Published in final edited form as:

Prev Med. 2017 December ; 105: 319–325. doi:10.1016/j.ypmed.2017.10.001.

The Differential Impact of State Tobacco Control Policies on Cessation Treatment Utilization Across Established Tobacco Disparities Groups

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Abstract

Tobacco control policies are effective in promoting quit attempts and increase the likelihood that smokers use evidence-based cessation treatments (e.g., nicotine replacement therapies (NRT), non-NRT medications, behavioral treatment, and/or quitlines). However, what is less clear is how these policies might differentially impact different groups of smokers, perhaps in some cases even widening disparities in the use of evidence-based tobacco dependence treatments. This paper examined how different state-level tobacco control policies impact the use of evidence-based cessation treatments by race/ethnicity, gender, socio-economic status (SES), age, and smoking history. Participants included 9,110 adult smokers reporting a past-year quit attempt within the 2010–2011 Tobacco Use Supplement to the Current Population Survey. Lasso regression modeling was used to identify a subset of interactions between tobacco policies and individual smoker characteristics that predicted use of evidence-based cessation treatment. Significant interactions were fitted via participant-weighted generalized linear models to determine effect sizes and relations to each cessation treatment outcome. Results highlighted that various state level tobacco control policies differentially impacted the reported use of both prescription and non-prescription stop smoking medications by race/ethnicity, age, and SES. The relationship between state level tobacco control policies and the use of behavioral treatments and quitlines did not differ by smoker characteristics. In sum, tobacco control policies differentially impact the use of FDA approved stop smoking medications across different race/ethnicity, age, and SES groups. Understanding such effects can help to target interventions to ensure equal access to evidence-based tobacco dependence treatments.

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Keywords

smoking cessation; health disparities; tobacco policy

INTRODUCTION

More than half of all smokers in the United States make an attempt to quit smoking annually, but 94% of them fail, typically within the first week(1). Utilization of evidence-based tobacco dependence treatment such as nicotine replacement therapy (NRT), non-NRT medications (e.g., varenicline, bupropion), behavioral treatment, and/or quitlines significantly improves a smoker's likelihood of cessation success(2). Yet, the majority of smokers attempting to quit do so unaided(3, 4). Despite widespread and rapidly increasing availability of evidence-based cessation treatments, rates of treatment utilization have remained relatively stagnant over the past 15 years. For example, use of cessation treatment increased from 22% in 2000 to only 31% in 2015(3–6). Thus, there is clear need to promote use of evidence-based cessation treatment at the population level.

Policy-based tobacco control is arguably the most effective means through which to promote population-level smoking cessation and perhaps, by extension, use of evidence-based cessation treatment(7–9). Over the last 50 years, tobacco control policies have contributed to a 55% decrease in smoking prevalence and the prevention of 2 million smoking-attributable deaths(10). Examples of tobacco control policies enacted at the state level include: tobacco excise taxation, tobacco control appropriations, comprehensive smoke-free laws (i.e., smoking bans in workplaces, restaurants, bars), provision of free cessation medications by quitlines, and state Medicaid coverage of cessation treatment. A number of studies demonstrate that these state-level tobacco control policies promote smoking cessation by promoting quit attempts and making it easier for smokers to access evidence-based tobacco dependence treatments(11–14). Moreover, a recent study from our group examined the main effects of a host of state tobacco control policies (e.g., tobacco excise taxation, tobacco control appropriations, state Medicaid coverage of treatment, provision of free cessation medications by state quitlines) on smoking cessation treatment utilization (15). Results indicated that total state and federal tobacco control appropriations was the most robust predictor of cessation treatment utilization and predicted NRT, quitline, and behavioral treatment use. Additionally, state Medicaid coverage of non-NRT medications and tobacco excise taxation significantly predicted NRT use while Medicaid coverage of behavioral treatment and tobacco excise taxation significantly predicted non-NRT medication use (15). What is less clear is how different state-level tobacco policies promote uptake of evidence-based cessation treatment across different subgroups of smokers.

This question of *for whom* state-level tobacco policies exert their impact is paramount as tobacco use is increasingly concentrated among marginalized populations who often have limited access to evidence-based tobacco dependence treatments(16, 17). Further, numerous studies have documented disparities in rates of smoking cessation by race/ethnicity(18, 19), gender(20, 21), socio-economic status (SES) (22, 23), smoking history(24), and age(25), which in turn correspond to higher rates of tobacco-related illness(26). These lower levels of

quitting smoking are likely, at least in part, due to disparities in the use of evidence-based tobacco dependence treatments(27–29).

To date, few studies have examined the impact of tobacco control policies on the use of evidence-based tobacco dependence treatments and how such policies might differentially impact subgroups of smokers. Herein, we present analysis of a large, nationally representative dataset of smokers, in which we examine how exposure to different state-level tobacco control policies relates to the use of evidence-based cessation treatments across racial/ethnic, gender, SES, smoking history, and age subgroups.

METHOD

The Tobacco Use Supplement to the Current Population Survey (TUS-CPS)

The Tobacco Use Supplement to the Current Population Survey (TUS-CPS)(30) is the largest national survey that queries on individual methods of quitting. Data for the present study were utilized from the 2010–2011 TUS-CPS. The CPS uses a multi-stage probability sample based on the results of the decennial census procedure to interview a nationally representative sample of households of non-institutionalized civilian U.S. population aged 15 and older, with coverage in all 50 states and the District of Columbia. The TUS is a periodic survey attached to the CPS every four years which includes data from U.S. households regarding smoking, use of tobacco products, and tobacco-related norms, attitudes, and policies. For 2010–2011, TUS questions were added to the CPS surveys in May 2010, August 2010, and January 2011. Nonresponse rates for self-respondents for the TUS were 37.7% in May 2010, 38.4% in August 2010, and 40.2% in January 2011. The TUS-CPS was more recently completed in 2014–2015, but that wave did not assess individual methods of quitting and thus was not utilized. Additional details regarding methodology employed by the TUS-CPS can be found by visiting the TUS-CPS website (<http://appliedresearch.cancer.gov/tus-cps/>).

Participants

Participants in the present study were smokers from the 2010–2011 TUS-CPS dataset who made a quit attempt in the last year lasting at least 24 hours. Use of each cessation method was asked of daily and some-days smokers (the latter defined as smoking on 12 or more days out of the last 30 days) who made a >24 hour quit attempt in the last year.

Within the 2010–2011 TUS-CPS, there were 171,365 self-respondents, of whom 27,611 were current daily/some-days smokers. Of this group, 9,232 (33.4%) reported a past-year quit attempt. An additional 122 were excluded from subsequent analyses due to missing data, resulting in a final sample of 9,110 (see Table 1 for demographics). A non-response adjustment weight, derived and provided by CPS, was used for all analyses.

Smoker Characteristics

The TUS-CPS collected demographic data on all participants, which were then utilized in the present study as individual-level moderators, reflecting established tobacco-related disparities. Demographic variables were selected that have previously been associated with

smoking cessation. Specifically, we examined: race/ethnicity (coded as Non-Hispanic White, Non-Hispanic Non-White, Hispanic), gender, and age. In order to reduce the total number of individual-level predictors, we created a composite heaviness of smoking variable from cigarettes per day and smoking status (daily, some-days) and an SES composite variable from income, education, and employment. These composite variables were created using principal components analysis in which the first principal component (PC) was retained. For heaviness of smoking, with only two input variables (cigarettes per day and smoking status), each was given equal weight. The first PC accounted for 75% of the variance. Current some-days smokers' heaviness of smoking scores were lower than those of daily smokers, and were ordered within smoking status by reported cigarettes per day (ranges: -2.44, -0.68 and -0.59, 2.85, respectively). The SES composite variable was defined as the first PC from a PC analysis which included income, education, and employment. The first PC explained 51% of the variance of the SES variables, with each having approximately equal weight in the generation of the composite score. The remaining 49% of the variance for the SES indicators was spread approximately evenly across the other two principal components.

State-level Tobacco Control Policies

Seven state-level tobacco control policies were identified a priori to examine as potential predictors of evidence-based cessation method utilization. All selected policies had a literature base supporting the relationship between the policy and smoking cessation and a publically available dataset quantifying the variable. See Table 2 for descriptive statistics for state-level tobacco control policies. These policies and their data sources are listed below. Except where noted, all data were ascertained from 2010 sources.

State Medicaid coverage of NRT, non-NRT medications, and behavioral treatment—Data regarding state Medicaid coverage of NRT, non-NRT medications, and behavioral treatment (yes/no, examined as three separate state-level tobacco control policies) were available via the CDC for 2008 and for 2014(31). Data from 2008 were utilized for present analyses as this data was collected closest in time to the 2010–2011 TUS-CPS.

Provision of free cessation medications by state quitline—Data were obtained from the 2010 North American Quitline Consortium (NAQC) Annual Survey and the Office on Smoking and Health's National Quitline Data Warehouse to identify whether each state provided free cessation medications(32). A state was considered as providing free medication if the state quitline provided at least one cessation medication.

State excise tax per pack—State excise tax per pack data were available via the National Conference of State Legislatures(33). 2010 state excise tax per pack data included price increases effective July 1, 2010. State tax was divided into quartiles: \$0.79; > \$0.79 to \$1.34; > \$1.34 to \$1.78; \$1.78.

Total state and federal tobacco control appropriations—Total state and federal tobacco control appropriations data were available via the CDC(34). Total state and federal control appropriations was divided by state population from the 2010 Census(35) in order to

calculate total state and federal control appropriations per capita (in thousands of dollars/capita), which was then divided into quartiles.

State comprehensive smoke-free laws—Data on state comprehensive smoke-free laws for 2010 were available via the CDC(36) and were coded dichotomously (yes/no). A state was considered as having comprehensive smoke-free laws if smoking was prohibited in workplaces, restaurants, and bars.

Use of Evidenced-Based Tobacco Dependence Treatments

Within the TUS-CPS, current smokers who endorsed making a quit attempt lasting longer than 24 hours in the past 12 months were asked the following: “Thinking back to the last time you tried to quit smoking in the past 12 months—did you use any of the following products: a nicotine patch; nicotine gum or nicotine lozenge; nicotine nasal spray or nicotine inhaler; a prescription pill called Chantix™ or Varenicline; a prescription pill called Zyban™, Bupropion, or Wellbutrin™; another prescription pill; a telephone help line or quitline; one-on-one counseling; a stop smoking clinic, class or support group?” Participants indicated yes or no to each method separately. For present analyses, quit methods were aggregated as follows: 1) NRT, inclusive of nicotine patch, gum, lozenge, nasal spray, or inhaler, 2) non-NRT medications, inclusive of Chantix™/Varenicline, Zyban™/Bupropion/Wellbutrin™, or another prescription pill, 3) behavioral treatments, inclusive of one-on-one counseling, a stop smoking clinic, class, or support group, 4) quitline, defined as using a telephone help line or quitline, and 5) any treatment, indicating utilization of any of the four previously listed treatments. Quit outcomes were not assessed by the TUS-CPS, although questions related to cessation treatment use were asked only of current smokers.

Analytic Plan

In order to determine *for whom* state-level policies promoted increased uptake of cessation treatments, interactions between all seven state-level policies and the five individual-level variables were created, providing 35 interactions plus the 12 main effects to consider for each cessation treatment. Lasso regression modeling(37), a shrinkage variable selection method that helps prevent multicollinearity issues by incorporating a size constraint on the coefficients, was used to identify an interpretable subset of variables, policies, and interactions that provided the strongest effect. Using the cv.glmnet package in R 3.2.5, 20-fold cross-validation was performed to select the shrinkage parameter, lambda, that determines which variables are retained in the model. For each cessation treatment outcome, 20 datasets were randomly sampled without replacement from the main dataset, and the individuals that used the cessation treatment method were evenly divided among these datasets. The 20 datasets were then used with a 95% training and 5% testing framework to determine the best lasso model for each outcome. The lasso model with the largest lambda such that cross-validation error was within 1 standard error of the minimum cross-validation was used to provide the simplest model within a reasonable error limit compared to the “best” model.

After identifying the best lasso model, the subset of variables, policies, and interactions from this model were then fit via participant-weighted generalized linear models using SAS

Version 9.3 to determine the effect sizes and relationships to each outcome, modeled separately. Pairwise comparisons of the least squares means within interactions were adjusted using a Bonferroni correction for multiple comparisons.

RESULTS

Results are presented below in cases of significant interactions; i.e., where tobacco policies are differentially associated with treatment use among various sub-groups. Effect sizes for pairwise comparisons within each individual-level group (i.e., within racial/ethnic groups, within age groups, etc.) are plotted in Figure 1 as a forest plot.

Use of NRT

Race—There were significant interactions between race/ethnicity and both taxation and total state and federal tobacco control appropriations for predicting utilization of NRT. In general, increases in taxation were most effective for promoting NRT use among non-Hispanic non-Whites. For example, as compared to non-Hispanic non-White residents of states in the lowest taxation quartile, residents of states in the highest taxation quartile were 1.66 times more likely to use NRT (95% CI: 1.64, 1.68). Interestingly, higher taxation, except when at the very highest tax quartile was associated with *lower* NRT utilization among Hispanics and non-Hispanic Whites.

Although higher appropriations were effective across racial/ethnic groups for promoting use of NRT, increases in appropriations were most effective for Hispanics. This effect was most pronounced for Hispanic residents of states in the second highest appropriations quartile. Hispanic residents of states in this appropriations quartile were 2.67 times more likely to use NRT (95% CI: 2.57, 2.79) than residents of states in the lowest appropriations quartile (see Figure 1).

Age—There was a significant interaction between age and state quitline provision of free cessation medications for predicting utilization of NRT. To understand the nature of this significant interaction, we examined the association between state quitline provision of free cessation medications (yes vs. no) and NRT use at the mean age, at one standard deviation below the mean age, and at one standard deviation above the mean age (Figure 1). The effect of quitline provision of free cessation medications was greatest among older individuals, such that among this age group residents of states that provided free cessation medications via quitlines were 1.08 (95% CI: 1.07, 1.08) times more likely to use NRT than residents of states that did not provide free medications.

Gender, Heaviness of Smoking, SES—There were no significant interactions across any tobacco policy with any of these individual variables for predicting NRT use.

Use of Non-NRT Prescription Medications

Race—There was a significant interaction between race/ethnicity and comprehensive smoke-free laws for predicting non-NRT medication utilization. Likelihood of utilizing non-NRT medications was always higher among smokers within states that had comprehensive smoke-free laws as compared to those without such laws. However, the magnitude of this

effect was greatest for Hispanics. As compared to Hispanic residents of states without comprehensive smoke-free laws, Hispanic residents of states with comprehensive smoke-free laws were 2.18 times more likely to utilize non-NRT medications (95% CI: 2.12, 2.25; Figure 1).

SES—There was a significant interaction between SES and taxation for predicting utilization of non-NRT medication. We further examined this association at the mean SES, at one standard deviation below the mean SES, and at one standard deviation above the mean SES (Figure 1). The greatest effect of taxation on non-NRT medication use was observed among those in the high SES (i.e., mean +1 standard deviation) group. Within this group, as compared to residents of states in the lowest taxation quartile, residents of states in the second highest taxation quartile were 1.10 (95% CI: 1.09, 1.11) times more likely to use non-NRT medications. Perhaps contrary to expectations, across SES groups, residents of states in the highest taxation quartile were significantly *less* likely to use non-NRT medications than residents of states in the lowest taxation quartile.

Gender, Age, Heaviness of Smoking—There were no significant interactions across any tobacco policy with any of these individual variables for predicting non-NRT medication use.

Use of Behavioral Treatment and Calling a State Quitline

Race, Gender, Age, Heaviness of Smoking, SES—There were no significant interactions across any tobacco policy with any of these individual variables for predicting behavioral treatment or quitline use.

Use of Any Treatment

Race—There were significant interactions between race/ethnicity and both taxation and appropriations for predicting utilization of any treatment. Increases in taxation were most effective for promoting any treatment use among non-Hispanic non-Whites and this effect was most pronounced when comparing non-Hispanic non-White residents of states in the second highest taxation quartile to residents of states in the lowest taxation quartile. As compared to non-Hispanic non-White residents of states in the lowest taxation quartile, residents of states in the second highest taxation quartile were 1.38 times (95% CI: 1.35, 1.40) more likely to use any treatment. As was also observed when examining the interaction between race/ethnicity and taxation for predicting NRT use, higher taxation, except when at the very highest tax quartile was associated with *lower* utilization of any treatment among Hispanics and non-Hispanic Whites.

Although higher appropriations were effective across racial/ethnic groups for promoting utilization of any treatment, such increases in appropriations were most effective for Hispanics. This effect was most pronounced for Hispanic residents of states in the second highest appropriations quartile. Hispanic residents of states in this appropriations quartile were 2.43 (95% CI: 2.35, 2.53) times more likely to use any treatment than residents of states in the lowest appropriations quartile.

Gender, Age, Heaviness of Smoking, SES—There were no significant interactions across any tobacco policy with any of these individual variables for predicting utilization of any treatment.

DISCUSSION

The findings from these analyses reveal that certain tobacco control policies differentially impact the use of FDA approved stop smoking medications across racial/ethnic, age, and SES groups. Understanding such effects can help to target interventions to ensure equal access to evidence based tobacco dependence treatments.

For non-Hispanic non-White smokers, higher tobacco excise taxation was associated with an increased likelihood of NRT and any treatment utilization, with greatest benefit at the highest taxation level. In contrast, for Hispanic and non-Hispanic White smokers, higher taxation was only associated with greater likelihood of utilization of these treatments at the highest taxation quartile. Lower taxation rates (i.e., for the second lowest and second highest taxation quartiles as compared to the lowest taxation quartile) were paradoxically associated with *decreased* likelihood of treatment utilization among Hispanic and non-Hispanic White smokers. These results add an element of nuance to the extant literature on the relationship between tobacco excise taxation and cessation, which has noted that raising taxes on tobacco is the single most effective way to reduce tobacco use(38, 39). Results from the present study suggest that for certain groups (i.e., Hispanic and non-Hispanic White smokers), increasing tobacco excise taxation may only be associated with greater cessation treatment utilization when increased to the very highest taxation levels. These results are partially consistent with the results of Yao and colleagues (40) and Farrelly and colleagues (41) who found that, although all racial/ethnic groups reduce cigarette consumption in response to cigarette price increases, Hispanic smokers (40) and White smokers (41) may be less price-responsive than other racial/ethnic groups. Thus, for certain racial/ethnic groups, tobacco price increases may need to be of a greater magnitude in order to promote cessation treatment utilization. Whether such an association extends to sustained cessation is an important avenue for future research. Currently, only 21 states tax tobacco at greater than or equal to \$1.78 per pack, which was the highest tobacco taxation quartile in the present study(42). Thus, across the remaining states, increasing tobacco taxation to at least \$1.78 may be promising for promoting NRT use across racial/ethnic groups.

The above relationship may differ for use of other, non-NRT prescription medications. For example, the greatest benefit of taxation on non-NRT medication use across SES groups was observed among residents of states in the second highest taxation quartile, which encompassed states with tobacco taxation > \$1.34 to \$1.78 per pack. Other taxation levels either had no significant effect as compared to the lowest taxation quartile, or a paradoxical detrimental effect across SES groups on non-NRT medication use. This of course is not to imply that higher taxation is not beneficial, but rather that the established benefits of higher taxation on cessation(38) may not necessarily extend uniformly to all evidence-based cessation treatments. Taken together, in regards to promoting cessation treatment utilization, optimal level of tobacco taxation may depend on both the treatment method and the group of interest.

Increased tobacco control appropriations, provision of free cessation medications by state quitlines, and comprehensive smoke-free laws also had differential impact for promoting treatment utilization (of NRT/Any Treatment, NRT, and non-NRT medications respectively) across groups. Increasing tobacco control appropriations was most effective for promoting utilization of NRT and of Any Treatment for Hispanic smokers; provision of free cessation medications by state quitlines was most effective for promoting NRT use among older smokers; and comprehensive smoke-free laws were most effective for promoting non-NRT medication use among Hispanic smokers. Thus, targeted and varied tobacco control policies will be needed to target specific tobacco disparity groups.

Though not without challenges, tobacco control policies could be targeted toward specific subgroups that under-use cessation treatment. For example, 2014–15 Behavioral Risk Factor Surveillance System data (43) indicate that, across all states, North Dakota has the highest smoking prevalence among Hispanic adults at 35%. In contrast, Vermont has the lowest smoking prevalence among Hispanic adults at 8.8%. Thus, North Dakota as compared to Vermont may have a more urgent need to promote utilization of smoking cessation treatment among Hispanic smokers. To do that, results from the present study suggest that 1) implementing comprehensive smoke-free laws, 2) increasing tobacco control appropriations to the second highest quartile, and 3) increasing tobacco taxation to the highest taxation quartile. These policies, of course, do not exist in a vacuum and are not meant to be applied to one demographic group alone. Thus, it is important to both consider effects of the policy changes on the targeted demographic group as well as effects of the policy changes on other groups. Across racial/ethnic groups, these three policy modifications are all associated with increased treatment utilization. The illustrative point is that certain policies are more effective than others among specific subgroups of smokers.

A number of tobacco policies did not have significant interactions with individual-level smoker characteristics for predicting treatment utilization. These policies include: state Medicaid coverage of treatment, tobacco control appropriations (for use of non-NRT medications), quitline provision of free cessation medications (for use of non-NRT medications and any treatment), and comprehensive smoke-free laws (for use of NRT and any treatment). None of the examined tobacco policies had significant interactions with any individual-level predictor for predicting use of behavioral treatments or quitlines. With a sample of this size, power was sufficient to detect significant interactions. Thus, the lack of significant interactions for these policies suggests they were equally effective across groups in terms of association with treatment utilization. Importantly, this does not necessarily mean that the policy significantly predicted treatment use, but that the effect of the policy on treatment use did not differ across groups.

Results should be interpreted with study limitations in mind. Cessation outcome (i.e., successful vs. unsuccessful) was unavailable via the TUS-CPS, and questions regarding quit method utilization were only asked of current smokers. The TUS-CPS only assessed quit method among smokers who made a >24 hour quit attempt in the last year. It is unclear whether results from the present study would generalize to samples of smokers who achieve longer durations of abstinence. Future studies should consider similar examination of the interaction between policies and individual variables for predicting cessation and among

groups of smokers who have quit smoking for a longer period of time. Moreover, the largest effects were often observed among the smallest groups (e.g., Hispanic and non-Hispanic non-White smokers), which may be due in part to each individual within the smaller groups representing a larger portion of the group when weighting was incorporated. Future studies should consider over-sampling members of established tobacco disparity groups to replicate present findings.

There are a number of important future directions following from this line of research. Prospective examination in which new tobacco policies are enacted and smokers are subsequently followed over time to examine uptake of cessation treatment will be important to further determine which tobacco policies are most impactful across tobacco disparity groups and why certain groups may be unresponsive to policy interventions. Importantly, although many of the interaction effect sizes from the present study are statistically small, when applied at the population level with implementation of new tobacco control policies, these effects can have large clinical impact. Additionally, both promoting cessation and preventing initiation have been highlighted as important targets for eliminating tobacco-related health disparities (44). While the present study speaks to cessation promotion, the interaction between state tobacco policies and individual-level factors for preventing tobacco use remains unknown as in an important avenue for future research.

In sum, the present study highlights certain tobacco control policies that are differentially effective on use of evidence-based cessation treatments across tobacco disparity groups. Eliminating health disparities related to tobacco use is a major public health challenge that likely can be addressed, at least in part, by implementation of targeted, efficacious tobacco control policies(44).

Acknowledgments

The authors would like to thank Drs. Anne Hartman and Todd Gibson for their help to access the TUS-CPS dataset as well as their feedback during study conceptualization. This work was supported by the National Institutes of health (T32 DA007288, K23 DA041616). The authors have no conflicts of interest to declare. The sponsor had no role in the design and conduct of the study; or in the preparation, review, or approval of the manuscript.

References

1. Centers for Disease Control and Prevention. Quitting smoking among adults--United States, 2001–2010. *Morb Mortal Weekly Rep.* 2011; 60(44):1513–1519.
2. Fiore, MC., Jaen, CR., Baker, T., Bailey, W., Benowitz, N., Curry, Se, et al. Treating tobacco use and dependence: 2008 update. Rockville, MD: US Department of Health and Human Services, Public Health Service; 2008.
3. Cokkinides VE, Ward E, Jemal A, Thun MJ. Under-use of smoking-cessation treatments: results from the National Health Interview Survey, 2000. *Am J Prev Med.* 2005; 28(1):119–122. [PubMed: 15626567]
4. Fix BV, Hyland A, Rivard C, McNeill A, Fong GT, Borland R, et al. Usage patterns of stop smoking medications in Australia, Canada, the United Kingdom, and the United States: findings from the 2006–2008 International Tobacco Control (ITC) four country survey. *Int J Environ Res Public Health.* 2011; 8(1):222–233. [PubMed: 21318025]
5. Fiore MC, Novotny TE, Pierce JP, Giovino GA, Hatziaandreu EJ, Newcomb PA, et al. Methods used to quit smoking in the United States: do cessation programs help? *JAMA.* 1990; 263(20):2760–2765. [PubMed: 2271019]

6. Babb S, Malarcher A, Schauer G, Asman K, Jamal A. Quitting Smoking Among Adults—United States, 2000–2015. *Morb Mortal Weekly Rep.* 2017; 65(52):1457–1464.
7. Farrelly MC, Pechacek TF, Thomas KY, Nelson D. The Impact of Tobacco Control Programs on Adult Smoking. *Am J Public Health.* 2011; 98(2):304–309.
8. Holford TR, Meza R, Warner KE, Meernik C, Jeon J, Moolgavkar SH, et al. Tobacco control and the reduction in smoking-related premature deaths in the United States, 1964–2012. *JAMA.* 2014; 311(2):164–171. [PubMed: 24399555]
9. Levy DT, Chaloupka F, Gitchell J. The effects of tobacco control policies on smoking rates: a tobacco control scorecard. *J Public Health Manag Pract.* 2004; 10(4):338–353. [PubMed: 15235381]
10. Levy DT, Meza R, Zhang Y, Holford TR. Gauging the effect of US tobacco control policies from 1965 through 2014 using SimSmoke. *Am J Prev Med.* 2016; 50(4):535–542. [PubMed: 26673484]
11. Bush T, Zbikowski S, Mahoney L, Deprey M, Mowery PD, Magnusson B. The 2009 US federal cigarette tax increase and quitline utilization in 16 states. *J Environ Public Health.* 2012; 2012
12. Sheffer MA, Redmond LA, Kobinsky KH, Keller PA, McAfee T, Fiore MC. Creating a perfect storm to increase consumer demand for Wisconsin's Tobacco Quitline. *Am J Prev Med.* 2010; 38(3):S343–S346. [PubMed: 20176306]
13. Morley CP, Pratte MA. State-Level Tobacco Control and Adult Smoking Rate in the United States: An Ecological Analysis of Structural Factors. *J Public Health Manag Pract.* 2013; 19(6):E20–E27.
14. Land T, Warner D, Paskowsky M, Cammaerts A, Wetherell L, Kaufmann R, et al. Medicaid coverage for tobacco dependence treatments in Massachusetts and associated decreases in smoking prevalence. *PLoS One.* 2010; 5(3):e9770. [PubMed: 20305787]
15. Dahne J, Wahlquist AE, Garrett-Mayer E, Heckman BW, Cummings KM, Carpenter MJ. State Tobacco Policies as Predictors of Evidence-based Cessation Method Usage: Results from a Large, Nationally Representative Dataset. *Nicotine Tobacco Res.* in press.
16. Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, Graffunder CM. Current cigarette smoking among adults—United States, 2005–2015. *Morb Mortal Weekly Rep.* 2016; 65(44):1205–1211.
17. Goodwin RD, Wall MM, Garey L, Zvolensky MJ, Dierker L, Galea S, et al. Depression among current, former, and never smokers from 2005 to 2013: The hidden role of disparities in depression in the ongoing tobacco epidemic. *Drug Alcohol Depend.* 2017; 173:191–199. [PubMed: 28209289]
18. Trinidad DR, Perez-Stable EJ, White MM, Emery SL, Messer K. A nationwide analysis of US racial/ethnic disparities in smoking behaviors, smoking cessation, and cessation-related factors. *Am J Public Health.* 2011; 101(4):699–706. [PubMed: 21330593]
19. Haiman CA, Stram DO, Wilkens LR, Pike MC, Kolonel LN, Henderson BE, et al. Ethnic and racial differences in the smoking-related risk of lung cancer. *N Engl J Med.* 2006; 354(4):333–342. [PubMed: 16436765]
20. Piper ME, Cook JW, Schlam TR, Jorenby DE, Smith SS, Bolt DM, et al. Gender, race, and education differences in abstinence rates among participants in two randomized smoking cessation trials. *Nicotine Tobacco Res.* 2010; 12(6):647–657.
21. Smith PH, Bessette AJ, Weinberger AH, Sheffer CE, McKee SA. Sex/gender differences in smoking cessation: A review. *Prev Med.* 2016; 92:135–140. [PubMed: 27471021]
22. Reid JL, Hammond D, Boudreau C, Fong GT, Siahpush M, Collaboration I. Socioeconomic disparities in quit intentions, quit attempts, and smoking abstinence among smokers in four western countries: findings from the International Tobacco Control Four Country Survey. *Nicotine Tobacco Res.* 2010; 12(suppl 1):S20–S33.
23. Barbeau EM, Krieger N, Soobader M-J. Working class matters: socioeconomic disadvantage, race/ethnicity, gender, and smoking in NHIS 2000. *Am J Public Health.* 2004; 94(2):269–278. [PubMed: 14759942]
24. Hymowitz N, Cummings KM, Hyland A, Lynn WR, Pechacek TF, Hartwell TD. Predictors of smoking cessation in a cohort of adult smokers followed for five years. *Tob Control.* 1997; 6(suppl 2):S57.
25. Steinberg MB, Akincigil A, Delnevo CD, Crystal S, Carson JL. Gender and age disparities for smoking-cessation treatment. *Am J Prev Med.* 2006; 30(5):405–412. [PubMed: 16627128]

26. Moolchan ET, Fagan P, Fernander AF, Velicer WF, Hayward MD, King G, et al. Addressing tobacco-related health disparities. *Addiction*. 2007; 102(s2):30–42. [PubMed: 17850612]
27. Fu SS, Sherman SE, Yano EM, Van Ryn M, Lanto AB, Joseph AM. Ethnic disparities in the use of nicotine replacement therapy for smoking cessation in an equal access health care system. *Am J Health Promot*. 2005; 20(2):108–116. [PubMed: 16295702]
28. Smith PH, Kasza KA, Hyland A, Fong GT, Borland R, Brady K, et al. Gender differences in medication use and cigarette smoking cessation: results from the International Tobacco Control Four Country Survey. *Nicotine Tobacco Res*. 2015; 17(4):463–472.
29. Hiscock R, Bauld L, Amos A, Fidler JA, Munafò M. Socioeconomic status and smoking: a review. *Ann N Y Acad Sci*. 2012; 1248(1):107–123. [PubMed: 22092035]
30. United States Department of Commerce Census Bureau. National Cancer Institute-sponsored Tobacco Use Supplement to the Current Population Survey (May 2010–2011). 2015.
31. Singleterry J, Jump Z, Lancet E, Babb S, MacNeil A, Zhang L, et al. State medicaid coverage for tobacco cessation treatments and barriers to coverage—United States, 2008–2014. *Morb Mortal Weekly Rep*. 2014; 63(12):264–269.
32. North American Quitline Consortium. 2009 NAQC Annual Survey Data. 2009. Retrieved from <http://www.naquitline.org/?page=NAQCannualsurvey>
33. National Conference of State Legislatures. 2010 State Cigarette Excise Taxes. 2010. Retrieved from <http://www.ncsl.org/research/health/2010-state-cigarette-excise-taxes.aspx>
34. Centers for Disease Control and Prevention. State tobacco revenues compared with tobacco control appropriations--United States, 1998–2010. *Morb Mortal Weekly Rep*. 2012; 61(20):370–374.
35. United States Census Bureau. Overview of Race and Hispanic Origin. 2010 Census Briefs. 2010
36. Centers for Disease Control and Prevention. State smoke-free laws for worksites, restaurants, and bars--United States, 2000–2010. *Morb Mortal Weekly Rep*. 2011; 60(15):472–475.
37. Friedman, J., Hastie, T., Tibshirani, R. The elements of statistical learning: Springer series in statistics. Springer; Berlin: 2001.
38. Chaloupka FJ, Straif K, Leon ME. Effectiveness of tax and price policies in tobacco control. *Tob Control*. 2010; 20(3):235–238. [PubMed: 21115556]
39. World Health Organization. WHO report on the global tobacco epidemic, 2015: Raising taxes on tobacco. 2015.
40. Yao, T., Ong, MK., Max, W., Keeler, C., Wang, Y., Yerger, VB., et al. *Tob Control*. 2017. Responsiveness to cigarette prices by different racial/ethnic groups of US adults.
41. Farrelly MC, Bray JW, Pechacek T, Woollery T. Response by adults to increases in cigarette prices by sociodemographic characteristics. *Southern Economic Journal*. 2001:156–165.
42. Campaign for Tobacco-Free Kids. State Cigarette Excise Tax Rates & Rankings. Retrieved from <https://www.tobaccofreekids.org/research/factsheets/pdf/0097.pdf>
43. Centers for Disease Control and Prevention. Department of Health and Human Services Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia, United States: p. 2014-2015.
44. Fagan P, King G, Lawrence D, Petrucci SA, Robinson RG, Banks D, et al. Eliminating tobacco-related health disparities: directions for future research. *Am J Public Health*. 2004; 94(2):211–217. [PubMed: 14759929]

HIGHLIGHTS

- Across groups, tobacco control differentially impacts cessation treatment use.
- Optimal tobacco excise taxation may depend on both treatment method and group.
- Targeted tobacco control will be needed to target specific disparity groups.

Figure 1.

Interactions between state policies and smoker characteristics for predicting cessation treatment use among 2010–2011 TUS-CPS smokers who attempted to quit in the last year. *Note:* Significant policy x individual interactions were probed within each individual-level grouping and are presented above with odds ratios and accompanying 95% confidence intervals within each grouping. Interactions with taxation and appropriations are presented for each quartile within each grouping as compared to the lowest quartile. Interactions with continuous individual-level predictors (i.e., age and SES) are presented at the mean for that predictor and at ± 1 standard deviation of the mean (ex., Younger age = Mean age – 1SD). NHNW = Non-Hispanic non-White, NHW = Non-Hispanic White; Laws = State

comprehensive smoke-free laws; Quitline Meds = State quitline provision of free smoking cessation medications.

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Table 1

Demographics

	Unweighted	Weighted
<i>n</i>	9,110	8,672,380
Age (<i>M</i> (<i>SD</i>))	43.3(14.6)	42.5(0.2)
Female (%)	52.4%	50.4%
Race/Ethnicity (%)		
Non-Hispanic White	77.1%	73.9%
Non-Hispanic Non-White	16.3%	17.8%
Hispanic	6.6%	8.3%
Income (%)		
< \$20k	28.7%	29.0%
\$20k – \$35k	23.1%	23.6%
\$35k – < \$60k	23.9%	23.1%
\$60k	24.3%	24.3%
Marital Status (% Married)	41.4%	41.1%
Education (%)		
Below High School Diploma/GED	14.7%	15.6%
High School Diploma or GED	39.1%	38.4%
Some College or Associate's Degree	34.1%	34.0%
Four Year College Degree or More	12.1%	12.0%
Smoking Status (%)		
Everyday	79.8%	79.9%
Some Days	20.2%	20.1%
Average Cigarettes Smoked Per Day (<i>M</i> (<i>SD</i>))	10.8(9.0)	10.7(0.1)

Note: All participants were recruited as part of the 2010–2011 Tobacco Use Supplement to the Current Population Survey.

Table 2

Descriptive Statistics for State-level Policies

State-level Tobacco Control Policy	
State Medicaid Coverage of NRT (% yes)	86.30%
State Medicaid Coverage of Non-NRT Medications (% yes)	86.30%
State Medicaid Coverage of Behavioral Treatment (% yes)	70.60%
Provision of Free Cessation Medications by State Quitline (% yes)	76.50%
State Excise Tax Per Pack ($M(SD)$)	\$1.45(0.93)
Total State and Federal Tobacco Control Appropriations/Capita ($M(SD)$)	\$3.51(3.48)
State Comprehensive Smoke-free Laws (% yes)	51.00%

Note: Frequencies above are reported as the percentage of states that had each tobacco policy. Total state and federal tobacco control appropriations is reported in dollars/capita.