Evaluation of California’s ‘Tobacco 21’ law
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ABSTRACT
Introduction California’s law raising the minimum tobacco sales age to 21 went into effect on 9 June 2016. This law, known as ‘Tobacco 21’ or ‘T21’, also expanded the definition of tobacco to include electronic smoking devices. This paper describes the T21 evaluation plan and initial evaluation results.

Methods An evaluation plan and logic model were created to evaluate T21. A tobacco retailer poll was conducted 7 months after the law went into effect to assess awareness, support and implementation; an online survey of California adults was fielded to provide data on tobacco use and attitudinal changes before and after T21 implementation; and tobacco purchase surveys were conducted to assess the retailer violation rate (RVR). Multivariate models estimated the odds of RVR and odds of being aware, agreeing with and observing advertisements related to T21.

Results Seven months after the T21 effective date, 98.6% of retailers were aware of the law and 60.6% supported the law. Furthermore, 66.2% of retailers agreed that people who start smoking before 21 would become addicted to tobacco products. The RVR using youth decoys under age 18 statistically decreased from 10.3% before T21 to 5.7% after T21 (P=0.002). Furthermore, the RVR using young adult decoys ages 18–19 was 14.2% (95% CI 9.3% to 19.1%) for traditional tobacco and 13.1% (95% CI 10.2% to 16.1%) for electronic smoking devices.

Conclusions Survey findings suggest that the high awareness and support for the law may have contributed to reducing illegal tobacco sales to youth under 18 and achieving widespread retailer conformity with the new law disallowing sales to young adults under 21.

INTRODUCTION
California has significantly reduced tobacco use since the California Tobacco Control Program began in 1989. California has an adult cigarette smoking prevalence of 10.5% in 2015; however, California still has 3.2 million adult cigarette smokers, more than the population of 21 other states. Legislation that raised the legal minimum age for tobacco sales from 18 to 21 years old was enacted in 2016 to further reduce tobacco use initiation and use among youth and young adults. This law, known as ‘Tobacco 21’ or ‘T21’, became effective on 9 June 2016. The law also expanded the definition of tobacco products to include electronic smoking devices and required retailers selling electronic smoking devices to obtain a tobacco retail licence from the State of California by 1 January 2017. In order to garner support for the law’s passage, active-duty military personnel in the United States Armed Forces were exempted from the new minimum age-of-sale restriction. The law also does not cover American Indian tribal lands.

Since the minimum age of sale for tobacco in California had been 18 years of age for 144 years, a campaign was launched to raise awareness and facilitate implementation of the law. The goals were to educate the public, alert tobacco retailers and help them comply, maintain strong public support and promote the California Smokers’ Helpline (CSH).

The campaign used a multipronged approach, including a website portal to rapidly disseminate information, a press conference, a tobacco retailer educational toolkit, paid advertisements and social media posts. The toolkit included training and educational materials and updated state-mandated minimum age-of-sale warning signs. To reach California’s diverse tobacco retailer population, select resources were translated into Arabic, Chinese, Korean, Punjabi, Spanish and Vietnamese. The media campaign included point-of-sale advertisements and convenience store posters. Advertising also included print advertisements, digital advertisements and e-blasts. The T21 information campaign launched on 9 June 2016, with an initial cost of US$542 594.

Studies on the effectiveness of T21 laws are currently limited to local jurisdictions and statistical modelling. Studies suggest that laws increasing the minimum age for tobacco sales likely reduce the ability of youth to purchase tobacco products and prevent or delay tobacco use initiation. Research further indicates that T21 laws are a promising strategy and, in future decades, may significantly avert low birth weight, preterm births and chronic diseases. Conceptually, T21 laws are likely to make it more difficult for youth under 18 to obtain cigarettes from older friends. Over 33 000 tobacco retailers and vape shops are located in California and approximately 29.2% of them are located within 1000 feet of schools.

METHODS
To assess the effectiveness and impact of California’s T21 law, an evaluation plan and logic model were developed. As part of this plan, a retailer poll was conducted to investigate tobacco retailers’ awareness, support and implementation of California’s T21. Two online surveys assessed tobacco use prevalence and awareness of paid media advertising. Four statewide tobacco purchase surveys assessed retailer violation rates on tobacco sales. This paper describes the methods and initial results of evaluating the impact of California’s T21.

Evaluation logic model
Figure 1 displays the T21 logic model. Key activities to implement the law are listed in column one of the model.

1Activities around educating the American Indian community are currently in the planning stages; evaluation of those activities will not be described here.
**California Tobacco 21 Logic Model**

| Activities | Outputs | Short-Term Outcomes | Intermediate Outcomes | Long-Term Outcomes |
|------------|---------|---------------------|----------------------|--------------------|
| Distribute new age-of-sale warning signs to all CA tobacco retailers | Warning signs posted at 100% of tobacco retailers | Increase awareness and support for new age-of-sale law among the general public and 18–20-year-olds | Decreased illegal sales of tobacco to youth under 18 and young adults ages 18–20 | Increased age of tobacco use initiation |
| Develop and disseminate materials to educate retailers about increased age of sale and effective employee training | Educational materials and training tools distributed to retailers | Increased perception among youth that tobacco is difficult to obtain | Decreased ability for minors under age 21 to obtain tobacco products | Decreased tobacco use prevalence |
| Administer and promote a statewide tobacco use quittance to general public and 18–20-year-old tobacco users | Operational quittance promoted to diverse populations and 18–20-year-old tobacco users | Increased awareness of new age of sale among retailers | Decreased sales of tobacco products | Decreased tobacco use prevalence among young adults ages 19–20 |
| Display ads at point of sale to educate public about increased age of sale and quittance | Advertisements notifying public about new law and quittance displayed at tobacco retailers | Increased competence of retailers to comply with the new age-of-sale law | Decreased susceptibility to experimentation with tobacco products | Decreased youth and adult tobacco use prevalence |
| Conduct enforcement-related compliance checks of tobacco sales to minors under 21 | Demand letters issued to violating retailers through compliance checks of tobacco sales to minors under 21 | Increased compliance with new age-of-sale law | Increased quit attempts among tobacco users ages 18–20 | Decreased tobacco consumption |
| Educate American Indian communities about tobacco age of sale disparity | Educational materials for American Indian communities | Increased awareness of dangers of young adult smoking | Increased number of tribal compacts or tribal policies with age of sale as 21 | Decreased exposure to secondhand smoke/tobacco aerosol |

Environmental Context: State excise tax rates, rates of tobacco use, national media campaigns, state tobacco control funding, utilization of statewide quitline, tobacco cessation insurance coverage, tobacco and e-cigarette industry spending

Note: "Tobacco products" include electronic smoking devices; "smoking" includes smoking tobacco and vaping electronic smoking devices; "smoke-free" and "secondhand smoke" include tobacco smoke and toxic aerosol emitted from electronic smoking devices; and "thirdhand smoke" includes residue from tobacco.

**Figure 1** T21 logic model.

The outputs reflect tangible results of each activity. Short-term outcomes include the earliest changes expected, such as increased awareness and support for the law, increased competence of retailers to comply with T21 and increased calls to the CSH. Intermediate outcomes include decreased illegal sales of tobacco to youth and young adults, and increased quit attempts. Long-term outcomes represent the ultimate goals of the law: increasing the age of tobacco use initiation, decreasing tobacco use prevalence and decreasing tobacco-related morbidity and mortality.

**California Tobacco Retailer Poll**

Sample design

The California Tobacco Retailer Poll (CTRP) was a telephone survey conducted in January 2017, 7 months after T21 became effective. Retailers were randomly sampled from the California Department of Tax and Fee Administration (CDTFA)II tobacco retail licensing list, stratified by region. A sample of 1454 respondents completed the survey. The adjusted response rate was 29.8% with a cooperation rate of 53.5%.

Questionnaires and outcomes

Interviews were conducted in English or Spanish using computer-assisted telephone interviewing software. The priority for participation, in order of availability, was the storeowner, managers or supervisors, and clerks. A qualifying question was asked to ensure that retailers currently sell tobacco. Questions included T21 awareness, support and compliance.

**Online California Adult Tobacco Survey**

Sample design

The Online California Adult Tobacco Survey (Online CATS) assessed tobacco use behaviour and attitudes, public awareness and exposure to T21 advertisements, with a focus on California's working-age population. Two cycles were conducted, a pre-T21 and post-T21 survey, both fielded by the GfK Group. Samples were drawn from GfK's KnowledgePanel, where panel members are randomly recruited by GfK through address-based sampling methods and then weighted to be representative of California's population. To qualify, respondents had to be between the ages of 18 and 64 years and reside in California. A total of 3071 respondents qualified and completed the pre-T21 survey (62.1% completion rate); in the post-T21 survey, 3065 respondents qualified and completed the survey (65.1% completion rate). More information on the GfK panel sample design is available elsewhere.11 Individuals ages 18–24 years were included in the analytic sample for both pre-T21 (n=184) and post-T21 survey (n=175).

Questionnaires and outcomes

The Online CATS questionnaire asked respondents to report past 30-day use of cigarettes, e-cigarettes, chewing tobacco, big cigars, little cigars or cigarillos, tobacco pipe and hookah. Respondents' reported use of any of these tobacco products for at least 1 day in the past 30 days was classified as a current tobacco user.

Respondents were questioned about recent exposure to two media advertisements informing the public about the change in the minimum legal age-of-sale for tobacco in either English or Spanish and the state-mandated minimum age-of-sale warning signs. Respondents were asked about awareness of T21 before the survey and if they agreed or disagreed with the following statement: 'Raising the legal sale of age for tobacco products will...'

Zhang X, et al. Tob Control 2018;27:656–662. doi:10.1136/tobaccocontrol-2017-054088
reduce youth smoking'. Demographic data were also collected, including age, gender, race/ethnicity and household income.

**Tobacco Purchase Surveys**

**Sample design**

The rate of sale of tobacco to underage youth and young adults was assessed using four surveys with samples drawn from CDFTA's tobacco licensing list:

1. A pre-T21 and post-T21(2) Youth Tobacco Purchase Survey (YTPS), which used decoys ages 15–16 years attempting to purchase traditional tobacco in randomly selected retailers. The final sample for the pre-T21 YTPS was 793 retailers with a 96.1% completion rate, and the post-T21 YTPS was 751 retailers with a 91.8% completion rate (online supplementary table 1).

2. A Young Adult Tobacco Purchase Survey (YATPS), which used young adult decoys ages 18–19 years attempting to purchase traditional tobacco. Retailers were selected using a stratified clustered design that stratified California into 12 regions. Within each region, a random sample of zip codes was selected. All tobacco retailers within the zip code were chosen for YATPS.

3. A Young Adult E-cigarette Purchase Survey (YAEPS), which used young adult decoys ages 18–19 years attempting to purchase electronic smoking devices. To reduce travel costs, zip codes with geographic proximity to the zip codes selected for YATPS were identified and then all tobacco retailers within the selected zip code were chosen for YAEPS.

**Questionnaires and outcomes**

The tobacco purchase surveys were unannounced, non-enforcement-related compliance checks that used a consummated buy protocol in which the decoy selected and purchased the tobacco product. Each survey used a diverse group of decoys. Equal distribution of each gender and age group was attempted to reduce bias.

YTPS and YATPS decoys attempted to purchase cigarettes, little cigars or cigarillos, big cigars or chewing tobacco; YAEPS decoys attempted to purchase cigalikes, e-liquids/e-juice or other electronic smoking device products. The accompanying researcher recorded the retailer type, whether the decoy had been asked their age or to show identification, and tobacco sale. Data were recorded on paper surveys for the pre-T21 YTPS and on handheld electronic devices using SurveyPocket (Survey Analytics, San Francisco, California, USA) for the others.

**Statistical analyses**

All analyses were generated using SAS 9.4 (SAS Institute). Analyses were weighted for the probability of selection and accounted for the sample design. A P value of <0.05 was considered statistically significant for this study.

Descriptive statistics were performed for all CTRP outcomes, with results stratified by the interviewees' position. Responses of strongly support and support were combined to describe overall support. A similar combination was used for importance, ease and attitudinal belief. Responses of undecided or don't know were treated as missing data.

Descriptive statistics and significance tests were performed for Online CATS responses to determine changes over time. The household income variable was recoded into a three-category response. Current tobacco use is based on past 30-day usage. Multivariate logistic regression models were conducted to estimate the odds of agreeing with the statement that raising the legal minimum age of sale would reduce youth tobacco use prevalence, odds of being aware of T21, odds of observing the updated minimum age-of-sale warning signage and odds of observing the T21 advertisements, after adjusting for the respondent’s gender, race, income and current use of cigarettes, e-cigarettes, little cigars or hookah.

Retail violation rates (RVRs) were calculated statewide and, if applicable, by geographic region. Adjustments were made to standardise the results to an equal distribution of the decoy’s gender and age. Multivariate logistic regression models were used to estimate odds of tobacco sales to decoys after adjusting for the clerk’s gender, decoy’s characteristics (age, race, gender) and retailer type in YTPS, with additional adjustment for geographic location for YATPS and YAEPS.

**RESULTS**

**Process data**

Website analytics recorded 40231 visits to the T21 webpage between June and December 2016. The press conference secured more than 50 earned media placements and 13 million impressions through TV, daily papers, Spanish and Asian outlets, and retail trade publications. Over 36,000 toolkits were mailed to tobacco retailers and vape shops, 22 trade associations and by certified mail to 33 tobacco companies to raise awareness of the new laws and to promote compliance. Two waves of point-of-sale advertising were conducted: July to September 2016 and January to March 2017. These advertisements (online supplementary Figure S1) were placed at over 800 and then 1400 gas stations and convenience stores, with some overlap among retailers in the two waves. Retailer print and digital advertising were placed in Convenience Store News, Supermarket News and California Grocer. Digital advertising targeting young adults occurred in the second wave. Facebook outreach reached 883452 individuals with positive sentiment expressed via user comments, likes and shares.

**California Tobacco Retailer Poll and Online California Adult Tobacco Survey**

Table 1 displays results from the CTRP with 98.6% of retailers aware of the T21 law and 60.6% supporting the T21 law. Furthermore, 66.2% of retailers agreed that people who start smoking before 21 will become addicted to tobacco products. Most retailers thought it was easy to train staff (90.7%) and easy to comply with T21 (85.6%). Over half of retailers reported hearing complaints from individuals under 21 years old at least once a month and nearly a quarter observed monthly ‘shoulder tap’ buys in which an underage person asks an adult stranger in or outside the store to buy tobacco for them.

Descriptive statistics from the Online CATS are displayed in tables 2 and 3 displays the adjusted OR (AOR) for attitude towards and awareness of T21, observing T21 signs and observing T21 advertising. Current e-cigarette users, ages 18–24 years, have lower odds of agreeing that increasing the minimum age of
sale would reduce youth tobacco use (AOR, 0.08; P=0.010) and higher odds of observing the minimum age-of-sales sign (AOR, 9.98; P=0.013) compared with never/former e-cigarette users. A significant association was also found with current hookah users having higher odds of agreeing that increasing the minimum age of sale would reduce youth tobacco use (AOR, 26.64; P=0.018). The models indicated that non-Hispanic Black have significantly higher odds of observing the T21 advertising compared with non-Hispanic Whites (AOR, 9.58; P=0.038), and the odds of women observing the T21 advertising were higher than compared with men (AOR, 8.69; P=0.027). Little-cigar users have higher odds of observing the T21 advertising compared with former/never little-cigar users (AOR, 8.88; P=0.040). Non-significant differences in the odds were observed for awareness of the T21 law. In addition, a non-significant increase in tobacco use from pre-T21 to post-T21 was observed (results not shown).

### Tobacco Purchase Surveys

The YTPS RVR statistically decreased from 10.3% before T21% to 5.7% after T21 (P=0.002) using youth decoys. Tobacco-only retailers (eg, smoke shops) violated the law at a significantly higher rate than other tobacco retailers (eg, supermarkets, convenience stores) in the post-T21 YTPS, with a rate of 12.0% (P=0.012); nevertheless, the RVR at tobacco-only retailers significantly decreased from the pre-T21 YTPS (P=0.006). The YATPS RVR was 14.2% (95% CI 9.3% to 19.1%) and the YAEPS RVR was 13.1% (95% CI 10.2% to 16.1%) using young adult

### Table 1 Retailer attitudes, compliance and observations 7 months after Tobacco 21 became effective from the California Tobacco Retailer Poll

| Owners (n=481) | Managers (n=646) | Clerks (n=327) | Total (n=1454) |
|---------------|-----------------|---------------|---------------|
| Support, awareness and attitudes | | | |
| Awareness of Tobacco 21, % (95% CI) | 98.0 (96.6 to 99.3) | 99.0 (98.2 to 99.7) | 98.7 (97.4 to 100.0) | 98.6 (98.0 to 99.2) |
| Support for Tobacco 21, % (95% CI) | 56.7 (52.3 to 61.2) | 64.0 (60.2 to 67.7) | 59.8 (54.4 to 65.3) | 60.6 (58.1 to 63.2) |
| Agree that people who start smoking before 21 will become addicted to tobacco products, % (95% CI) | 60.2 (55.4 to 64.9) | 70.7 (66.9 to 74.4) | 66.1 (60.3 to 71.7) | 66.2 (63.6 to 68.8) |
| Compliance and training | | | |
| New minimum age-of-sale warning sign posted, % (95% CI) | 90.9 (88.2 to 93.5) | 94.2 (92.4 to 96.0) | 94.6 (92.1 to 97.1) | 93.2 (91.9 to 94.5) |
| Easy to train staff to comply with Tobacco 21, % (95% CI) | 87.5 (84.4 to 90.5) | 93.1 (91.2 to 95.1) | – * | 90.7 (89.0 to 92.5) |
| Easy to comply with Tobacco 21, % (95% CI) | 84.0 (80.6 to 87.3) | 90.8 (88.5 to 93.1) | 77.6 (72.9 to 82.3) | 85.6 (83.8 to 87.5) |
| Customer observations | | | |
| Individuals under 21 years of age complaints at least once a month, % (95% CI) | 58.9 (54.3 to 63.4) | 58.0 (54.0 to 61.9) | 56.2 (50.6 to 61.7) | 57.9 (55.3 to 60.5) |
| Observed ‘shoulder tap’ buys at least once a month, % (95% CI) | 24.1 (20.1 to 28.2) | 19.4 (16.3 to 22.6) | 31.1 (25.7 to 36.4) | 23.6 (21.3 to 25.9) |

*Compared with reverse category (ie, past 30-day cigarette user vs not a past 30-day cigarette user).

### Table 2 Attitudes, awareness and observations of Tobacco 21-related questions of California adults, ages 18–24 years, from the Online California Adult Tobacco Survey

| Agree that raising minimum age of sale reduces youth prevalence | Aware of T21 law | Observed minimum age-of-sale warning sign | Observed T21 advertising |
|---------------------------------------------------------------|----------------|----------------------------------------|-------------------------|
| % (95% CI) | P | % (95% CI) | P | % (95% CI) | P |
| Total | 61.7 (51.8 to 71.6) | – | 63.6 (53.5 to 73.7) | – | 39.0 (29.1 to 48.9) | – | 12.6 (6.6 to 18.6) | – |
| Gender | | | | | | | | |
| Male | 68.0 (54.5 to 81.5) | 0.213 | 61.3 (46.8 to 75.7) | 0.654 | 37.0 (23.2 to 50.9) | 0.695 | 6.4 (1.3 to 11.4) | 0.020 |
| Female | 55.5 (41.2 to 69.7) | – | 65.9 (51.8 to 80.0) | – | 41.0 (27.0 to 55.0) | – | 18.8 (8.3 to 29.3) | – |
| Race/ethnicity | | | | | | | | |
| White | 41.7 (24.2 to 59.3) | 0.006 | 66.9 (50.1 to 83.7) | 0.428 | 39.6 (22.3 to 56.9) | 0.135 | 14.5 (2.4 to 26.5) | 0.050 |
| Black | 91.7 (83.5 to 100.0) | – | 66.3 (40.2 to 92.3) | – | 24.7 (8.8 to 40.6) | – | 36.2 (10.9 to 61.4) | – |
| Hispanic | 65.6 (51.9 to 79.2) | – | 67.1 (53.3 to 80.8) | – | 48.2 (33.7 to 62.7) | – | 10.4 (2.3 to 18.4) | – |
| Other | 82.4 (57.3 to 100.0) | – | 43.3 (10.5 to 76.1) | – | DSU | – | 3.0 (0.0 to 9.1) | – |
| Household income | | | | | | | | |
| Under US$35000 | 63.7 (49.7 to 77.6) | 0.505 | 57.0 (42.1 to 71.9) | 0.512 | 33.8 (20.3 to 47.3) | 0.821 | 12.2 (3.7 to 20.6) | 0.906 |
| US$35000 to US$849999 | 64.4 (47.5 to 81.4) | – | 71.0 (53.2 to 88.8) | – | 39.4 (22.1 to 56.8) | – | 10.6 (1.1 to 20.0) | – |
| Over US$85000 | 50.0 (27.2 to 72.8) | – | 60.1 (37.8 to 82.5) | – | 41.5 (18.7 to 64.2) | – | DSU | – |
| Past 30-day use* | | | | | | | | |
| Cigarettes | 56.2 (35.0 to 77.4) | 0.569 | 84.1 (69.4 to 98.7) | 0.024 | 53.6 (32.9 to 74.4) | 0.127 | 29.3 (12.0 to 46.5) | 0.008 |
| E-cigarettes | 49.8 (27.0 to 76.2) | 0.285 | 73.4 (51.5 to 95.4) | 0.410 | 73.2 (55.7 to 90.7) | <0.001 | 42.8 (20.6 to 65.0) | <0.001 |
| Little cigars | 73.9 (45.3 to 100.0) | 0.435 | 83.4 (67.1 to 99.7) | 0.069 | 68.9 (46.8 to 90.9) | 0.014 | 61.6 (35.9 to 87.3) | <0.001 |
| Hookah | 85.8 (70.0 to 100.0) | 0.035 | 90.1 (78.6 to 100.0) | 0.006 | 58.2 (31.5 to 84.9) | 0.161 | 50.2 (24.1 to 76.3) | <0.001 |

*Compared with reverse category (ie, past 30-day cigarette user vs not a past 30-day cigarette user).

DSU, data suppressed.
decloys. Geographically, Los Angeles had the highest YATPS RVR at 21.5% (95% CI 8.9% to 34.1%), which is over five times higher than that of the San Francisco Peninsula and Northern Bay region (RVR, 3.3%; 95% CI 2.3% to 4.4%). Riverside had the highest YAEPS RVR with a RVR of 20.5% (95% CI 14.4% to 26.7%). The RVR for each purchase survey is in online supplementary table 2.

Table 4 presents the AOR for the RVRs by store type and region for each purchase survey. In the adjusted models, vape shops (AOR, 3.66; P=0.025) and tobacco-only retailers (AOR, 6.13; P<0.001) have significantly higher odds of selling electronic smoking devices in YAEPS when compared with convenience stores that sell gasoline, the most common type of tobacco retailer. In addition, the odds of selling traditional tobacco in YATPS is significantly lower in Orange (AOR, 0.45; P=0.007), Alameda (AOR, 0.21; P<0.001), the San Francisco Peninsula and Northern Bay regions (AOR, 0.24; P<0.001), the North Coast, Shasta Cascade and Eastern Sierra Nevada region (AOR, 0.50; P=0.063), and the Sacramento region (AOR, 0.15; P<0.001), compared with Los Angeles. When comparing the pre-T21 and post-T21 YTPS, there was a significant change in the AOR for RVR for tobacco-only retailers (P=0.006) and the ‘other’ retailers (P=0.005) compared with convenience stores that sell gasoline when controlled for other factors.

**DISCUSSION**

Following Hawaii and California, three states adopted T21 laws in 2017: New Jersey, Maine and Oregon.14 As demonstrated by the number of localities adopting T21 laws in the USA, there continues to be strong interest in preventing youth tobacco use.3 8 14 Momentum for this policy strategy should build if public and retailer support is demonstrated and with additional direct evidence that this strategy reduces youth access and use of tobacco products. While California is in the early phase of implementation, findings indicate the initial implementation was successful.

Preliminary results demonstrate high awareness and support for California’s T21 law among two key audiences: young adults and tobacco retailers. Overall, almost two-thirds (63.6%) of young adults ages 18–24 years were aware of the law and awareness was uniformly high across Hispanics, non-Hispanic Blacks and non-Hispanic Whites. Moreover, more than 60% of young adults agreed that raising the age of tobacco sales to 21 would reduce youth tobacco use. This attitude was significantly stronger among Hispanics and non-Hispanic Blacks than non-Hispanic Whites. E-cigarette users were significantly less likely to agree, suggesting that continued public health education campaigns are needed to communicate the health risks associated with e-cigarettes.

Young adults reported higher observation of the new minimum age-of-sale warning sign (39.0%) than the T21 advertisement (12.6%). Women, non-Hispanic Blacks and current little-cigar users were significantly more likely to have observed the T21 point-of-sale advertising campaign, suggesting that the campaign reached target audiences of interest.

Studies modelling the public health impact of raising the minimum age of tobacco sales to 21 suggest that reducing tobacco use, low and premature births, and chronic diseases rests on achieving strong compliance.5 Awareness and support for the law, along the continuum of the tobacco retail owners,
managers and clerks, are essential for obtaining good compliance with the law. Seven months after implementing California’s T21 law, awareness of the law was very high (98.6%) among tobacco retail owners, managers and clerks with more than 60% supporting the law and 66% agreeing that people who start smoking before 21 will become addicted to tobacco products. Furthermore, 85.6% agreed that it was easy to comply with the law and 90.7% stated it was easy to train staff to comply with the law. However, nearly 58% of retailers indicated that they received at least one complaint per month about the law. Particularly troubling is that 23.6% of retailers reported observing shoulder tapping at least once per month, suggesting that educational efforts need to discourage persons over 21 from purchasing tobacco products for underage persons.

At this time, tobacco use data among California teens post-T21 law implementation is not available; however, there was a non-significant increase in tobacco use among young adults ages 18–19 years of age. Prior to T21, the YTPS RVR had been flat since 2009, suggesting that the T21 law played a role in the reduction. Particularly encouraging was the significant decline in sales among tobacco-only stores, which decreased from 31.8% to 12.0%.

Tobacco purchase survey data also suggest widespread compliance with the T21 law in terms of tobacco sales to young adults, ages 18–19 years. The YATPS RVR was 14.2% and the YAEPS RVR was 13.1%, which is substantially less than the federal Syracuse rate of 20.0% in order to avoid penalties to the state’s Substance Abuse Prevention and Treatment block grant. Store types whose primary business is the sale of tobacco product (tobacco-only stores and vape shops) were most likely to make an illegal tobacco sale, while pharmacies and supermarkets were the least likely to make a sale. There were large regional variations in compliance with the T21 law; Los Angeles, Riverside, Santa Clara and the Central Valley regions had RVR greater than 15.0%.

This study has several limitations. First, only short-term outcomes are available at this point. While Online CATS is a repeated cross-sectional study, the length of time between waves of Online CATS was not sufficient to show significant changes in behaviour due to T21. Furthermore, it will be difficult to distinguish the effects of T21 and California’s tobacco tax increase that became effective on April 2017. Second, due to the cluster sampling design for YATPS and YAEPS, there was a risk that retailers would alert one another and the RVR to be under-reported. Finally, low response rates are an increasingly common problem in telephone surveys and there is a potential for non-response bias.

### Table 4  Adjusted OR (AOR) for retailer violation rates from the Youth Tobacco Purchase Survey (YTPS), the Young Adult Tobacco Purchase Survey (YATPS) and the Young Adult E-cigarette Purchase Survey (YAEPS)

| Retailer type                        | Pre-T21 (n=793) | Post-T21 (n=751) | YATPS (n=1228) | YAEPS (n=842) |
|--------------------------------------|-----------------|------------------|---------------|---------------|
| Conveniences stores with gas         | Reference       | Reference        | Reference     | Reference     |
| Conveniences stores without gas      | 0.50 (0.21 to 1.21) | 0.80 (0.29 to 2.18) | 0.66 (0.32 to 1.35) | 0.67 (0.25 to 1.81) |
| Liquor stores                        | 0.46 (0.20 to 1.04) | 0.33 (0.09 to 1.20) | 0.75 (0.36 to 1.54) | 1.47 (0.63 to 3.43) |
| Pharmacies                           | <0.01** (<0.01 to <0.01) | <0.01** (<0.01 to <0.01) | 0.204 (0.06 to 0.71) | 0.23 (0.03 to 2.06) |
| Small markets                        | 0.61 (0.20 to 1.89) | 1.45 (0.56 to 3.73) | 0.465 (0.25 to 0.84) | 0.90 (0.19 to 4.30) |
| Supermarkets                         | 0.65 (0.25 to 1.71) | 0.27 (0.04 to 2.13) | 0.274 (0.09 to 0.80) | 0.11 (0.01 to 1.10) |
| Tobacco stores                       | 4.17** (1.98 to 8.77) | 1.89 (0.76 to 4.70) | 1.33 (0.58 to 3.06) | 6.13** (2.38 to 15.77) |
| Vape shops                           | –§              | –§               | –§            | 3.66 (1.18 to 11.35) |
| Others                               | 2.78‡ (1.15 to 6.73) | 0.45 (0.10 to 2.00) | 1.00 (0.52 to 1.92) | 2.02 (0.69 to 5.96) |

*P<0.05; **P<0.01.
†Controlled for retailer type, decry’s age, decry’s gender, decry’s race and clerk’s gender.
‡Controlled for retailer type, geographic region, decry’s age, decry’s gender, decry’s race and clerk’s gender.
§Regional breakdown not modelled in YTPS due to sampling design.
¶Regional breakdown not modelled in YTPS due to sampling design.
§Vape shops were not in a separate category in the pre-T21 YTPS and were included with ‘others’ in post-T21 YTPS and YATPS due to small sample size.
†Controlled for retailer type, decry’s age, decry’s gender, decry’s race and clerk’s gender.
¶Regional breakdown not modelled in YTPS due to sampling design.
however, studies have shown that there is not a direct correlation between response rate and validity.\(^{17,18}\)

**CONCLUSIONS**

California is still in the early stages of implementing and understanding the impact of its T21 law. Preliminary results demonstrate that despite the short implementation period, very high awareness about the law was achieved among tobacco retailers and young adults. Survey findings suggest that the high awareness and support for the law may have contributed to reducing illegal tobacco sales to youth under 18 and achieving widespread retailer compliance with T21. As evidenced by retailer compliance in New York City, vigilance and reinforcement are needed to sustain and improve compliance with tobacco sales to those under 21 years of age.\(^7\)

Pursuant to the logic model, further analyses related to tobacco use and the economic impact of the T21 will be performed. Additionally, efforts are in the early planning stages to assess community readiness among California’s tribal governments to adopt T21 laws and to support that interest with grant funding and technical assistance support.

**What this paper adds**

- Provides evidence that there is very high awareness and support of California’s T21 law among tobacco retailers, training clerks and implementing the law were easy, and the majority of retailers agree that increasing the minimum age of sale will reduce youth tobacco use.
- Provides evidence that there is very high awareness and support of California’s T21 law among young adults across diverse racial/ethnic groups and a majority of young adults agree that increasing the minimum age of sale will reduce youth tobacco use.
- Provides evidence of a significant reduction in access to tobacco products by teens under 18 years of age following the implementation of the T21 law and fair compliance with the law in terms of tobacco sales to those under 21 years of age.

**Acknowledgements**

The authors would like to thank Todd Rogers and Kurt Ribisl for their guidance on the study design of the tobacco purchase surveys and CTRP instruments, Lisa Henriksen for providing vape shop list for the tobacco purchase surveys, and the program staff and data collectors from the Institute for Social Research at the California State University, Sacramento.

**Contributors**

XZ led the study design, conducted data analysis and wrote the manuscript. TDV managed the contract for data collection, developed the data collection protocol, conducted data analysis and wrote the manuscript. EA-R developed the evaluation plan and logic model for the evaluation and edited the manuscript. AR instructed the evaluation studies, wrote the discussion of the manuscript and edited the manuscript.

**Funding**

This research received no specific grant from funding agencies in the public, commercial or not-for-profit sectors.

**Competing interests**

None declared.

**Ethics approval**

California Committee for the Protection of Human Subjects.

**Provenance and peer review**

Not commissioned; externally peer reviewed.

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