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Relapse among Cigarette Smokers: The CARDIA longitudinal study - 1985–2011[★]

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Abstract

Rationale—There is little information about long-term relapse patterns for cigarette smokers.

Objective—To describe long-term prevalence of relapse and related smoking patterns by sex, race, age, and education level among a community-based cohort of young adults followed for 25 years.

Methods—We examined 25 years of data from Coronary Artery Risk Development in Young Adults (CARDIA), an ongoing study of a community-based cohort of 5115 men and women aged 18 to 30 years at baseline with periodic re-examinations. At each examination smoking, quitting, and relapse were queried. We examined prevalence of smoking relapse among 3603 participants who attended at least 6 of the 8 examinations.

Results—About 53% of 3603 participants never reported smoking on a regular basis. Among the remaining 1682 ever smokers, 52.8% of those who reported current smoking at baseline were still smoking by the end of the study, compared to 10.7% of those who initiated smoking by year 5.

Among those classified as former smokers at baseline, 39% relapsed at least once; of these, 69.5% had quit again by the end of the study. Maximum education level attained, age at study baseline, and race were associated with failure to quit smoking by the end of the study and relapse among those who did quit. Maximum education level attained and age at study baseline were also associated with ability to successfully quit after a relapse.

Conclusions—Smoking relapse after quitting is common, especially in those with lower education level. Education was the strongest predictor of all three outcomes. Improvements in access to treatment and treatment options, especially for underserved populations, are needed to prevent relapse when smokers quit.

Keywords

Relapse; Cessation; Cigarette; Smoking; Abstinence

1. Introduction

The National Institute of Drug Abuse describes nicotine as one of the most heavily used addictive drugs available (NIDA, 2009). An estimated 70% of the approximately 45 million adult cigarette smokers would like to quit and about 50% have made one or more quit attempts (stopped for 1 day) in the past year (Malarcher, Dube, Shaw, Babb, & Kaufmann, 2011). Only about 6% of those who attempt quitting report achieving successful cessation, consistent with the general acceptance of tobacco dependence as a chronic condition. Even though approximately half of adults who ever smoked regularly are classified as former smokers at the point when information is collected (CDC, 2011) and short-term patterns of abstinence among those who quit have been documented (Hughes et al., 2012; Peters & Hughes, 2009; Piasecki, 2006), not much is known about long term patterns of relapse.

Studies that have addressed factors associated with relapse are either of cross-sectional design (Meyer, Rumpf, Schumann, Hapkke, & John, 2003), fairly short-term longitudinal follow-ups (i.e., 1 month, 12–24 months) (Alpert et al., 2012; Fidler, Shahab, & West, 2011; Hughes et al., 2012; Nonnemaker et al., 2011; Peters & Hughes, 2009) or limited to specific populations (e.g., youth) (Rosendahl, Galanti, & Gilljam, 2008). Patterns of relapse have been described for up to five years (Fidler et al., 2011; Piasecki, 2006); however, longer patterns of relapse have not been as well documented.

It has been reported that frequent and multiple quit attempts are needed before permanent abstinence is achieved (Malarcher et al., 2011; Yankelovitch, 2002). In other words, relapse (i.e., resuming regular smoking after a period of abstinence) among people attempting to quit is not unusual (Hughes et al., 2012; Peters & Hughes, 2009; Yeomans et al., 2011). However, there is little information about the timing of – permanent – quitting among ever smokers over a long period.

1.1. Study objective

The objectives of the study are to describe the prevalence of relapse over a span of 25 years (1985–1986 to 2010–2011) and to describe differences in quitting, relapse, quit after relapse, and long term active smoking by sex, race, age, and maximum educational achievement

within the longitudinal Coronary Artery Risk Development in Young Adults (CARDIA) study. This article addressed general patterns over a 25 year period, but did not present patterns of specific transitions in the seven inter-examination follow-up periods.

2. Methods

2.1. Participants

The Coronary Artery Risk Development in Young Adults (CARDIA) study is a community-based prospective cohort that examines the development and determinants of clinical and subclinical cardiovascular disease and their risk factors that began in 1985–6 (year 0, baseline). The 5115 individuals were randomly selected after stratification so that there would be approximately the same number of people in subgroups of sex, race (Black versus White), education (at most high school versus more than high school) and age (18–24 versus 25–30) in each of the four participating centers (Birmingham, AL; Chicago, IL; Minneapolis, MN; and Oakland, CA) (Friedman et al., 1988).

These same individuals were asked to participate in follow-up examinations during 1987–1988 (year 2), 1990–1991 (year 5), 1992–1993 (year 7), 1995–1996 (year 10), 2000–2001 (year 15), 2005–2006 (year 20), and 2010–1011 (year 25). By the 2010–2011 follow-up, the group aged 43 to 55 years. Most survivors (there have been <300 deaths to date) have been examined at each of the follow-up examinations (91%, 86%, 81%, 79%, 74%, 72%, and 72%, respectively); 2494 participated at all seven of the follow-up examinations. We included all CARDIA participants with smoking status available for at least 6 examinations (N = 3603) (Table 1).

Data have been collected using comparable protocols on physical measurements such as weight and body composition as well as lifestyle factors such as tobacco use. More complete descriptions can be found at http://www.cardia.dopm.uab.edu/.

Of the 3603 participants with at least 6 examinations, 1682 (46.7%) were ever (current, new, or former) smokers (Table 1). Among 1546 current smokers at year 0, 65.3% had at least 6 examinations, compared to 74.9% of 676 former smokers and 77.7% of 2857 never smokers (36 participants were missing smoking classification at year 0).

As compared with smokers at baseline who attended 6 examinations, smokers at baseline who had <6 examinations were more likely to be male, Black, and younger, with high school or less education (all p-values < 0.05).

2.2. Definition of variables

2.2.1. Demographics—The following demographic characteristics collected at baseline were used in the analysis: sex (men, women), race (White, Black), age (18–24, 25–30), and education level (< high school diploma, high school graduate, some college, college, and graduate study). Race was self-reported. Age, sex, and race were verified at year 2.

2.2.2. Patterns of smoking, quitting and relapse—The following questions were asked to the participants at each examination: have you ever smoked cigarettes regularly for

at least 3 months? By regularly, we mean at least 5 cigarettes per week, almost every week? Those who stated "no" were considered a non-smoker for that time period, while those who stated "yes" were then asked whether they currently smoked cigarettes. Those who responded "yes" were considered to be current smokers for that time period and those who responded "no" were considered to be former smokers for that time period. No questions were asked about experimenting with cigarettes or irregular/occasional smoking patterns.

To describe the prevalence of distinct patterns of quitting, relapse, quit after relapse, and active smoking at the end of study in this cohort, we used self-reports of smoking status at baseline and at 7 follow-up points. Individuals at baseline who reported either smoking or previously smoking (year 0, N = 1505) and individuals who first reported smoking at year 2 or 5 (years 2 and 5, N = 177; one new smoker had missing data at T0 and eleven had missing smoking status at year 2 or year 5) constituted the denominator for our analysis of quit patterns (N = 1682). Those who reported they never smoked cigarettes regularly for at least 3 months (at least 5 cigarettes per week almost every week) at baseline and who did not initiate smoking by year 5 were excluded from most of the analyses (N = 1921, of the total group of 3603) (Table 1).

A participant was considered *never a regular smoker* if he or she reported being a non-smoker at all time periods. Categories of smoking were created to ascertain early smoking status. Those who answered the smoking questions positively at baseline (1985–1986) were classified as *current smokers*. Those who have a missing smoking response at baseline followed by a current smoker response at year 2, or who have missing smoking status at baseline and year 2 but are current smokers at year 5 are also classified as a *current smoker*. *Former smokers* are those who are classified as a former smoker at baseline, have missing baseline smoking status and classified as a former smoker at year 2, or have missing smoking status at the first two time points and classified as a former smoker at year 5. Respondents who were classified as a never smoker at baseline and reported being a former or current smoker at year 2 or 5 were classified as *new smokers*. Within each of 3 early smoker categories (current, new, former), four additional categories were created for ever smokers: 1) always smoked: smoked at each examination (only for current and new smokers); 2) successful quitter without relapse: reported to quit at any examination and did not smoke at any following examination; 3) successful quitter with relapse: relapsed, but quit by year 25; and 4) unsuccessful quitter: relapsed and did not quit again by year 25.

Because questions about duration of abstinence and relapse between waves were not included in the CARDIA study, it was necessary to develop an algorithm for categorizing smoking patterns to capture as many of the study participants as possible. We only included in our analysis those with no more than two missing data points, which introduced little disease-related bias because death and severe morbidity remain rather rare in CARDIA. Because we were interested in long-term relapse patterns and to use what information we had regarding recent smoking initiation, we divided the study examinations into early examinations (year 0, year 2, or year 5), or subsequent examinations (years 7, 10, 15, 20, or 25) and created categories of smoking relative to early smoking status.

2.3. Analysis

Descriptive analyses were conducted to characterize patterns of smoking and relapse, according to early study smoking status. Demographics that were included are sex, race, age at baseline, and the highest education level attained. Three multivariable analyses were conducted. The first multivariable analysis (Table 4) included all ever smokers (1682 participants) and the outcome variable was current smoking at last follow-up (yes/no). The second multivariable analysis (Table 5) included those who ever smoked but excluded those who reported smoking at each wave (n = 434) during the duration of the study (final sample size = 1248); the outcome variable was if they relapsed (yes/no) during the study. Finally, the last multivariable analysis (Table 6) included those who ever smoked and stopped smoking but started smoking again (relapsed) (n = 501); the outcome variable was failure to quit (yes/no) by last follow-up. We tested whether smoking pattern was significantly different between demographic categories simultaneously in the model (sex, race, age, education). Data were analyzed using SAS version 9.2 (SAS Institute, Inc., Cary, North Carolina).

3. Results

3.1. Descriptive findings

Over half (53.3%) of our 3603 participants reported that they were never regular smokers at any of the 6–8 examinations for which they reported smoking status. Among the 1682 ever smokers, 59.4% were current smokers at baseline, 10.5% started smoking at one of the first two follow-ups, and 30.1% were former smokers at baseline (Table 1). The 114 respondents who attended 6 examinations and reported smoking initiation after study year 5 were excluded from the analysis because we did not use survival-type analysis in our study and considered them not to have the same length of time in the study to quit and relapse as others.

3.2. Follow-up findings

52.7% of current smokers at baseline were still smoking by the end of the study (40.1% always smoked and 12.6% quit but relapsed and still smoked), compared with 29.4% of new smokers and 11.9% of former smokers (Table 2). Also, 40.1% of current smokers at baseline reported smoking at each wave during the follow-up span compared to 18.6% of new smokers. At follow-ups, 34.0% of baseline current smokers were successful quitters without relapse once they quit compared to 55.4% of new and 61.1% of former smokers.

3.3. Demographic differences in smoking patterns

Among all 1682 participants who ever smoked, significant demographic differences were found in smoking patterns by sex, race, age, and education (Table 3). However, when stratified by baseline-current, new, and baseline-former smoker, the sex differences for patterns of smoking were non-significant (p > 0.05). As shown in Table 3, when stratified by race, 36.8% of Black ever smokers smoked at each follow-up compared to 16.4% of White ever smokers. Also, while 54.0% of White ever smokers did not smoke again at any follow-up once they quit, only 33.2% of Black ever smokers did not smoke again at any follow-up once they quit. When the analysis was stratified by age, those at the younger baseline age

group (18–24 years) were more likely to always smoke (30.1%) and less likely, once they quit, not to smoke again (37.5%) at follow-up than those aged 25–30 years (23.1% and 48.7%, respectively). Finally, when the analysis was stratified by the highest attained formal education, results show that the lower the level of formal education the more likely they were to smoke at each wave and the less likely they were to be a successful quitter without further relapse at follow-up.

3.3.1. Active smoking by the end of the study (Table 4)—In the multivariate analysis to examine active smoking at the end of the study overall, each covariate (sex, age, race, and education) was statistically significant. Males and Blacks were more likely to be smoking at the end of follow-up than females and Whites. The odds of active smoking at the end of the study decreased with increasing age (12 years of age difference, from baseline age 18 years to 30 years) and the number of years of maximum attained education (1 to 20 or more years). However, when stratified analyses were conducted for current, new, and former smokers, no sex difference was found regarding active smoking by the end of the study for any of these specific groups of ever smokers.

3.3.2. Relapse (Table 5)—In a subset multivariable analysis about smoking relapse during the study, in which participants who smoked at each wave (n = 434) were excluded from the analysis, statistically significant results were observed by race, age, and education. Blacks were more likely to relapse during the study after stopping smoking than Whites. For every year of age increase we saw a decrease in the odds of relapse. Also, for every year of education increase we saw a decrease in the odds of relapse.

3.3.3. Non-abstinence by the end of the study after relapse (Table 6)—Finally, another subset group of the previous multivariable analysis was performed for non-abstinence by the end of the study after relapse for those who relapsed during the study. In this analysis, in addition to excluding those who smoked at each wave in the study, we also excluded those who after quitting never relapsed at follow-ups. The odds of smoking by the end of the study after a relapse decreased with increasing age and with the number of years of maximum attained education. No significant difference was observed between Black and White smokers.

4. Discussion

The findings of this 25 year follow-up are mostly consistent when looking at socio-demographic differences in active smoking by the end of the study, differences in the prevalence of relapse, and differences in non-abstinence by the end of the study after relapse. In all three, younger adults and those with lower education were more likely to have outcomes that could be interpreted to be detrimental to their health than older adults and those with a higher education. Regarding racial differences, Black smokers were more likely to be active smokers by the end of the study and to relapse during the study than Whites.

Previous studies highlight the importance of quitting early in life (Doll, Peto, Boreham, & Sutherland, 2004; Gawron, Hou, Ning, Berry, & Lloyd-Jones, 2012; Taylor, Hasselblad, Henley, Thun, & Sloan, 2002). Ever smokers who quit by age 35 years have a risk of dying

of a smoking-related disease very similar to those who never smoked. In our study, 40% of baseline smokers (who comprised about 60% of ever smokers) were current smokers at each follow-up. About 40% of former smokers and 26% of current or new smokers relapsed one or more times at some point during follow-up. Also, a higher percentage of Black smokers smoked at each wave than White smokers, Black baseline and new smokers were more likely to be active smokers by the end of the study, and Black former smokers were more likely to relapse than their White counterparts. Continuous smoking, relapse, and inability to quit again after relapse likely adds duration to exposure to mainstream cigarette smoke. This is of great concern given that it is well established that length (duration) of smoking, in addition to the amount of cigarettes smoked per day on days the person smoked, is strongly associated with a higher likelihood of developing and dying from a smoking-related disease such as lung cancer, COPD, and heart attack (Surgeon General Report, 2004).

As our study results show, long-term cessation may be complicated by several instances of relapse. As a group, those at higher risk of uninterrupted smoking, relapse, and short-term abstinence are vulnerable groups of the population with lower access to proven cessation treatments, including relapse prevention interventions for smokers who recently quit (Fiore et al., 2008; Trinidad, Pérez-Stable, White, Emery, & Messer, 2011). As stated by Ferguson, Shiffman, and Bruno (2012) in a commentary, there is limited practical use in identifying those smokers who are at great risk of relapsing, if there are no substantial improvements in the available treatment options for them. Therefore, attempting to design and evaluate strategies to prevent relapse and/or to provide assistance for those who do relapse is of critical importance in reducing the overall prevalence of smoking in the population and as a consequence, reducing rates of disease, death, and cost due to smoking. Another key element is increasing the frequency of quit attempts.

The results from this and other studies confirm the difficulty that the majority of smokers have in quitting for good (e.g., Conklin et al., 2005; Piasecki, 2006; Yeomans et al., 2011). It is well documented that nicotine addiction is a condition that affects both brain and behavior, characterized by compulsive drug seeking and use despite harmful consequences (NIDA, 2010). This does not mean that tobacco addiction cannot be treated, but successful cessation for most smokers will require long-term treatment and involve multiple attempts to quit (Fiore et al., 2008). The clinical practice guideline (Fiore et al., 2008) on treating tobacco use and dependence provides guidance on intervening with patients who recently quit, smokers who want to quit, the need to develop various effective formats for relapse prevention treatments (e.g., effectiveness of telephone contacts in reducing the likelihood of relapse after a minimal intervention), and promising treatment adaptations for smokers who are of low SES/have limited formal education, young, and for low-income Black smokers. In a study conducted by Trinidad et al. (2011) using 2003 nationally representative sample of U.S. adults aged 20 to 64 years, the authors suggest a need to develop cessation programs tailored to different racial/ethnic groups.

Disparities in relapse were observed by education among smokers. We found that the higher the level of education, the more likely that the person was to quit by the end of the study. This finding is consistent with results from Malarcher et al. (2011), who found that those with a college degree were more likely to quit than those with a high school education or

less. They also found that those with some college were more interested in quitting than those with less than a high school education.

A higher proportion of Black current smokers smoked at each wave than White current smokers. We also found that the odds for relapse among Black smokers were almost twice as high as for White smokers. Malarcher et al. (2011) found that even though interest in quitting and quit attempts in the last year were more prevalent among Black smokers than White smokers, cessation per se was less likely among Black smokers than White smokers. In our study, Black smokers were more likely to be active smokers by the end of the study than White smokers. One possible explanation for these findings could be found in their preference for menthol cigarettes, use of which has been associated with a greater degree of tobacco dependence (Hoffman & Simmons, 2011). In fact, an advisory committee to the Food and Drug Administration (FDA) concluded that the use of menthol cigarettes is likely associated with reduced success in smoking cessation, especially among Blacks, and that the use of menthol cigarettes is likely associated with increased dependence (FDA TPSAC report, 2010).

5. Limitations

There are some limitations that should be kept in mind in interpreting the findings from this study. First, the longitudinal study was conducted in specific community-based locations. Even though participant enrollment in those locations tried to mimic the general population, the study results may not necessarily be representative of the general U.S. population. In particular, smokers had a higher dropout rate than nonsmokers, and it would be expected that those smokers who did drop out would be more likely to continue smoking. Still, the overall prevalence of smoking in the CARDIA study in 2010 (19.9%) was close to the 2010 U.S. prevalence estimate of 22.0% for individuals aged 25–44 years (CDC) and close to the 21.1% estimate for individuals aged 45–64 years (CDC, 2011); the participants in this community-based study aged 43–55 years in 2010. Second, although the study design was longitudinal, these data are self-reported and no objective validation (i.e., serum cotinine levels) of active smoking was obtained at the follow-ups. A validation study using serum cotinine levels was performed at the CARDIA baseline exam (Wagenknecht, Burke, Perkins, Haley, & Friedman, 1992), finding that misclassification was less than 4.0%, resulting only in a slight underestimate of smoking at baseline. Given the focus on resumption of smoking following a report of abstinence, it is unlikely that individuals would overreport relapse. If any misrepresentation of smoking status did occur, it is more likely that reports of continued abstinence would be overreported. Third, since smoking cessation was not a primary focus of the original cohort study, specific information on occurrences of smoking, quitting, and relapse between data collection points were not obtained, nor was there any information collected on nicotine dependence. Thus, for example, it is possible that even though a person may have reported not smoking at the time of the year 10 and 15 interviews, he or she may have smoked and quit between the two periods and this information would not be known. It is possible that the two contiguous reports of smoking could have included one or more episodes of quitting in that time period. Finally, never smokers were defined as those who never smoked regularly (weekly), anyone who smoked <5 cigarettes per week, or anyone who may have smoked regularly but for less than 3

months. The definition used by the National Center for Health Statistics (NCHS) National Health Interview Survey (NHIS) and some other adult surveys to define an adult nonsmoker is those who never smoked in their lives 100 cigarettes or more. Thus, our study definition departs some from the NCHS adult never smoker definition, and as a result, may include more established smokers (weekly) at baseline.

6. Conclusions

To conclude, there are large and persistent disparities in continued smoking, relapse and quitting after 20–25 years among ever smokers, including education and race. Black smokers seem to be at higher risk of relapse than White smokers. Population-level cessation interventions, which may have greater reach among these populations than clinical ones, include counter-tobacco mass media campaigns, increases in the prices of tobacco products, and implementation of smoke-free policies, although a comprehensive approach that includes clinical intervention is a key. Finally, even though proven strategies exist to encourage and support smoking cessation, these strategies are not fully implemented, and there is also a need for a chronic care approach that involves evidence-based strategies to prevent relapse among those who quit and to provide support for individuals to resume abstinence if they do relapse (Joseph et al., 2011; Piper et al., 2013).

Acknowledgments

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HIGHLIGHTS

- We examined the prevalence of smoking relapse among 3,603 participants who were followed for 20 – 25 years.

- Among those classified as former smokers at baseline, 39% relapsed at least once; of these, 69.5% had quit again by the end of the study.

- Maximum education level attained, age at study baseline, and race were associated with failure to quit smoking by the end of the study and relapse among those who did quit.

- Smoking relapse after quitting is common, especially in those with lower education level.

Table 1

Distribution of 3,603 participants with 6 or more examinations, by smoking status early (baseline, year 2, or year 5) in the study—CARDIA 1985–2011.

Early study smoking status	All participants		Ever smokers	
	N	%	N	%
Never reported smoking during the study	1921	53.3	–	–
Current smoker at year 0	999	27.7	999	59.4
Non-smoker at year 0 but new smoker at year 2 or 5	177	4.9	177	10.5
Former smoker at year 0	506	14.1	506	30.1
Total	3603	100.00	1682	100.00

Table 2

Percentage (95% confidence intervals) of 1682 ever smokers by early (baseline, year 2 and year 5) smoking status and subsequent smoking patterns—CARDIA 1985–2011.

Early smoking status (baseline, year 2, or 5)	N	Always smoked: Smoked at each examination		Successful quitter without relapse: Reported to quit at any examination, but did not smoke at any following examination		Successful quitter with relapse: Relapsed, quit by the end of study		Unsuccessful quitter: Relapsed, did not quit by the end of study	
		n	Row frequency (95% CI)	n	Row frequency (95% CI)	n	Row frequency (95% CI)	n	Row frequency (95% CI)
Baseline current smoker	999	401	40.1 (37.1–43.2)	340	34.0 (31.1–37.0)	132	13.2 (11.1–15.3)	126	12.6 (10.6–14.7)
New smoker (started smoking by year 5)	177	33	18.6 (12.9–24.4)	98	55.4 (48.0–62.7)	27	15.3 (10.0–20.6)	19	10.7 (6.2–15.3)
Baseline former smoker	506	–	–	309	61.1 (46.8–65.3)	137	27.1 (23.2–31.0)	60	11.9 (9.0–14.7)
Total	1682	434		747		296		205	

Table 3

Percentage (95% confidence intervals) distribution of smoking patterns among 1682 ever smokers by early (baseline, year 2 and year 5) smoking status and subsequent smoking patterns—CARDIA 1985–2011.

Demographics	Always smoked: Smoked at each examination N = 434			Successful quitter without relapse: Reported to quit at any examination, but did not smoke at any following examination N = 747			Successful quitter with relapse: Relapsed, quit by the end of study N = 296			Unsuccessful quitter: Relapsed, did not quit by the end of study N = 205			p-Value
	Freq.	%	95% CI	Freq.	%	95% CI	Freq.	%	95% CI	Freq.	%	95% CI	
Sex													
Men	216	29.4	26.1–32.8	300	40.9	37.3–44.4	120	16.4	13.7–19.0	98	13.4	10.9–15.8	0.0048
Women	218	23.0	20.3–25.7	447	47.2	44.0–50.3	176	18.6	16.1–21.0	107	11.3	9.3–13.3	
Race													
White	148	16.4	13.9–18.8	489	54.0	50.8–57.3	166	18.3	15.8–20.9	102	11.3	9.2–13.3	<0.0001
Black	286	36.8	33.4–40.2	258	33.2	29.9–36.5	130	16.7	14.1–19.4	103	13.3	10.9–15.6	
Age													
18–24	195	30.1	26.6–33.6	243	37.5	33.8–41.2	113	17.4	14.5–20.4	97	15.0	12.2–17.7	<0.0001
25–30	239	23.1	20.5–25.7	504	48.7	45.7–51.8	183	17.7	15.4–20.0	108	10.4	8.6–12.3	
Education													
<High school	34	52.3	40.2–64.5	13	20.0	10.3–29.7	10	15.4	6.6–24.2	8	12.3	4.3–20.3	<0.0001
High school	125	40.9	35.3–46.4	102	33.3	28.1–38.6	33	10.8	7.3–14.3	46	15.0	11.0–19.0	
Some college	186	31.4	27.6–35.1	222	37.4	33.5–41.3	101	17.0	14.0–20.1	84	14.2	11.4–17.0	
College	53	15.6	11.7–19.4	169	49.7	44.4–55.0	77	22.7	18.2–27.1	41	12.1	8.6–15.5	
Graduate	36	9.5	6.6–12.5	241	63.8	58.9–68.6	75	19.8	15.8–23.9	26	6.9	4.3–9.4	

Table 4

Odds ratio estimates of active smoking by the end of the study among all ever smokers (n = 1682) by socio-demographic variables—CARDIA 1985–2011.

Variable	Odds ratio	Lower CI	Upper CI	p-Value
Female	Ref.	–	–	
Male	1.34	1.08	1.66	0.01
White	Ref.	–	–	
Black	1.86	1.49	2.31	<0.01
Age at baseline[a]	0.93	0.91	0.96	<0.01
Highest education during the study[a]	0.79	0.75	0.83	<0.01

Note: Active smoking by the end of the study is defined as current smoking at last follow-up (year 20 or year 25).

Number of observations: 1682 (still active: 639; not active: 1043).

[a]Continuous variable.

Table 5

Odds ratio estimates of relapse among baseline former smokers and persons who quit during the study[a] (n = 1248) by socio-demographic variables—CARDIA 1985–2011.

variable	Odds ratio	Lower CI	Upper CI	p-Value
Female	Ref.	–	–	
Male	1.011	0.88	1.40	0.38
White	Ref.	–	–	
Black	1.43	1.12	1.83	<0.01
Age at baseline[b]	0.95	0.92	0.98	<0.01
Highest education during the study[b]	0.93	0.89	0.97	<0.01

Note: Relapse is defined as having stopped smoking at a previous follow-up and started smoking again at any of next follow-ups.

Number of observations: 1248 (relapsed: 501; did not relapse: 747).

[a]Excludes those who always smoked (n = 434) in Table 2.

[b]Continuous variable.

Table 6

Odds ratio estimates of failure to quit after relapse[a] (n = 501) by socio-demographic variables—CARDIA 1985–2011.

Variable	Odds ratio	Lower CI	Upper CI	p-Value
Female	Ref.	–	–	
Male	1.27	0.88	1.85	0.20
White	Ref.			
Black	1.05	0.72	1.53	0.80
Age at baseline[b]	0.92	0.87	0.97	<0.01
Highest education during the study[b]	0.85	0.78	0.92	<0.01

Note: Failure to quit after relapse is defined as someone who stopped smoking at a previous follow-up and started smoking again at any of next follow-ups but was a current smoker at last follow-up.

Number of observations: 501 (failed: 205; did not fail 296).

[a] Excludes those who always smoked (n = 434) as well as those successful quitters without relapse (n = 747) in Table 2.

[b] Continuous variable.