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Tobacco use disparities by racial/ethnic groups: California compared to the United States



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ABSTRACT

Racial/ethnic disparities in cigarette use and cessation persist. This study compared cigarette consumption and former smoking trends in California (CA) with the rest of the United States (US) by racial/ethnic categories of non-Hispanic White, Black, Hispanic/Latino, and Asian/Pacific Islander groups. Data were analyzed from the 1992 to 2011 Tobacco Use Supplement to the Current Population Survey. Consumption levels across decades were examined and adjusted logistic regression models were fit to compare across CA and US.

Results indicated steady declines in ever smoking prevalence for all groups with much lower magnitudes of change among US Blacks and Whites compared to their CA counterparts. After controlling for age, gender, and education, CA had significantly fewer heavy smokers (OR = 0.45, 95%CI:0.38–0.54), more light and intermittent smokers (LITS; OR = 1.68, 95%CI: 1.45–1.93), and a greater proportion of former smokers (OR = 1.35, 95%CI: 1.24–1.48) than the rest of US. Data were stratified by race/ethnicity and the patterns shown were mostly consistent with CA performing statistically better than their US counterparts with the exception of Black LITS and Asian/Pacific Islander former smokers. California's success in reducing tobacco use disparities may serve as a prime example of tobacco control policy for the country. CA and the US will need to continue to address tobacco use and cessation in the context of the growing diversity of the population.

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1. Introduction

Racial/ethnic minority populations suffer disproportionately from tobacco-related morbidity and mortality compared to non-Hispanic Whites (Whites) (American Lung Association, 2010; US Department of Health and Human Services, 1998, 2000, 2004; Xu, Murphy, Kochanek, & Bastian, 2016). African Americans smoke fewer cigarettes (Haiman et al., 2006) and are more likely to be non-daily smokers than Whites (Trinidad et al., 2009), yet they have an elevated risk of lung cancer (Centers for Disease Control and Prevention, 2008; Fagan, Moolchan, Lawrence, Fernander, & Ponder, 2007; Haiman et al., 2006; Howe,

Lake, Schymura, & Edwards, 2009). Hispanics/Latinos also smoke fewer cigarettes and are more likely to be non-daily smokers; however lung cancer is the leading cause of cancer death among Hispanic/Latino men and second leading cause among Hispanic/Latina women (American Cancer Society, 2012; Siegel, Naishadham, & Jemal, 2012). Disparities for smoking cessation are also apparent. African Americans had greater intentions to quit smoking compared to Whites (49.3% vs. 40.9%, respectively), but fewer African American adult ever smokers actually quit compared to Whites (44.1% vs. 57.1%, respectively) (US Department of Health and Human Services, 2014).

The state of California has been widely recognized for having the longest running and most effective comprehensive tobacco control program in the US. The California Tobacco Control Program (CTCP) has demonstrated significant reductions in overall smoking initiation (Messer et al., 2007; Pierce, Messer, White, Cowling, & Thomas, 2011; Pierce, White, & Gilpin, 2005), cigarette consumption (Al-Delaimy, White, Gilmer, Zhu, & Pierce, 2008; Gilpin, Messer, White, & Pierce, 2006; Pierce, White, & Messer, 2009), and associated reductions in

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Table 1a
Demographic characteristics and smoking behaviors, CALIFORNIA by race/ethnicity, by decade.

	Non-Hispanic White			Black								
	1990s		2000s		2010s		1990s		2000s		2010s	
	Unweighted N = 24,067		Unweighted N = 19,469		Unweighted N = 6682		Unweighted N = 2377		Unweighted N = 2296		Unweighted N = 779	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Age (years)												
18–24	10.5	(10.1–10.9)	10.9	(10.7–11.1)	10.5	(9.3–11.7)	11.4	(10.6–12.1)	14.2	(13.6–14.8)	14.3	(11.5–17.1)
25–44	41.3	(41.0–41.7)	35.4	(35.1–35.7)	31.3	(30.0–32.5)	49.9	(48.6–51.3)	42.5	(41.8–43.2)	38.5	(35.7–41.4)
45–64	29.4	(29.1–29.7)	35.5	(35.2–35.7)	38.0	(36.8–39.2)	26.8	(25.5–28.1)	30.9	(30.2–31.5)	34.5	(32.0–37.1)
65 +	18.8	(18.6–19.1)	18.2	(17.9–18.6)	20.3	(19.1–21.4)	11.9	(11.0–12.8)	12.4	(11.9–12.9)	12.6	(10.1–15.1)
Sex												
Men	49.3	(48.7–49.9)	49.5	(49.3–49.6)	49.3	(48.6–50.0)	45.1	(42.6–47.6)	46.6	(46.2–47.1)	46.9	(44.8–49.0)
Women	50.7	(50.1–51.3)	50.5	(50.4–50.7)	50.7	(50.0–51.4)	54.9	(52.4–57.4)	53.4	(52.9–53.8)	53.1	(51.0–55.2)
Education												
Less than high school	8.8	(8.0–9.0)	6.6	(6.5–6.8)	5.0	(4.3–5.6)	15.2	(14.6–15.9)	12.3	(11.8–12.9)	10.5	(8.0–12.9)
High school grad	26.0	(25.7–26.2)	22.1	(21.8–22.3)	20.1	(18.7–21.4)	29.3	(28.6–30.1)	25.0	(24.3–25.7)	26.4	(23.2–29.5)
Some college	34.3	(34.1–34.6)	35.2	(34.9–35.5)	33.5	(31.8–35.2)	36.7	(35.9–37.4)	41.4	(40.6–42.2)	39.0	(35.4–42.7)
College grad	30.9	(30.6–31.3)	36.1	(35.7–36.5)	41.5	(39.6–43.3)	18.8	(18.0–19.6)	21.3	(20.5–22.0)	24.1	(20.9–27.3)
Cigarette smoking levels												
Never	51.3	(51.0–51.6)	58.8	(58.5–59.1)	64.9	(63.6–66.1)	57.2	(56.5–57.9)	67.6	(66.9–68.3)	74.5	(71.0–78.1)
Ever	48.7	(48.4–49.0)	41.2	(40.9–41.5)	35.1	(33.9–36.4)	42.8	(42.1–43.5)	32.4	(31.7–33.1)	25.5	(21.9–29.0)
Current	20.3	(20.0–20.5)	15.7	(15.5–15.9)	12.1	(11.2–13.1)	24.1	(23.5–24.8)	17.6	(17.0–18.2)	12.1	(9.7–14.6)
Former	28.4	(28.2–28.7)	25.3	(25.1–25.5)	22.6	(21.6–23.6)	18.7	(18.1–19.3)	14.7	(14.1–15.2)	13.0	(10.5–15.5)
LITS: occasional + daily, ≤5 cpd	5.1	(5.0–5.2)	5	(4.9–5.1)	4.3	(3.6–4.9)	8.4	(8.0–8.9)	7.4	(7.0–7.9)	6.1	(4.5–7.7)
Moderate: daily, 6–19 cpd	5.9	(5.8–6.1)	5.3	(5.2–5.4)	4.8	(4.2–5.5)	9.5	(9.1–9.9)	6.3	(5.9–6.7)	5.1	(3.3–6.9)
Heavy: daily, 20 ≤ cpd	9.1	(9.9–9.2)	5.4	(5.2–5.5)	2.9	(2.4–3.3)	5.8	(5.4–6.2)	3.3	(2.9–3.6)	0.8	(0.1–1.4)

Note: CI = confidence interval; cpd = cigarettes per day; All consumption variables in this table are calculated with overall ethnic subpopulation as the denominator.

cardiovascular and cancer morbidity and mortality rates (Lightwood & Glantz, 2013; Max, Sung, Shi, & Stark, 2015). As a result, California reaped an overall savings of \$134 billion in healthcare expenditures for the state (Lightwood & Glantz, 2013; Max et al., 2015). As a whole, the US has also seen declines in tobacco use and savings due to reductions in health care expenditures and increases in quality of life measures (US Department of Health and Human Services, 2014). However, tobacco control programs have not been implemented uniformly and comparisons between California and the rest of the US on tobacco use disparities are limited.

Examining population levels of cigarette consumption provides important information on how various groups may be shifting their cigarette usage patterns. This information can be used to fine tune prevention and cessation programs. Recent work has established that light and intermittent smoking (LITS) has increased over time in California and that Asian American, African American, and Hispanic/Latino smokers are more likely to be LITS than heavy daily smokers (Blanco et al., 2014a, b; Pulvers et al., 2014; Sakuma et al., 2015). Among US youth, daily moderate to heavy smokers (defined as smoking ten cigarettes or more per day) appears to be decreasing, further supporting shifting trends in consumption levels (Kozlowski & Giovino, 2014). However, it is unknown how the significant patterns observed in LITS among racial/ethnic minority adult smokers in California will compare to the US. Further investigation is needed to understand the full distribution of smoking consumption levels and quitting behaviors within each racial/ethnic subgroup.

With the increase in diversity projected for the US population, California may represent the future demographic profile of the nation (US Census Bureau, 2012). Population-level smoking rates and associated morbidity and mortality may shift alongside these demographic changes in the US, potentially increasing tobacco related health disparities. Although research has examined CTCF's differential effects across racial/ethnic groups within California (Trinidad et al., 2007), understanding how consumption and quit rates have varied over time in California, a

state with a strong tobacco control program, compared to the rest of the US across different racial/ethnic groups will help define and strengthen efforts to curtail the effects of tobacco on the US population.

2. Methods

2.1. Data source

This study used cross-sectional data collected from the 1992–2011 Tobacco Use Supplement (TUS) to the Current Population Survey (CPS) to estimate cigarette smoking prevalence and frequency across racial/ethnic groups in California and the rest of the US. The CPS, administered by the US Census Bureau, uses a multistage probability sample design to collect monthly national and state data from approximately 60,000 households on labor force characteristics among the civilian, non-institutionalized US population age 15 and older (US Census Bureau, 2006). The TUS, conducted in conjunction with the CPS every three years, collects data on tobacco use and related attitudes and practices among CPS participants. The present study used data from 1992/1993, 1995/1996, 1998/1999, 2001/2002, 2003, 2006/2007, and 2010/2011 surveys. The TUS-CPS has a self-response rate range from 62% (2006–2007) to 72% (1992–1993) (National Cancer Institute, 2015). Analyses were restricted to those who were 18 years or older, were self-responders and not proxy responders (typically family members), and those who completed the interview in person rather than by telephone.

2.2. Measures

2.2.1. Demographic characteristics

Demographic measures include age group (18–34 years, 35–49 years, 50–64 years, and 65 years or older), gender, level of education (less than high school, high school graduate with diploma or equivalent, some college, and college graduate), and race/ethnicity. We used the US

Hispanic/Latino				Asian/Pacific Islander							
1990s		2000s		2010s		1990s		2000s		2010s	
Unweighted N = 9520		Unweighted N = 10,111		Unweighted N = 4276		Unweighted N = 4093		Unweighted N = 3979		Unweighted N = 1648	
%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Age (years)											
20.7	(19.4–22.1)	17.8	(17.6–18.1)	18.4	(17.3–19.5)	12.8	(11.8–13.9)	13.3	(12.9–13.6)	10.6	(8.8–12.4)
53.8	(53.3–54.2)	52.2	(51.9–52.6)	47.7	(46.4–49.0)	50.0	(48.6–51.4)	43.4	(42.8–43.9)	40.4	(38.2–42.5)
18.1	(17.3–18.9)	23.2	(22.9–23.5)	26.1	(24.9–27.3)	25.9	(25.4–26.5)	30.4	(30.0–30.8)	33.6	(31.5–35.8)
7.4	(7.1–7.8)	6.8	(6.5–7.0)	7.8	(6.9–8.6)	11.3	(10.7–11.8)	12.9	(12.5–13.3)	15.4	(13.6–17.2)
Sex											
48.5	(45.9–51.1)	49.2	(49.0–49.4)	50.9	(49.9–51.8)	48.3	(47.9–48.7)	46.0	(45.6–46.4)	45.9	(44.0–47.8)
51.5	(48.9–54.1)	50.8	(50.6–51.0)	49.1	(48.2–50.1)	51.7	(51.3–52.1)	54.0	(53.6–54.4)	54.1	(52.2–56.0)
Education											
47.8	(47.2–48.3)	42.2	(41.7–42.7)	35.6	(33.6–37.6)	13.6	(12.9–14.3)	10.3	(9.7–10.8)	7.3	(5.8–8.8)
26.1	(25.7–26.5)	25.6	(25.2–25.9)	29.0	(27.4–30.6)	20.1	(19.6–20.6)	17.22	(16.8–17.7)	16.6	(14.4–18.7)
19.1	(18.7–19.4)	23.4	(23.0–23.8)	25.2	(23.7–26.8)	26.5	(25.8–27.1)	26.1	(25.6–26.7)	25.2	(22.5–27.8)
7.1	(6.8–7.3)	8.8	(8.6–9.0)	10.2	(9.0–11.3)	39.8	(39.0–40.7)	43.3	(45.6–47.1)	51.0	(47.5–54.4)
Cigarette smoking levels											
71.8	(71.4–72.1)	78.2	(77.9–78.5)	81.3	(80.1–82.6)	72.8	(72.2–73.4)	78.9	(78.5–79.4)	81.3	(79.5–83.2)
28.2	(27.9–28.6)	21.8	(21.5–22.1)	18.7	(17.4–19.9)	27.2	(26.6–27.8)	21.1	(20.6–21.5)	18.7	(16.8–20.5)
13.8	(13.5–14.2)	10.0	(9.7–10.3)	7.7	(6.9–8.6)	14.1	(13.6–14.5)	10.0	(9.6–10.4)	8.2	(6.9–9.6)
14.4	(14.1–14.7)	11.7	(11.5–11.9)	10.7	(9.7–11.7)	13.1	(12.7–13.5)	10.8	(10.5–11.1)	10.2	(8.7–11.8)
8.3	(8.1–8.6)	6.4	(6.2–6.6)	4.9	(4.2–5.6)	5.3	(5.0–5.5)	5.1	(4.9–5.4)	4.4	(3.3–5.5)
3.4	(3.2–3.6)	2.5	(2.4–2.6)	2.3	(1.8–2.7)	4.7	(4.5–5.0)	3.2	(3.1–3.4)	2.7	(2.1–3.4)
2.0	(1.8–2.1)	1.0	(0.9–1.1)	0.5	(0.3–0.7)	4.0	(3.7–4.2)	1.5	(1.4–1.6)	1.0	(0.5–1.5)

Census categories to define Hispanic/Latino ethnicity first then categorized the remaining respondent's race as non-Hispanic Black (Black), non-Hispanic Asian/Pacific Islander, non-Hispanic White (White); all others were not included in the analyses.

2.2.2. Cigarette consumption

TUS-CPS respondents were asked, "Have you smoked at least 100 cigarettes in your entire life?" Respondents were considered ever smokers if they answered yes. Ever smokers were further asked, "Do you now smoke every day, some days, or not at all?" Those who reported smoking every day or some days were considered current smokers. All current smokers were also asked to report the number of cigarettes they consumed on the days when they smoked in the past 30 days. Light daily smokers were defined as every day smokers who consumed 1–5 cigarettes per day, moderate daily smokers were every day smokers who consumed 6–19 cigarettes per day, and heavy daily smokers were every day smokers who consumed 20 or more cigarettes per day. Those who indicated that they smoked only some days were considered intermittent smokers (i.e., occasional/non-daily smokers). Light daily smokers and intermittent smokers (LITS) were combined into a single category (Husten, 2009). Former smokers were defined as ever smokers who reported not smoking at the time of the survey. The prevalence of the consumption variable of interest (i.e., LITS, moderate smokers, heavy smokers) is reported as those respective variables over the subpopulation of current smokers within ethnic/racial groups.

2.3. Statistical analysis

The data were separated into California versus the remaining states and the District of Columbia. This study focused on overall trends across time. The 1992/1993, 1996/1997 and 1998/1999 survey years were combined to create the 1990s decade for California and for the US, separately. Similarly, the 2001/2002, 2003, and 2006/2007 survey years were combined to create the 2000s decade. The 2010/2011 surveys,

the most recent available, were left as a single year representing the new 2010s decade.

All computations were carried out in SAS, version 9.3 (SAS Institute, 2011). Estimates were weighted using the household respondent's person-level TUS-CPS survey weights. Variance estimates used replicate weights with Fay's balanced repeated replication (US Census Bureau, 2006, p. 66). Demographic information, including variance estimates, were calculated using SAS PROC SURVEYMEANS and SURVEYFREQ. Multivariable logistic regression models were fit for the most recent decade to compare heavy smoking between California and US racial/ethnic groups using PROC SURVEYLOGISTIC. Models predicting LITS or heavy smoking (versus all other consumption levels) included California (versus remaining US states), race/ethnicity, and adjusted for age, gender, and education. Data were further stratified and models rerun by race/ethnicity groups.

3. Results

3.1. Demographic characteristics

Demographic information from 1992 to 2011 for White, Black, Hispanic/Latino and Asian/Pacific Islander groups in California and the rest of the US are presented in Table 1a and 1b, respectively. Comparing California with the rest of the US, for each decade, the 95% CIs overlapped for each age group stratum indicating no significant differences. With the exception of the Hispanic/Latino group, there were significantly more women than men for both California and the rest of the US by decade, similar to other TUS research studies (Trinidad et al., 2009). For California and the US, Asian/Pacific Islanders had a greater proportion of college graduates than other educational strata compared to all other racial/ethnic groups and across all decades. In contrast, Hispanics/Latinos in California and the rest of the US had the largest proportion of those with less than high school education.

Table 1b
Demographic characteristics and smoking behaviors, UNITED STATES by race/ethnicity, by decade.

	Non-Hispanic White			Black		
	1990s	2000s	2010s	1990s	2000s	2010s
	Unweighted N = 428,545	Unweighted N = 400,569	Unweighted N = 119,849	Unweighted N = 46,785	Unweighted N = 45,508	Unweighted N = 15,966
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Age (years)						
18–24	11.2 (10.7–11.7)	11.5 (11.4–11.5)	11.3 (11.2–11.4)	14.7 (14.0–15.6)	15.8 (15.7–15.9)	16.5 (16.2–16.8)
25–44	41.5 (41.1–41.9)	35.5 (35.5–35.6)	31.7 (31.6–31.8)	48.2 (48.9–48.5)	42.6 (42.6–42.7)	38.0 (37.7–38.3)
45–64	28.9 (28.8–29.0)	34.3 (34.3–34.4)	37.3 (37.2–37.4)	24.9 (24.6–25.2)	29.9 (29.9–30.0)	33.2 (33.0–33.5)
65+	18.4 (18.4–18.5)	18.7 (18.6–18.7)	19.8 (19.7–19.9)	12.2 (11.6–12.9)	11.6 (11.6–11.7)	12.3 (12.1–12.5)
Sex						
Men	47.4 (46.8–48.0)	48.1 (48.1–48.1)	48.2 (48.1–48.3)	42.6 (40.6–44.6)	44.3 (44.2–44.3)	44.9 (44.6–45.2)
Women	52.6 (52.0–53.2)	51.9 (51.9–51.9)	51.8 (51.7–51.9)	57.4 (55.4–59.4)	55.7 (55.7–55.8)	55.1 (54.8–55.4)
Education						
Less than high school	14.3 (14.1–14.4)	10.9 (10.8–10.9)	8.5 (8.2–8.8)	26.1 (25.7–26.5)	20.7 (20.5–20.9)	16.5 (15.7–17.2)
High school grad	35.1 (35.0–35.3)	32.3 (32.2–32.4)	30.3 (29.9–30.5)	35.5 (35.3–35.8)	34.8 (34.6–35.0)	33.4 (32.4–34.3)
Some college	26.1 (26.0–26.2)	28.0 (27.9–28.1)	29.2 (28.9–29.5)	25.5 (25.3–25.7)	28.3 (28.1–28.5)	31.9 (31.0–32.7)
College grad	24.5 (24.4–24.6)	28.8 (28.7–28.9)	32.0 (31.6–32.5)	12.9 (12.8–13.1)	16.1 (16.0–16.3)	18.3 (17.5–19.1)
Cigarette smoking levels						
Never	49.8 (49.7–50.0)	54.9 (54.8–55.0)	59.8 (59.3–60.2)	61.6 (61.4–61.7)	68.1 (67.9–68.3)	72.3 (71.4–73.1)
Ever	50.2 (50.1–50.3)	45.1 (45.0–45.2)	40.2 (39.8–40.7)	38.4 (38.3–38.6)	31.9 (31.7–32.1)	27.7 (26.9–28.6)
Current	24.6 (24.5–24.7)	21.1 (21.1–21.2)	17.9 (17.5–18.2)	19.3 (19.1–19.4)	19.3 (19.1–19.4)	16.3 (15.5–17.0)
Former	25.6 (25.5–25.7)	23.8 (23.7–23.9)	22.1 (21.7–22.4)	14.2 (14.0–14.4)	12.4 (12.3–12.5)	11.1 (10.6–11.6)
LITS: occasional + daily, ≤5 cpd	4.5 (4.5–4.5)	4.3 (4.3–4.3)	4.0 (3.9–4.2)	7.9 (7.8–8.1)	6.7 (6.6–6.8)	6.6 (6.1–7.1)
Moderate: daily, 6–19 cpd	6.1 (6.1–6.1)	6.3 (6.3–6.4)	6.4 (6.2–6.6)	9.0 (8.9–9.1)	7.5 (7.4–7.6)	6.4 (5.9–6.8)
Heavy: daily, 20 ≤ cpd	13.8 (13.8–13.9)	10.3 (10.2–10.3)	7.2 (7.0–7.4)	7.0 (6.8–7.1)	4.8 (4.7–4.8)	3.1 (2.8–3.4)

Note: CI = confidence interval; cpd = cigarettes per day; All consumption variables in this table are calculated with overall ethnic subpopulation as the denominator.

3.2. Cigarette smoking levels

California cigarette smoking levels are reported in Table 1a and US levels in Table 1b as a proportion of the overall population. The largest decrease in prevalence of ever smoking between the 1990s and 2010s in California was among Blacks (17.3%) followed by Whites (13.6%), Hispanic/Latinos (9.5%), and Asian/Pacific Islanders (8.5%). In contrast, the largest decreases in the rest of the US were among Hispanic/Latinos (11.2%), with Blacks (10.7%), Whites (10%) and Asian/Pacific Islander groups (8.7%) close behind. US Blacks and Whites had much lower magnitudes of change for ever smoking prevalence than their California counterparts.

The proportion of current smokers over the total population within racial/ethnic groups, steadily declined across the 18-year span for both California and the US among all racial/ethnic groups (Table 1a and Table 1b). The data illustrate the largest decreases in current smoking prevalence were among California Blacks (12%), followed by Whites (8.2%), Hispanics/Latinos (6.1%), and Asian/Pacific Islanders (5.9%). In comparison, the US Hispanic/Latino (7.2%) decrease in current smoking was greater than that observed in California; US Asian/Pacific Islander (5.4%) was about equivalent; and White (6.7%) and Black (3%) decreases in current smoking prevalence nationally was much less than California.

3.2.1. Light and intermittent smoking among current smokers

Among current smokers in California, a moderate increase was observed in LITS between the 1990s and 2010s for Asian/Pacific Islanders (16.3%), Blacks (15.3%) and Whites (10.1%). In contrast, among current smokers in the rest of the US, moderate increases in LITS were observed for Hispanics/Latinos (10.5%) and to a lesser extent, Blacks (7.8%), and Whites (4.3%). Data are presented in Table 2 and illustrated in Supplemental Fig. 1.

3.2.2. Moderate smoking

Among current smokers in California, of the racial/ethnic groups only Whites (10.7%) showed significant changes in moderate smoking

between 1990s and 2010s. Similarly, among current smokers in the rest of the US, only Whites showed a significant increase (11.2%) in moderate smoking during the same time period (Table 2, Supplemental Fig. 1).

3.2.3. Heavy smoking

Among current smokers in California, there were significant and large decreases in heavy smoking between the 1990s and 2010s for Whites (21.1%), Blacks (17.4%), Asian/Pacific Islander (16.1%), and Hispanic/Latinos (7.7%). Similarly, among current smokers in the rest of the US, there were also large decreases for Whites (15.8%), Hispanic/Latinos (10.4%), Blacks (9.7%), and Asian/Pacific Islanders (9.5%; Table 2, Supplemental Fig. 1).

3.3. Former smoking

California started with higher proportions of former smokers (among ever smokers) in the overall population in the 1990s and demonstrated a slight decrease over the years compared to US groups (Tables 1a and 1b). Among ever smokers in California, the proportion of former smokers decreased for all groups between the 1990s and 2010 (White: 5.8%; Black: 5.7%; Hispanic/Latino: 3.7%; Asian/Pacific Islander: 2.9%; Table 2). Similarly, among ever smokers in the rest of the US, all groups showed small decreases (Hispanic/Latino: 4.3%; Whites: 3.5%; Asian/Pacific Islanders: 3.5%; Blacks: 3.1%; Table 2) over the same time period.

3.4. Logistic regression

Multivariable logistic regression models were fit to predict differences in heavy smoking between California versus the US during 2010s. After adjustment for age, education level, gender, and race/ethnicity, California had reduced odds (OR = 0.45, 95%CI: 0.38–0.54) for heavy smoking than the rest of the US. Although there was not enough statistical power to detect significant interactions for California/US and

Hispanic/Latino				Asian/Pacific Islander							
1990s		2000s		2010s		1990s		2000s		2010s	
Unweighted N = 28,044		Unweighted N = 36,301		Unweighted N = 13,554		Unweighted N = 11,124		Unweighted N = 14,530		Unweighted N = 5861	
%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Age (years)											
18.7	(17.7–19.8)	18.4	(18.3–18.5)	18.0	(17.5–18.5)	13.7	(13.4–14.4)	12.8	(12.5–13.0)	14.0	(13.0–14.9)
49.6	(48.8–50.4)	49.3	(49.1–49.4)	46.4	(45.9–46.9)	53.7	(52.5–54.9)	50.6	(50.4–51.0)	45.3	(44.1–46.4)
22.9	(22.7–23.1)	23.6	(23.5–23.7)	26.4	(25.9–26.9)	24.9	(24.3–25.4)	27.7	(27.4–27.9)	29.7	(28.6–30.7)
8.8	(8.6–9.0)	8.7	(8.6–8.8)	9.2	(8.9–9.5)	7.5	(7.1–7.8)	8.9	(8.7–9.1)	11.1	(10.2–12.1)
Sex											
48.2	(46.3–50.0)	51.3	(51.2–51.4)	51.4	(51.0–51.8)	48.5	(48.2–48.7)	48.1	(47.9–48.3)	48.4	(47.6–49.3)
51.8	(50.0–53.7)	48.7	(48.6–48.8)	48.6	(48.2–49.0)	51.5	(51.3–51.8)	51.9	(51.7–52.1)	51.6	(50.7–52.4)
Education											
41.1	(40.8–41.5)	40.0	(39.7–40.3)	31.7	(30.5–32.9)	11.6	(11.3–11.9)	10.0	(9.7–10.3)	8.9	(7.5–10.4)
28.2	(27.9–28.4)	28.7	(28.5–28.9)	30.8	(29.8–31.7)	21.8	(21.4–22.1)	19.5	(19.1–19.8)	19.5	(17.9–21.1)
20.2	(19.9–20.5)	19.6	(19.4–19.7)	23.7	(22.7–24.7)	22.1	(21.8–22.5)	19.0	(18.7–19.3)	21.0	(19.7–22.3)
10.5	(10.3–10.7)	11.7	(11.6–11.9)	13.8	(13.0–14.6)	44.5	(43.9–45.1)	51.6	(51.0–52.1)	50.6	(48.7–52.6)
Cigarette smoking levels											
66.5	(66.1–66.9)	73.5	(73.3–73.7)	77.7	(76.8–78.7)	72.9	(72.5–73.3)	78.2	(77.9–78.5)	81.6	(80.4–82.8)
33.5	(33.1–33.9)	26.5	(26.3–26.7)	22.3	(21.3–23.2)	27.1	(26.7–27.5)	21.8	(21.5–22.1)	18.4	(17.2–19.6)
19.3	(19.0–19.6)	15.2	(15.0–15.4)	12.1	(11.4–12.9)	14.4	(14.1–14.7)	11.4	(11.2–11.7)	9.0	(8.1–9.9)
14.2	(14.1–14.4)	11.11	(11.0–11.3)	9.9	(9.3–10.5)	12.7	(12.4–13.0)	10.3	(10.1–10.5)	9.2	(8.4–10.0)
8.5	(8.3–8.7)	7.4	(7.3–7.5)	6.6	(6.2–7.1)	5.1	(4.9–5.3)	4.5	(4.4–4.7)	3.5	(2.9–4.1)
1.5	(1.5–1.6)	4.6	(4.5–4.7)	3.6	(3.2–4.0)	5.3	(5.2–5.5)	4.2	(4.1–4.3)	3.7	(3.1–4.4)
4.9	(4.7–5.0)	3.1	(3.0–3.1)	1.8	(1.5–2.1)	3.9	(3.7–4.0)	2.6	(2.5–2.7)	1.6	(1.3–1.9)

race/ethnicity during the 2010s, models run on earlier decades showed significant interaction terms warranting stratification.

Data were stratified by race/ethnicity and models predicting heavy smoking were rerun. Results indicate that across each of the racial/ethnic groups, odds of heavy smoking were lower in California than the rest of the US with the exception of the Asian/Pacific Islander group but trended in the same direction (see Fig. 1; regression data are provided in Supplemental Table 1). Across all racial/ethnic groups, men were at significantly higher odds for heavy smoking compared to women.

Similar models were run predicting LITS and former smoking differences between California versus the rest of the US during 2010s. California had greater odds of LITS smokers than the rest of the US (OR = 1.68, 95%CI: 1.45–1.93, data not shown in tables). After stratification by race/ethnicity, California had greater odds across all ethnicities for LITS compared to the US, except for Blacks (see Fig. 1). For former smoking, California had greater odds for former smoking than the rest of the US (OR = 1.35, 95%CI: 1.24–1.48, data not shown in tables). After stratification by race/ethnicity, California had greater odds across all ethnicities for Former smoking compared to the US, except for Asian/Pacific Islanders (see Fig. 1).

4. Discussion

There have been significant declines in the overall prevalence of cigarette smoking in the past few decades with California starting off more aggressively and decreasing more dramatically than the rest of US. The successes in decreased tobacco use in California is likely due to concerted efforts of early and comprehensive tobacco prevention and control (Messer & Pierce, 2010; Pierce et al., 2010). Other states have also had successes in reducing prevalence of cigarette use and related morbidity and mortality (Farrelly et al., 2013, 2014; Kuiper, Nelson, & Schooley, 2005). It was expected that California would exhibit greater success in tobacco control than the rest of the US, however the differential and strong effects for racial/ethnic minority groups is both striking and an indicator of success in reducing tobacco disparities in California. Trends

in reductions of heavy smoking across the decades were greater across all California groups, with the exception of Hispanic/Latino populations where the US appears to have greater change. This may be due to Hispanics/Latinos having lower proportions of heavy smokers in California to begin with compared to the Hispanic/Latino population in the rest of the US. In 2010, California had fewer heavy smokers compared to the rest of the US across all racial/ethnic groups with the exception of Asian/Pacific Islanders. The US may benefit from California's experience in curtailing smoking across the most populous racial/ethnic groups. Furthermore, it appears California may benefit by refocusing efforts at addressing the specific needs of the diverse and growing Asian/Pacific Islander populations for both reducing heavy smoking and increasing smoking cessation. Asian/Pacific Islanders are an aggregate group with diverse smoking rates (Tong, Nguyen, Vittinghoff, & Pérez-Stable, 2009). Disaggregated data are needed at the local and state levels to determine how to best target specific Asian or Pacific Islander groups at highest risk.

California had greater proportions of LITS across all race/ethnicities except Blacks when compared to the rest of the US. The trends indicate that California has led the shift toward lower consumption levels across the various racial/ethnic groups with greater magnitudes in change and the overall higher prevalence of LITS compared to the US. However, for Blacks in 2010 there appeared to be no significant difference in LITS prevalence between California and the US. Although the unadjusted LITS prevalence is lower in the US, it may be that other factors, such as education, account for the differences we see when compared to California. Other studies support the observed greater increase in LITS among Blacks when compared to Whites (Sakuma et al., 2015; Trinidad et al., 2009) thus, this is an area in which greater attention is needed.

This study also used a narrower definition of light smokers than previously used (Husten, 2009). This study utilizes a definition for very light smokers that may be more clinically relevant in the present day. For example, traditional definitions of light smoking use a cutoff point of smoking fewer than ten cigarettes per day whereas this study used the cutoff of five cigarettes or fewer per day. Ten cigarettes is the

Table 2
Cigarette smoking levels among current smokers for California vs. US by major racial/ethnic categories.

	California LITS				US LITS												
	1990s		2000s		2010s		Absolute change 1990s–2010s										
	%	(95%CI)	%	(95%CI)	%	(95%CI)	%	(95%CI)									
White	25.0	(24.5–25.5)	31.5	(30.9–32.1)	35.1	(31.0–39.2)	10.1		18.3	(18.2–18.5)	20.5	(20.4–20.6)	22.6	(21.8–23.4)	4.3		
Black	34.8	(33.2–36.5)	35.1	(31.0–39.2)	50.1	(39.7–60.5)	15.3		32.8	(32.4–33.2)	34.8	(34.4–35.2)	40.6	(38.4–42.9)	7.8		
Hispanic/Latino	60.3	(59.4–61.3)	63.3	(62.8–65.0)	63.5	(57.9–69.2)	3.2		44.1	(43.5–44.6)	48.8	(48.3–49.3)	54.6	(51.7–57.5)	10.5		
Asian/Pacific Islander	37.4	(35.8–39.1)	51	(49.3–52.7)	53.7	(45.2–62.1)	16.3		35.3	(34.2–36.3)	39.7	(38.8–40.6)	39.1	(34.1–44.2)	3.8		
	California moderate smokers				US moderate smokers												
	1990s		2000s		2010s		Absolute change 1990s–2010s			1990s		2000s		2010s		Absolute change 1990s–2010s	
	%	(95%CI)	%	(95%CI)	%	(95%CI)				%	(95%CI)	%	(95%CI)	%	(95%CI)		
White	29.2	(28.6–29.8)	33.6	(33.1–34.2)	39.9	(36.1–43.7)	10.7		24.8	(24.7–24.9)	30	(29.9–30.2)	36	(35.3–36.8)	11.2		
Black	39.4	(37.9–40.9)	35.9	(34.0–37.8)	42.2	(31.6–52.8)	2.8		37.3	(36.9–37.6)	39.1	(38.7–39.5)	39.3	(37.0–41.6)	2		
Hispanic/Latino	24.5	(23.6–25.4)	25.3	(24.5–26.2)	29.3	(23.8–34.8)	4.8		30.1	(29.5–30.6)	30.4	(29.9–30.8)	29.7	(27.1–32.2)	–0.4		
Asian/Pacific Islander	33.8	(32.2–35.3)	32.4	(31.0–33.9)	33.3	(25.9–40.6)	–0.5		37	(36.0–38.0)	36.8	(35.9–37.6)	41.8	(36.4–47.2)	4.8		
	California heavy smokers				US heavy smokers												
	1990s		2000s		2010s		Absolute change 1990s–2010s			1990s		2000s		2010s		Absolute change 1990s–2010s	
	%	(95%CI)	%	(95%CI)	%	(95%CI)				%	(95%CI)	%	(95%CI)	%	(95%CI)		
White	44.7	(44.1–45.3)	34.1	(33.6–34.7)	23.6	(20.5–26.8)	–21.1		56.2	(56.0–56.3)	48.6	(48.4–48.8)	40.4	(39.5–41.2)	–15.8		
Black	24.0	(22.3–25.7)	18.6	(16.9–20.3)	6.6	(0.9–12.2)	–17.4		28.7	(28.3–29.0)	24.7	(24.3–25.0)	19	(17.4–20.6)	–9.7		
Hispanic/Latino	14.2	(13.3–15.0)	10.1	(9.2–10.9)	6.5	(3.6–9.5)	–7.7		25.4	(24.9–25.9)	20.2	(19.8–20.6)	15	(12.8–17.2)	–10.4		
Asian/Pacific Islander	28.2	(26.7–29.7)	15	(13.8–16.3)	12.1	(6.4–17.8)	–16.1		27.1	(26.1–28.0)	22.7	(21.9–23.5)	17.6	(14.3–20.8)	–9.5		
	CA former smokers ^a				US former smokers ^a												
	1990s		2000s		2010s		Absolute change 1990s–2010s			1990s		2000s		2010s		Absolute change 1990s–2010s	
	%	(95%CI)	%	(95%CI)	%	(95%CI)				%	(95%CI)	%	(95%CI)	%	(95%CI)		
White	28.4	(28.2–28.7)	25.3	(25.0–25.5)	22.6	(21.6–23.6)	–5.8		25.6	(25.5–25.7)	23.8	(23.7–23.9)	22.1	(21.7–22.4)	–3.5		
Black	18.7	(18.1–19.3)	14.7	(14.1–15.2)	13	(10.5–15.5)	–5.7		14.2	(14.0–14.4)	12.4	(12.3–12.5)	11.1	(10.6–11.6)	–3.1		
Hispanic/Latino	14.4	(14.0–14.7)	11.7	(11.5–11.9)	10.7	(9.7–11.7)	–3.7		14.2	(14.1–14.4)	11.1	(11.0–11.3)	9.9	(9.3–10.5)	–4.3		
Asian/Pacific Islander	13.1	(12.7–13.5)	10.8	(10.5–11.1)	10.2	(8.7–11.8)	–2.9		12.7	(12.4–13.0)	10.3	(10.1–10.5)	9.2	(8.3–10.0)	–3.5		

Note: CI = confidence interval; LITS = light and intermittent smoking; **Bolded** absolute change = non-overlapping CIs between 1990s and 2010s.

Note: LITS, Moderate, and Heavy Smokers are calculated among current smokers.

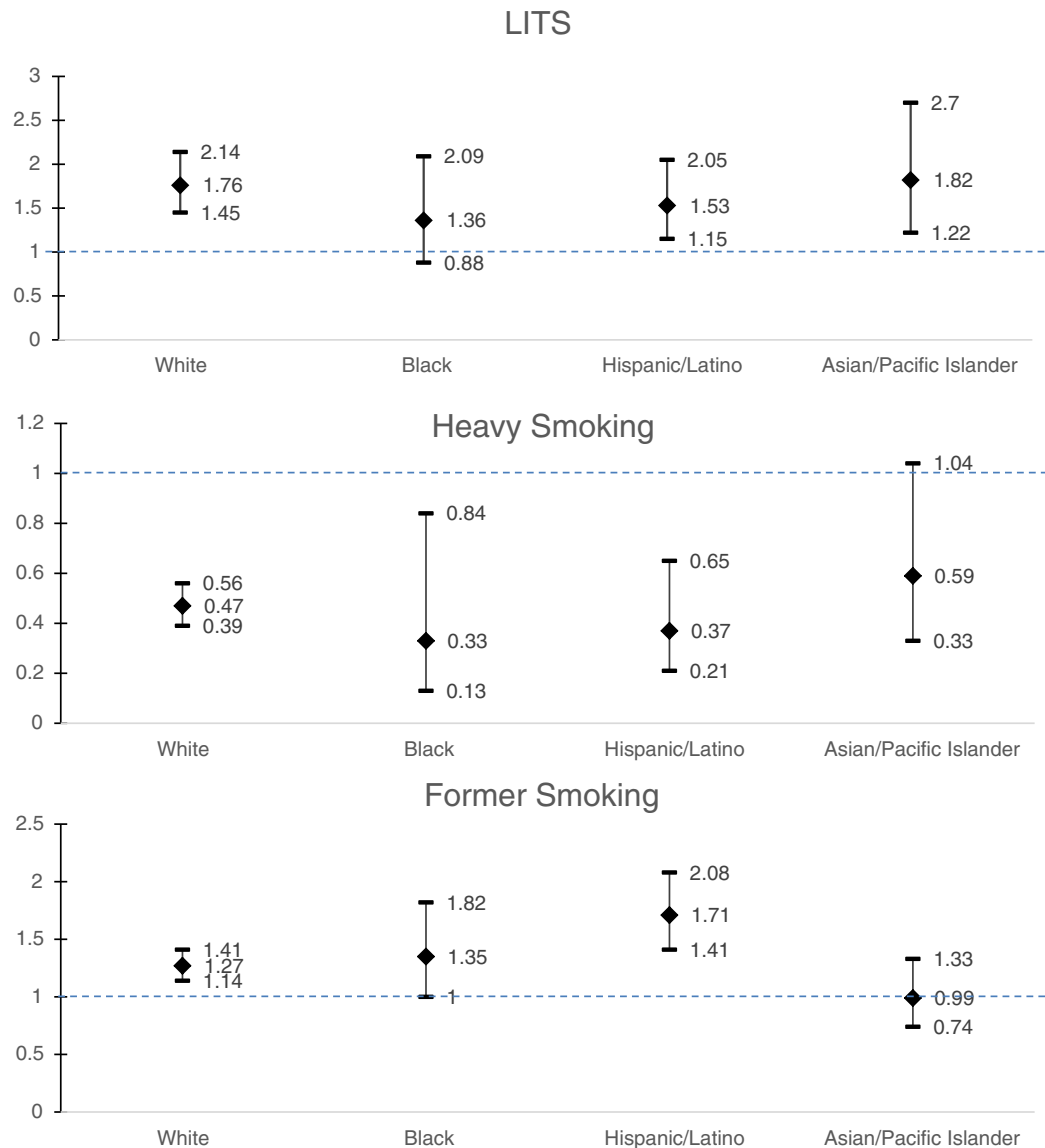
^a Formers are calculated among Ever Smokers.

equivalent of smoking half a pack per day, which may not be considered “light” smoking in today’s context of high tobacco taxes and anti-smoking norms or in the smoking behavior patterns reported among minority populations. Using a more restrictive cut-off for light smoking may inflate moderate smoking consumption levels in the earlier decades but it would afford the opportunity to observe any changes in these lighter levels of consumption, particularly among racial/ethnic minority groups who tend to smoke fewer cigarettes per day in general (Blanco et al., 2014a, b; Trinidad et al., 2009).

This study observed a decrease in ever smokers over time. This is supported by other studies that suggest that prevention efforts have largely been successful (Pierce et al., 2010). However, the proportion of former smokers among ever smokers have decreased indicating that smokers may not be quitting over time or those who continue to smoke need increasingly more support. The large reductions in heavy smoking that were observed for both California and the rest of the US across all major racial/ethnic groups may actually indicate that rather than quitting, a proportion of heavy smokers are moving into other categories of smoking (e.g., LITS) reducing their consumption levels. Although successful quitting is ideal, these reductions in consumption are promising. This is consistent with a recent study that also demonstrated US and European population reductions in consumption (Kulik & Glantz, 2015). Disparities in quitting behavior appear greater among the US population compared with California, however much work is needed to increase cessation across all groups, regardless of state of residence.

4.1. Limitations

Though the present study utilizes large nationally representative datasets to observe population level distributions of smoking, it does not allow for more nuanced investigations into specific subpopulations. Generalizing the results of this study to specific race/ethnic subgroups should be done with caution. In-depth studies that disaggregate each racial/ethnic group to explore consumption and former smoking in different tobacco control contexts are needed. For example, Asian/Pacific Islanders as an aggregate racial/ethnic group may appear to be low risk for many health behaviors (Chen & Hawks, 1995; Ghosh, 2003; Kwong, Chen, Snipes, Bal, & Wright, 2005). However, Asian/Pacific Islanders are made up of two separate racial groups and consists of more than 32 distinct ethnic and national subgroups and nearly 500 distinct languages and dialects (Chen, 1993; US Department of Health and Human Services, 1998). The different cultural, linguistic, and historical backgrounds influence risk and protective factors for smoking (Kandula, Wen, Jacobs, & Lauderdale, 2009; Ro, 2002). For example, regional studies conducted in the US have shown that Native Hawaiians in Hawaii, a Pacific Islander group, are more likely to be heavier smokers compared to other Asian (Filipino and East Asian) racial/ethnic groups (Herzog & Pokhrel, 2012). Among Hispanic/Latinos, differences in consumption and health outcomes have also been observed by national origin (Blanco et al., 2014a, b). This study reaffirms the need for disaggregated nationality data for specific race/ethnic groups without abandoning the aggregated results in comparison to Whites.



Note: If the interval does not contain 1, the corresponding OR is significant

Fig. 1. Odds ratios (OR, 95% CI) for cigarette smoking levels comparing California with the rest of the US by Race/Ethnic Group, 2010–2011.

These results are promising but limited to population level interpretations. Data were aggregated across decades and are not longitudinal so differences in reported prevalence levels cannot definitively be associated with individuals moving toward cessation or lower levels of consumption. Additionally, the data are limited to non-institutionalized populations and collected from in-person interviews among US households. Although statistically these data were made to be representative of the US population, our results may be underestimated if we consider the overrepresentation of certain subgroups in the homeless, incarcerated, and military populations, all of which may have higher rates of smoking. Furthermore, we used self-reported education levels as a proxy for socioeconomic status which allowed for aggregated data and interpretable results but limited our ability to precisely measure and assess economic impact on these outcomes. These design and data limitations are important to consider when generalizing our results and provide valuable avenues for future studies.

Lastly, this study's definition of former smoking does not differentiate between successful cessation from those who recently quit or from those who smoke occasionally and do not consider themselves under the LITS definition. The former smoking prevalence may be inflated if

smokers chose to answer that they were not currently smoking every day or some days. Furthermore, the former smoking prevalence includes recent quitters (those who quit within the last six months) who are at increased risk for relapse thereby masking true smoking rates and inflating former smoking rates.

4.2. Future directions

Despite the positive progress made toward reducing tobacco disparities, Asian/Pacific Islanders are still lagging behind other racial/ethnic groups in terms of progress in California and the US. Between 2014 and 2060, the Asian population is expected to be the fastest-growing ethnic group in the US with a rate of 143% projected for Asians alone or in combination with one or more races (Colby & Ortman, 2014). Native Hawaiians and Other Pacific Islanders are projected to increase by 101% (Colby & Ortman, 2014; US Census Bureau, 2015). Significant effort will be required to obtain disaggregated data to understand how best to address the needs of these groups.

Both California and the rest of the US can be more purposeful in moving smokers toward successful cessation for all racial/ethnic groups.

Despite California's success relative to the rest of the US, it demonstrated modest gains in the number of former smokers across some racial/ethnic groups. Such modest progress highlights the need to increase efforts beyond reducing consumption to focusing on increasing cessation rates.

Finally, the smoking landscape may be affected by the rise of non-cigarette tobacco products (e.g. Cigarillos/cigars, electronic cigarettes/vapes, hookah) and the shifting norms surrounding marijuana and its changing legal status in some US states like Colorado and Oregon. Future studies should take into account the changing contexts and the need for tobacco control programs to be flexible in addressing tobacco in this setting. Furthermore, as attention gets drawn to these new products, the public health community must remain vigilant in its efforts to reduce and eliminate cigarette smoking across all populations.

5. Conclusion

California demonstrated greater effects in reducing heavy smoking prevalence and increases in the proportion of former smokers compared to the rest of the US across all racial/ethnic groups except Asian/Pacific Islanders. California also demonstrated greater increases in LITS prevalence across all racial/ethnic groups except Blacks when compared to the US. This suggests that California is reducing tobacco burden and disparities across its diverse populations. With the US becoming more diverse in the coming decades, more attention will need to be directed toward addressing current tobacco health disparities. California's comprehensive tobacco control efforts can serve as an exemplar in reducing tobacco use disparities in the rest of the US.

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Declaration of interest

None declared.

Transparency document

The Transparency document associated with this article can be found, in online version.

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