviors [13,14]. This literature has shown that low education is a risk factor for tobacco use in pregnancy [21,29,35,41]. Extensive work by Marmot [42–45], Link and Phelan [46–48], Ross and Mirowsky [13,14,49,50] and others [51] have shown SES as protective against risk behaviors such as tobacco.

Our second result on the MDRs of educational attainment on smoking status during pregnancy is in line with the literature on higher-than-expected risks of smoking and alcohol use in high SES (e.g., education, income, and employment) Blacks and Hispanics [34,35]. This finding is also in line with broader literature on the diminished returns of SES of a wide range of Blacks and Hispanics’ outcomes than Whites [33]. MDRs are reported for the effects of educational attainment [52], income [53], employment [54], and marital status [55] on several health outcomes.

The third finding is also in line with a few studies which have proposed that income and poverty status may be the mechanism behind diminished educational attainment returns for Blacks [52]. However, we are not aware of any similar studies for Hispanics. In one study, MDRs of education on self-rated health were mediated by income, suggesting that labor market discrimination may be the cause of educational MDRs for Blacks [52]. One study showed that education has a smaller effect on bringing people out of poverty for Black than White individuals [56]. Similarly, educational attainment better predicts future raises of salary for White than Black people [57]. Upward social mobility is more difficult for Blacks than Whites [58]. As a result, eliminating discrimination in the U.S. labor market has become a priority for eliminating disparities, particularly those shaped by differential effects of education on health [52].

Another finding was lower odds of current smoking in pregnant Black and Hispanic women than pregnant White and Non-Hispanic women. The higher prevalence of smoking in Whites than Whites and Hispanics is well described in the literature [16–20]. Despite the protective (main) effects of race and ethnicity, we observed a differential effect of educational attainment on smoking of racial and ethnic groups, with pregnant Black and Hispanic women not gaining much from their educational attainment in terms of low smoking to pregnant White women. Other people have shown similar MDRs for some outcomes [59,60].

There is a need to understand why educational attainment shows smaller effects on the behaviors of Blacks and Hispanics than Whites. One area that is still needed is research on the tobacco industry’s predatory marketing practices in communities of color [61]. We have previously proposed that such marketing strategies may reduce SES’s returns in terms of smoking for racial/ethnic minority people [34,35]. Here, we argue that such marketing practices may be responsible for the MDRs of education for pregnant women. People of color and residents of low SES environments report higher exposure to tobacco advertisements [62–64]. Thus, highly educated people in predominantly minority areas would still be disproportionately exposed to tobacco advertisements to a degree that is more than expected given their education. It is unknown whether more restrictive marketing policies that do not allow or at least reduce point-of-sale advertisements and flavoring tobacco products will reduce the smoking rates of people of color, and whether pregnant women would disproportionately benefit from such policies [65,66]. In other words, restricting predatory marketing may reduce tobacco use disparities by race, ethnicity, and SES. However, this hypothesis needs more research in the future [67].

At least some of the racial and ethnic tobacco disparities are beyond individuals’ choices and shaped by social forces that marginalize Black and Hispanic people and increase their risk of tobacco exposure [68–71]. Among the well-described phenomena are that racial, ethnic, and low SES people are commonly targeted by predatory tobacco marketing practices [63,72,73]. Low SES individuals and racial and ethnic minorities are more frequently exposed to environmental tobacco risk factors, including, but not limited
to, retail displays, coupons, discounts, and point-of-sale advertisements [61]. We have observed a high vulnerability of racial/ethnic populations across all SES levels [74], which may result in a more rapid transition of Black and Hispanic population from initiation to undesired outcomes, particularly because such populations have low access to and trust in cessation programs [75–77].

This study is not without methodological limitations. The cross-sectional design of our data does not allow causal inferences. The sample size was imbalanced across race and ethnic groups. Income, employment, marital status, and area-level SES were missing. We did not have information on the trimester of pregnancy. Finally, the sample size was low because the study was not conducted on pregnant women. To have a nationally representative sample, we used a national survey and selected only pregnant women. The study also only compared Blacks, Whites, and Hispanics. More research is needed on other ethnic groups such as Asian American, and Native Americans. Hispanics are a diverse group; therefore, there is a need to compare groups of Hispanics based on the country of origin. Despite these limitations, we believe that this study still makes a meaningful contribution to the literature.

5. Conclusions

In the United States, highly educated pregnant Black and Hispanic women stay at high risk of smoking due to a diminished educational attainment return on smoking risk. Disproportionately high risks of smoking in highly educated pregnant Black and Hispanic women are a threat because it is suggestive of high congenital disabilities and poor pregnancy outcomes of the next generation of middle-class Blacks and Hispanics. Health disparities are not a low SES problem because it extends to highly educated Blacks and Hispanics, who are the major growing sections of the U.S. population [78–81].

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Informed Consent Statement: All the adults participating in the PATH study provided written informed consent.

Data Availability Statement: Data are available online: https://www.icpsr.umich.edu/web/NAHDAP/studies/36231 (accessed on 7 July 2021).

Conflicts of Interest: The authors declare no conflict of interest.

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