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E-cigarette and Cigarette Purchasing Among Young Adults Before and After Implementation of California's Tobacco 21 Policy

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Abstract

Background: Tobacco 21 (T21) laws, which raise the minimum legal age of sale of tobacco products to 21, have been proposed and implemented in states and cities across the US. However, limited data are available on the effect of T21 laws on youth tobacco purchasing behaviors and access to tobacco products.

Methods: Participants in a population-based prospective cohort in southern California completed questionnaires before (N=1609, Age=18–19) and after (N=1502, Age=19–20) T21 was implemented in California (June 2016). We examined the prevalence of past 30-day cigarette and e-cigarette use, and among past 30-day users, purchase location of tobacco products before (Pre-) vs. after (Post-) T21. We also examined whether, Post-T21, participants were refused purchase of tobacco products due to their age, and the perceived relative ease of purchasing cigarettes and e-cigarettes (vs. Pre-T21).

Results: Negligible changes in cigarette and e-cigarette use were observed Pre-T21 vs. Post-T21. At both time points, the majority of past 30-day users purchased cigarettes from gas stations and e-cigarettes from vape shops. Post-T21, the proportion of participants who reported purchasing cigarettes at gas stations decreased. Post-T21, most past 30-day cigarette or e-cigarette users were not refused purchase of cigarettes (65.4%) or e-cigarettes (82.0%) in the past 30 days, despite being under 21; half of participants felt it was harder to purchase cigarettes (54.3%) and e-cigarettes (43.6%) Post-T21.

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Competing Interests. None declared.

Patient Consent and Ethics Approval. The study obtained ethics approval from the University of Southern California institutional review board (protocol #: HS-13-00708) and participants gave informed consent before taking part.

Conclusion: Post-T21, few participants were refused purchase of any tobacco product, despite the illegality of such sales. Better enforcement of T21 is needed to improve the efficacy of T21 legislation.

INTRODUCTION

The increase in e-cigarette use among United States (U.S.) high school students over the last 5 years – and the corresponding flattening of the decline in cigarette smoking – has heightened concern regarding youth tobacco use.[1, 2] In response to these reports, policymakers have urgently sought solutions to curb youth initiation and use of tobacco products.[1, 2] Tobacco 21 laws (T21), which raise the minimum legal age of sale to 21 years, have been proposed and implemented in 18 U.S. states, including in California, and many more cities and counties.[3] In April of 2019, members of the U.S. Senate expressed support for a national T21 law,[4] suggesting a widening of the appeal for T21.

T21 laws were first proposed in 2015, when the Institute of Medicine (IOM) commissioned a report to evaluate the potential impact of such laws across the U.S., by estimating the decrease in tobacco initiation that would result from raising the legal purchase age to either 19, 21, or 25 years. The report concluded that although raising the legal purchase age to any of these proposed ages would delay tobacco initiation rates of youth, the impact would be substantially higher if the age was raised to 21 as compared to 19, but the added impact would be negligibly larger if the age was raised higher, to 25.[5] Studies in three states that have passed T21 laws (California, New York, and Massachusetts) have evaluated the impact of T21,[6–8] and found reductions in retail violation rates[6] and youth tobacco prevalence.[7, 8] However, the effect of T21 on purchasing behaviors, particularly in states like California, which have low rates of tobacco use, is not yet known.

Data on locations where youth purchase tobacco products are needed, as point of sale is a key area where T21 may have a substantial impact on reducing youth tobacco use. The location where youth purchase these products is critical to informing effective prevention policies. For example, a recent survey conducted in California found that adolescents most commonly purchase cigarettes and e-cigarettes in smoke shops,[9] and a separate California-based survey found that nearly 50% of tobacco and vape shops did not check identification when underage decoys attempted to purchase vaping products.[10] Thus, if data demonstrate that particular retail locations disproportionately sell to underage youth, current and future T21 laws may benefit from a priori targeted vendor education and Post-T21 violation checks and enforcement efforts. On the other hand, if data suggest that the majority of youth purchase tobacco products online, better e-verification would be necessary to ensure low online retail violation rates.

This study investigated tobacco use and purchasing behaviors among young adults enrolled in the Southern California Children's Health Study (CHS). Data were collected in 2015–2016 (Pre-T21; Mean Age=18.9 [SD=0.6]) and 2016–2017 (Post-T21; Mean Age=20.2 [SD=0.6]). Notably, participants in this cohort aged through these policy changes; all participants *were* legally able to purchase tobacco at the Pre-T21 assessment, and then *not* legally able to purchase tobacco at the Post-T21 assessment. Through this period, we

examined changes in the prevalence of cigarette and e-cigarette use and locations of cigarette and e-cigarette purchase Pre-T21 and Post-T21. We also examined, Post-T21, refusal of purchase of tobacco products due to age and perceived relative ease of purchase of tobacco products.

METHODS

Study design and sample

The Southern California Children's Health Study (CHS) is a prospective cohort study of youth from communities across Southern California. The study design has been described previously.[11, 12] Briefly, the cohort was first recruited in 2002–2003 when participants were in Kindergarten or 1st grade (split sample). Data on an expanded set of tobacco use behavior items were first collected when participants were in 11th or 12th grade in Spring 2014 (N=2097) by pencil-and-paper questionnaires at participants' high schools. Additional data were subsequently collected approximately every 1–1.5 years after participants reached the age of 18, administered via online surveys. In the current analysis, we used data from the wave immediately prior to T21 implementation (Pre-T21; Feb 2015-Oct 2016; N=1609; Mean Age=18.9 [SD=0.6]) and shortly after T21 implementation (Post-T21; Oct 2016-Oct 2017; N=1502; Mean Age=20.2 [SD=0.6]).

Ethics statement

This study was approved by the University of Southern California Institutional Review Board. After reaching the age of 18, participants provided informed consent online prior to data collection.

Measures

Prevalence.—At both assessments, all participants were asked their age at first use of cigarettes and of e-cigarettes, and the number of days that each product was used in the past 30 days (0 days, 1–2, 3–5, 6–9, 10–19, 20–29, or all 30 days). Participants who reported an age of first use of a product were considered "ever users" of that product; participants who reported use of these products on any of the last 30 days were classified as "past 30-day users."

Purchase location.—Participants who reported past 30-day use of cigarettes and e-cigarettes were asked "During the past 30 days, where did you buy your own [product]?" (separately, by product) with select-all-that-apply response options, including "a gas station," "a convenience store," "a grocery store," "a drugstore," "over the Internet," "through the mail," "a vape shop," "a tobacco specialty store," "some other place not listed here (Specify)."

Refusal of purchase.—Participants who reported use of cigarettes or e-cigarettes in the past 30 days were asked in the Post-T21 survey "During the past 30 days, did anyone refuse to sell you [product] because of your age?" Answer choices, for cigarettes and e-cigarettes, independently, were "I did not try to buy [product] in the last 30 days," "Yes," "No," and "Don't know." To estimate the proportion of persons who were not refused purchase for

tobacco products, we excluded participants who did not try to buy that product (e-cigarettes [n=65] or cigarettes [n=59], in separate analyses) in the past 30 days.

Ease of purchase.—Among past 30-day cigarette or e-cigarette users, participants' perceptions of the ease of purchase of cigarettes and e-cigarettes (separately) were measured in the Post-T21 survey, "Compared to about a year ago, is it (Easier, About the Same, or Harder) to purchase [product]?"

Enforcement of local sales to youth policy.—For the present analyses, we used 2017 American Lung Association (ALA) letter grades that quantify the strength of local tobacco enforcement policies to evaluate whether results differed by enforcement measures in place. The ALA in California provides a local political jurisdiction grade for "Reducing Sales of Tobacco Products to Youth," based on tobacco retail licensing ordinances adopted by jurisdictions to reduce availability and sales of tobacco products to minors[13] where communities with stronger tobacco control receive better grades (i.e., "A") and those with poorer tobacco control efforts receive poorer grades (i.e., "F"). Methods used to assign grades to each locality in the CHS, and details regarding the criteria for each letter grade, have been described previously.[14, 15]

Demographic characteristics.—Participants' gender (female, male), age (<21 or ≥21 at each wave), and race/ethnicity (Hispanic white, Non-Hispanic white, other) were assessed by questionnaire.

Statistical Analysis

All results are reported separately by product (cigarette or e-cigarette). Descriptive data for ever use and past 30-day use are reported among all participants who completed either Pre-T21 or Post-T21 surveys. Descriptive data for purchase location are reported among past 30-day users of cigarettes or e-cigarettes (for purchase location for cigarettes and e-cigarettes, respectively). Descriptive data at the Post-T21 survey are reported for refusal of purchase, and ease of purchase among participants who had used cigarettes or e-cigarettes in the past 30 days. To evaluate whether purchase location changed after implementation of T21, reported purchase location served as the primary outcome measure (for each purchase location, in separate models) in multivariate logistic regression models as a function of study wave (Pre-T21 vs. Post- T21), which included a random effect for participant ID. Models investigating whether purchase location differed by demographic characteristics or ALA grade included a time (Pre-T21, Post-T21) by characteristic (gender, race/ethnicity, ALA grade) interaction term (respectively). We conducted the following sensitivity analyses: 1) restriction to participants who completed both the Pre-T21 and Post-T21 surveys, and 2) exclusion of participants who completed the Pre-T21 survey just after T21 implementation in June 2016 (N=151); results did not differ substantively in either sensitivity analysis (data not tabulated). All models were adjusted for gender, race/ethnicity, and ALA grade. SAS v.9.4 was used for all analyses.

RESULTS

Demographics

At the Pre-T21 survey, all participants were over 18 and no participants were over 21. Among the Post-T21 survey respondents (N=1502), 11.1% were over 21 and the remainder were under the age of 21 (N=1310).

Participants were approximately evenly distributed by gender (51.4% female) (Table 1). About half of participants were Hispanic White (HW; 49.5%) and the remaining were Non-Hispanic White (NHW; 37.5%) or of another racial/ethnic group (13.0%).

Changes from Pre-T21 to Post-T21

Prevalence.—The prevalence of ever and past 30-day e-cigarette use was higher than cigarette use at the Pre-21 survey (Table 1). At the Post-T21 survey, the prevalence of ever e-cigarette use was higher than the prevalence of ever cigarette use, while the prevalence of past 30-day e-cigarette use was lower than past 30-day cigarette use. Ever use and past 30-day use of cigarettes increased slightly between the two study waves; ever use of e-cigarettes increased slightly, and past 30-day use of e-cigarettes decreased slightly Post-T21.

Purchase Location.—At both the Pre-T21 and Post-T21 surveys, the majority of past 30-day cigarette users purchased cigarettes from a gas station, while the majority of past 30-day e-cigarette users purchased e-cigarettes from a vape shop; few smokers or vapers purchased products online (Figure 1). Compared to Pre-T21, the proportion of past 30-day cigarette smokers reporting that they purchased cigarettes at gas stations decreased (Pre-T21 44.5%, Post-T21 32.7%; $p<0.05$); the proportion reporting that they had not purchased cigarettes in the past 30 days increased (Pre-T21: 38.4%; Post-T21: 45.9%). Among past 30-day e-cigarette users, the proportion reporting that they purchased their e-cigarettes from a vape shop decreased (Pre T21: 37.8%; Post T21: 29.1%) while the proportion reporting not purchasing products increased (Pre T21: 51.8%; Post T21: 57.5%), though these changes were not statistically significant.

Differences by demographic characteristics.: A higher percentage of females did not purchase cigarettes or e-cigarettes in the last 30 days both Pre-T21 and Post-T21 compared to males (Supplemental Table 1). Among past 30-day e-cigarette users, males (vs. females) reported higher rates of purchasing e-cigarettes at vape shops at both surveys, though differences by gender were not statistically significant.

The proportion of NHW participants reporting purchase of cigarettes at gas stations decreased Pre-T21 (55.1%) to Post-T21 (30.9%); for HW participants, the proportion who purchased cigarettes at gas stations increased (Pre-T21: 31.8%; Post-T21: 34.3%) (Supplemental Table 1). While the purchase of e-cigarettes from a vape shop decreased for both NHW (Pre-T21: 35.8%; Post-T21: 32.8%) and HW participants (Pre-T21: 40.2%; Post-T21: 21.2%), the decrease was greater for HW participants than for NHW participants ($p=0.08$).

The proportion of participants living in ALA grade “A” communities who reported that they did not try to purchase cigarettes decreased from Pre- to Post-T21, while the proportions of participants in ALA grade “C” and “F” communities reporting that they did not try to purchase cigarettes increased, though changes were not statistically significant (Supplemental Table 1). Only small changes Pre- to Post-T21 were observed for other purchasing behaviors, and changes did not differ significantly by ALA grade.

Purchasing Behaviors and Perceptions Post-T21

Refusal of Purchase.—At the Post-T21 survey, the majority of participants under 21 reported that in the past 30 days, they were not refused cigarette purchase (65.4%) or e-cigarette purchase (82.0%) because of their age (Figure 2). Participants under 21 who were female, NHW, and lived in communities with poor tobacco control (ALA grade of “F”) were generally refused purchase of tobacco products more often than their counterparts (Supplemental Table 2).

Ease of Purchase.—A majority of participants under the age of 21 Post-T21 reported that cigarettes and e-cigarettes were harder to purchase compared to a year earlier (before T21 was enacted) (Figure 3).

DISCUSSION

The current study provides data describing youth purchasing behaviors of cigarette and e-cigarette products before and after T21 was enacted in California. This cohort was unique as all participants were legally able to purchase tobacco products Pre-T21, and then most were no longer able to legally purchase tobacco products Post-T21. Past 30-day use of cigarettes increased slightly Pre- to Post-T21, while past 30-day e-cigarette use decreased slightly Pre- to Post-T21. Among those attempting to purchase tobacco products while under the legal age Post-T21, most reported that no one had refused to sell them cigarettes or e-cigarettes because of their age. Most participants reported purchasing cigarettes at gas stations, and e-cigarettes at vape shops. The proportion of participants who reported purchasing cigarettes at gas stations decreased after T21 went into effect, but no significant differences in purchase location for e-cigarettes were observed.

Although about half of participants reported that it seemed harder to purchase tobacco products after T21 went into effect, the majority of participants under 21 reported that no one had refused to sell them tobacco products due to their age. This raises concerns regarding enforcement of the T21 policy in California. One possible explanation for the high rates of illicit sales of tobacco products to minors may be that retailers are simply not checking IDs. A recent study found that in California, nearly 50% of tobacco and vape shops did not check IDs when underage decoys attempted to purchase vaping products.[10] When a T21 law passed in New York City, a study investigated retailer compliance with ID checks and found that compliance actually decreased after T21 policies were enacted (from 71% compliance to 62%).[16] It was also found that independent retailers of tobacco products had significantly lower compliance rates compared to chain stores.[16] Independent retailers may be reluctant to check IDs of individuals if they are similar in age to the retailers.[17] In

addition, infrequent retailer compliance checks by law enforcement may lead to retailers believing there is little risk to non-compliance.[18, 19]

Alternatively, the high rate of non-compliance with ID checks and findings from the current study that few underage youth were refused purchase of tobacco products may reflect a lack of understanding or knowledge of T21 law implementation by retailers. A recent study of tobacco retailers in Los Angeles, California interviewed retailers on their perceptions of FDA tobacco regulatory authority and reported low likelihood of viewing the FDA as trustworthy, that they often did not know or understand federal rules, and that tobacco companies urged retailers not to comply with federal regulations; more mistrust was observed among African-American retailers.[20] Although these findings pertained to the FDA and federal regulations, retailers may have similar reservations about state regulatory officials and state laws. Data suggest that utilizing resources to develop training and education programs for retailers to learn more about the regulations relevant to their sales may lead to fewer tobacco sales to underage individuals.[20]

The high rate of underage purchase could also be due to use of false identification (fake IDs) to obtain tobacco products. A study at a large, public university in the mid-Atlantic U.S. from 2014 found that 66.1% of their sample of college-aged participants had used a fake ID at least once while they were in college.[21] Gas station and vape shop merchants may be unable to recognize fake IDs, thus, unable to refuse purchase of tobacco products to underage patrons. Although scanner systems are implemented in a number of places, such as retail stores and bars across the U.S.,[22] it is not clear how effective this technology is at detecting highly sophisticated fake IDs, which can be easily purchased by underage youth online.[22] Additional research is needed to better understand why sales to underage purchasers are so common after T21 enactment.

Despite the enactment of T21, only the proportion of participants who reported purchasing cigarettes from a gas station decreased significantly; no other purchase locations changed significantly Pre- to Post-T21. These findings may reflect tobacco retailers' noncompliance with T21 regulations. If the locations where participants typically obtained their tobacco products from Pre-T21 did not enforce T21 when the law was enacted, then Post-T21, participants would continue to obtain their products from those same locations. Gas stations, however, may represent a subset of tobacco retailers that are enforcing T21 policies, which deterred participants who had purchased cigarettes from gas stations Pre-T21 from doing so Post-T21.

The impact of T21 on purchasing behavior could have been impacted by one of several other policy changes or campaigns in California during the data collection period. During this time, many anti-tobacco campaigns targeting youth were implemented[23–26] and the tax on tobacco products in California was increased (2017).[27] Anti-tobacco campaigns in California or nationally, or increases in the tobacco tax in California, might be expected to supplement T21 and result in changes to overall use and to purchasing behavior.[28–30] Such policies and campaigns may also have affected patterns of cigarette and e-cigarette use over this time. Thus, it is challenging to determine the impact of individual policies and

campaigns, including the unique influence T21 policies may have had on youth and young adult tobacco purchasing behavior or use rates.

Limitations.

As sample sizes for this analysis were small, our analyses may have been underpowered to detect statistical significance. This study was not able to capture methods that participants under 21 used to purchase tobacco products from places such as gas stations or vape shops after T21 was enacted (i.e., by using a fake ID or frequenting stores where they are familiar to the owners), which may explain how participants continue to have access and evade refusal of purchase of tobacco products. We also did not assess potentially popular purchase locations (e.g., directly from a peer) nor where participants may have accessed tobacco products that they did not purchase (e.g., borrowing a vape or “bumming” a cigarette from a friend). In an earlier wave of this study, we found that while the most common method of obtaining cigarettes was by borrowing or bumming them, the most common method of obtaining e-cigarettes was buying the product themselves (data not published). As participants get older, their purchasing behaviors and tobacco product use may change naturally, which may contribute to the findings observed Pre-T21 vs. Post-T21. Finally, recall bias as well as social desirability bias may impact the validity of the data as it was collected through self-report.

The results of this study raise considerations for optimal methods of T21 implementation in other U.S. states and countries. For T21 to be effective in limiting youth access to tobacco products, it must be consistently enforced. Prior research demonstrates that the success of tobacco regulatory policies relies on proper enactment and enforcement of these policies.[15] Future policies might focus on enforcement efforts, including higher penalties for noncompliance, and means of implementation that are effective in both larger chain retailers of tobacco products as well as individual retailers, specifically in tobacco-only retailers (tobacco specialty stores or vape shops). In addition, when implementing future policies, resources should be dedicated to retailer education and training on these policies to ensure retailers are well informed on the regulations impacting their sales. For example, Assurances of Voluntary Compliance (AVCs), which are state-level contracts between corporation and attorneys general to ensure retailer training, provide age-of-sale signage, and implement mystery shopper checks, may be a feasible method of both enforcing and educating a subset of corporate-owned retailers on T21.[31] While there is currently limited evidence on the efficacy of AVCs in curbing underage tobacco sale, AVCs are a promising tool to assist in T21 compliance and future longitudinal studies should be utilized to verify this.[31] Although AVCs may be impactful in targeting corporate-owned tobacco retailers, it is imperative that independent retailers also receive education on enforcement and are periodically held accountable for upholding T21. It is important that the FDA develop personalized educational programs for independent retailers in order to build trust between them and combat any potential influence of the tobacco industry. In addition, periodic retailer compliance checks targeted at independent retailers could be implemented. Last, penalties for failing to comply with regulations could be increased, which may make independent retailers more likely to comply with T21, as the penalty fees for not doing so may largely impact on their profits.

Conclusion

Despite the implementation of T21 in 2016, a large proportion of underage tobacco users were not refused purchase of cigarettes or e-cigarettes due to their age. These data suggest that enactment of T21, alone, may be insufficient to markedly reduce young adult tobacco product consumption. Additionally, education about T21 and improved enforcement efforts for T21 policies are needed to affect positive changes in young adult tobacco product purchasing behaviors and use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

STATEMENTS

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Data availability.

De-identified participant data are available upon reasonable request to the corresponding author (JBT).

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WHAT THIS PAPER ADDS

What is already known on this subject:

- T21 laws – which raise the legal age of sale of tobacco products to those 21 or older – have been implemented in a number of states and local political jurisdictions.
- Some evidence suggests that the prevalence of tobacco use among youth may decrease after implementation of T21 laws

What important gaps in knowledge exist on this topic:

- It is not known how youth tobacco purchasing behaviors and access to tobacco products may change after implementation of T21 laws.

What this study adds:

- Youth and young adults primarily purchase cigarettes from gas stations and e-cigarettes from vape shops (which was consistent both Pre-T21 and Post-T21).
- Most tobacco product using youth in this study in California were not refused purchase of products due to their age, despite being under the legal age of 21 at the time of purchase.

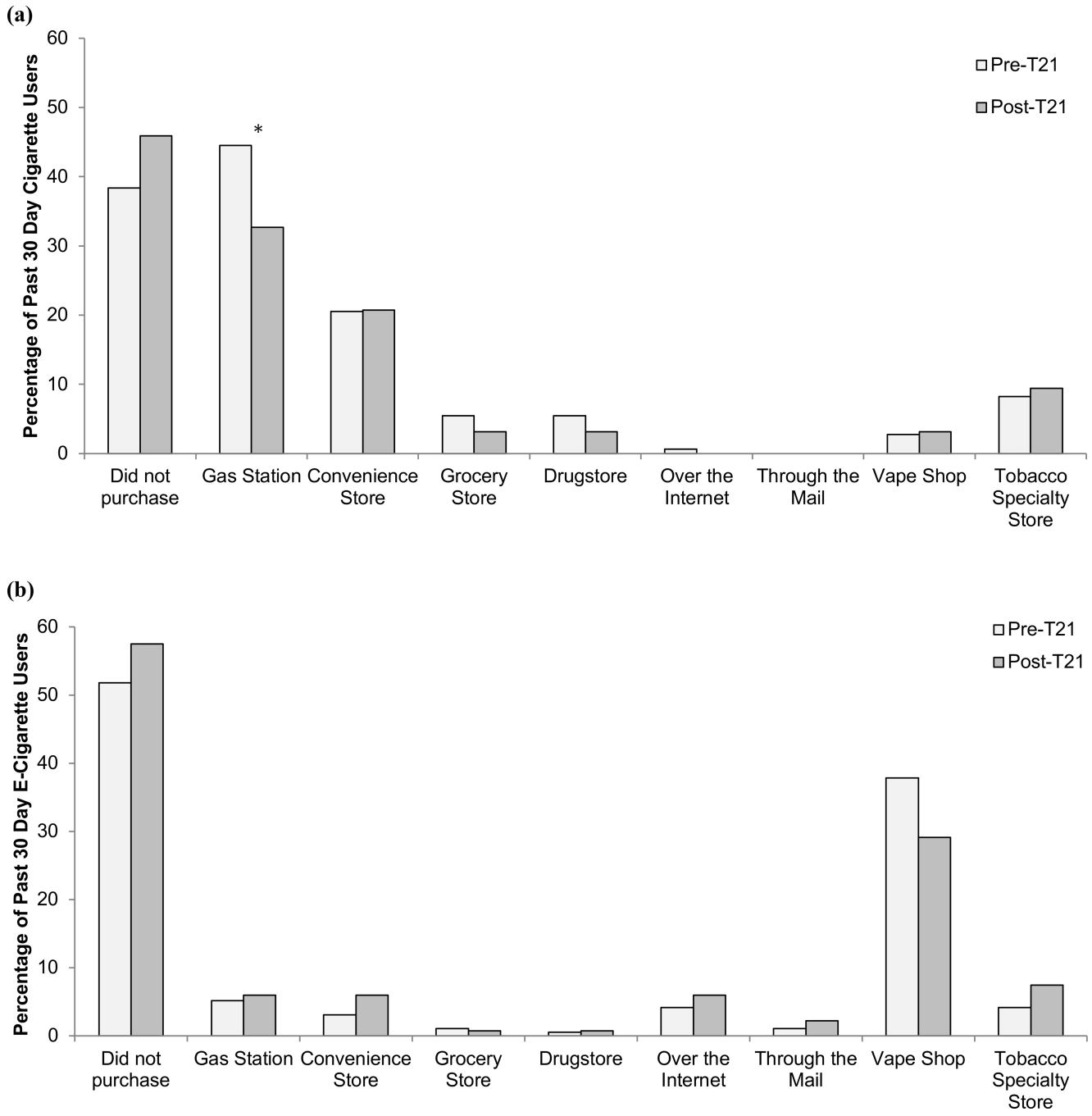

Figure 1. (a) Cigarette and (b) e-cigarette purchase locations of past 30-day cigarette and e-cigarette users, respectively, Pre-T21 (N_{cig} = 146; $N_{e\text{-}cig}$ = 193) and Post-T21 (N_{cig} = 159; $N_{e\text{-}cig}$ = 134), among past 30-day users

*P<0.05 for multivariate logistic regression models of the association of time (Pre-T21 vs. Post-T21) with reported purchase location (primary outcome measure for each purchase location, in separate models); This question was asked with select-all-that-apply response options (categories are not mutually exclusive); Tests of statistical significance were coadjusted for gender, race/ethnicity, ALA grade, and included a random intercept of ID.

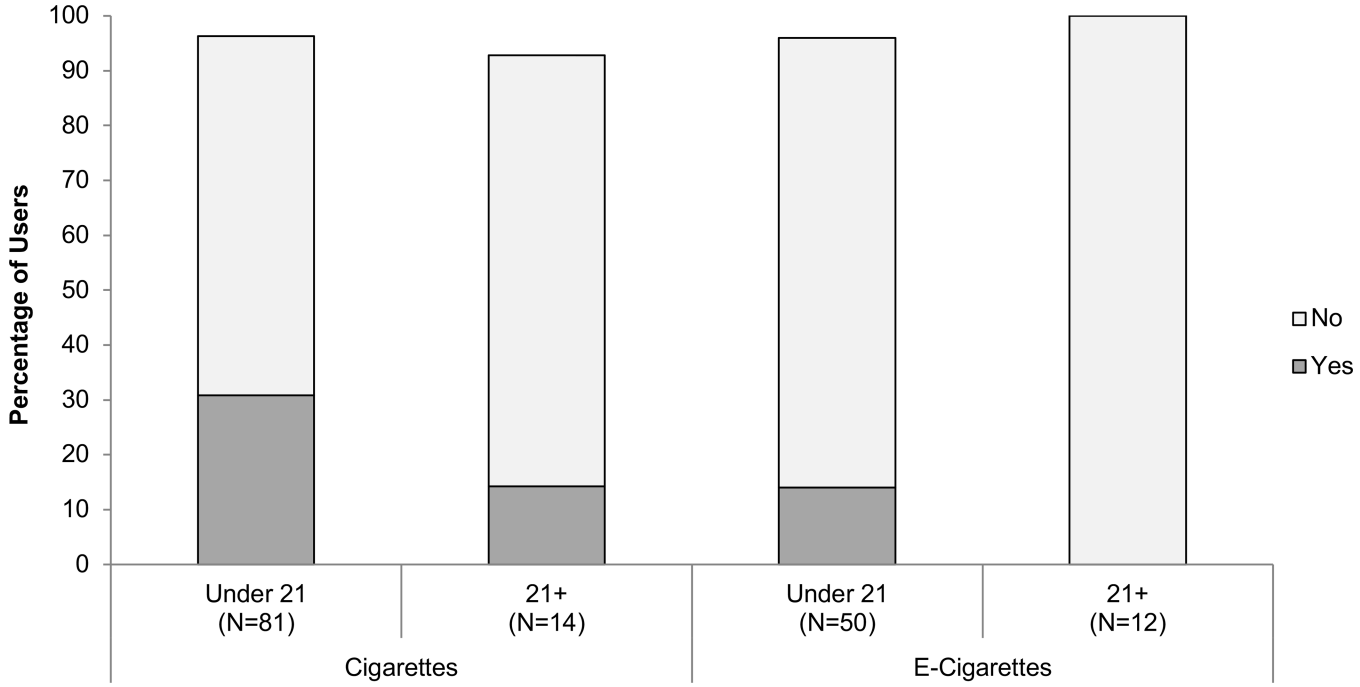

Figure 2. Proportion of cigarette and e-cigarette past 30-day purchase refusals Post-T21 by age over/under 21, among past 30-day cigarette (N = 95) and e-cigarette (N= 62) users, respectively

*Note not all of the proportions sum to 100% as participants who selected the answer choice "I did not try to buy this product in the last 30 days" were excluded from analyses and the proportion of participants that selected the answer choice "Don't know" are not reported.

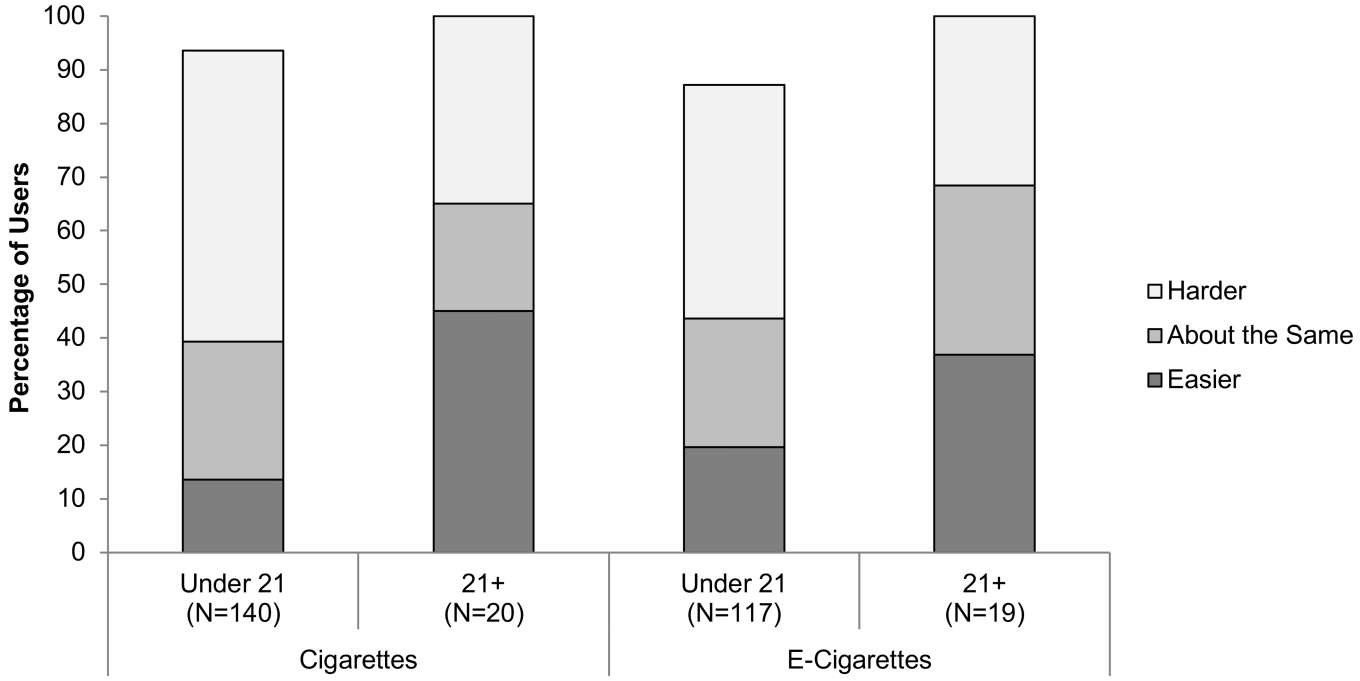

Figure 3. Proportion of participants reporting ease of cigarette (N= 160) and e-cigarette (N= 136) purchase Post-T21 by age over/under 21, among past 30-day cigarette and e-cigarette users, respectively

*Note not all of the proportions sum to 100% as the proportion of participants that selected the answer choice “Don’t know” are not reported.

Table 1.

Sociodemographic characteristics and tobacco use prevalence of participants, N = 1637

Characteristic	Total *N* (%)
Gender	
Female	841 (51.4)
Male	796 (48.6)
Race/ethnicity	
Hispanic white	811 (49.5)
Non-Hispanic white	614 (37.5)
Other	212 (13.0)
Pre-T21	
Age (M [SD])	18.9 (0.6)
Ever Use	
Cigarette	437 (27.8)
E-Cigarette	632 (40.5)
Past 30 Day Use	
Cigarette	150 (9.6)
E-Cigarette	195 (12.9)
Post-T21	
Age (M [SD])	20.2 (0.6)
Ever Use	
Cigarette	515 (34.7)
E-Cigarette	729 (49.1)
Past 30 Day Use	
Cigarette	164 (11.1)
E-Cigarette	139 (9.4)

*May not sum to total due to missing data