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Financial challenges and hardship during the COVID-19 pandemic and tobacco expenditure minimizing strategies among U.S. adult commercial tobacco users

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ARTICLE INFO

Keywords:
Tobacco expenditure minimizing strategies
Financial challenges
Hardships
COVID-19

ABSTRACT

Introduction: Commercial tobacco (CT) users employ tobacco expenditure minimizing strategies (TEMS) to manage their CT expenditures. We examined how financial challenges and hardships during the COVID-19 pandemic relate to increases in TEMS use.

Methods: Data from a nationally representative sample of 1,700 U.S. adult recent former and current CT users were collected from an online panel during January–February 2021. Participants reported if they had increased use of eight TEMS to save money on CT since the pandemic, and experienced financial challenges (e.g., losing a job) and hardships (e.g., not having enough money to pay for food). The number of financial hardships experienced was counted (range: 0–6). Weighted multivariable logistic regression models were used to examine the associations between financial challenges and hardships and increased TEMS use, adjusting for demographics.

Results: Since the COVID-19 pandemic, three TEMS showed the largest increase in use by U.S. adult current and recent former CT users: cutting back (22.4%), finding less expensive places to purchase (15.6%), and buying by bulk (15.5%). Many financial challenges and hardships were consistently associated with increased uses of TEMS. Furthermore, every additional count of financial hardships was associated with higher odds of increasing use of each TEMS (AORs ranging between 1.12 and 1.23).

Conclusions: Many CT users increased TEMS use to manage their CT expenditures when facing financial challenges and hardships during the pandemic. This could hinder CT cessation and promote relapse. Prohibiting certain TEMS (e.g., discount coupon and price promotions) may promote CT cessation among this financially vulnerable group.

1. Introduction

Commercial tobacco (CT) use accounts for more than 8 million annual deaths worldwide and costs the global economy 1.4 trillion U.S. dollars each year (World Health Organization, 2021). Given that cost is one of the most common motives for smoking cessation (Pisinger, Aadahl, Toft, & Jorgensen, 2011), CT users engage in tobacco expenditure minimizing strategies (TEMS) to manage and reduce their tobacco-related expenditures to continue CT use (Choi & Boyle, 2018). These strategies include using discount coupons and promotions, buying a cheaper brand of the same product, finding less expensive places to buy tobacco products (including a different state), using another form of tobacco, cutting back on tobacco consumption, borrowing tobacco products from friends and family, and sharing fewer products with other smokers (Betzner, Boyle, & St Claire, 2016; Choi & Boyle, 2018; Choi, Hemmikus, Forster, & St Claire, 2012). For example, following a cigarette tax increase in the state of Minnesota in 2013, more smokers used several TEMS including rolling their own cigarettes, using other tobacco products, and buying cigarettes from cheaper places, but fewer smokers used discount coupons and price promotions.

Abbreviations: TEMS, Tobacco expenditure minimizing strategies; CT, Commercial tobacco; SES, Socioeconomic status.

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https://doi.org/10.1016/j.addbeh.2022.107547
Received 8 August 2022; Received in revised form 31 October 2022; Accepted 9 November 2022
Available online 13 November 2022
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carton (Choi & Boyle, 2018). Lower socioeconomic status (SES) smokers are more likely to receive and use specific TEMS such as tobacco direct mail/email coupons (Choi, Chen, Tan, Soneji, & Moran, 2018), and use a higher number of TEMS (Choi et al., 2012).

Altogether, TEMS can hinder tobacco cessation, especially among socially disadvantaged groups including lower income and higher poverty populations. For instance, smokers who have purchased cigarettes by the carton to save money were less likely to make a quit attempt (Choi et al., 2012). Direct-to-consumer tobacco coupons have also been shown to promote progression of smoking among nonsmokers, and continuation of smoking and progression to daily smoking among adult smokers in the U.S. (Choi, Soneji, & Tan, 2018). Similar findings have also been observed in tobacco direct mail marketing and smoking behaviors of adolescents and young adults in the U.S. (Choi & Forster, 2014; Choi & Forster, 2014). Additionally, receiving tobacco direct mail/email coupons has also been associated with increased odds of smoking initiation among never smokers, becoming established smokers among experimenters, becoming daily smokers among non-daily smokers, and smoking relapse among former smokers, as well as reduced odds of smoking cessation >6 months among current smokers (Choi et al., 2018). Any use of TEMS and the number of TEMS used has shown negative associations with smoking cessation, specifically reductions in the number of days smoked in the past 30 days (Choi et al., 2012).

The use of TEMS can occur in response to factors such as taxes or increased product prices, but other factors that impact the income of tobacco users may influence the use of TEMS. The COVID-19 pandemic has imposed financial challenges and hardships on many individuals, especially lower SES individuals prior to the pandemic. As a result, CT may have become less affordable to CT users throughout the pandemic, who may have subsequently relied more on TEMS to continue their CT use. However, it is unclear if COVID-19 pandemic-related financial challenges and hardships are influencing TEMS use. While the current literature on this topic is still evolving, financial hardships since the COVID-19 pandemic have already been associated with health risk behaviors and health effects, particularly related to psychosocial and mental health (Chatterji et al., 2021; Wittteveen & Velthorst, 2020). Additionally, recent studies have found that COVID-19-related financial stressors (job loss, decreases in pay, trouble paying bills) are each significantly associated with higher odds of changes in health risk behavior including more smoking/vaping and drinking alcohol and less exercise, sleep, and healthy eating (Sampson, Ettman, & Abdalla, 2021).

To date, the impact of COVID-19 financial challenges and hardships on changes in TEMS use remain largely unknown. Understanding the relationship between pandemic-related financial hardships and TEMS use is of public health significance. Specifically, whether and how tobacco users engaged in TEMS to reduce their tobacco-related expenditures during the COVID-19 pandemic can inform policy efforts to reduce TEMS utilization in the future and promote tobacco cessation including during historic periods of financial hardships. The present study aimed to overcome these limitations by providing data on eight TEMS use, collected through a U.S. representative sample of adult current and recent former CT users, and assessing changes in TEMS use since the COVID-19 pandemic. We examined increases in TEMS use among U.S. adult current and recent former tobacco users in January–February 2021, ten months into the COVID-19 pandemic. Furthermore, we assessed if increased use of TEMS was associated with financial hardships experienced during the COVID-19 pandemic.

2. Methods

2.1. Study population

Data were from a U.S. representative sample of adult (≥21 years) current and recent former CT users (n = 1700) with oversampling of Asian and Black/African American individuals from the YouGov online panel (YouGov) in January–February 2021. The rationale for including people who were recent former CT users (i.e., stopped using CT within 12 months prior to the survey) in the study is because the study attempted to retrospectively reconstruct a cohort of current CT users prior to the timeframe the survey instrument measured (i.e., during the 12 months prior to the survey). YouGov used a sampling matching approach with weighting to achieve national representation similar to traditional random-digit dialing sampling (Rivers & Bailey, 2009). In brief, YouGov used nationally representative benchmark datasets (e.g., American Community Survey, Current Population Survey, Population Assessment on Tobacco and Health Study) to create a sample that met the inclusion criteria of this study (Jessee, Malhotra, & Sen, 2022). YouGov then found a sample of respondents from their opt-in online panel members with matching demographic characteristics with the sample from these benchmark datasets. YouGov further weighted the respondents with poststratification weights provided to ensure the survey sample was nationally representative. Eligible individuals completed an online survey after providing informed consent and were compensated according to YouGov policy (cooperation rate = 88.3% among those screened eligible). This study used deidentified data, which does not require review or approval from the Institutional Review Board per National Institutes of Health policy and 45 CFR 46.

2.2. Measures

In eight items, participants reported if they used expenditure minimizing strategies to save money on tobacco or electronic vaping products since the pandemic. These strategies included: 1) using discount coupons or promotions, 2) finding less expensive places to buy products, 3) purchasing products by bulk, 4) buying a cheaper brand of the same product, 5) using another form of tobacco, 6) using roll-your-own cigarettes, 7) cutting back on tobacco use, and 8) borrowing tobacco products from friends and family. Response options for these items included, “Yes, less than before the COVID-19 pandemic”, “Yes, same as before the COVID-19 pandemic”, “Yes, more than before the COVID-19 pandemic”, and “Did not do this”. Responses were dichotomized into “Increased use since the COVID-19 pandemic” and “No increased use since the COVID-19 pandemic” (including “Yes, same as before the COVID-19 pandemic”, “Yes, less than before the COVID-19 pandemic”, and “Did not do this”).

Participants also reported financial challenges experienced during the pandemic (e.g., losing work-related income or a job, picking up additional jobs to maintain income, depleting all or most of their savings, increasing their debt, and not having a regular place to sleep or stay). Participants reported how often they have experienced any of the following financial hardships since the COVID-19 pandemic: 1) not enough money to pay for food, 2) not enough money to pay for rent or mortgage, not 3) enough money to pay for utilities, 4) not enough money to pay for medications, 5) not enough money to pay for unexpected expenses, 6) not enough money to pay for hand sanitizer, disinfectant, and face masks. Response options for these items included, “Never”, “Rarely”, “Sometimes”, “Often”, and “Always”. Responses were dichotomized into “At least sometimes” (Sometimes,” “Often” and “Always” responses) and “Less than sometimes” (“Never” and “Rarely”). The number of these six financial hardships experienced since the COVID-19 pandemic was counted (range: 0–6).

Participants reported pre-pandemic commercial tobacco product use including, 1) cigarettes, 2) electronic vaping products (e.g., e-cigarettes, vape-pen, e-hookah, mod, JUUL, Vuse, or similar products), 3) cigars, little cigars, cigarillos, or filtered cigars (not including blunt), 4) hookah, 5) other combustible tobacco products (e.g., roll-your-own cigarettes, pipe, etc.), 6) smokeless tobacco (e.g., chewing tobacco, snus, snuff, etc.). Participants were asked if they used these products 12 months prior to completing the survey (i.e., pre-pandemic). For each tobacco product, responses included “Never”, “Used before [month] 2020, but not then”, “Some days”, and “Every day.” These responses were
dichotomized into “Currently using pre-pandemic” (responses “Every day” and “Some days”) and “Not currently using pre-pandemic” (responses “Never” and “Used before [month] 2020, but not then”).

Demographic information (age, sex, race, ethnicity, marital status, and education level) was also collected. Race/ethnicity responses were combined into the categories of “Asian”, “Black or African American”, “Hispanic or Latino”, “White” and “Other” (a category which included “American Indian or Alaska Native”, “Middle Eastern or North African”, “Pacific Islander”, and “Multiracial/multiethnic”). Marital status information was combined into categories of “Has a partner” and “No partner”. Information about the highest level of education completed was combined into categories of “High school or less” or “More than high school.”

2.3. Statistical analyses

Data were weighted to be nationally representative. Weighted distributions of demographics, pre-pandemic CT use, and increased use of each TEMS were estimated. We then estimated the prevalence of increased use of each TEMS by demographics and pre-pandemic CT use and used multiple imputation to handle missing data. Weighted multivariable logistic regression models were used to examine the associations of demographics and pre-pandemic CT use with increased use in each TEMS. Models were fit for each of the 25 multiply imputed data sets. Additionally, we estimated prevalence of increased use of each TEMS by financial challenges and hardships and used multiple imputation. Weighted multivariable logistic regression models were also used to examine the associations between financial challenges and hardship experiences and increased use of the eight TEMS, adjusting for demographics and using multiple imputation. Adjustments for multiple comparisons were also made (p-values < 0.05, 0.01, 0.001). Multiple imputation was performed using fully conditional specification methods implemented in SAS® software version 9.4 (SAS Institute: Cary, NC). Variables with missing data included variables pertaining to TEMS use, financial challenges and hardships, and tobacco use behaviors. About 24 % of cases had missing data on TEMS use, while between 0 and 0.2 % of cases had missing data on tobacco use behaviors and/or financial challenges or hardships. All available data included in the analysis were used to impute the missing data, generating 25 imputed datasets. Prevalence and model parameter estimates were calculated for each of the 25 multiply imputed data sets using the SAS SURVEYFREQ and LOGISTIC procedures incorporating weights, and parameter estimates were summarized using multiple imputation methods implemented in the SAS MIANALYZE procedure. Sensitivity analyses included conducting the analyses based on available data only and employing the full information maximum likelihood (FIML) algorithm to handle missing data (Enders, 2001). Overall, the findings reported were consistent across all three analytic approaches, signaling the robustness of the findings.

3. Results

Table 1 presents the weighted demographics, pre-pandemic CT use behaviors, and financial hardships among U.S. recent former and current commercial tobacco users, 2021.

| Variable | Unweighted N | Weighted % |
|----------|--------------|------------|
| Sex      |              |            |
| Male     | 966          | 59.14      |
| Female   | 734          | 40.86      |
| Age: mean (SE) | 42.70 (0.57) |          |
| Race/ethnicity |   |        |
| Asian    | 258          | 4.51       |
| Black/African American | 310 | 13.59 |
| Latino/Hispanic  | 271   | 13.12     |
| White    | 794          | 46.43      |
| Other    | 67           | 2.35       |
| Marital status |   |        |
| Has a partner | 912 | 53.57 |
| No partner | 788 | 46.43 |
| Highest level of education |   |        |
| <High school | 569 | 77.77 |
| >High school | 1131 | 22.23 |
| Pre-pandemic tobacco product use |   |        |
| Cigarettes | 1130 | 67.35 |
| Electronic vaping products | 624 | 30.29 |
| Cigars | 461 | 20.92 |
| Hookah or other combustible tobacco products | 436 | 20.17 |
| Smokeless tobacco | 283 | 14.38 |
| Financial challenges and hardships |   |        |
| Current employment status |   |        |
| Working full time now | 627 | 32.32 |
| Working part time now | 212 | 13.04 |
| Unemployed, looking for jobs | 220 | 13.41 |
| Other, not in labor force | 641 | 30.33 |
| Lost any work-related income due to COVID-19 |   |        |
| Yes | 625 | 36.23 |
| No | 1074 | 63.70 |
| Missing | 1 | 0.07 |
| Lost your job due to COVID-19 |   |        |
| Yes, lost job | 291 | 17.14 |
| No, but work fewer hours | 340 | 17.94 |
| Works the same hours as before | 528 | 30.61 |
| Did not work before the COVID-19 pandemic | 541 | 34.30 |
| Picked up additional jobs due to COVID-19 to maintain income |   |        |
| Yes | 322 | 17.82 |
| No | 1378 | 82.18 |
| Used up all or most of savings due to COVID-19 |   |        |
| Yes | 585 | 35.69 |
| No | 763 | 41.07 |
| Did not have savings | 351 | 22.33 |
| Missing | 1 | 0.01 |
| Gone into debt or debt increased due to COVID-19 |   |        |
| Yes | 611 | 35.85 |
| No | 1088 | 64.11 |
| Missing | 1 | 0.04 |
| Since the COVID-19 pandemic, experienced not enough money to: |   |        |
| Pay for food | 601 | 35.24 |
| Pay for rent or mortgage | 601 | 34.48 |
| Pay for utilities | 652 | 36.24 |
| Pay for medications | 566 | 32.42 |
| Pay for unexpected expenses | 824 | 48.37 |
| Pay for hand sanitizer, disinfectant, and face masks | 585 | 34.07 |

Composite hardship score: mean (SE) = 2.21 (0.08)

Table 1

Since the COVID-19 pandemic, experienced not enough money to:

Did not have a regular place to sleep/stay since COVID-19

| Variable       | Unweighted N | Weighted % |
|----------------|--------------|------------|
| Did not have a regular place to sleep/stay since COVID-19 |   |        |
| Yes | 316 | 16.58 |
| No | 1383 | 83.38 |
| Missing | 1 | 0.04 |

maintain income; 35.7 % reported using up all or most of their savings due to the pandemic; and 35.9 % reported going into debt or increasing debt due to the pandemic. Additionally, 16.6 % reported not having a regular place to stay or sleep since the COVID-19 pandemic. Since the COVID-19 pandemic, 35.2 % reported experiencing not having enough money to pay for food, 34.5 % for rent or mortgage, 36.2 % for utilities,
32.4 % for medications, 48.4 % for unexpected expenses, and 34.1 % for hand sanitizer, disinfectant, and face masks. The mean composite hardship score was 2.2 (standard error = 0.08).

Regarding TEMS, many U.S. adult current and recent former CT users reported increases in engaging with the following strategies: 22.4 % in cutting back on tobacco use; 15.6 % in finding less expensive places to buy products; 15.5 % in purchasing products by bulk; 13.6 % in buying a cheaper brand of the same product; 12.0 % in CT coupon and promotion use to save money during the pandemic; 9.0 % in borrowing tobacco products from friends and family; 8.9 % in using another form of tobacco; and 8.7 % in using roll-your-own cigarettes. Table 2 presents the weighted prevalence estimates of increased use of each TEMS by demographics and pre-pandemic CT use. Supplemental Table 1 also presents the prevalence of TEMS use during the COVID-19 pandemic. In multivariable logistic regression analyses, demographics and pre-pandemic CT use did not show consistent patterns in their associations with increased use of TEMS (Table 3).

Weighted prevalence estimates of increased use of each TEMS by financial challenges and hardships are presented in Table 4. Table 5 contains the results of the multivariable logistic regression models examining the associations between financial challenge and hardship experiences and increased TEMS. While employment status showed no associations with increased TEMS use, losing any job due to the pandemic were associated with increased coupon and promotion use and finding less expensive places to purchase CT, with losing a job due to the pandemic also associated with increased purchasing by bulk and borrowing tobacco products from friends and family (p < 0.05). Picking up additional jobs to maintain income was associated with finding less expensive places to buy tobacco products (p < 0.05). Using up all or most of savings due to COVID-19 pandemic was associated with coupon/promotion use, finding less expensive places to buy tobacco products, purchasing products by bulk, buying a cheaper brand, cutting back on tobacco use, and borrowing products from friends and family (p < 0.05). Increased debt due to the pandemic was associated with increased coupon/promotion use, finding less expensive places to buy tobacco products, purchasing products by bulk, using another form of tobacco, and cutting back on tobacco (p < 0.05). Additionally, not having a regular place to sleep or stay since the COVID-19 pandemic was associated with increased use of multiple TEMS (p < 0.05). The composite score of financial hardships was associated with increased use of all eight TEMS (p < 0.05).

### 4. Discussion

We conducted the first U.S. national study examining increased use in TEMS among adult current and recent former CT users almost a year into the COVID-19 pandemic. We observed substantial increases in self-reported TEMS use, with increased use in individual strategies varying between an estimated 8–22 %. Cutting back on tobacco use was the strategy that increased the most since the COVID-19 pandemic to save tobacco-related expenditures. By contrast, borrowing tobacco products from friends and family increased the least since the COVID-19 pandemic. Overall, more CT users have relied on TEMS during the pandemic, which could have sustained CT use behaviors and hindered cessation. Previous studies have shown that smokers engage in TEMS to save money on cigarettes and other tobacco products and continue smoking, which is in turn associated with lower likelihood of cessation (Choi & Boyle, 2018). Not only can increases in TEMS potentially further exacerbate tobacco use related deaths and health disparities (U.S. National Cancer Institute, 2017), but they can potentially lead to other health risks including increased risk of developing severe symptoms of COVID-19 if infected (U.S. Centers for Disease Control and Prevention) given the relationship between smoking, lung damage, and susceptibility to respiratory infections and other health complications. While our study did not find consistent associations between demographic variables and increased odds of all TEMS use, several findings on the determinants of TEMS use presented in this study are noteworthy. Consistent with previous research, we found that younger adult smokers are more likely than older smokers to use some TEMS (Choi et al., 2012; White, White, Freeman, Gilpin, & Pierce, 2006), e.g., using another form

### Table 2

**Prevalence of increased use of tobacco expenditure minimizing strategies by demographics and pre-pandemic commercial tobacco use.**

| Characteristics                        | Increased use of:                                                                 |
|----------------------------------------|----------------------------------------------------------------------------------|
|                                        | Coupon or promotion use (%) | Found less expensive places to buy tobacco/electronic vaping products (%) | Purchased by bulk (%) | Bought a cheaper brand of the same product (%) | Used another form of tobacco (%) | Used roll-your-own cigarettes (%) | Cut back on tobacco use (%) | Borrowed tobacco products from friends and family (%) |
| **Sex**                                |                                |                                                                         |
| Male                                   | 10.0                           | 15.1                                                                    | 16.2                   | 12.8                                       | 9.0                                | 7.4                                | 19.8                                | 8.8                                      |
| Female                                 | 15.0                           | 16.3                                                                    | 14.4                   | 14.7                                       | 8.6                                | 10.7                              | 26.0                                | 9.1                                      |
| **Race/Ethnicity**                     |                                |                                                                         |
| Asian                                  | 15.8                           | 19.1                                                                    | 17.0                   | 16.3                                       | 10.0                               | 8.9                                | 22.2                                | 6.5                                      |
| Black/African American                 | 18.3                           | 17.5                                                                    | 20.4                   | 21.8                                       | 12.1                               | 16.9                              | 26.9                                | 11.4                                     |
| Latino/Hispanic                        | 10.2                           | 16.7                                                                    | 17.2                   | 15.6                                       | 14.7                               | 12.0                              | 28.8                                | 12.6                                     |
| White                                  | 10.7                           | 15.0                                                                    | 13.5                   | 11.5                                       | 6.8                                | 6.4                                | 20.4                                | 7.9                                      |
| Other                                  | 18.4                           | 7.6                                                                    | 28.7                   | 8.8                                        | 12.9                               | 8.7                                | 16.1                                | 8.7                                      |
| **Marital Status**                     |                                |                                                                         |
| Has a Partner                          | 11.1                           | 14.8                                                                    | 12.5                   | 10.0                                       | 6.7                                | 6.4                                | 20.3                                | 8.7                                      |
| No Partner                             | 13.1                           | 16.5                                                                    | 18.9                   | 17.7                                       | 11.4                               | 11.4                              | 24.8                                | 9.2                                      |
| ≤ High school                          | 13.5                           | 14.8                                                                    | 13.6                   | 15.0                                       | 10.5                               | 9.7                                | 22.4                                | 9.8                                      |
| > High School                          | 10.7                           | 16.3                                                                    | 17.2                   | 12.3                                       | 7.4                                | 7.9                                | 22.3                                | 8.2                                      |
| **Pre-pandemic current commercial tobacco use** |                        |                                                                         |
| Cigarettes                             | 14.3                           | 15.3                                                                    | 14.8                   | 14.5                                       | 6.9                                | 9.3                                | 22.3                                | 9.8                                      |
| Electronic                             | 16.3                           | 22.6                                                                    | 22.6                   | 21.3                                       | 12.8                               | 11.2                              | 29.4                                | 13.5                                     |
| Vaping Products                        |                                |                                                                         |
| Cigars                                 | 16.6                           | 23.0                                                                    | 23.9                   | 23.7                                       | 16.6                               | 19.1                              | 27.2                                | 16.9                                     |
| Hookah/Other Combustibles              | 20.6                           | 22.5                                                                    | 22.7                   | 22.4                                       | 24.2                               | 25.4                              | 29.7                                | 19.1                                     |
| Smokeless Tobacco                      | 14.9                           | 19.9                                                                    | 23.3                   | 21.8                                       | 21.9                               | 17.8                              | 32.1                                | 14.1                                     |
Table 3: Associations between demographics, pre-pandemic commercial tobacco use, and increased use of tobacco expenditure minimizing strategies.

| Independent variable | Coupon or promotion use – AOR (95% CI) | Found less expensive places to buy tobacco/electronic vaping products – AOR (95% CI) | Purchased bulk of the same tobacco product – AOR (95% CI) | Bought a cheaper brand of the same product – AOR (95% CI) | Used another form of tobacco – AOR (95% CI) | Used roll-your-own cigarettes – AOR (95% CI) | Cut back on tobacco use – AOR (95% CI) | Borrowed tobacco products from friends and family – AOR (95% CI) |
|----------------------|----------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------|---------------------------------------------|
| Sex (Reference: Male) |                                        |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Female               | 1.63                                   | 1.21(0.86-1.69)                                                                           | 0.97(0.69-1.37)                                        | 1.40(0.95-2.06)                                        | 1.21(0.79-1.86)                         | 1.21(0.79-1.86)                         | 1.59(1.19-2.12)                                             | 1.09(0.69-1.74)                   |
| (1.09-2.44)*        |                                        |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Age                  | 1.00(0.98-1.01)                         | 1.00(0.99-1.01)                                                                           | 1.01(0.99-1.02)                                        | 0.99(0.98-1.01)                                        | 0.98(0.96-0.99)**                       | 0.97(0.95-0.99)**                       | 0.99(0.98-1.00)                                            | 0.97(0.96-0.99)**               |
| Race (Reference: White) |                                      |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Asian                | 1.37(0.58-3.21)                         | 1.07(0.51-2.24)                                                                           | 1.02(0.51-2.07)                                        | 1.18(0.53-2.66)                                        | 0.97(0.38-2.52)                         | 0.93(0.32-2.67)                         | 0.92(0.48-1.76)                                            | 0.56(0.19-1.71)                   |
| Black/African American | 1.58(0.96-2.59)                        | 1.04(0.61-1.79)                                                                           | 1.45(0.89-2.36)                                        | 1.67(0.99-2.80)                                        | 1.18(0.62-2.26)                         | 1.83(0.87-2.07)                         | 1.15(0.60-2.23)                                            |                                |
| Latino/Hispanic      | 0.77(0.42-1.41)                         | 0.94(0.59-1.52)                                                                           | 1.13(0.70-1.83)                                        | 1.03(0.61-1.74)                                        | 1.19(0.67-2.11)                         | 1.01(0.55-1.85)                         | 1.35(0.93-1.96)                                            | 1.12(0.62-2.03)                   |
| Other                | 1.67(0.65-4.29)                         | 0.40(0.11-1.50)                                                                           | 2.65(1.16-6.09)**                                      | 0.57(0.17-1.89)                                        | 1.32(0.44-3.90)                         | 0.75(0.19-2.97)                         | 0.64(0.24-1.69)                                            | 0.79(0.20-3.12)                   |
| Highest Level of Education (Reference: >High School) |                                      |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| <High School         | 1.25(0.82-1.89)                         | 0.91(0.66-1.24)                                                                           | 0.69(0.50-0.95)**                                      | 1.22(0.86-1.72)                                        | 1.25(0.80-1.93)                         | 0.99(0.61-1.60)                         | 1.00(0.75-1.34)                                            | 1.09(0.72-1.65)                   |
| Pre-pandemic commercial tobacco use (Reference: Not currently using pre-pandemic) |                                  |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Cigarettes           | 2.15                                   | 0.98(0.71-1.34)                                                                           | 0.94(0.68-1.29)                                        | 1.44(1.00-2.06)*                                       | 0.52(0.33-0.81)**                       | 0.61(0.38-0.95)**                       | 1.45(1.08-2.54)                                            | 1.65(1.08-2.54)                   |
| (1.42-3.26)**        |                                        |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Electronic           | 1.58                                   | 1.69(1.42-2.03)                                                                           | 1.76(1.27-2.45)**                                      | 1.80(1.26-2.59)**                                      | 0.82(0.51-1.33)                         | 0.61(0.38-0.95)**                       | 1.45(1.08-1.96)                                            |                                |
| Vaping Products      |                                        |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Cigars               | 1.09(0.72-1.66)                         | 1.53(1.06-2.20)*                                                                          | 1.49(1.03-2.15)*                                      | 1.70(1.16-2.51)**                                      | 1.19(0.74-1.93)                         | 1.96(1.22-3.15)**                                      | 0.99(0.71-1.38)                                            | 1.64(1.03-2.62)                   |
| Hookah/Other         | 1.94                                   | 1.35(0.93-1.96)                                                                           | 1.26(0.86-1.85)                                        | 1.16(0.78-1.74)                                        | 3.87(2.44-6.15)**                       | 4.72(2.94-7.58)**                       | 1.06(0.76-1.48)                                            | 2.20(1.40-3.45)**               |
| (1.28-2.94)**        |                                        |                                                                                            |                                                       |                                                       |                                          |                                          |                                |                                                            |
| Smokeless            | 0.96(0.54-1.73)                         | 0.99(0.65-1.52)                                                                           | 1.28(0.81-2.03)                                        | 1.38(0.86-2.22)                                        | 1.91(1.20-3.06)**                       | 1.32(0.77-2.19)                         | 1.65(1.14-2.40)**                                           | 0.90(0.52-1.56)                   |

All independent variables in the table were including in each model. Bolded estimates are statistically significant (p < 0.05).

* p < 0.05.

** p < 0.01.

*** p < 0.001.
of CT, roll-your-own cigarettes, and borrowing from friends and family. This demographic has traditionally been price sensitive and potentially more likely to find opportunities to save money on cigarettes and other tobacco products (Levy, Chaloupka, & Gitchell, 2004). Furthermore, young adults are a key target market for tobacco companies (Ling & Glantz, 2002).

We observed that financial challenges and hardships were associated with increased use of TEMS. The role of the tobacco industry may partially explain this relationship. In its annual cigarette and smokeless tobacco report, the Federal Trade Commission (FTC) recently announced that annual cigarette and smokeless tobacco sales increased from 2019 to 2020 (Federal Trade Commission, 2021; Federal Trade Commission, 2021). FTC also reported that amounts spent on cigarette advertising and promotion increased from 2019 to 2020, and price discounts to retailers and wholesalers – a strategy that is associated with increased cigarette purchasing behaviors (Choi, Kreuger, McNeel, & Osgood, 2021) and disproportionately affects lower SES individuals – represented the largest expenditure categories in 2020. Altogether, these industry expenditures may potentially exacerbate SES-related CT use disparities during and beyond the COVID-19 pandemic.

There are several policy options to reduce TEMS use. Increasing taxes on CT can potentially help counteract increases in some types of TEMS use, particularly using discount coupons and promotions or purchasing cartons instead of packs, while encouraging behavioral steps toward quitting or achieving sustained tobacco cessation in response to taxes (Choi & Boyle, 2018; Parks, Kingsbury, Boyle, & Choi, 2017). However, tax increases can still lead to increases in certain types of TEMS such as buying a cheaper brand of tobacco products, using roll-your-own cigarettes, finding less expensive places to buy tobacco products, and using

| Variable                      | Coupon or promotion use (%) | Found less expensive places (%) | Purchased by bulk (%) | Bought a cheaper brand of the same product (%) | Used another form of tobacco (%) | Used roll-your-own cigarettes (%) | Cut back on tobacco use (%) | Borrowed tobacco products from friends and family (%) |
|-------------------------------|-----------------------------|--------------------------------|-----------------------|----------------------------------------------|---------------------------------|---------------------------------|--------------------------|---------------------------------|
| Employment Status             |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Working full-time             | 10.7                        | 14.6                           | 15.1                  | 12.4                                         | 8.8                             | 9.6                             | 23.9                     | 11.0                             |
| Working part-time             | 13.3                        | 18.5                           | 15.4                  | 15.6                                         | 9.3                             | 6.4                             | 17.1                     | 7.8                              |
| Unemployed, looking for jobs  | 16.5                        | 20.8                           | 11.3                  | 18.5                                         | 12.5                           | 11.3                            | 28.0                     | 11.1                             |
| Other, not in labor force     | 11.2                        | 13.6                           | 17.2                  | 12.2                                         | 7.5                             | 7.9                             | 20.8                     | 7.0                              |
| Lost any work-related income due to the pandemic | 16.6 | 19.7 | 16.4 | 15.0 | 11.0 | 10.2 | 24.4 | 11.2 |
| No                            | 9.4                         | 13.3                           | 14.9                  | 12.8                                         | 7.6                             | 7.9                             | 21.2                     | 7.7                              |
| Lost job due to the pandemic  |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| No, work the same hours as before | 7.6 | 11.7 | 13.7 | 12.4 | 7.3 | 7.8 | 19.4 | 4.8 |
| Yes                           | 20.9                        | 19.3                           | 20.3                  | 18.7                                         | 11.7                           | 12.7                            | 25.4                     | 12.1                             |
| No, but hours were reduced    | 14.2                        | 18.9                           | 15.6                  | 12.7                                         | 11.3                           | 10.4                            | 24.8                     | 10.9                             |
| Did not work before the pandemic | 10.5 | 15.5 | 14.5 | 12.6 | 7.6 | 6.7 | 22.3 | 10.2 |
| Picked up additional jobs to maintain income | 13.9 | 23.8 | 21.1 | 19.9 | 14.0 | 9.0 | 25.5 | 11.3 |
| No                            | 11.6                        | 13.8                           | 14.2                  | 12.2                                         | 7.8                             | 8.7                             | 21.7                     | 8.5                              |
| Used up all or most of savings due to the pandemic | 16.8 | 20.9 | 19.5 | 17.0 | 10.2 | 11.0 | 25.5 | 10.7 |
| No                            | 8.2                         | 10.8                           | 12.1                  | 9.2                                          | 6.9                             | 7.6                             | 17.4                     | 5.4                              |
| Did not have savings before the pandemic | 11.6 | 15.9 | 15.1 | 16.2 | 10.4 | 7.2 | 26.4 | 12.5 |
| Gone into debt or debt increased during the pandemic | 18.3 | 21.0 | 18.6 | 16.6 | 12.7 | 11.7 | 28.3 | 11.5 |
| No                            | 8.5                         | 12.6                           | 13.7                  | 12.0                                         | 6.7                             | 7.1                             | 19.0                     | 7.6                              |
| Since the COVID-19 pandemic, did not have a regular place to sleep or stay | 19.0 | 22.5 | 20.2 | 28.1 | 19.9 | 23.2 | 27.2 | 17.9 |
| No                            | 10.7                        | 14.2                           | 14.5                  | 10.7                                         | 6.7                             | 5.9                             | 21.4                     | 7.2                              |
| Food                          |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Yes                           | 19.7                        | 21.9                           | 17.9                  | 18.9                                         | 13.0                           | 12.8                            | 31.1                     | 14.2                             |
| No                            | 7.9                         | 12.1                           | 14.1                  | 10.7                                         | 6.6                             | 6.5                             | 17.6                     | 6.1                              |
| Rent or mortgage              |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Yes                           | 18.7                        | 21.8                           | 18.0                  | 19.1                                         | 13.7                           | 13.5                            | 31.7                     | 15.1                             |
| No                            | 8.5                         | 12.3                           | 14.1                  | 10.7                                         | 6.3                             | 6.2                             | 17.4                     | 5.7                              |
| Utilities                     |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Yes                           | 17.6                        | 21.1                           | 18.4                  | 19.7                                         | 14.0                           | 14.5                            | 32.0                     | 14.0                             |
| No                            | 8.9                         | 12.4                           | 13.8                  | 10.1                                         | 5.9                             | 5.5                             | 16.9                     | 6.1                              |
| Medications                   |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Yes                           | 20.0                        | 21.8                           | 24.0                  | 21.6                                         | 16.0                           | 14.3                            | 31.7                     | 14.5                             |
| No                            | 8.2                         | 12.6                           | 11.4                  | 9.8                                          | 5.5                             | 6.1                             | 17.9                     | 6.3                              |
| Unexpected expenses           |                             |                                |                       |                                              |                                 |                                 |                          |                                  |
| Yes                           | 16.8                        | 21.1                           | 18.6                  | 16.4                                         | 11.2                           | 11.5                            | 30.5                     | 12.9                             |
| No                            | 7.6                         | 10.4                           | 12.5                  | 11.0                                         | 6.7                             | 6.2                             | 14.7                     | 5.2                              |
| Hand sanitizer, disinfectant, and face masks | 16.4 | 21.0 | 22.1 | 21.1 | 16.3 | 16.8 | 32.6 | 17.0 |
| No                            | 9.8                         | 12.8                           | 12.0                  | 9.7                                          | 5.0                             | 4.5                             | 17.1                     | 4.8                              |
Table 5
Associations of financial challenges and hardships with increased use of tobacco expenditure minimizing strategies.

| Variable                                              | Coupon or promotion use – AOR (95 % CI) | Found less expensive places to buy – AOR (95 % CI) | Purchased by bulk – AOR (95 % CI) | Bought a cheaper brand of the same product – AOR (95 % CI) | Used another form of tobacco – AOR (95 % CI) | Used roll-your-own cigarettes – AOR (95 % CI) | Cut back on tobacco use – AOR (95 % CI) | Borrowed tobacco products from friends and family – AOR (95 % CI) |
|-------------------------------------------------------|----------------------------------------|----------------------------------------------------|---------------------------------|-------------------------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------|
| Employment Status (Reference: Working Full-Time)      |                                         |                                                    |                                 |                                                             |                                             |                                             |                                             |                                                                                  |
| Working part-time                                      | 1.16 (0.62–2.15)                       | 1.30 (0.87–2.20)                                   | 1.08 (0.64–1.82)                | 1.25 (0.71–2.22)                                            | 0.94 (0.48–1.82)                            | 0.50 (0.22–1.14)                            | 0.62 (0.38–1.14)                            | 0.63 (0.30–1.31)                                                                            |
| Unemployed, looking for jobs                           | 1.50 (0.86–2.61)                       | 1.62 (0.99–2.66)                                   | 0.75 (0.42–1.32)                | 1.43 (0.88–2.31)                                            | 1.13 (0.60–2.14)                            | 0.87 (0.44–1.72)                            | 1.13 (0.73–1.74)                            | 0.84 (0.45–1.57)                                                                            |
| Other, not in labor force                              | 1.06 (0.66–1.70)                       | 1.03 (0.69–1.53)                                   | 1.38 (0.94–2.03)                | 1.05 (0.69–1.61)                                            | 1.00 (0.59–1.72)                            | 0.80 (0.45–1.41)                            | 0.89 (0.69–1.41)                            | 0.69 (0.41–1.16)                                                                            |
| Lost any work-related income due to the pandemic (Reference: No) | 1.94 (1.30–2.91)**                     | 1.51 (1.07–2.14)**                                 | 1.11 (0.78–1.57)                | 1.06 (0.74–1.51)                                            | 1.09 (0.69–1.72)                            | 0.90 (0.58–1.39)                            | 1.03 (0.78–1.37)                            | 1.17 (0.77–1.80)                                                                            |
| Lost job due to the pandemic (Reference: No, work the Same Hours) | 3.00 (1.74–5.18)**                      | 1.70 (1.05–2.75)**                                 | 1.72 (1.08–2.73)**              | 1.40 (0.89–2.21)                                            | 1.42 (0.76–2.67)                            | 1.17 (0.66–2.09)                            | 1.18 (0.80–1.73)                            | 2.17 (1.12–4.18)**                                                                            |
| No, but hours were reduced before the pandemic         | 1.97 (1.09–3.58)**                      | 1.62 (0.99–2.66)**                                 | 1.11 (0.68–1.81)                | 0.87 (0.50–1.51)                                            | 1.14 (0.61–2.12)                            | 0.96 (0.50–1.86)                            | 1.19 (0.80–1.78)                            | 2.21 (1.14–4.27)**                                                                            |
| Did not work                                          | 1.47 (0.83–2.61)                       | 1.64 (1.03–2.61)**                                 | 1.25 (0.80–1.96)                | 1.16 (0.72–1.87)                                            | 1.75 (0.93–2.39)                            | 1.07 (0.58–1.97)                            | 1.36 (0.94–1.96)                            | 3.80 (2.05–7.04)**                                                                           |
| Picked up additional jobs to maintain income           | 1.13 (0.68–1.87)                       | 1.79 (1.20–2.67)**                                 | 1.43 (0.94-2.17)                | 1.51 (0.99–2.31)                                            | 1.02 (0.61–1.71)                            | 0.55 (0.32–0.95)                            | 1.02 (0.70–1.47)                            | 0.93 (0.56–1.53)**                                                                           |
| Used up all or most of savings due to pandemic (Reference: No) | 2.12 (1.38–3.25)**                      | 2.22 (1.48–3.32)**                                 | 1.93 (1.29–2.90)**              | 1.75 (1.14–2.70)**                                          | 1.39 (0.85–2.26)                            | 1.18 (0.74–1.88)                            | 1.42 (1.02–1.98)**                           | 1.71 (1.00–2.93)**                                                                           |
| Did not have savings before the pandemic               | 1.42 (0.82–2.46)                       | 1.71 (1.09–2.70)**                                 | 1.50 (0.97–2.33)                | 1.91 (1.21–3.01)**                                          | 1.90 (1.01–3.57)**                          | 0.90 (0.48–1.57)                            | 1.67 (1.16–2.42)**                           | 2.66 (1.48–4.78)**                                                                           |
| Gone into debt or debt increased due to the pandemic (Reference: No) | 2.43 (1.65–3.59)**                      | 1.85 (1.35–2.52)**                                 | 1.47 (1.03–2.08)**              | 1.40 (0.98–2.02)                                            | 1.62 (1.06–2.48)**                          | 1.36 (0.90–2.07)                            | 1.56 (1.18–2.07)**                           | 1.36 (0.89-2.06)**                                                                          |
| Since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.61 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.56 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.30 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 2.80 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.54 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 2.39 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.06 since the pandemic, did not have a regular place to sleep or stay (Reference: No) | 1.76 since the pandemic, did not have a regular place to sleep or stay (Reference: No) |

Since the pandemic, experienced not enough money to pay for:

- **Food**
  - (Reference: No) 2.58 (1.71–3.90)**
- **Rent**
  - (Reference: No) 2.20 (1.45–3.33)**
- **Utilities**
  - (Reference: No) 1.91 (1.30–2.81)**
- **Medications**
  - (Reference: No) 2.77 (1.85–4.13)**
- **Unexpected expenses**
  - (Reference: No) 2.19 (1.47–3.27)**
- **Hand sanitizer, disinfectant, and face masks**
  - (Reference: No) 1.40 (0.94–2.07)**
- **Number of hardships (0–6)**
  - (Reference: No) 1.22 (1.12–1.33)**

Bolded estimates are statistically significant (p < 0.05).

*, p < 0.05.

**, p < 0.01.

***, p < 0.001.
another form of tobacco (Choi & Boyle, 2018). Minimum cigarette price laws are another potential policy to reduce cigarette consumption. However, minimum price law policies typically have had limited impact on the retail price of cigarettes, particularly if they still allow the use of promotional programs and incentives (Feighery, Ribisl, Schleicher, Zellers, & Wellington, 2005). Additional policies that prohibit “buy down” promotional programs (e.g., time-limited discount or sales, coupons) or ban selling cigarettes by the carton may be effective in reducing TEMS use. A combination of tax and non-tax policies as well as population-based public health programs that especially assist lower income individuals have potential to promote tobacco cessation, even during periods of prolonged financial hardships such as a pandemic or recession.

One limitation of our study is that it is not a true prospective study, and a longitudinal study with sufficient statistical power and minimal recall bias is needed to understand the downstream effects of increased TEMS use during the COVID-19 pandemic, e.g., changes in CT use behaviors. Still, previous studies have shown that TEMS promote initiation (Choi et al., 2018), progression, and continuation of smoking (Choi & Forster, 2014; Choi & Forster, 2018) and relapses (Choi et al., 2018), and also reduce smoking cessation (Choi et al., 2012, 2018). Additionally, we did not account for geographical variations in closure of non-essential businesses during the pandemic. Since many tobacco retailers were classified as essential businesses (e.g., gas stations, convenience stores, grocery stores), it is unlikely that inclusion of this covariate would significantly attenuate our findings. Our study findings may have limited generalizability due to the limited period of the ongoing COVID-19 pandemic studied. Both the prevalence and magnitude of financial hardships, as well as the prevalence of increased TEMS use may have increased since the first year of the COVID-19 pandemic. Survey respondents may not be able to accurately recall their use of TEMS in the past 12 months. However, the robustness of the associations between the financial hardship experiences reported and the increases in TEMS use supports the survey design and constructs used in our study. Given our survey design, we are also unable to assess product-specific patterns among participants who switched to using another form of tobacco as a TEMS. Another limitation is the lack of information about use of the product that participants switched to during the pandemic (e.g., from e-cigarettes to combustible cigarettes). Nonetheless, the use of TEMS, including direct mail coupons, and their effects on population health is of significant concern for tobacco cessation and control efforts, especially during periods of financial hardships.

In conclusion, the use of TEMS increased among tobacco users during the COVID-19 pandemic and showed significant associations with financial challenges and hardships experienced during the pandemic. A combination of tobacco control strategies — including tobacco marketing prohibition, tax increases on CT, increasing floor prices of CT — could reduce TEMS use and improve tobacco cessation during prolonged periods of financial hardships.

CRediT authorship contribution statement

Kasra Zarei: Conceptualization, Formal analysis, Investigation, Methodology, Software, Writing – original draft, Writing – review & editing. Kristen Hamilton-Moseley: Conceptualization, Writing – original draft, Writing – review & editing. Julia Chen-Sankey: Conceptualization, Data curation, Writing – review & editing. Lilianna Phan: Conceptualization, Data curation, Writing – review & editing. Ariruddh Ajith: Conceptualization, Writing – review & editing. Kiana Hacker: Conceptualization, Writing – review & editing. Bambi Jettew: Conceptualization, Writing – review & editing. Kelvin Choi: Conceptualization, Supervision, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This work is supported by the U.S. National Institute on Minority Health and Health Disparities, Division of Intramural Research. Dr. Chen-Sankey was also supported by the U.S. National Cancer Institute and Food and Drug Administration (NCI/FDA) funding (K99CA242589). Dr. Phan was also supported by the National Institutes of Health and Food and Drug Administration funding (K99CA272919). Opinions and comments expressed in a rural agrarian community in India and are not necessarily reflect those of the U.S. Government, Department of Health and Human Services, National Institutes of Health, and National Institute on Minority Health and Health Disparities.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jaddbeh.2022.107547.

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