BMJ Open

Determinants of cigarette smoking status in a national cohort of black and white adult ever smokers in the USA: a cross-sectional analysis of the REGARDS study

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To cite: Parekh TM, Wu C, McClure LA, *et al*. Determinants of cigarette smoking status in a national cohort of black and white adult ever smokers in the USA: a cross-sectional analysis of the REGARDS study. *BMJ Open* 2019;**9**:e027175. doi:10.1136/bmjopen-2018-027175

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2018-027175).

Received 10 October 2018
Revised 4 April 2019
Accepted 5 April 2019

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ABSTRACT

Objectives While awareness of cigarette smoking's harmful effects has increased, determinants associated with smoking status remain understudied, including potential racial differences. We aim to examine factors associated with former versus current smoking status and assess whether these associations differed by race.

Setting We performed a cross-sectional analysis using the population-based Reasons for Geographic and Racial Differences in Stroke(REGARDS)study.

Outcome measures Logistic regression was used to calculate the OR of former smoking status compared with current smoking status with risk factors of interest. Race interactions were tested using multiplicative interaction terms.

Results 16 463 participants reported smoking at least 100 cigarettes in their lifetime. Seventy-three per cent (n=12 067) self-reported former-smoker status. Physical activity (reference (REF) <3×/week; >3×/week: OR=1.26, 95% CI 1.11 to 1.43), adherence to Mediterranean diet (REF: low; medium: OR=1.46, 95% CI 1.27 to 1.67; high: OR=2.20, 95% CI 1.84 to 2.64), daily television viewing time (REF: >4 hours; <1 hour: OR=1.32, 95% CI 1.10 to 1.60) and abstinence from alcohol use (REF: heavy; none: OR=1.50, 95% CI 1.18 to 1.91) were associated with former-smoker status. Male sex, higher education and income $35 000–$74 000 (REF: <$20 000) were also associated with former-smoker status. Factors associated with lower odds of reporting former-smoker status were younger age (REF: ≥65 years; 45–64 years: OR=0.34, 95% CI 0.29 to 0.39), black race (OR=0.62, 95% CI 0.53 to 0.72) and single marital status (REF: married status; OR=0.66, 95% CI 0.51 to 0.87), being divorced (OR=0.60, 95% CI 0.50 to 0.72) or widowed (OR=0.70, 95% CI 0.57 to 0.85). Significant interactions were observed between race and alcohol use and dyslipidaemia, such that black participants had higher odds of reporting former-smoker status if they were abstinent from alcohol (OR=2.32, 95% CI 1.47 to 3.68) or had a history of dyslipidaemia (OR=1.31, 95% CI 1.06 to 1.62), whereas these relationships were not statistically significant in white participants.

Conclusion Efforts to promote tobacco cessation should consist of targeted behavioural interventions that incorporate racial differences.

Strengths and limitations of this study

- Using a cohort that oversampled black smokers and those living in the southeastern USA, we analysed the associations of potentially modifiable social and behavioural determinants of smoking status in a large cohort of black and white smokers.
- To further investigate tobacco-related differences in smoking status, we analysed the independent interactions of demographic, social, psychosocial, economic and behavioural factors with race.
- Our study is a cross-sectional analysis, and therefore the data presented do not establish causation.
- Covariates included in our analyses were assessed at the time of study entry and not necessarily at the time of change in smoking status.
- Factors associated with smoking status may represent co-occurring changes rather than predictive determinants.

INTRODUCTION

Despite the fact that tobacco use is on a decline in the USA, ~15% of Americans continue to smoke,[1] contributing to significant morbidity and mortality, including heart disease, stroke, chronic obstructive pulmonary disease and lung cancer.[2] In the past 50 years, 20 million premature deaths have been attributed to smoking and second-hand smoke exposure,[3] with tobacco-related morbidity and mortality disproportionately affecting racial minorities and individuals in low socioeconomic groups.[4 5] Disparities in tobacco-related morbidity and mortality are poorly understood; however, individual and

environmental characteristics have been considered. Tobacco use, primarily in the form of cigarettes, is most prevalent in the midwestern and southern regions of the USA, among those with disabilities and those with lower socioeconomic status.[1 6] Black smokers start smoking later in life and smoke fewer cigarettes than white smokers, yet they inhale 30% more nicotine per cigarette.[7] They are less likely to have access to health insurance[8] or to use pharmacological aids to help quit smoking.[9] Point-of-sale marketing of menthol cigarettes is targeted to communities with predominantly black residents[10] who are known prominent consumers.[11] Despite starting to smoke at a later age, black smokers bear a significant proportion of tobacco-related cancers with higher rates of oral, lung and oesophageal cancers.[12–14]

Ongoing public health efforts are responsible for the decline in tobacco use; however, significant sociodemographic disparities exist among those who quit smoking. For example, black smokers have a higher number of quit attempts, yet are less successful at quitting.[15] While higher income and education are known determinants of quitting smoking,[16 17] there are limited data that evaluate social, psychosocial, economic and behavioural determinants of smoking status, especially in black smokers, and in the south, where smoking is prevalent. Understanding facilitators and barriers to a change in smoking status is an essential step to reducing tobacco-related disparities. We addressed this gap in knowledge by using the Reasons for Geographic and Racial Differences in Stroke (REGARDS) study.[18] The REGARDS study collected in-depth information regarding social, psychosocial, economic and behavioural determinants that may impact one's ability to quit smoking. This national cohort oversampled black smokers and individuals living in the stroke belt of the southeastern USA (North Carolina, South Carolina, Georgia, Tennessee, Mississippi, Alabama, Louisiana and Arkansas)[19]; thus, it is an ideal setting to examine sociodemographic determinants of former-smoker status. We evaluated demographic, social, psychosocial, economic and behavioural factors associated with former-smoker status among ever-smoker participants in the REGARDS study. We hypothesised that former smokers would have higher income, higher education, stronger social support, better access to healthcare, healthier diet and less stress, alcohol and television use. We anticipated that these individual determinants would vary by race.

METHODS

Study design and cohort

We performed a cross-sectional population-based analysis of participants in the REGARDS cohort. The REGARDS study began in 2003 to investigate the causes for excess stroke mortality among black smokers and people living in the southeastern USA. The cohort consists of 30 239 participants from across the continental USA. Participants were aged 45 years or older at baseline; 55% of the participants resided in the stroke belt, 42% were black individuals and 55% were women. Between 2003 and 2007, participants were recruited by mail and then were contacted via telephone for an in-depth health information interview, followed by an in-home exam that involved blood pressure measurement, blood and urine samples, an ECG and medication information. Further details regarding the study design have been previously published.[18]

Patient and public involvement

Patients were not involved in the design of the current study.

Outcome of interest

Study participants reported smoking history as packs smoked per day×total years smoked, age at initiation and current smoking status. The primary outcome was smoking status defined by self-reported 'former-smoker' or 'current-smoker' status in persons who had smoked at least 100 cigarettes in their lifetime.

Definition of covariates

Specific covariates chosen to be included in our model were those available in the REGARDS database that impacted smoking status based on various levels of influence, including personal, interpersonal, community and environmental levels. Demographic characteristics in the analysis included age at study enrolment, sex, race (self-identified as non-Hispanic white or non-Hispanic black individuals), size of household (number of people), geographical region (defined by the U.S. Census Bureau[20] as midwest, northeast, south and west) and living environment (urban: >75% urban, rural: <25% urban or mixed: 25%–75% urban; based on census definition). Economic variables included level of education (less than high school, high school graduate, some college, and college graduate or higher education), annual household income (<$20 000, $20 000–$34 000, $35 000–$74 000, ≥$75 000 and not reported) and health insurance (yes vs no). Biological variables (height and weight to calculate body mass index (BMI)) and comorbidities consisting of coronary artery disease, stroke, atrial fibrillation, kidney disease, dyslipidaemia and hypertension were included. Stroke and hypertension were self-reported. Dyslipidaemia was determined by self-reported use of lipid-lowering medication. Coronary artery disease was determined by self-report or by history of myocardial infarction, stenting or bypass surgery. Atrial fibrillation was determined by ECG or by self-report. Kidney disease was determined by a glomerular filtration rate of <60 mL/min. Other self-reported measures of health included general health, as well as the mental and physical composite scores of the 12-Item Short-Form Survey (SF-12).[21] Stress level was determined by Cohen's Perceived Stress Index.[22] Depressive symptoms were assessed by the Center for Epidemiologic Studies depression scale.[23]

Social variables included marital status (married, single, divorced, widowed or other), number of close

friends (<2, 2–3, 4–5, ≥6, based on quartiles of the distribution), number of close relatives (<2, 2–4, 5–8,>8, based on quartiles of the distribution) and percentage of close friends/relatives seen per month. Behavioural characteristics included those that are reflective of a healthy or health-conscious lifestyle. These included physical activity ('How many times per week do you engage in intense physical activity, enough to work up a sweat?' <3 vs ≥3 times/week),[24] medication adherence (assessed by a 4-item validated scale and classified as low, medium or high),[25] alcohol use per week (none, moderate or heavy),[26] adherence to a Mediterranean diet (assessed with the Mediterranean diet score by a three-level categorization as low, medium or high[27]) and television use (average number of hours spent watching television every day: ≤1, 2, 3 and ≥4).

Statistical analysis

We included all REGARDS participants who reported smoking at least 100 cigarettes in their lifetime. Characteristics of participants who reported former-smoker status versus those who reported current-smoker status were compared using χ^2 tests of association or t-tests, as appropriate. We built a multivariable logistic regression model and evaluated demographic, social, economic and behavioural determinants associated with former-smoker status in a single model. We excluded anyone with missing values for any of the covariates. Because of the large number of missing values due to Food Frequency Questionnaires that were not returned, we did a sensitivity analysis excluding variables that were derived from that form (television use and Mediterranean diet). The magnitude of association was described as OR with an accompanying 95% CI. We also examined interactions between race and each of the risk factors using multiplicative interaction terms, with each interaction examined in a separate model. We used SAS V.9.4 for all statistical analyses. All hypothesis testing was two sided, and to be conservative due to the exploratory nature of the analyses, we considered p<0.01 to be significant.

RESULTS

Of the 30 239 REGARDS participants, 16 463 (54.4%) reported smoking at least 100 cigarettes during their lifetime and were included in this analysis. Of these, 4396 (27%) participants identified as current smokers and 12 067 (73%) as former smokers. Table 1 describes the characteristics of the cohort, overall and by current smoking status. The mean age at study enrolment was 64.9 years (SD=9.0), 47% were women, and 41% were black individuals. The majority resided in the south (67%) and in urban areas (72%) and were married (59%). With respect to health comorbidities, a majority reported having a history of hypertension (59%).

Determinants of former-smoker status

Demographic factors associated with former-smoker status

Table 2 describes the determinants of former-smoker status. Male sex (OR=1.35, 95% CI 1.18 to 1.56), health insured status (OR=1.39, 95% CI 1.10 to 1.75), higher education and higher income were associated with increased odds of reporting former-smoker status, such that college graduates or those with higher education (OR=1.39, 95% CI 1.10 to 1.77) and an annual income of $35 000–$74 000 (OR=1.31, 95% CI 1.07 to 1.61) had the highest odds of former-smoker status relative to those with less than high school education and those with <$20 000 income, respectively. The odds of former-smoker status were lower among black smokers than white smokers (OR=0.62, 95% CI 0.53 to 0.72), among younger adults (45–64 years) compared with older adults (≥65 years; OR=0.34, 95% CI 0.29 to 0.39) and among those with larger household sizes compared with smaller household sizes (OR=0.90, 95% CI 0.86 to 0.095). Geographical region and living environment were not associated with smoking status.

Social factors associated with former-smoker status

Marital status was significantly associated with reporting former-smoker status with single (OR=0.66, 95% CI 0.51 to 0.87), divorced (OR=0.60, 95% CI 0.50 to 0.72) and widowed (OR=0.70, 95% CI 0.57 to 0.85) participants having lower odds of former-smoker status, compared with those who were married. However, the number of close friends or close relatives, and the frequency of social interactions with friends/relatives were not associated with former-smoker status in the full model.

Comorbidities associated with former-smoker status

History of atrial fibrillation (OR=1.42, 95% CI 1.13 to 1.79), chronic kidney disease (OR=1.38, 95% CI 1.10 to 1.73) and hypertension (OR=1.24, 95% CI, 1.08 to 1.42) were associated with higher odds of reporting former-smoker status, while other comorbidities were not, nor was physical health as summarised by the SF-12 measure. Those with BMI in the non-obese categories and those reporting their general health as less than excellent had significantly lower odds of former-smoker status, compared with those with obesity and those with excellent general health, respectively. Perceived stress and depressive symptoms were not associated with former-smoker status. However, higher mental health summary score by the SF-12 was associated with former-smoker status (1 SD change: OR=1.13, 95% CI 1.04 to 1.23).

Behavioural factors associated with former-smoker status

Physical activity performed three times or more per week (compared with physical activity <3× per week: OR=1.26, 95% CI 1.11 to 1.43) and high adherence to a Mediterranean diet (compared with low adherence to a Mediterranean diet: OR=2.20, 95% CI 1.84 to 2.64) were associated with higher odds of reporting former-smoker status. Participants who did not consume alcohol on a

Table 1 Baseline characteristics of former and current smokers

Characteristics	Total n=16 463	Former smoker n=12 067	Current smoker n=4396	P value
Demographic factors				
Female sex	7723 (47)	5307 (44)	2416 (55)	<0.0001
Age (mean (SD))	64.9 (9.0)	66.3 (8.9)	61.3 (8.4)	<0.0001
Black race	6789 (41)	4609 (38)	2180 (50)	<0.0001
Size of household (nmiss=6)	2.2 (1.2)	2.1 (1.1)	2.2 (1.3)	<0.0001
Region				<0.0001
Midwest	2725 (17)	1942 (16)	783 (18)	
South	11 032 (67)	8032 (67)	3000 (68)	
Northeast	1207 (7)	879 (7)	328 (8)	
West	1499 (9)	1214 (10)	285 (7)	
Economic factors				
Education (nmiss=12)				<0.0001
Less than high school	2319 (14)	1527 (13)	792 (18)	
High school graduate	4359 (27)	3033 (25)	1326 (30)	
Some college	4663 (28)	3366 (28)	1297 (30)	
College graduate	5110 (31)	4134 (34)	976 (22)	
Income				<0.0001
<$20 000	3181 (19)	1942 (16)	1239 (28)	
$20 000–$34 000	4101 (25)	2943 (24)	1158 (26)	
$35 000–$74 000	4918 (30)	3830 (32)	1088 (25)	
≥$75 000	2360 (14)	1921 (16)	439 (10)	
Refused to answer	1903 (12)	1431 (12)	472 (11)	
Access to healthcare				
Health insurance (nmiss=13)	15 272 (93)	11 446 (95)	3826 (87)	<0.0001
Social factors				
Marital status				<0.0001
Married	9690 (59)	7627 (63)	2063 (47)	
Single	850 (5)	503 (4)	347 (8)	
Divorced	2594 (16)	1615 (13)	979 (22)	
Widowed	2890 (18)	2067 (17)	823 (19)	
Other	439 (3)	255 (2)	184 (4)	
Number of close friends (nmiss=306)				<0.0001
<2	2226 (14)	1460 (12)	766 (18)	
2–3	4738 (29)	3332 (28)	1406 (32)	
4–5	3958 (25)	2934 (25)	1024 (24)	
>5	5235 (32)	4088 (35)	1147 (26)	
Number of close relatives (nmiss=205)				<0.0001
<2	2033 (13)	1343 (11)	690 (16)	
2–4	5805 (36)	4219 (36)	1586 (37)	
5–8	4271 (26)	3203 (27)	1068 (25)	
>8	4104 (25)	3105 (26)	999 (23)	
Percentage of close friends and relatives whom the participant sees at least once a month (mean (SD)) (nmiss=653)	61.1	60.5	62.9	0.005
Pre-existing comorbidities and self-reported measures of health				
Coronary artery disease (nmiss=296)	3446 (21)	2598 (22)	848 (20)	0.002

Continued

Table 1 Continued

Characteristics	Total n=16 463	Former smoker n=12 067	Current smoker n=4396	P value
History of stroke (nmiss=62)	1210 (7)	842 (7)	368 (8)	0.003
Atrial fibrillation (nmiss=392)	1511 (9)	1172 (10)	339 (8)	<0.001
Chronic kidney disease (nmiss=686)	1772 (11)	1412 (12)	360 (9)	<0.0001
Dyslipidaemia (nmiss=170)	5869 (36)	4541 (38)	1328 (31)	<0.0001
Diabetes (nmiss=59)	3891 (24)	2943 (25)	948 (22)	0.0001
Hypertension (nmiss=80)	9717 (59)	7230 (60)	2487 (57)	<0.0001
BMI (nmiss=111)				<0.0001
Obese	6113 (37)	4743 (40)	1370 (31)	
Overweight	6206 (38)	4712 (39)	1494 (34)	
Normal	3828 (23)	2460 (21)	1368 (31)	
Underweight	205 (1)	71 (0.6)	134 (3)	
SF-12 physical summary (mean (SD)) (nmiss=795)	45.6 (10.8)	46.0 (10.6)	44.6 (11.3)	<0.0001
General health (nmiss=37)				<0.001
Excellent	2297 (14)	1876 (16)	421 (10)	
Very good	4793 (29)	3714 (31)	1079 (25)	
Good	5877 (36)	4183 (35)	1694 (39)	
Fair	2751 (17)	1833 (15)	918 (21)	
Poor	708 (4)	437 (4)	271 (6)	
Perceived Stress Index (mean (SD)) (nmiss=3)	3.2 (3.0)	3.0 (2.8)	3.8 (3.3)	<0.0001
Depression symptoms (mean (SD)) (nmiss=103)	1.2 (2.2)	1.0 (1.9)	1.8 (2.7)	<0.0001
SF-12 mental health summary (mean (SD)) (nmiss=795)	43.8 (8.8)	54.7 (8.0)	51.4 (10.4)	<0.0001
Behavioural factors				
Physical activity per week (nmiss=241)				
Less than 3×	8902 (55)	6269 (53)	2633 (61)	<0.0001
Mediterranean diet adherence (nmiss=4877)				<0.0001
Low	3843 (33)	2548 (29)	1295 (45)	
Medium	4769 (41)	3643 (42)	1126 (39)	
High	2974 (26)	2510 (29)	464 (16)	
Alcohol consumption (nmiss=400)				<0.0001
Heavy	918 (6)	570 (5)	348 (8)	
Moderate	6311 (39)	4694 (40)	1617 (38)	
None	8834 (55)	6522 (55)	2312 (54)	
Pack-years (mean (SD)) (nmiss=943)	25.3 (26.3)	22.7 (25.8)	32.3 (26.4)	<0.0001
Age started smoking (mean (SD)) nmiss=365)	18.4 (5.6)	18.2 (5.2)	18.8 (6.5)	<0.0001
Television use per day (hours) (nmiss=3463)				<0.0001
>4	4486 (35)	3043 (31)	1443 (44)	
3	3593 (28)	2719 (28)	874 (27)	
2	2666 (21)	2174 (22)	492 (15)	
<1	2255 (17)	1780 (18)	475 (14)	
Medication adherence (nmiss=1502)				0.004
Low	349 (2)	233 (2)	116 (3)	
Medium	4257 (28)	3162 (28)	1095 (29)	
High	10 355 (69)	7724 (69)	2631 (68)	

BMI, body mass index; nmiss, number missing; SF-12, 12-Item Short-Form Survey.

Table 2 Multivariable analysis of factors associated with former-smoker status (n=7322)

Variable	OR (95% CI)	P value
Demographic factors		
Age (years)		
65+	REF	<0.001
45–64	0.34 (0.29 to 0.39)	
Sex		<0.001
Female	REF	
Male	1.35 (1.18 to 1.56)	
Race		<0.001
White	REF	
Black	0.62 (0.53 to 0.72)	
Size of household	0.90 (0.86 to 0.95)	<0.001
Region		0.5
West	REF	
Northeast	0.87 (0.64 to 1.19)	
Midwest	0.82 (0.63 to 1.06)	
South	0.85 (0.67 to 1.07)	
Living environment		0.4
Urban	REF	
Rural	1.03 (0.84 to 1.26)	
Mixed	0.88 (0.73 to 1.07)	
Economic factors		
Education		0.01
Less than high school	REF	
High school graduate	1.10 (0.88 to 1.36)	
Some college	1.12 (0.90 to 1.39)	
College graduate	1.39 (1.10 to 1.77)	
Income		0.003
<$20 000	REF	
$20 000–$34 000	1.16 (0.96 to 1.40)	
$35 000–$74 000	1.31 (1.07 to 1.61)	
≥$75 000	1.27 (0.98 to 1.64)	
Refused to answer	1.69 (1.29 to 2.20)	
Access to healthcare		
Health insurance	1.39 (1.10 to 1.75)	0.007
Social factors		
Marital status		<0.001
Married	REF	
Single	0.66 (0.51 to 0.87)	
Divorced	0.60 (0.50 to 0.72)	
Widowed	0.70 (0.57 to 0.85)	
Other	0.78 (0.52 to 1.17)	
Number of close friends		0.4
<2	REF	
2–3	1.03 (0.84 to 1.23)	
4–5	0.91 (0.74 to 1.13)	
>5	0.92 (0.74 to 1.14)	
Number of close relatives		0.2
<2	REF	
2–4	1.21 (0.99 to 1.48)	
5–8	1.24 (1.00 to 1.54)	
>8	1.21 (0.96 to 1.51)	
Percentage of close friends and relatives whom the participant sees at least once a month	0.97 (0.92 to 1.03)	0.4
Pre-existing comorbidities and self-reported measures of health		
Coronary artery disease	0.95 (0.80 to 1.12)	0.5
History of stroke	0.99 (0.77 to 1.28)	0.9
Atrial fibrillation	1.42 (1.13 to 1.79)	0.002
Chronic kidney disease	1.38 (1.10 to 1.73)	0.005
Dyslipidaemia	1.05 (0.92 to 1.12)	0.5
Diabetes	1.17 (1.00 to 1.38)	0.05
Hypertension	1.24 (1.08 to 1.42)	0.002
BMI		
Obese	REF	<0.001
Overweight	0.62 (0.54 to 0.72)	
Normal	0.37 (0.31 to 0.44)	
Underweight	0.17 (0.10 to 0.28)	
SF-12 physical summary (1 SD change)	0.97 (0.89 to 1.06)	0.5
General health		<0.001
Excellent	REF	
Very good	0.68 (0.54 to 0.84)	
Good	0.49 (0.39 to 0.61)	
Fair	0.56 (0.42 to 0.75)	
Poor	0.63 (0.40 to 0.97)	
Perceived Stress Index (1 SD change)	0.94 (0.87 to 1.01)	0.07
Depression symptoms (1 SD change)	0.99 (0.91 to 1.07)	0.7
SF-12 mental health summary (1 SD change)	1.13 (1.04 to 1.23)	0.005
Behavioural factors		
Physical activity per week		<0.001
Less than 3×	REF	
3× or more	1.26 (1.11 to 1.43)	

Table 2 Continued

Variable	OR (95% CI)	P value
Mediterranean diet adherence		<0.001
Low	REF	
Medium	1.46 (1.27 to 1.67)	
High	2.20 (1.84 to 2.64)	
Alcohol consumption		<0.001
Heavy	REF	
Moderate	1.15 (0.90 to 1.46)	
None	1.50 (1.18 to 1.91)	
Cigarette smoking		
Pack-years (one pack change)	0.98 (0.98 to 0.98)	<0.001
Cigarette smoking		
Age started smoking (1-year change)	0.96 (0.95 to 0.97)	<0.001
Television use per day (hours)		<0.001
>4	REF	
3	1.13 (0.97 to 1.32)	
2	1.45 (1.21 to 1.74)	
<1	1.32 (1.10 to 1.60)	
Medication adherence		0.05
Low	REF	
Medium	1.05 (0.69 to 1.60)	
High	0.89 (0.59 to 1.34)	

BMI, body mass index; REF, reference; SF-12, 12-Item Short-Form Survey.

weekly basis had higher odds of former-smoker status (compared with heavy alcohol use weekly: OR=1.50, 95% CI 1.18 to 1.91). Higher number of pack-years and older age of starting smoking were associated with lower odds of former-smoker status. Participants who watched 2 hours or less of television per day had higher odds of reporting former-smoker status (compared with ≥4 hours: 2 hours: OR=1.45, 95% CI 1.21 to 1.74; <1 hour: OR=1.32, 95% CI 1.10 to 1.60).

Sensitivity analyses

Excluding variables derived from the Food Frequency Questionnaire deemed the results of the analysis largely unchanged (online supplementary table 1). The exceptions were that now the northeast, midwest and south all had significant lower odds of former-smoker status than the west, while participants with diabetes and dyslipidaemia each had higher odds of former-smoker status than participants without diabetes and dyslipidaemia.

Interaction between key determinants and race

We present findings for the significant interactions between race and determinants of former-smoker status in table 3. We found a significant interaction (p=0.0002) between race and alcohol consumption, such that black participants had significantly higher odds of reporting former-smoker status if they were abstinent from alcohol (OR=2.32, 95% CI 1.47 to 3.68) compared with those participants with heavy alcohol use; however, the relationship was not statistically significant in white participants. Self-reported history of dyslipidaemia and race interacted such that black participants with a history of dyslipidaemia had higher odds of former-smoker status (OR=1.31, 95% CI 1.06 to 1.62); however, the relationship was not statistically significant in white participants.

CONCLUSION

We evaluated predictors of former-smoker status in the REGARDS cohort and found that male sex, white race, income ($35 000–$74 000) and higher education were associated with higher odds of reporting former-smoker status. Out of the potentially modifiable social and behavioural factors that were used in our model, all behavioural factors were significantly associated with smoking status, including television use, alcohol use, exercise and adherence to a Mediterranean diet. With the exception of marriage, no social factors were associated with smoking status. In addition, stress level and depression, which have been previously associated with smoking,[28 29] had no association with smoking status in our study. In our interaction analysis, we found that those who abstained from alcohol, compared with those who heavily used alcohol, and those who had a history

Table 3 Interactions between race and key determinants associated with former smoker status (n=7322)

	White race	Black race	Interaction
Variable	OR (95% CI)	OR (95% CI)	P value
Dyslipidaemia	0.92 (0.78 to 1.08)	1.31 (1.06 to 1.62)	0.008
Alcohol consumption			<0.001
Heavy	REF	REF	
Moderate	1.12 (0.84 to 1.50)	1.30 (0.81 to 2.09)	
None	1.21 (0.91 to 1.61)	2.32 (1.47 to 3.68)	

REF, reference.

of dyslipidaemia improved the odds of reporting former-smoker status among black, but not white, participants.

Addiction to tobacco and alcohol coexist as positive reinforcements for each other, with alcohol consumption increasing the urge to smoke[30] and nicotine inhalation increasing the urge to drink.[31] Tobacco companies are well aware of this association and have tailored marketing strategies to encourage the concurrent use of both substances.[32] Tobacco and alcohol use disorders commonly present together with significant negative consequences occurring from the abuse of both substances. Former smokers are four times more likely to experience initial smoking relapse while drinking.[33] Alcoholics smoke more cigarettes per day and score higher on nicotine dependence measures compared with other drug abusers.[34] In addition, alcohol abuse places smokers at higher risk of certain cancers, including oral, throat and oesophageal cancers.[35]

While alcohol use is known to increase tobacco use,[36] the magnitude of association between abstaining from alcohol and quitting smoking in black populations has implications for future interventions. Black and white populations have cultural and social differences that warrant consideration when designing and evaluating cessation interventions. Racial minorities are historically under-represented in intervention trials,[37] and while evidence-based guidelines may recommend specific interventions for smoking cessation, population-based interventions are most effective when designed to reach all populations equally. A secondary analysis of the Timing of Alcohol and Smoking Cessation study evaluated the racial/ethnic differences in outcomes of 499 tobacco and alcohol abuse participants undergoing cessation treatments, comparing those who had concurrent alcohol abstinence and smoking cessation treatment versus those who had alcohol abstinence treatment followed by a smoking intervention 6 months later. Alcohol abstinence outcomes (reduced time to first use of alcohol after treatment and risk of alcohol resumption) were worse for white participants in the concurrent group compared with the delayed group, but were not significantly different between black groups,[38 39] suggesting that the optimal approach to concurrent cessation therapy differs by race/ethnicity. Previous interventions have treated different types of substance abuse separately, and while some data support treating both conditions simultaneously, further studies are needed to define best practices for treating concomitant tobacco and alcohol abuses,[40] specifically in racial/ethnic minority populations.

Our study also reports an interaction between race and dyslipidaemia. Black smokers suffer disproportionately from cardiovascular diseases,[41] and treatment of risk factors, including dyslipidaemia, is vital to protect against cardiovascular events. However, black smokers with dyslipidaemia are less likely to be aware of their disease and less likely to be treated for it.[42] The presence of dyslipidaemia in our study was defined by self-reported use of lipid-lowering medication and was associated with higher odds of former-smoker status in black individuals. This suggests that the awareness of a dyslipidaemia diagnosis could have an impact on smoking status, which has been previously reported.[43]

Our report adds to existing literature documenting determinants of smoking status. Yang *et al* evaluated determinants of smoking cessation in a Korean population and found results similar to our study; married status, higher education, alcohol abstinence and disease morbidity were associated with quitting smoking.[44] Data from the US National Health and Wellness survey found that Hispanic ethnicity (vs non-Hispanic white individuals), higher income, obese weight, regular physical activity, insured status, and those who received the influenza vaccine and who were taking steps to lose weight were more likely to be former smokers.[45] A systematic review including prospective studies analysing predictors of successful smoking cessation found that lower levels of cigarette dependence predicted smoking cessation.[46] Few studies have examined whether social, behavioural and economic determinants of smoking cessation vary by sociodemographic subgroups, particularly race, although these findings are desirable for targeted intervention development. In a report from the National Epidemiological Study of Alcohol and Related Conditions evaluating determinants of smoking cessation, Agrawal *et al* stratified results by age and found that alcoholism was associated with persistent smoking in older adults, but not in younger adults.[17] In a study evaluating racial differences in attempts to quit smoking and smoking cessation after screening for lung cancer, black smokers had more frequent 24-hour and 7-day quit attempts; however, the 6-month cessation rate between black and white smokers did not differ.[47] This further highlights the need for identifying factors that may help promote successful quitting in black smokers. The strength of our study lies in a deeper exploration of the unique interaction of determinants of smoking status by key demographic characteristics. Using a resource that is distinctively enriched to identify racial differences, we make a novel observation that race interacts with alcohol use and history of dyslipidaemia in determining former smoking status.

The results of our study should be interpreted in light of several limitations. Former-smoker status was self-reported and not defined by biochemical confirmation; therefore, we can only assess status as reported by the participant. However, in large population-based studies, biochemical confirmation can lead to selection bias unrelated to smoking status.[48] Our study examined smoking status at time of study entry, and therefore the determinants of each participant were reflective of study entry and not necessarily at the time of smoking cessation. In addition, factors associated with former-smoker status may also reflect differences in those who initiate smoking (men vs women). By design, REGARDS enrolled only black and white participants who were 45 years or older; therefore, it could not address smoking status of those who were younger or were from other racial/ethnic

backgrounds. Our study highlights the importance of race in tobacco-related disparities; however, race in the current study reflects a social construct and does not imply ancestry as participants self-identified as 'black' or 'white'. Finally, we performed a cross-sectional analysis, and therefore the data presented do not establish causation. For example, factors such as improved diet and increased physical activity may be co-occurring changes rather than determinants of smoking status changes. However, the associations and interactions uncovered in our study call for further complex investigations that may establish causality.

Despite the progress being made in reducing tobacco use, there has been no consistent increase in cessation rates[49] and fewer than 1 in 10 smokers who wish to quit are able to quit successfully.[15] Smokers who are black have a higher number of quit attempts yet are less successful at quitting.[50] In an environment that impedes quitting smoking, we are further petitioned to address factors that are within our reach, including alcohol abstinence and dyslipidaemia education and treatment, especially in black smokers. It is critically important that alcohol and tobacco use intervention studies ensure diverse recruitment and analyse results by race in order to assess the effectiveness of interventions in minority groups. The results of our study can inform public health professionals and clinicians to consider including alcohol abstinence and dyslipidaemia education as key elements of a culturally sensitive intervention to achieve smoking cessation in black smokers.

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Funding TMP is supported by the National Institutes of Health grant 5T32HL105346-07. This research project is supported by a cooperative agreement, U01 NS041588, from the National Institute of Neurological Disorders and Stroke, the National Institutes of Health and the Department of Health and Human Service. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Neurological Disorders and Stroke or the National Institutes of Health. Representatives of the funding agency have been involved in the review of the manuscript but were not directly involved in the collection, management, analysis or interpretation of the data. The authors thank the other investigators, the staff and the participants of the Reasons for Geographic and Racial Differences in Stroke (REGARDS) study for their valuable contributions (a full list of participating REGARDS investigators and institutions can be found at http://www.regardsstudy.org). This work is not under consideration for publication elsewhere. Some contents were presented as an abstract at the American Thoracic Society Conference in May 2018.

Competing interests TMP, CW, LAM, VJH, MC, AMM and KFH have no conflicts of interests to report. ALC reports research support from Boehringer Ingelheim and consulting fees from AstraZeneca and Novo Nordisk. MTD reports grants from the National Institutes of Health involving the work under consideration for publication; grants from the Department of Defense outside the submitted work; contracted clinical trial support from AstraZeneca, Boehringer Ingeheim, Boston Scientific, GlaxoSmithKline, Novartis, PneumRxBTG, Pulmonx and Yungjin outside the submitted work; and consulting fees from AstraZeneca, GlaxoSmithKline and PneumRxBTG outside the submitted work. SB has no conflicts to report.

Patient consent for publication Not required.

Ethics approval The institutional review boards of participating institutions approved the study methods. The ethics approval for the initial study allowed for secondary analyses without additional ethics review.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement This study uses data from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) cohort. In order to abide by its obligations with the National Institutes of Health/National Institute of Neurological Disorders and Stroke and the Institutional Review Board of the University of Alabama at Birmingham, REGARDS facilitates data sharing through formal data use agreements. Any investigator is welcome to access the REGARDS data through this process. Requests for data access may be sent to regardsadmin@uab.edu.

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