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TITLE: Widening Disparities in Cigarette Smoking by Race/Ethnicity across Education Level in the United States

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ABSTRACT:

Reducing tobacco use is an important public health objective. It is the largest preventable cause of death and disease, yet inequalities remain. This study examines combined educational and racial/ethnic disparities in the United States related to cigarette smoking for the three largest racial/ethnic groups (African Americans, Hispanics/Latinos, and non-Hispanic Whites). Data included nine Tobacco Use Supplements to the Current Population Surveys (TUS-CPS) conducted in the United States from 1992/1993-2018 for four smoking metrics: ever smoking rates, current smoking rates, consumption (cigarettes per day), and quit ratios. Across all TUS-CPS samples, there were 9.5% African Americans, 8.8% Hispanics/Latinos, and 81.8% non-Hispanic Whites who completed surveys. Findings revealed that lower educational attainment was associated with increased ever and current smoking prevalence over time across all racial/ethnic groups, and education-level disparities within each race/ethnicity widened over time. Disparities in ever and current smoking rates between the lowest and highest categories of educational attainment (less than a high school education vs. completion of college) were larger for African Americans and non-Hispanic Whites than Hispanics/Latinos. Non-Hispanic Whites had the highest cigarette consumption across all education levels over time. College graduates had the highest quit ratios for all racial/ethnic groups from 1992- 2018, with quit ratios significantly increasing for Hispanics/Latinos and non-Hispanic Whites, but not African Americans. In conclusion, educational disparities in smoking have worsened over time, especially among African Americans and Hispanics/Latinos. Targeted tobacco control efforts could help reduce these disparities to meet public health objectives, although racial/ethnic disparities may persist regardless of educational attainment.

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Conflict of Interest Statement

No conflicts of interest were reported by the authors of this paper.

Availability of data and material

Data was from the US Government's Tobacco Use Supplements of the US Census Bureau's Current Population Survey.

Code availability

SAS version 9.4 was used for the statistical analyses.

Authors' contributions

All authors further certify that they have contributed substantially to the preparation of the manuscript.

Introduction

Reducing tobacco use is a public health priority because it is the largest preventable cause of death and disease [1]. In the United States (US), 14% of all adults are current smokers, and cigarette smoking causes more than 480,000 deaths per year [2]. The Healthy People initiative of the US Office of Disease Prevention and Health Promotion³ recognizes the tremendous public health impact of reducing tobacco use and specifies objectives that center around tobacco use prevalence, health system changes, and social-environmental changes. However, the US will not achieve the Healthy People 2020's smoking prevalence target of 12% or less, despite declining smoking rates since 1964, when the Surgeon General's Report on the health consequences of smoking created awareness of tobacco's implication in disease causation and prompted public health action [1]. Smoking rate reductions have not been uniform across the population, so identifying, investigating, and eliminating tobacco-related disparities is critical to achieving tobacco use objectives.

Tobacco use rates diverge pronouncedly across level of educational attainment. Educational attainment has a major impact on smoking behaviors, where smoking rates generally decrease with increasing education levels [4-7]. An investigation of national cigarette smoking trends between 1974-1985 showed a large and increasing gap in smoking status across education, with an annual decline in smoking prevalence about five times greater among college graduates than those with less than a high school education [8]. The education gap in smoking rates continues to grow: in 2018, cigarette smoking rates were six times greater for US adults with less than a high school education than for those with an advanced degree [9]. Education also impacts smoking cessation: successfully quitting cigarettes increases with higher educational attainment [10], and adults with an advanced degree have the highest quitting success rate compared to those who completed only up to high school in 2018 [9]. However, recent research suggests that educational attainment may disproportionately impact health by race/ethnicity status [11]. The differential effect among racial/ethnic groups related to tobacco use has been attributed to the *Minorities' Diminished Returns* theory, which posits that higher educational attainment is less protective for racial/ethnic minorities compared to non-Hispanic White counterparts [12,13]. Racial/ethnic minorities show wide disparities in smoking behaviors, according to a large body of research [1]. Among the three largest US racial/ethnic groups, smoking prevalence was highest among non-Hispanic Whites (15.2%), African Americans (14.9%) and Hispanics/Latinos (9.9%) in 2017 [2]. Smoking onset also differs by race/ethnicity, with African Americans initiating smoking at a later age than other race/ethnicities [14]. Quitting behavior also varies by race/ethnicity:

African Americans tend to smoke for longer periods before attempting to quit and make more quit attempts, but are less successful in quitting than non-Hispanic Whites [15,16]. Hispanics/Latinos, in contrast, smoke for a shorter period of time before attempting to quit than their counterparts [15]. Healthy People 2020 also notes racial/ethnic disparities in smoking rates and successful cessation, with a consistent pattern of African Americans having the lowest success rate in quitting among all racial/ethnic groups [3]. Smoking intensity (consumption), measured by number of cigarettes consumed per day, also varies by race/ethnicity [17].

While it is well-established that education and race/ethnicity each influence smoking behavior, less is known about the influence of education level on various smoking behaviors within race/ethnicities. Recent findings suggest that racial/ethnic disparities in smoking behaviors may in part be explained by differences in socioeconomic status, with 38% of observed racial/ethnic disparity in smoking status explained by educational differences [4]. More research is needed to examine the differences in smoking behavior attributed to race/ethnicity and education concurrently over longer time frames, and to explore the relationship between the influence of these factors on smoking behaviors during a period of increasing tobacco control efforts nationwide.

This study examines population-level trends in smoking behavior across education level for the three largest racial/ethnic groups in the US. Specifically, we examine ever smoking, current smoking, cigarette consumption, and quit ratios in African Americans, Hispanics/Latinos, and non-Hispanic Whites between 1992 and 2018. Investigating how educational attainment influences cigarette use by race/ethnicity and the changing trends will help identify populations disproportionately affected by tobacco, and highlight differences that warrant further study. This information can help improve the effectiveness of public health efforts with better targeted prevention, intervention, and cessation programs, and contribute to interventions that address inequalities.

Methods

To assess smoking behavior, we used estimates from nine Tobacco Use Supplements (TUS) of the US Census Bureau's Current Population Survey (CPS) collected in 1992/93, 1995/96, 1998/99, 2001/02, 2003, 2006/07, 2010/11, 2014/15, and 2018. Detailed methodology of the CPS is published elsewhere [18]. Smoking trends were examined for the three largest racial/ethnic groups in the United States, as they were the only groups with a large enough sample size to generate stable estimates for analyses. African Americans only included those who identified as non-Hispanic, while Hispanics/Latinos included all races. Analyses by sex were not included due to the small

sample sizes after considering race/ethnicity, education level, and sex, and resulted in wide confidence intervals. Levels of educational attainment were categorized as less than high school, high school graduate, some college, and college graduate.

Among self-identified African Americans, Hispanics/Latinos, and non-Hispanic Whites, we examined four smoking metrics: ever smoking, current smoking, cigarette consumption, and quit ratio. Those who had smoked at least 100 cigarettes in their entire life were considered ‘ever smokers,’ which is a common convention used to signify a smoking pattern beyond experimentation and representing initiation of established smoking patterns. This proportion of adults could be considered as a population-level proxy for smoking initiation, where trends were estimated for ever smokers aged 18-35 years. Ever smokers who reported currently smoking cigarettes every day or some days at the time of survey were considered ‘current smokers.’ Current smoking rates represent the prevalence of cigarette smoking among all US adults (age 18+). Reported cigarette consumption is the average number of cigarettes smoked per day (CPD) in the past month among adult current smokers (age 18+). CPD is a common measure used to identify the intensity of smoking. The quit ratio, an accepted population-level indicator of smoking cessation, was calculated as the proportion of ever smokers at least 25 years old who reported they currently smoked ‘not at all’. The majority of experimentation has ceased by age 25 but lifetime risks of tobacco-related diseases begin to increase according to the Surgeon General [1].

Statistical analyses were conducted using SAS version 9.4 [19]. All estimates were weighted using respondents’ person-level TUS-CPS survey weights, and data were standardized by age and sex within race/ethnicity and educational categories to the 2010 US population [20]. Variance estimates used replicate weights with Fay’s balanced repeated replication (provided with the TUS-CPS) [21]. We computed 95% confidence intervals to ascertain potential overlaps when comparing between education levels and racial/ethnic groups over time.

Results

Across the TUS-CPS from 1992/93-2018, there were 136,225 (9.5%) African Americans, 126,379 (8.8%) Hispanics/Latinos, and 1,178,468 (81.8%) non-Hispanic Whites. Table A1 presents sample sizes and descriptive statistics for age, sex and education level within race/ethnicity for each survey; means, percentages and SE are weighted. In 2018, the weighted mean age (years) was 44.9 (Standard Error [SE]:0.06) for African Americans, 41.6

(SE:0.05) for Hispanics/Latinos, and 50.0 (SE:0.02) for non-Hispanic Whites. The 2018 survey sample included 23,933 females and 19,699 males, and approximately was evenly split between females- to-males within each racial/ethnic group (54.4% African Americans, 50.4% Hispanics/Latinas, and 51.5% non-Hispanic Whites were female). We examined race/ethnicity within each education level for all surveys. By 2018, the lowest to highest educational attainment levels (categorized as less than a high school education, high school graduate, some college, and college graduate) among African Americans were 9.7%, 32.3%, 49.1%, and 8.9%, respectively. Hispanics/Latinos' education levels were 23.6%, 32.2%, 39.2%, and 5.0%, and non-Hispanic Whites' education levels were 5.2%, 26.0%, 54.3%, and 14.5%, respectively.

Ever Smoking Prevalence

We present ever smoking prevalence by race/ethnicity across education level in Figure 1. Among African Americans, there were marked differences in ever smoking rates by education level that persisted over time. Although ever smoking rates in general decreased between 1992-2018, there was a noticeable gradient by education. In 1992/93, ever smoking rates of those with less than a high school education (37.5%; CI:34.6–40.4) were more than double that of college graduates (16.5%; CI:13.5–19.5). Due to a greater decline among African Americans who completed college (-0.32 annual percentage change) than those who did not complete high school (-0.23%/year), the education-level disparity between African American ever smokers with less than a high school education (37.5%; CI:34.6–40.4) and those who graduated college (16.5%; CI:13.5–19.5) increased from 2.2-fold difference in 1992/93 to four-fold difference between African Americans with less than a high school education (38.7%; CI:23.4–62.1) and those who completed college (9.5%; CI:5.9–15.4) in 2018.

Although the education-level gradient was less evident among Hispanics/Latinos, the rate of ever smoking in 1992/93 among those with less than a high school education (29.6%; CI:27.9–31.3) was approximately 9-percentage points greater than college graduates (20.1%; CI:16.2–24.0). Also, smoking prevalence significantly decreased across all education levels among Hispanics/Latinos between 1992-2018, with smoking prevalence between 20-30% in 1992/93 and declining to about 15% except among college graduates (8.7%; CI:5.7-11.7). Nonetheless, the ever smoking rate among Hispanics/Latinos with less than a high school education was nearly double (15.6%; CI:10.7–20.5) that of those who completed college (8.7%; CI:5.7–11.7; -0.47%/year) by 2018.

Non-Hispanic Whites had the highest ever smoking rates across race/ethnicity over time and across education levels. In 1992/93, the ever smoking rate for non-Hispanic Whites who did not complete high school was 63.9% (CI:59.9–67.9) and declined to 41.2% (CI:35.4–47.0) by 2018. Among college graduates, the ever smoking rate was 25.1% in 1992/93 (CI:24.2–26.0) and declined to 13.4% (CI:12.0–14.9) by 2018. There was a particularly marked decrease in the ever smoking rate for non-Hispanic Whites with less than a high school education between 1992/93–2018 (-0.92%/year) compared to other education levels.

The prevalence of ever smoking among non-Hispanic Whites was higher than African Americans and Hispanics/Latinos across all education levels. Across education levels, African American and Hispanic/Latino college graduates had the lowest ever smoking rates in 2018. However, ever smoking rates of African Americans who did not complete high school and graduated college did not significantly decline over time, unlike their Hispanic/Latino and non-Hispanic White counterparts. Additionally, ever smoker prevalence rates in 2018 were similar for Hispanics/Latinos with less than a high school education (18.5%; CI:16.2–20.8) and non-Hispanic White college graduates (17.7%; CI:16.9–18.5).

PLACEHOLDER: INSERT FIGURE 1 (graphs at the end of this document)

Current Smoking Prevalence

Current smoking prevalence by race/ethnicity across education level is presented in Figure 2. Current cigarette smoking among African Americans decreased significantly across all education levels between 1992/93–2018, except those with less than a high school education. In 1992/93, current smoking prevalence among African Americans who did not complete high school (31.3%; CI:29.9–32.7) was more than double that of college graduates (14.8%; CI:13.3–16.3). By 2018, the education-level disparity had widened to a five-fold difference (30.0%; CI:23.4–36.5 and 6.2%; CI:4.7–7.8, respectively), in large part due to a significant decline among college graduates (-0.40%/year).

Differences in current smoking by education level were significant but less pronounced among Hispanics/Latinos than African Americans and non-Hispanic Whites. In 1992/93, current smoking prevalence among Hispanics/Latinos without a high school education was 21.1% (CI:19.8–22.4) compared to 12.7% (CI:10.7–

14.7) for college graduates. By 2018, current smoking prevalence had decreased to 11.3% (CI:9.0–13.6) for those who did not complete high school compared to 4.3% (CI:2.8–5.8) for those who completed college.

There were marked differences in current smoking prevalence by education level for non-Hispanic Whites. In 1992/93, the difference was nearly three-fold between current smokers with less than a high school education (35.3%; CI:34.2–36.4) and those who graduated college (12.0%; CI:11.7–12.3). This disparity by education level continued such that, by 2018, the current smoking prevalence between non-Hispanic Whites with less than a high school education (29.5%; CI:27.0–32.1) was about six times greater than college graduates (5.0%; CI:4.5–5.4).

The education-level gradient for current smoking was more pronounced for African Americans and non-Hispanic Whites than for Hispanics/Latinos. However, current smoking rates among those who graduated college were similar (approximately 4–6%) across race/ethnicity by 2018.

PLACEHOLDER: INSERT FIGURE 2 (graphs at the end of this document)

Cigarette Consumption

Consumption as measured by cigarettes per day is presented by race/ethnicity across education level in Figure 3. Differences in cigarette consumption were not pronounced across education levels among African Americans, with about 2 CPD difference in 1992/93 between those who did not complete high school (12.4 CPD; CI:11.8–13.0) and those who completed college (10.5 CPD; CI:9.5–11.5). Consumption declined over time, and by 2018, those with less than a high school education smoked about 2.8 CPD (9.1 CPD; CI:7.3–10.9) about 2.8 CPD more than college graduates (6.3 CPD; CI:4.7–7.9).

Differences in cigarette consumption for Hispanics/Latinos were not pronounced across education levels. In 1992/93, there was no significant difference in CPD between those who did not complete high school (10.4 CPD; CI:9.7–11.1) and college graduates (11.3 CPD; CI:9.6–13.0). Consumption levels decreased over time such that, by 2018, Hispanics/Latinos with less than a high school education smoked about 2.2 CPD more (7.6 CPD; CI:6.2–8.9) than college graduates (5.4 CPD; CI:3.7–7.1).

Non-Hispanic Whites had the highest consumption levels across race/ethnicity over time. In 1992/93, cigarette consumption among non-Hispanic Whites with less than a high school education was 20.0 CPD (CI:19.7–20.3) compared to 16.0 CPD (CI:15.6–16.4) among college graduates. Consumption declined significantly across

educational levels over time, such that by 2018, non-Hispanic Whites with less than a high school education were consuming 5.2 CPD more (15.1; CI:14.1–16.1) than those who graduated college (9.9 CPD; CI:9.1–10.7).

Non-Hispanic Whites had the highest cigarette consumption compared to African Americans and Hispanics/Latinos across education level and over time. However, consumption levels were similar for non-Hispanic White college graduates and African Americans with less than a high school education. Differences in consumption between educational levels for non-Hispanic Whites also were more pronounced compared to African Americans and Hispanics/Latinos.

PLACEHOLDER: INSERT FIGURE 3 (graphs at the end of this document)

Quit Ratios

Quit ratios by race/ethnicity across education level are presented in Figure 4. African Americans had higher quit ratios with greater educational attainment. In 1992/93, the quit ratio for African Americans who completed college was 17-percentage points higher (55.6%; CI:51.7–59.5) than those who did not complete high school (38.7%; CI:37.2–40.2). The education-level disparity remained significant over time, with higher quit ratios reported in African Americans with higher education levels. By 2018, African Americans with less than a high school education had a quit ratio of 35.3% (CI:28.6–41.9) compared to 53.9% (CI:42.9–64.8) for college graduates.

Quit ratios among Hispanics/Latinos also were higher among those with greater educational attainment. In 1992/93, the quit ratio among those with less than a high school education was 41.7% (CI: 39.4–44.0) and 59.3% (CI: 53.9–64.7) for college graduates. The quit ratio gap across education levels widened over time: by 2018, the quit ratio for Hispanics/Latinos who did not complete high school was 47.9% (CI: 39.4–56.5) and 74.3% (CI: 65.4–83.3) and who graduated college. Across education levels, the annual rate of change for quit ratios increased significantly only for Hispanics/Latinos who completed college (0.71%/year).

There was a positive relationship between the quit ratio and education level among non-Hispanic Whites. The quit ratio for non-Hispanic Whites with less than high school education (about 49%) and high school graduates (53-54%) remained flat from 1992/93-2018. Those with some college education exhibited a modest increase in the quit ratio from 1992/93 (56.6%; CI:55.8–57.4) to 2018 (58.3%; CI:56.3–60.3), and the quit ratio among college graduates increased from 70.6% (CI:69.8–71.4) in 1992/93 to 76.6% (CI:74.5–78.7) in 2018.

African Americans continued to have the lowest quit ratios across all education levels compared to Hispanics/Latinos and non-Hispanic Whites from 1992-2018, with a decrease in quit ratios by 2018 for African Americans who did not complete high school and graduated college. In contrast, quit ratios of Hispanic/Latino and non-Hispanic White college graduates increased significantly over time, particularly for Hispanics/Latinos.

PLACEHOLDER: INSERT FIGURE 4 (graphs at the end of this document)

Discussion

As the US enters a new decade and new targets are being developed for Healthy People 2030, analysis of nationally-representative population-level data can shed light on smoking trends between 1992 to 2018. Our study findings show the continued decline of tobacco use over the past three decades. However, this progress has been most pronounced for highly educated non-Hispanic Whites, while highly educated African Americans and Hispanics/Latinos and lower education levels across all races have remained at risk. These findings are in line with the *Minorities' Diminished Returns* theory [12,13], which postulates that non-Hispanic Whites may experience a greater protective effect with increasing educational attainment than racial/ethnic minorities. Our study also found that smoking prevalence and cigarette consumption levels have been historically higher in general among non-Hispanic Whites than African Americans and Hispanics/Latinos. Upon closer examination, prevalence and cigarette consumption by race/ethnicity within education levels revealed substantial disparities between African Americans and non-Hispanic Whites, but were less evident compared to Hispanics/Latinos.

While previous research indicated that socioeconomic factors can explain differences in smoking across race/ethnicity [4], our analysis suggests that the relative importance of educational attainment varies substantially by race/ethnicity. For example, there were marked differences in smoking behavior over time across educational attainment between African Americans and non-Hispanic Whites with decreases in smoking initiation (ever smoking), smoking prevalence (current smoking), and cigarette consumption (CPD), while smoking cessation (quit ratios) was generally increasing. Hispanics/Latinos followed similar trends, but the gap between those with less than a high school education and those who graduated college were less marked in their difference compared to those for African Americans and non-Hispanic Whites. Our findings show that the influence of educational attainment among racial/ethnic groups is not only limited to prevalence, but extends across all smoking stages from initiation to

cessation, which suggests that persisting disparities could continue unless new smoking prevention strategies eliminate these educational differences.

Furthermore, African Americans had the lowest quit ratios across education levels and compared to the other racial/ethnic groups, and our findings did not show a significant decrease in ever smoking for African Americans between 1992 to 2018. Possible explanations contributing to smoking cessation disparities could be that African Americans were less likely to receive smoking cessation advice from a health care professional and use cessation treatments less often than non-Hispanic Whites [16,22]. This shortfall can be compounded since racial/ethnic minorities historically have lower utilization of health care services than non-Hispanic Whites, which has been partially attributed to socioeconomic factors (including education measures) [23].

The relationship between reduced cigarette use with greater educational attainment has been previously documented [7-9]. We recently found that young adults who attended college were less likely to smoke cigarettes than their nonattending counterparts and that the effect extended across race/ethnicities. In that study, we also found evidence support a “socio-ecological effect,” whereby college attenders had fewer friends who smoked, were exposed to fewer smoking advertisements, and perceived stronger anti-smoking norms [7].

Overall, this study’s findings support prior research that suggested a causal relationship between educational attainment and smoking behavior [5-6], and expand on past studies by including the impact of educational attainment on smoking rates among Hispanics/Latinos [11,24]. Study limitations include the potential role of unaccounted-for additional factors: for example, acculturation may influence smoking behaviors among Hispanics/Latinos [25], but the TUS-CPS lacked measures of acculturation. Furthermore, this study only focused on the three largest racial/ethnic groups in the US, but understanding the relationship between smoking and education among other races is important and would require targeting other minority groups. Also, self-report data from the national surveys may introduce systematic error, and are subject to information bias that can occur due to inaccurate recall and social desirability. Lastly, causality cannot be established based on cross-sectional data.

Conclusion

This study highlights the importance of considering both education levels and race/ethnicity when examining smoking behavior. Increasing educational attainment for specific races could by extension reduce racial/ethnic disparities in smoking to an extent, particularly since disparities persist and further widen among

African Americans and non-Hispanic Whites by education level. It is noteworthy that such smoking-by-education disparities were not as evident for Hispanics/Latinos, suggesting the need to investigate possible factors that account for these findings. Efforts to increase cessation have been mainly successful in college graduates, highlighting the need to further explore strategies to improve quitting success among the lower education levels across race/ethnicity.

Our analysis of population-level data over time will help understand smoking behavior patterns and changes in disparities as they relate to educational attainment. Our findings also suggest that education may not fully serve as an equalizer, but rather, can be a possible source of inequalities where non-Hispanic Whites may benefit more than other racial/ethnic minorities. Study findings will also help identify progress achieved in meeting the Healthy People objectives to reduce tobacco use, and provide insight to help inform and refine future public health strategies.

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(FIGURES IN THE MAIN TEXT)

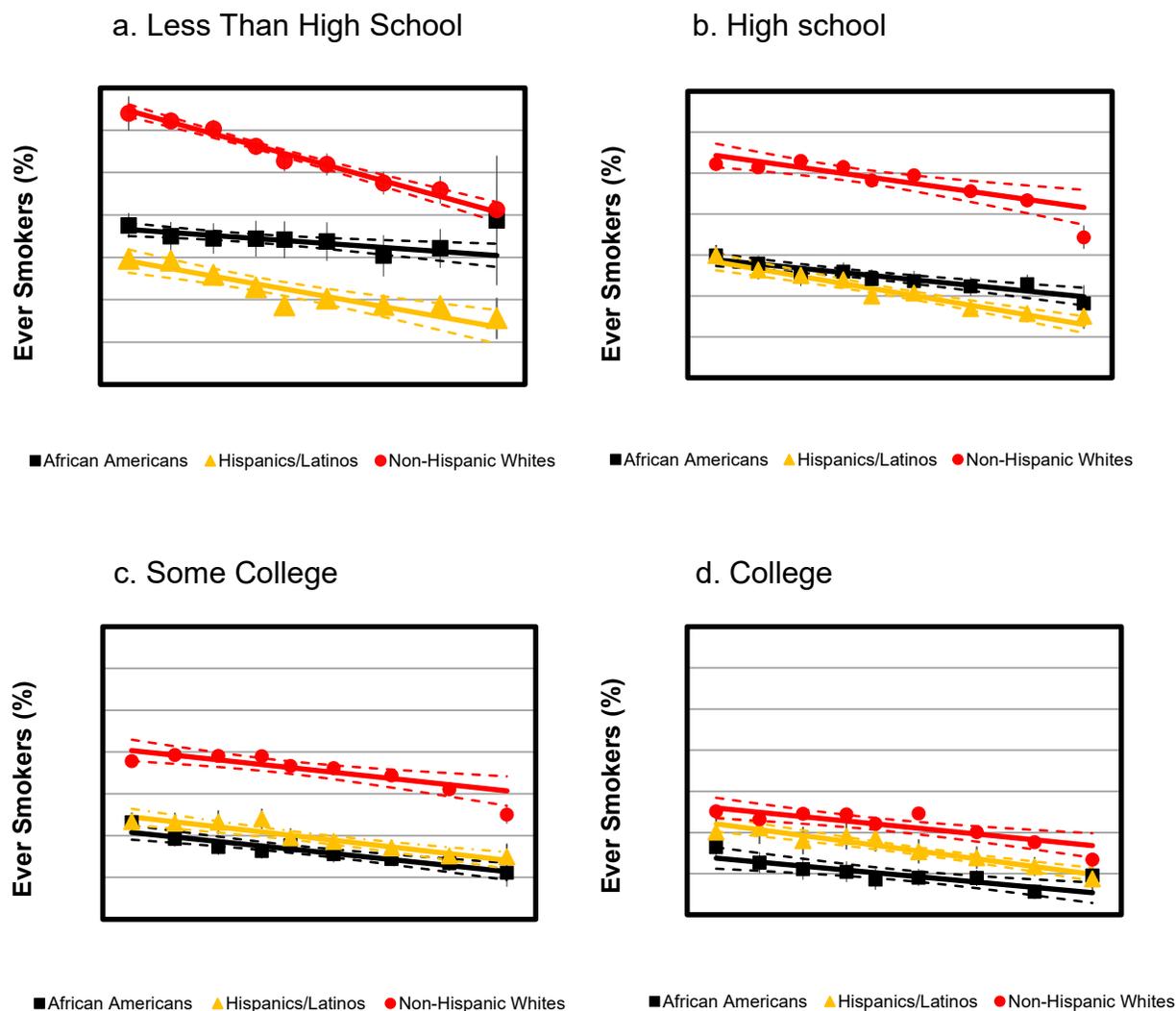


Fig 1. Ever Smoking Prevalence and Trend Lines by Race/Ethnicity across Education Level (18+ years old) based on Tobacco Use Supplement-Current Population Surveys (TUS-CPS) in the United States, 1992/93-2018. Stratification of ever smoking prevalence was by education levels, where Panel A represents the percentage of current smokers with less than a high school education, Panel B represents the percentage who graduated high school, Panel C represents the percentage with some college education, and Panel D represents the percentage who graduated college. The x-axis represents each TUS-CPS, and the y-axis is the percentage of adult ever smokers (ages 18-35). Solid lines are the trend lines of the point estimates, where squares represent African Americans, triangles for Hispanics/Latinos, and circles for non-Hispanic Whites. Dotted lines are the 95% confidence intervals for each trend line.

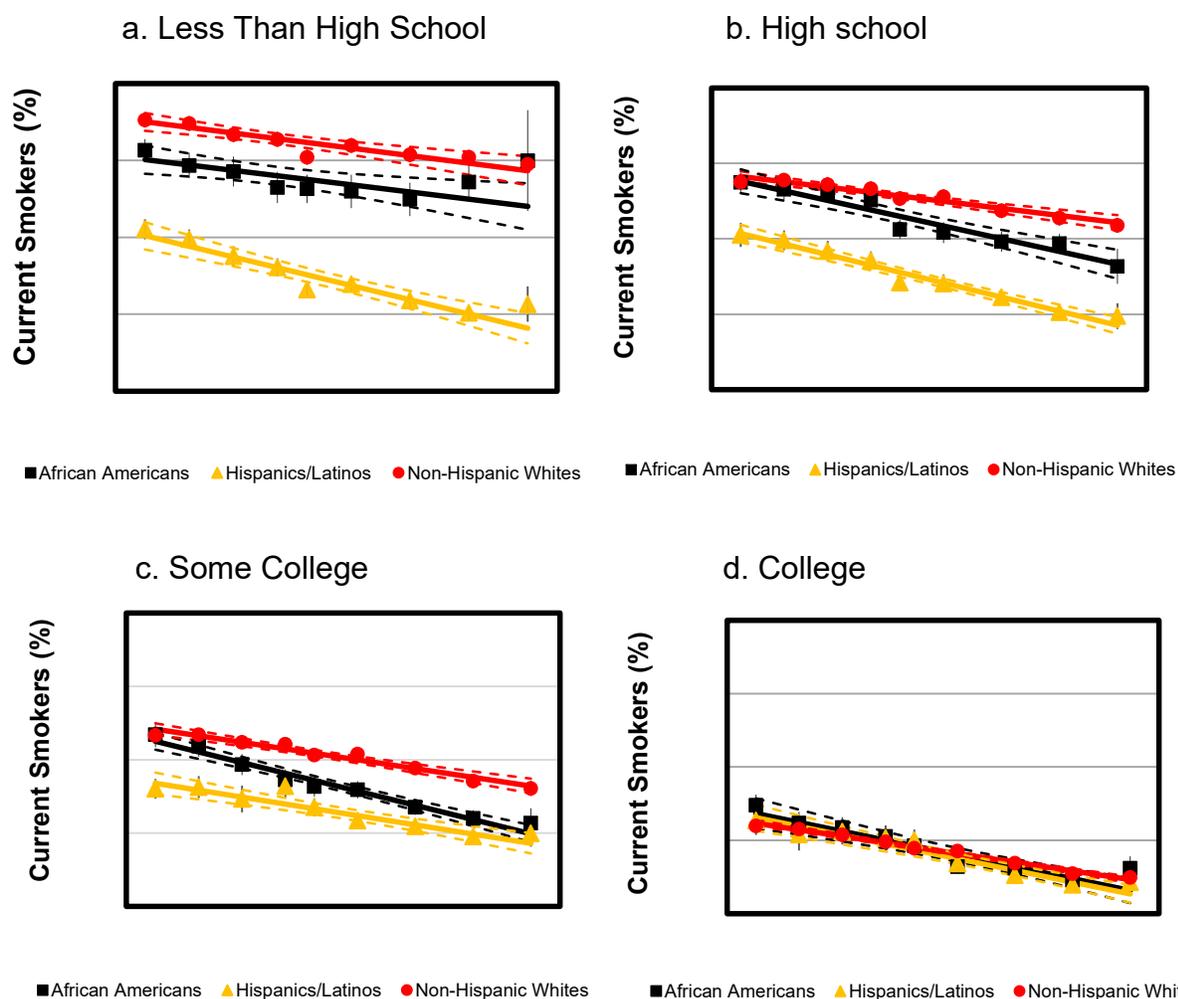


Fig 2. Current Smoking Prevalence and Trend Lines by Race/Ethnicity across Education Level (18+ years old) based on Tobacco Use Supplement-Current Population Surveys (TUS-CPS) in the United States, 1992/93-2018. Stratification of current smoking prevalence was by education levels, where panel A represents the percentage of current smokers with less than a high school education, B represents the percentage who graduated high school, C represents the percentage with some college education, and D represents the percentage who graduated college. The x-axis represents each TUS-CPS, and the y-axis is the percentage of adult current smokers (age 18+). Solid lines are the trend lines of the point estimates, where squares represent African Americans, triangles for Hispanics/Latinos, and circles for non-Hispanic Whites. Dotted lines are the 95% confidence intervals for each trend line.

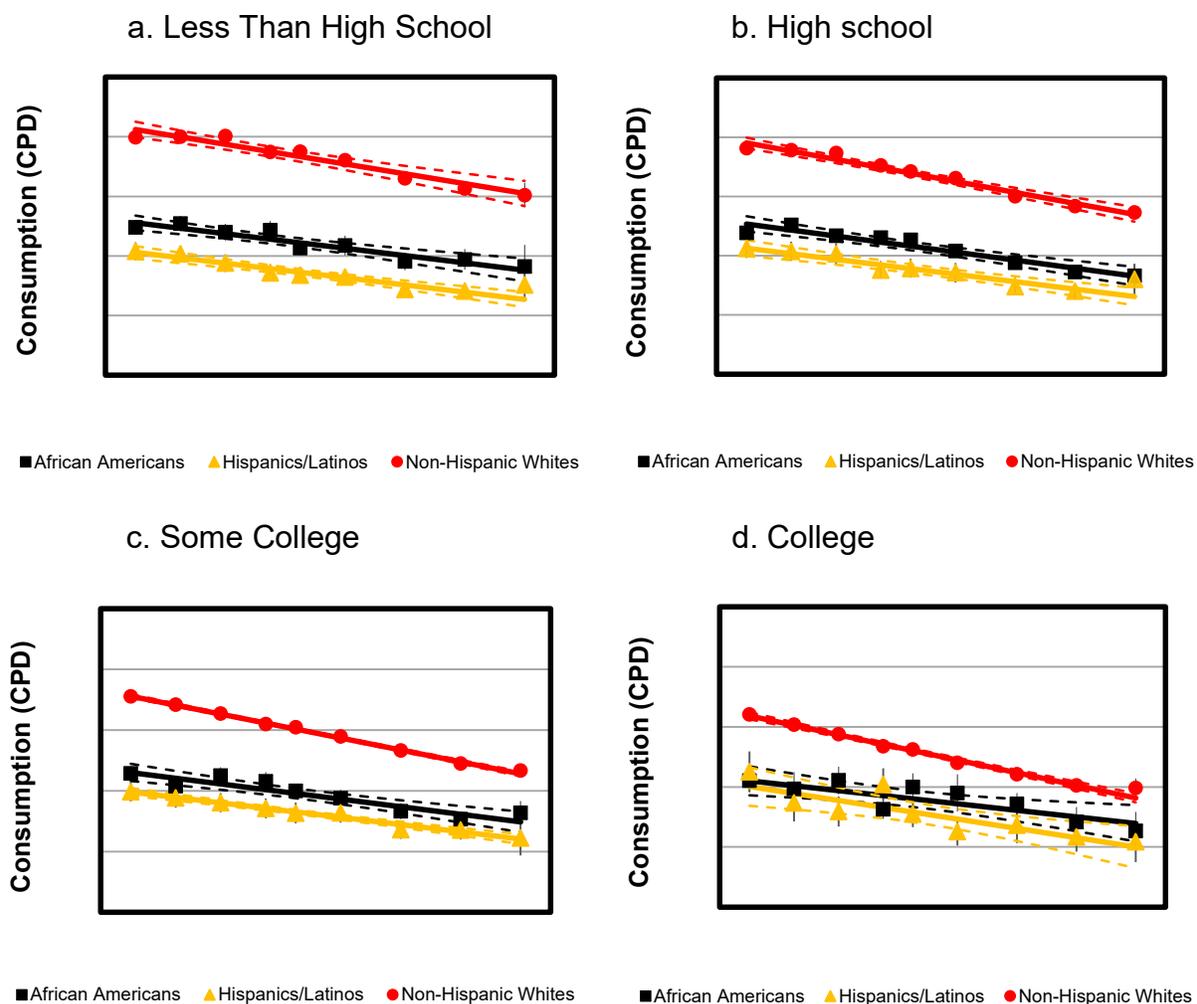


Fig 3. Cigarette Smoking Consumption (defined as cigarettes per day) and Trend Lines by Race/Ethnicity across Education Level (18+ years old) based on Tobacco Use Supplement-Current Population Surveys (TUS-CPS) in the United States, 1992/93-2018. Stratification of cigarette smoking consumption was by education levels, where Panel A represents the percentage of smokers with less than a high school education, Panel B represents the percentage who graduated high school, Panel C represents the percentage with some college education, and Panel D represents the percentage who graduated college. The x-axis represents each TUS-CPS, and the y-axis is the cigarette consumption of adult smokers (age 18+). Solid lines are the trend lines of the point estimates, where squares represent African Americans, triangles for Hispanics/Latinos, and circles for non-Hispanic Whites. Dotted lines are the 95% confidence intervals for each trend line.

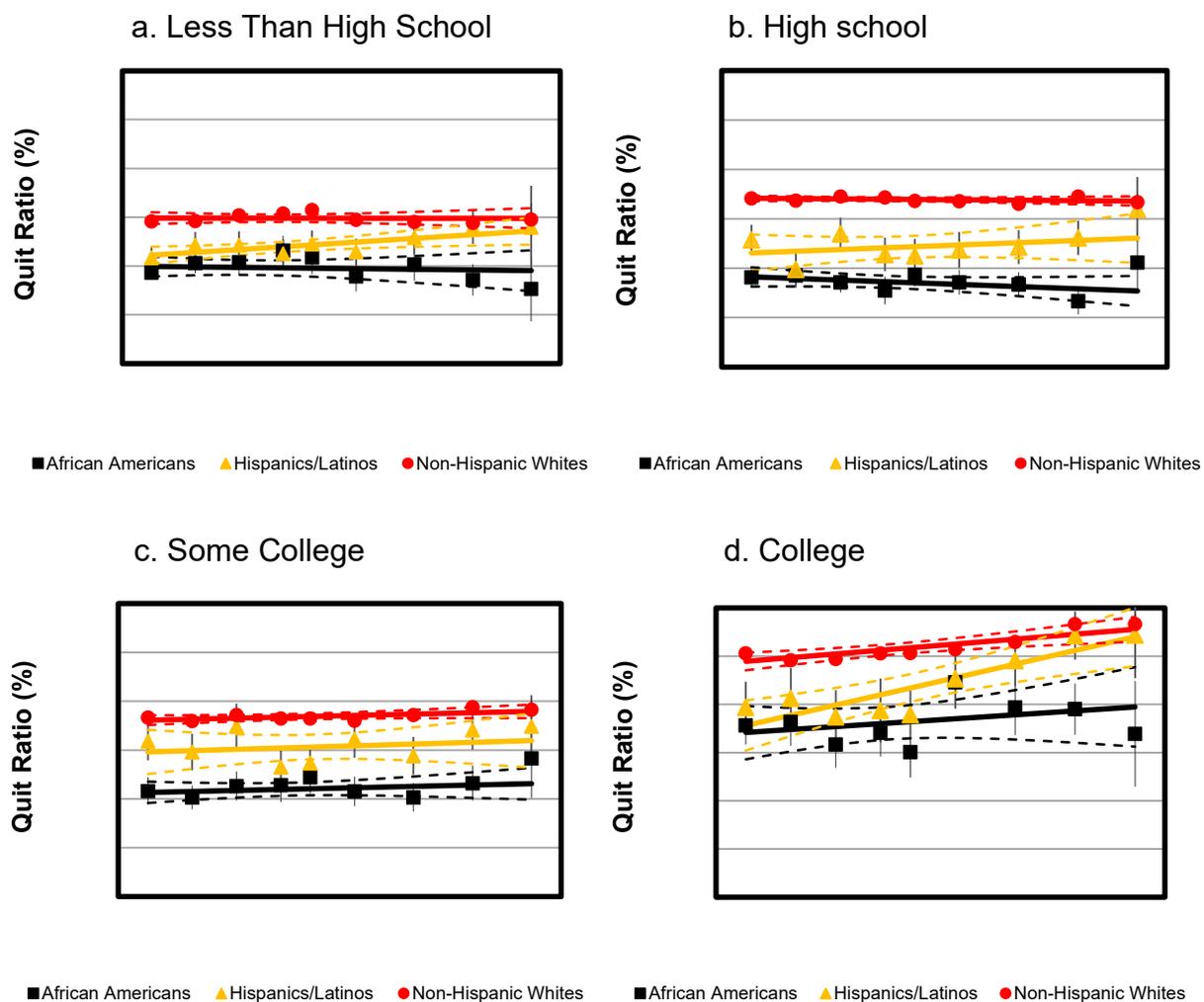


Fig 4. Quit Ratios and Trend Lines by Race/Ethnicity across Education Level (25+ years old) based on Tobacco Use Supplement-Current Population Surveys (TUS-CPS) in the United States, 1992/93-2018. Stratification of quit ratios was by education levels, where Panel A represents the percentage of smokers who quit with less than a high school education, Panel B represents the percentage who graduated high school, Panel C represents the percentage with some college education, and Panel D the represents the percentage who graduated college. The x-axis represents each TUS-CPS, and the y-axis is the percentage of the population (age 25+) who has quit smoking. Solid lines are the trend lines of the point estimates, where squares represent African Americans, triangles for Hispanics/Latinos, and circles for non-Hispanic Whites. Dotted lines are the 95% confidence intervals for each trend line.

(TABLE IN THE APPENDIX)**Table A1.** Demographic Characteristics of Age, Sex, and Education Level by Race/Ethnicity (African Americans, Hispanics/Latinos, and non-Hispanic Whites) from 1992/93-2018 Tobacco Use Supplement-Current Population Surveys (TUS-CPS) in the United States (N=1,441,072)

	African Americans	Hispanics/ Latinos	Non-Hispanic Whites
Sample from all surveys (n, %)	136,225 (9.5%)	126,379 (8.8%)	1,178,468 (81.8%)
1992/93 TUS-CPS (N)	19,510	13,890	186,781
Weighted mean age (years, CI)	41.1 (0.06)	38.0 (0.12)	45.3 (0.02)
Sex (n, %)			
males	7,050 (44.2%)	5,967 (50.3%)	81,063 (47.9%)
females	12,460 (55.8%)	7,923 (49.7%)	105,718 (52.1%)
Education (n, %)			
less than high school	5,873 (28.2%)	6,047 (44.4%)	28,636 (15.2%)
high school graduate	6,880 (35.7%)	3,905 (27.5%)	68,182 (35.7%)
some college	6,027 (32.4%)	3,560 (25.5%)	75,966 (41.5%)
college graduate	730 (3.7%)	378 (2.5%)	13,997 (7.6%)
1995/96 TUS-CPS (N)	16,765	12,689	150,826
Weighted mean age (years, CI)	41.5 (0.07)	38.4 (0.10)	45.9 (0.02)
Sex (n, %)			
males	5,996 (44.6%)	5,311 (49.8%)	64,694 (48.0%)
females	10,769 (55.4%)	7,378 (50.2%)	86,132 (52.0%)
Education (n, %)			
less than high school	4,472 (24.7%)	5,520 (44.3%)	20,938 (13.8%)
high school graduate	5,715 (34.7%)	3,506 (26.8%)	51,694 (33.6%)
some college	5,928 (36.9%)	3,326 (26.3%)	65,972 (44.3%)
college graduate	650 (3.7%)	337 (2.6%)	12,222 (8.3%)
1998/99 TUS-CPS (N)	15,789	13,333	140,314
Weighted mean age (years, CI)	42.0 (0.07)	38.9 (0.10)	46.4 (0.02)
Sex (n, %)			
males	5,748 (44.3%)	5,842 (49.8%)	61,050 (48.2%)
females	10,041 (55.7%)	7,491 (50.2%)	79,264 (51.8%)

Education (n, %)			
less than high school	3,830 (22.3%)	5,502 (41.5%)	17,616 (12.5%)
high school graduate	5,431 (35.3%)	3,733 (28.0%)	47,294 (33.1%)
some college	5,768 (37.9%)	3,726 (27.6%)	63,199 (45.6%)
college graduate	760 (4.4%)	372 (2.9%)	12,205 (8.8%)
2001/02 TUS-CPS (N)	16,554	14,087	146,773
Weighted mean age (years, CI)	42.2 (0.07)	39.3 (0.08)	46.7 (0.02)
Sex (n, %)			
males	6,340 (44.5%)	6,424 (49.1%)	64,744 (48.3%)
females	10,214 (55.5%)	7,663 (50.9%)	82,029 (51.7%)
Education (n, %)			
less than high school	3,761 (21.4%)	5,736 (41.7%)	17,050 (11.6%)
high school graduate	5,590 (34.4%)	4,033 (27.8%)	47,984 (31.9%)
some college	6,369 (39.5%)	3,885 (27.7%)	68,119 (47.1%)
college graduate	834 (4.7%)	433 (2.8%)	13,620 (9.4%)
2003 TUS-CPS (N)	15,719	16,106	142,208
Weighted mean age (years, CI)	42.7 (0.07)	38.8 (0.05)	47.1 (0.02)
Sex (n, %)			
males	5,907 (44.2%)	7,316 (51.2%)	62,357 (48.1%)
females	9,812 (55.8%)	8,790 (48.8%)	79,851 (51.9%)
Education (n, %)			
less than high school	3,357 (20.3%)	6,462 (41.0%)	14,917 (10.4%)
high school graduate	5,394 (34.4%)	4,642 (28.1%)	45,940 (31.5%)
some college	6,113 (40.5%)	4,506 (28.0%)	67,530 (48.1%)
college graduate	855 (4.8%)	496 (2.8%)	13,821 (9.9%)
2006/07 TUS-CPS (N)	14,792	16,219	131,057
Weighted mean age (years, CI)	42.9 (0.07)	39.4 (0.05)	47.6 (0.02)
Sex (n, %)			
males	5,570 (44.6%)	7,297 (51.5%)	57,456 (48.3%)
females	9,222 (55.4%)	8,922 (48.5%)	73,601 (51.7%)
Education (n, %)			
less than high school	2,993 (19.1%)	6,365 (39.6%)	12,601 (9.5%)
high school graduate	4,954 (33.9%)	4,476 (27.5%)	41,135 (30.9%)

some college	5,950 (41.5%)	4,823 (29.7%)	63,639 (49.2%)
college graduate	895 (5.5%)	555 (3.3%)	13,682 (10.4%)
2010/11 TUS-CPS (N)	16,217	17,830	126,532
Weighted mean age (years, CI)	43.5 (0.05)	40.0 (0.05)	48.2 (0.02)
Sex (n, %)			
males	6,390 (44.9%)	7,905 (51.3%)	56,578 (48.3%)
females	9,827 (55.1%)	9,925 (48.7%)	69,954 (51.7%)
Education (n, %)			
less than high school	2,740 (16.5%)	6,013 (33.6%)	10,201 (8.3%)
high school graduate	5,318 (33.0%)	5,201 (29.9%)	37,774 (29.4%)
some college	7,034 (44.3%)	5,902 (32.8%)	63,699 (50.8%)
college graduate	1,125 (6.2%)	714 (3.7%)	14,858 (11.5%)
2014/15 TUS-CPS (N)	16,393	17,242	119,814
Weighted mean age (years, CI)	44.3 (0.07)	40.7 (0.06)	49.4 (0.02)
Sex (n, %)			
males	6,496 (44.9%)	7,686 (49.7%)	54,389 (48.5%)
females	9,897 (55.1%)	9,556 (50.3%)	65,425 (51.5%)
Education (n, %)			
less than high school	2,385 (13.4%)	5,063 (28.8%)	8,150 (6.7%)
high school graduate	5,382 (32.8%)	5,198 (30.5%)	33,376 (27.2%)
some college	7,237 (45.9%)	6,137 (36.4%)	62,332 (53.1%)
college graduate	1,389 (7.8%)	844 (4.3%)	15,956 (13.0%)
2018 TUS-CPS (N)	4,486	4,983	34,163
Weighted mean age (years, CI)	44.9 (0.13)	41.6 (0.10)	50.0 (0.04)
Sex (n, %)			
males	1,826 (45.6%)	2,181 (49.6%)	15,692 (48.5%)
females	2,660 (54.4%)	2,802 (50.4%)	18,471 (51.5%)
Education (n, %)			
less than high school	519 (9.7%)	1,236 (23.6%)	1,843 (5.2%)
high school graduate	1,441 (32.3%)	1,543 (32.2%)	8,929 (26.0%)
some college	2,104 (49.1%)	1,921 (39.2%)	18,303 (54.3%)
college graduate	422 (8.9%)	283 (5.0%)	5,088 (14.5%)