
Original investigation

Racial/Ethnic Differences in Duration of Smoking Among Former Smokers in the National Health and Nutrition Examination Surveys

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Abstract

Introduction: The burden of tobacco-related disease is not uniformly distributed across racial/ethnic groups. Differences in smoking duration by race/ethnicity may contribute to this disparity. Previous studies have examined racial/ethnic differences in smoking duration among ever smokers (former and current smokers combined). It is unknown if racial/ethnic differences in smoking duration are evident among quitters. This study examined racial/ethnic differences in duration of smoking among former smokers in the United States.

Methods: We studied 6030 white, black, and Mexican-American former smokers (3647 men and 2383 women) aged 20–79 years who participated in the National Health and Nutrition Examination Survey (NHANES) from 1999 through 2012. Mean differences in smoking duration by race/ethnicity were estimated using linear regression models.

Results: After adjustment for demographics, age at smoking initiation and smoking intensity, compared to white men, black men smoked for 2.3 (95% confidence interval [CI]: 1.3, 3.3) years longer before quitting and Mexican-American men for 0.2 (95% CI: –1.6, 1.2) years less before quitting. Compared to white women, black women smoked for 1.9 (95% CI: 0.7, 3.0) years longer before quitting and Mexican-American women for 0.9 (95% CI: –2.4, 0.5) years less before quitting.

Conclusions: In a representative sample of US adults, black former smokers continued smoking for longer periods before quitting compared to white former smokers. These findings support the need for smoking cessation efforts that address racial/ethnic differences in smoking behaviors. The longer time to quit among black former smokers should be investigated as an explanation for racial/ethnic disparities in smoking-associated diseases.

Implications: In a representative sample of US adults that successfully quit smoking, the timing of smoking cessation differed by race/ethnicity with blacks smoking for longer periods before quitting compared to whites. Racial/ethnic differences in duration of smoking among former smokers differed by participant age and age at smoking initiation. These findings support the need for smoking cessation efforts that address racial/ethnic differences in smoking behaviors.

Introduction

Tobacco use is the leading cause of preventable mortality in the United States.¹ The burden of tobacco-related disease, however, is not uniformly distributed across the population. Despite smoking fewer cigarettes per day,² black men and women have a higher mortality rate for tobacco-related cancers compared to their white counterparts.³⁻⁵ African Americans also have the highest mortality rates for coronary heart disease and stroke followed by non-Hispanic whites and Hispanics, respectively.⁵⁻⁷ Racial/ethnic differences in smoking behaviors other than smoking intensity may explain disparities in tobacco-related disease. Previous studies have examined racial/ethnic differences in current smoking prevalence or smoking cessation ratios.⁸⁻¹⁷ Data from the 2013 National Health Interview Survey showed that the prevalence of current cigarette use among white (19%) and black (18%) adults was significantly higher than among Hispanics (12%).¹⁷ The percentage of ever smokers who had quit (ie, quit ratio) also differs by race/ethnicity, with the highest quit ratio observed for whites (51%), followed by Hispanics (43%) and being lowest among blacks (37%).⁸

Duration of smoking can have health implications separate from other measures of tobacco use, such as smoking intensity or cumulative dose.¹⁸⁻²¹ Longer duration of smoking has been associated with reductions in life expectancy and increases in risk for smoking-associated diseases.^{1,22-24} Among current smokers, each 5 year increase in smoking duration was associated with a 20% higher odds of lung cancer.²² Among former smokers, the benefits in reduced morbidity and mortality for tobacco-associated diseases decrease with longer time to smoking cessation.¹

Differences in smoking duration by race/ethnicity may contribute to racial/ethnic disparities in smoking-associated diseases. Previous studies examining racial/ethnic differences in duration of smoking have focused on differences among ever smokers (ie, current and former smokers combined) and found longer smoking durations among black ever smokers and shorter durations among Hispanic/Latino ever smokers compared to whites.^{16,25} It is unknown if racial/ethnic differences in the duration of smoking are evident among persons who have quit smoking (ie, how long does a smoker continue smoking before quitting). The objective of this study was to examine differences in the duration of smoking comparing non-Hispanic white, non-Hispanic black and Mexican-American former smokers. Racial/ethnic differences in smoking duration among former smokers may indicate differences in the quitting process or differences in timing of smoking cessation services by some racial/ethnic groups which can inform smoking cessation treatment programs aimed at reducing racial/ethnic disparities in tobacco-associated diseases.

Methods

Study Population

The National Health and Nutrition Examination Survey (NHANES) is conducted by the US National Center for Health Statistics (NCHS; Centers for Disease Control and Prevention [CDC], Atlanta, GA), using a complex multistage sampling design to obtain a representative sample of the civilian non-institutionalized US population.²⁶ NHANES study protocols for the 1999–2012 survey years were approved by the National Center for Health Statistics Institutional Review Board, and oral and written informed consent was obtained from all participants. For this cross-sectional analysis, we used data from 8347 former smokers 20–79 years of age who participated in

NHANES 1999–2012 interviews and examinations. We excluded 276 pregnant women, 871 participants of racial/ethnic groups other than non-Hispanic white, non-Hispanic black or Mexican American, 706 participants missing age at smoking initiation or cessation (needed to estimate years of smoking), 431 former smokers who reported never smoking regularly (ie, former occasional smokers) and 33 participants who were missing other relevant covariates, leaving 6030 participants (3647 men and 2383 women) for this study.

Participant Characteristics and Cigarette Use

Self-reported information on sex, age, race/ethnicity, and education was collected by interview. Race/ethnicity was subsequently categorized by NCHS as non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, and other race. The number of other Hispanic ($N = 440$) and other race/ethnicity ($N = 298$) former smokers were too small to be analyzed separated and these participants were excluded. Information on smoking status and behavior was obtained from a self-reported questionnaire administered to participants ≥ 20 years of age. Former smokers were defined as individuals who reported smoking ≥ 100 cigarettes in their lifetime but were not currently smoking at the time of the NHANES interview. To assess smoking initiation and cessation, participants were asked, “How old were you when you first started to smoke cigarettes fairly regularly?” and “How old were you when you last smoked cigarettes fairly regularly?” Responses to these questions were used to determine the age when participants started smoking regularly and the age when participants last smoked regularly. Duration of smoking was calculated using the age last smoked cigarettes regularly minus the age when started smoking regularly. Information was also obtained on the number of cigarettes usually smoked per day at the time of quitting (ie, at the age they last smoked regularly). Number of cigarettes smoked for the entire smoking history was not ascertained. As pack-years of smoking combines smoking duration with intensity, pack-years were not calculated. Data on age of smoking initiation and cessation were not available for participants that reported never smoking cigarettes regularly.

Statistical Analysis

Descriptive statistics were stratified by sex and race/ethnicity (non-Hispanic white [“white”], non-Hispanic black [“black”], and Mexican American). We used linear regression models to estimate unadjusted and multivariable-adjusted mean differences in duration of smoking comparing black and Mexican-American former smokers to white former smokers. Multivariable models were adjusted first for age (continuous), sex and country of birth (US-born/non-US born) (Model 1). Second, we adjusted for education (<high school/high school/>high school) (Model 2). Third, we adjusted for age at smoking initiation (continuous) (Model 3). More intense smoking behavior, measured by more frequent smoking or a larger number of cigarettes smoked per day, may prolong smoking and making quitting difficult.²⁷⁻²⁹ To account for differences in intensity of smoking prior to quitting, we further adjusted for the number of cigarettes smoked per day at time of quitting (continuous) (Model 4). Analyses were conducted for all former smokers (“overall”) and separately for men and women.

To assess if racial/ethnic differences in smoking duration differ by age or age at smoking initiation, we also estimated the mean difference in duration of smoking comparing black and Mexican-American former smokers to white former smokers stratified by

tertiles of participant age at the time of NHANES participation and by tertiles of age at smoking initiation. Tertile cutoffs were based on the weighted distributions of age and age at smoking initiation in the study population. Effect modification was examined using a product term of the indicator variables for the participants' race/ethnicity and tertile of age at NHANES participation or at smoking initiation. Using the Wald test, the *p*-values for interaction were combined into a single *p*-value for interaction ("pinteraction"). All statistical analyses were performed using the survey package (version 3.28) in R software (version 3.0.2) to account for the complex sampling design and weights in NHANES 1999–2012 and to obtain appropriate estimates and standard errors. All statistical tests were two-sided and confidence intervals were set at 95%.

Results

Characteristics of Former Smokers by Race/Ethnicity

Eighty-six percent of former smokers were white, 7.5% were black, and 6.4% were Mexican American. Compared to former smokers from other race/ethnicities, white former smokers were older and had higher education at the time of participation in NHANES, and smoked more cigarettes per day at the time of quitting (Table 1). Mexican-American former smokers on the other hand were younger, had less education, were more likely to be born outside the United States and smoked fewer cigarettes per day at the time of quitting. The mean age at smoking initiation was youngest for Mexican-American men and white women compared to other race/ethnicities (mean age at smoking initiation was 17.2, 18.2, and 16.9 years for white, black, and Mexican-American men, respectively and 18.2, 19.2, and 19.3 years for white, black, and Mexican-American women, respectively, Table 1). Black former smokers were older at the time of quitting compared to other race/ethnicities (mean age at smoking cessation was 36.2, 38.6, and 32.0 years for white, black, and Mexican-American men, respectively and 36.0, 39.7, and 32.8 years for white, black, and Mexican-American women,

respectively, Table 1). In unadjusted analyses, duration of smoking was longest among black men and women and shortest among Mexican-American men and women.

Differences in Smoking Duration by Race/Ethnicity

Among male former smokers, black men smoked significantly longer than their white counterparts (1.4 years, 95% CI: 0.1, 2.6; Table 2, Unadjusted); this difference increased with further adjustment for covariates including age at initiation and intensity of smoking at time of quitting (2.3 years, 95% CI: 1.3, 3.3; Table 2, Model 4). In contrast, Mexican-American men smoked significantly less than their white counterparts (–4.0 years, 95% CI: –5.2, –2.8; Table 2, Unadjusted), though this difference was attenuated and no longer significant with full adjustment for covariates (Table 2, Model 4). Similar patterns were observed for female former smokers. Among female former smokers, black women smoked significantly longer than white women (2.8 years, 95% CI: 1.5, 4.1; Table 2, Unadjusted); this difference was slightly attenuated and no longer statistically significant with further adjustment for covariates including age at initiation and intensity of smoking at time of quitting (1.9 years, 95% CI: 0.7, 3.0; Table 2, Model 4). In contrast, Mexican-American women smoked significantly less than their white counterparts (–4.3 years, 95% CI: –5.5, –3.0; Table 2, Unadjusted), though this difference was attenuated and no longer significant with full adjustment for covariates (Table 2, Model 4).

Differences in Smoking Duration by Race/Ethnicity, Effects of Age at Time of NHANES Participation

Racial/ethnic differences in duration of smoking differed by participant age for men ($p_{\text{interaction}} = .002$) and women ($p_{\text{interaction}} = .003$). Among men <48 years of age, there were no racial/ethnic differences in duration of smoking among male former smokers (Table 3, Model 4). However, black men 48–62 years of age smoked for 2.7 (95% CI: 0.8, 4.5) years longer before quitting and black men >62 years of age smoked for 3.4 (95% CI: 1.5, 5.3)

Table 1. Participant and Smoking Characteristics by Race/Ethnicity, NHANES 1999–2012

	Men			Women		
	White	Black	Mexican American	White	Black	Mexican American
N	2185 (85.2)	656 (7.0)	806 (7.8)	1522 (87.2)	471 (8.2)	390 (4.6)
Characteristics						
Age, y	55.5 (0.4)	55.2 (0.6)	46.2 (0.7)	53.5 (0.4)	55.4 (0.7)	46.5 (0.8)
Education						
<High school	731 (14.3)	185 (33.0)	261 (62.1)	343 (11.4)	95 (30.1)	153 (48.7)
High school	506 (26.4)	151 (27.1)	203 (17.3)	349 (23.2)	84 (23.1)	122 (21.9)
>High school	1008 (59.3)	275 (39.9)	327 (20.5)	774 (65.5)	190 (46.8)	273 (29.4)
Country of birth						
US-born	1848 (95.5)	504 (88.4)	637 (33.1)	1316 (96.1)	335 (98.2)	484 (52.6)
Non-US born	397 (4.5)	107 (11.6)	154 (66.9)	150 (3.9)	34 (1.8)	64 (47.4)
Age at initiation, y	17.2 (0.1)	18.2 (0.2)	16.9 (0.2)	18.2 (0.1)	19.2 (0.2)	19.3 (0.3)
Age at cessation, y	36.2 (0.3)	38.6 (0.5)	32.0 (0.5)	36.0 (0.4)	39.7 (0.6)	32.8 (0.7)
Years of smoking, y ^a	19.0 (0.3)	20.4 (0.5)	15.0 (0.5)	17.7 (0.4)	20.6 (0.6)	13.5 (0.6)
Cigarettes per day ^b	23.0 (0.4)	16.4 (0.5)	12.2 (0.6)	16.1 (0.4)	14.2 (0.7)	8.8 (0.6)

NHANES = National Health and Nutrition Examination Survey. Values represent N (weighted %) for categorical variables or means (standard errors) for continuous variables.

^aYears of smoking is the age last smoked cigarettes regularly minus the age when started smoking regularly.

^bCigarettes smoked per day at time of quitting.

Table 2. Mean Difference (95% CI) in Years of Smoking by Race/Ethnicity, NHANES 1999–2012

	N	Unadjusted	Model 1	Model 2	Model 3	Model 4
Overall						
White	3707	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	1127	2.0 (1.1, 3.0)*	1.7 (0.8, 2.6)*	0.7 (-0.1, 1.6)	1.7 (0.9, 2.5)*	2.1 (1.3, 2.9)*
Mexican American	1196	-3.9 (-4.8, -3.0)*	0.3 (-0.8, 1.4)	-1.9 (-2.9, -0.8)*	-1.2 (-2.2, -0.1)*	-0.4 (-1.5, 0.6)
Men						
White	2185	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	656	1.4 (0.1, 2.6)*	1.5 (0.5, 2.6)*	0.6 (-0.4, 1.6)	1.7 (0.8, 2.7)*	2.3 (1.3, 3.3)*
Mexican American	806	-4.0 (-5.2, -2.8)*	0.7 (-0.7, 2.2)	-1.4 (-2.8, -0.1)*	-1.0 (-2.4, 0.3)	-0.2 (-1.6, 1.2)
Women						
White	1522	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	471	2.8 (1.5, 4.1)*	1.9 (0.7, 3.1)*	0.9 (-0.3, 2.1)	1.6 (0.4, 2.8)*	1.9 (0.7, 3.0)*
Mexican American	390	-4.3 (-5.5, -3.0)*	-0.6 (-2.0, 0.8)	-2.6 (-4.2, -1.1)*	-1.5 (-2.9, 0.0)	-0.9 (-2.4, 0.5)

CI = confidence interval; NHANES = National Health and Nutrition Examination Survey. Model 1 adjusted for age, sex (overall only), and country of birth. Model 2 further adjusted for education. Model 3 further adjusted for age at smoking initiation. Model 4 further adjusted for intensity of smoking before quitting (number of cigarettes per day at time of quitting).

* $p < .05$ for t test.

Table 3. Mean Difference (95% CI) in Years of Smoking by Race/Ethnicity Stratified by Age at Participation, NHANES 1999–2012

Age at NHANES participation	N	Model 1	Model 2	Model 3	Model 4
Men					
Age <48 y					
White	515	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	167	-0.1 (-1.4, 1.1)	-0.7 (-2.0, 0.7)	-0.1 (-1.3, 1.2)	0.3 (-1.1, 1.6)
Mexican American	225	0.4 (-1.2, 2.0)	-1.2 (-2.8, 0.3)	-1.0 (-2.5, 0.4)	-0.5 (-2.0, 1.1)
Age 48–62 y					
White	674	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	202	1.9 (0.1, 3.8)*	0.7 (-1.2, 2.5)	2.0 (0.2, 3.8)*	2.7 (0.8, 4.5)*
Mexican American	228	1.2 (-1.1, 3.6)	-1.5 (-3.8, 0.8)	-0.7 (-3.1, 1.8)	0.4 (-2.0, 2.8)
Age >62 y					
White	996	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	287	2.5 (0.6, 4.3)*	1.3 (-0.5, 3.1)	2.8 (0.9, 4.6)*	3.4 (1.5, 5.3)*
Mexican American	353	0.6 (-2.8, 4.0)	-1.3 (-4.5, 2.0)	-0.9 (-4.0, 2.2)	0.0 (-3.1, 3.2)
Women					
Age <48 y					
White	366	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	110	1.4 (-0.4, 3.1)	0.8 (-0.9, 2.5)	1.6 (-0.1, 3.2)	1.8 (0.1, 3.5)*
Mexican American	102	0.5 (-1.0, 2.0)	-0.7 (-2.3, 1.0)	0.1 (-1.6, 1.7)	0.4 (-1.3, 2.0)
Age 48–62 y					
White	481	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	147	1.5 (-0.7, 3.8)	0.7 (-1.7, 3.0)	1.4 (-0.8, 3.6)	1.4 (-0.7, 3.6)
Mexican American	107	0.5 (-2.8, 3.8)	-1.4 (-4.9, 2.1)	-0.4 (-3.6, 2.8)	0.0 (-3.2, 3.1)
Age >62 y					
White	675	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	214	2.7 (0.4, 5.1)*	1.3 (-1.1, 3.7)	2.0 (-0.5, 4.6)	2.8 (0.1, 5.4)*
Mexican American	181	-5.7 (-9.5, -2.0)*	-8.4 (-12.2, -4.6)	-5.7 (-9.3, -2.2)*	-4.1 (-7.5, -0.6)*

CI = confidence interval; NHANES = National Health and Nutrition Examination Survey. Model 1 adjusted for age, and country of birth. Model 2 further adjusted for education. Model 3 further adjusted for age at smoking initiation. Model 4 further adjusted for intensity of smoking before quitting (number of cigarettes per day at time of quitting). Age cutoffs based on tertiles values from weighted distribution.

* $p < .05$ for t test.

years longer before quitting compared to their white counterparts (Table 3, Model 4). There was no statistical difference in smoking duration between Mexican-American men and their white counterparts among men aged 48–62 years or men >62 years. The pattern among female former smokers was slightly different. Among women <48 years of age, black women smoked 1.8 (95% CI: 0.1, 3.5) years longer before quitting compared to their white counterparts (Table 3, Model 4), but there was no significant difference in

smoking duration between Mexican-American women and whites. There were no racial/ethnic differences in duration of smoking among female former smokers 48–62 years of age (Table 3, Model 3). However, among women >62 years of age, black women smoked for 2.8 (95% CI: 0.1, 5.4) years longer before quitting and Mexican-American women smoked for 4.1 (95% CI: -7.5, -0.6) years less before quitting compared their white counterparts (Table 3, Model 4).

Differences in Smoking Duration by Race/Ethnicity, Effects of Age at Smoking Initiation

Racial/ethnic differences in duration of smoking differed by participant age at smoking initiation for men ($p_{\text{interaction}} < .001$) and women ($p_{\text{interaction}} < .001$). Among men who initiated smoking at <16 years of age, there were no racial/ethnic differences in duration of smoking among male former smokers (Table 3, Model 4). However, among men who initiated smoking between 16 and 18 years, black men smoked 2.8 (95% CI: 1.1, 4.4) years longer before quitting compared to their white counterparts (Table 4, Model 4), but there was no statistically significant difference in smoking duration comparing Mexican-American men and whites. Among men who initiated smoking after 18 years of age, both black men (2.5 years, 95% CI: 0.9, 4.1) and Mexican-American men (2.2 years, 95% CI: 0.2, 4.2) smoked longer before quitting compared to their white counterparts (Table 4, Model 4). The pattern among female former smokers was slightly different. Among women who initiated smoking at <16 years of age, black women smoked 3.2 (95% CI: 0.8, 5.7) years longer before quitting compared to their white counterparts (Table 4, Model 4), but there was no statistically significant difference in smoking duration between Mexican-American women and whites. There were no racial/ethnic differences in duration of smoking among female former smokers who initiated smoking between 16 and 18 years of age (Table 4, Model 4). However, among women who initiated smoking after 18 years of age, black women smoked for 2.4 (95% CI: 0.7, 4.1) years longer before quitting than their

white counterparts, but there was no difference in smoking duration between Mexican-American women and whites (Table 4, Model 4).

Discussion

Previous studies have focused on racial/ethnic differences in rates of smoking cessation or intensity of smoking.⁸⁻¹⁵ In a representative sample of US adults who participated in NHANES 1999–2012 and who successfully quit smoking, we found that black former smokers smoked over longer durations before quitting compared to whites. There was no difference in smoking duration among Mexican-American former smokers compared to whites, except maybe a shorter smoking duration among older Mexican-American women and a longer duration among Mexican-American men who began smoking after age 18.

Duration of smoking can influence the development of tobacco-related diseases beyond other measures of tobacco use (Lubin JH, Couper D, Lutsey PL, et al., unpublished data, 2015).¹⁸⁻²¹ Data from over 117 000 currently smoking men and women from the Cancer Prevention Study II showed that years of cigarette smoking was more important than the number of cigarettes smoked in predicting lung cancer risk.¹⁸ Among 14 233 participants in the Atherosclerosis Risk in Communities (ARIC) study smoking fewer cigarettes per day for longer durations was more strongly associated with cardiovascular disease risk than smoking more cigarettes per day over shorter durations²¹.

Table 4. Mean Difference (95% CI) in Years of Smoking by Race/Ethnicity Stratified by Age at Smoking Initiation, NHANES 1999–2012

Age at smoking initiation	N	Model 1	Model 2	Model 3	Model 4
Men					
Age <16 y					
White	583	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	187	1.0 (-0.8, 2.8)	0.4 (-1.3, 2.2)	0.5 (-1.2, 2.2)	1.0 (-0.7, 2.6)
Mexican American	230	-0.5 (-3.9, 2.9)	-1.6 (-4.9, 1.7)	-1.7 (-5.3, 1.8)	-1.1 (-4.8, 2.6)
Age 16–18 y					
White	897	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	274	3.1 (1.6, 4.7)*	2.1 (0.5, 3.6)*	2.2 (0.7, 3.8)*	2.8 (1.1, 4.4)*
Mexican American	295	-0.3 (-1.9, 1.3)	-2.0 (-3.6, -0.4)*	-1.7 (-3.3, -0.1)*	-0.9 (-2.5, 0.8)
Age >18 y					
White	705	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	195	1.8 (0.3, 3.4)*	1.5 (-0.1, 3.1)	1.9 (0.4, 3.5)*	2.5 (0.9, 4.1)*
Mexican American	281	2.1 (0.3, 4.0)*	1.3 (-0.7, 3.4)	1.4 (-0.6, 3.4)	2.2 (0.2, 4.2)*
Women					
Age <16 y					
White	412	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	130	3.5 (1.2, 5.9)*	2.9 (0.4, 5.4)*	2.9 (0.6, 5.2)*	3.2 (0.8, 5.7)*
Mexican American	107	2.3 (-0.5, 5.1)	0.6 (-2.5, 3.8)	0.4 (-2.8, 3.6)	0.8 (-2.6, 4.1)
Age 16–18 y					
White	616	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	195	1.0 (-1.2, 3.1)	0.0 (-2.3, 2.2)	0.1 (-2.2, 2.3)	0.4 (-1.9, 2.7)
Mexican American	154	-0.4 (-2.3, 1.5)	-2.4 (-4.5, -0.3)*	-2.2 (-4.3, -0.1)*	-1.5 (-3.5, 0.5)
Age >18 y					
White	494	0.0 (ref)	0.0 (ref)	0.0 (ref)	0.0 (ref)
Black	146	2.8 (1.3, 4.4)*	2.2 (0.6, 3.8)*	2.4 (0.8, 4.1)*	2.4 (0.7, 4.1)*
Mexican American	129	-1.8 (-4.3, 0.6)	-3.1 (-5.7, -0.5)*	-1.8 (-4.2, 0.6)	-1.3 (-3.7, 1.2)

CI = confidence interval; NHANES = National Health and Nutrition Examination Survey. Model 1 adjusted for age, and country of birth. Model 2 further adjusted for education. Model 3 further adjusted for age at smoking initiation. Model 4 further adjusted for intensity of smoking before quitting (number of cigarettes per day at time of quitting). Cutoffs based on tertiles values from weighted distribution.

* $p < .05$ for t test.

Age at smoking cessation differed by race/ethnicity in our study with a mean age of around 36, 39, and 32 years of age at time of quitting for white, black, and Mexican-American former smokers respectively. These differences may have important implications for the health of these populations, as the benefits of smoking cessation are greater with younger ages at cessation.^{30,31} Using data from 216 917 adults in the 1997–2004 National Health Interview Survey whose deaths were linked to the National Death Index, smoking cessation before 34 years of age was associated with hazard ratios for deaths from all causes similar to those for participants who had never smoked.³¹ This benefit in mortality risk among former smoker decreased with later ages of smoking cessation with smokers who had quit by 39 years of age having a 20% greater risk of death from all causes compared to never smokers (hazard ratio: 1.20 [95% CI: 1.00, 1.40]).³¹ Cessation of smoking even at older ages results in significantly lower risk for death and gains in life expectancy compared to those who continued to smoke.^{30–32} The longer durations of smoking and the later age of smoking cessation among black former smokers compared to whites in our study may explain some of the racial/ethnic disparity in tobacco-related diseases.

Racial/ethnic differences in duration of smoking among former smokers differed by age. Older adults have been shown to report lower interest in quitting when compared to younger adults with quit attempts decreasing with age.^{15,33} Older black men (≥ 48 years) and women (> 62 years) former smokers in our study had a significantly longer duration of smoking compared to their white counterparts. We also found no racial/ethnic differences in duration of smoking for men < 48 years and women 48–62 years of age. These findings may indicate less racial/ethnic disparities in smoking behaviors among younger generations who quit smoking. The racial/ethnic differences in duration of smoking among former smokers also differed by age of smoking initiation. There were no racial/ethnic differences in the duration of smoking among men who began smoking before 16 years of age or among women who began smoking between 16 and 18 years of age. It is possible that initiation of smoking during adolescence may decrease the probability of quitting and prolong cigarette smoking, independent of race/ethnicity. This is consistent with findings from a study of ever smoking black and white women that found that there were no racial/ethnic differences in quitting among adolescent initiators; however, among young adult initiators, white women were more likely than black women to quit smoking.³⁴ The patterns observed in our study could also reflect racial/ethnic differences in the generational effect of smoking in the United States^{35,36} or in smoking behaviors across age groups.^{37–42} Black adolescents and young adults are less likely to smoke cigarettes compared to whites.^{37–39} In our study, only 43.6% of black former smokers reported smoking before 18 years of age compared to 52.7% of white former smokers and 53.3% of Mexican-American former smokers. Despite the lower prevalence of smoking among black adolescents, black individuals that do begin smoking have a greater difficulty in quitting compared to their white counterparts. In a study of black and white women of childbearing age (18–44 years of age), white women began smoking at younger ages than black women but were more likely to quit and to do so at younger ages; as a result, the rates of current smoking converged at age 25 and crossover (higher in black women vs. white women) by age 30.⁴² Findings for Hispanic adolescents and young adults have been mixed with most studies findings lower prevalence of smoking^{37,38,40,41} and one finding no difference compared to whites.⁴³

There were no differences in the duration of smoking comparing Mexican Americans to whites in our study except for a longer duration among Mexican-American men who began smoking after age 18 and a shorter duration among Mexican-American women over age 62, compared to their white counterparts. Country of birth and acculturation may influence smoking behaviors and smoking cessation practices among Mexican Americans.^{41,44–49} Mexican ever smokers who were born in the United States had a greater mean number of years of smoking compared to ever smokers born in Mexico.⁴⁹ Mexican-American participants in our study were more likely to be born outside of the United States compared to other race/ethnicities however, Mexican-American men who begin smoking after age 18 were more likely to have been born in the United States compared to Mexican-American men who began smoking before age 18 (33.3% vs. 30.5%) as were Mexican-American women over age 62 compared to Mexican-American women ≤ 62 years (60.3% vs. 51.1%). Among 5030 adults in Texas, the prevalence of smoking among US-born Mexican men was higher than the prevalences among Mexican-born or non-Hispanic white men but similar to the smoking prevalences among non-Hispanic black men.⁴⁹ Among women, the prevalence of smoking was higher for US-born Mexican women than Mexican-born women although these prevalences were still lower than non-Hispanic white or black women.⁴⁹

Black smokers have been shown to be more likely to attempt to quit^{15,33,50} but less likely to successfully quit smoking^{8,10} compared to whites. The longer smoking duration among black former smokers compared to whites in this study could be related to a larger number of unsuccessful quit attempts prior to quitting. Information on number of quit attempts prior to successfully quitting was not available for the former smokers in our study and we are unable to confirm this hypothesis. Previous studies have found that black and Hispanic smokers are less likely to receive health professional's advice to quit and had a lower utilization of evidence-based cessation treatments compared to white adult smokers.^{14,15,51–55} Using data from population-based surveys, black and Hispanic current smokers received less smoking cessation advice from a healthcare provider compared to white current smokers.^{9,56} Thus, the racial/ethnic differences in smoking duration observed in our study may reflect delays in the receipt and utilization of smoking cessation services. Also, as heavier smokers are more likely to receive cessation advice,^{51,52,54,57} black and Mexican-American smokers who smoke fewer cigarettes per day compared to white smokers, may receive cessation advice less frequently. In a study using data from the Tobacco Use Supplement of the Current Population Survey,⁵⁶ racial/ethnic differences in the receipt of cessation advice among smokers were no longer statistically significant after adjusting for demographics and cigarettes smoked per day. In our study of former smokers, racial/ethnic differences in time to quitting remained statistically significant for black but not Mexican Americans after adjustment for cigarettes smoked per day. In fact, for Mexican Americans, the difference in smoking duration was attenuated and no longer statistically significant after adjustment for smoking intensity, potentially explaining differences in smoking duration in Mexican Americans compared to whites. In contrast, among black former smokers adjustment for smoking intensity increased differences in smoking duration among black former smokers compared to whites, indicating that blacks continue smoking for longer periods than whites despite smoking fewer cigarettes per day. The lower rates of smoking cessation among black smokers despite their lower cigarette consumption levels compared to whites may indicate that

cigarette addiction and the quitting process may be different for black smokers.⁵⁸ Indeed, in a study of current smokers enrolled in smoking cessation trial, black smokers reported greater nicotine dependence and Hispanic smokers reported lower nicotine dependence compared to white smokers.⁵⁹ These findings highlight the need for culturally-specific smoking cessation treatment and guidelines that address the specific barriers to quitting among particular racial/ethnic groups.

This study, conducted in a representative sample of the US population, examined racial/ethnic differences in the duration of smoking independent of smoking intensity. Most studies examining differences in smoking behaviors have been limited to blacks and whites⁶⁰; while this study also included Mexican-American participants. The study has some limitations. Information on age of smoking initiation, which was used to estimate smoking duration, was assessed by self-report and subject to recall. This would not be expected to be differential by race/ethnicity and should not bias findings regarding a difference in smoking duration between white, black, and Mexican-American former smokers. Second, we used number of cigarettes smoked per day at time of quitting as our measure of smoking intensity however a smoker may reduce their number of cigarettes per day in preparation for quitting.^{27,61-64} This measure may therefore underestimate the intensity of smoking throughout the participants' smoking history. It is unknown if black or Mexican-American smokers would reduce their cigarette consumption prior to quitting differently compared to white smokers. Also, menthol cigarette use, which is highly prevalent in black smokers,^{2,65-69} may facilitate smoking initiation^{70,71} or reduce cessation,^{60,72-80} which could explain the observed differences in smoking duration among black former smokers compared to whites. Information on use of menthol cigarettes was not available for former smokers in NHANES. In subgroup analyses, racial/ethnic differences in smoking duration differed in some subgroups defined by age at NHANES participation and age at smoking initiation; we had no a priori hypothesis regarding differences in smoking duration in these subgroups, and these post hoc findings should be interpreted with caution. Despite overall declines in cigarette smoking in the United States in past decades, subgroups defined by race/ethnicity differ with regard to smoking prevalence and the probability of smoking cessation. In a representative sample of US adults we found that among those who successfully quit smoking, the timing of smoking cessation differed by race/ethnicity with blacks quitting significantly later compared to whites even when taking into account differences in smoking initiation and smoking intensity. Such differences could explain, in part, differences in the tobacco-related disease burden among US racial/ethnic groups. Given the differences in smoking behavior by race/ethnicity and the importance of early smoking cessation to health outcomes, this study highlights the need for additional strategies to address the racial/ethnic differences in the timing of smoking cessation in order to reduce disparities in tobacco-related disease.

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Declaration of Interests

None declared.

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