OBSERVATIONS: BRIEF RESEARCH REPORTS

Changes in Cigarette Sales in the United States During the COVID-19 Pandemic

Background: The COVID-19 pandemic may have been associated with changes in smoking behaviors.

Objective: To estimate changes in cigarette sales in the United States during the COVID-19 pandemic after accounting for the long-term declining trend in sales.

Methods: Data on cigarettes released for consumption based on monthly filings by the tobacco companies from January 2007 to June 2021 were obtained from the Alcohol and Tobacco Tax and Trade Bureau of the U.S. Department of the Treasury (1). To calculate the aggregate volume of cigarettes released for consumption (henceforth cigarette sales), we combined taxable cigarettes, cigarettes removed for personal consumption by industry employees, and imported cigarettes released for consumption. Domestically manufactured cigarettes exported or stored were omitted because they were not released for consumption. The aggregate volumes of cigarettes were converted into packs (20 sticks) of cigarette sales per capita using the U.S. Census Bureau population estimates. Monthly population estimates not available in 2021 were extrapolated with 2020 population growth rates.
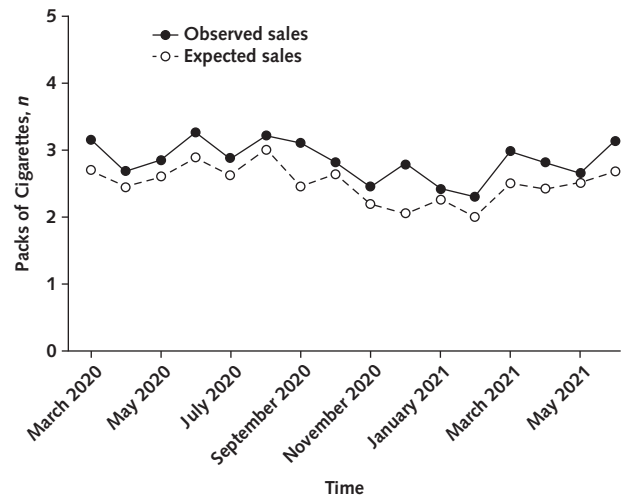
Observed cigarette sales during the COVID-19 pandemic (March 2020 to June 2021) were compared with expected sales for the same period in the absence of the pandemic using an interrupted time series model (**Figure 1** caption). The model predicted the expected sales of cigarettes during the COVID-19 pandemic on the basis of the long-term declining trend from before the pandemic (January 2007 to February 2020) after adjustment for seasonality (peaking in summer and plunging in winter) (2); composition of age, sex, and race; real per capita personal disposable income; unemployment rate; and Consumer Price Index for alcohol and tobacco products.

Analyses were done using the itsa command in Stata, version 15.1 (StataCorp) (3). All results are reported as point estimates with 95% CIs.

Findings: Observed cigarette sales exceeded expected sales for all months after the onset of the COVID-19 pandemic (**Figure 1**). The estimated average difference between observed and expected cigarette sales after adjustment for all covariates indicates a monthly excess sale of 0.34 pack (95% CI, 0.25 to 0.44 pack) per capita (**Figure 2**, *top*, model specification A). It represents 14.1% (CI, 9.7% to 18.5%) higher cigarette sales compared with what was expected to be sold had the pre–COVID-19 pandemic trend persisted (**Figure 2**, *bottom*, model specification A). The finding of excess sales was robust to model specifications that adjusted for various combinations of the covariates (**Figure 2**, model specifications B, C, and D). The evidence of excess sales was valid even after we analyzed cigarette sales with a 1-month lag from the month when cigarette supply was released from manufacturers to allow for the transit of cigarettes from the factory gate to the point of retail sales (excess sales of 0.17 pack [CI, 0.06 to 0.28 pack] and an increase of 9.0% [CI, 1.3% to 16.8%]) (**Figure 2**, model specification E).

Discussion: The finding shows a surge in cigarette sales during the COVID-19 pandemic. We estimated an increase of about 0.34 pack per month per capita, corresponding to about

Figure 1. Observed and expected monthly cigarette sales per capita (packs) from March 2020 to June 2021.

The expected sales were based on the interrupted time series equation: $Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t \times T_t + \varphi Z_t + \gamma_m + \xi_t$, where Y_t = per capita monthly cigarette sales in packs; X_t = an indicator variable taking the value 0 before the onset of the COVID-19 pandemic and 1 from March 2020 to June 2021; T_t = linear monthly time trend in cigarette sales, which takes 0 starting from January 2007 and increases by 1 every successive month; Z_t = a vector of covariates adjusted for in the model (composition of age, sex, race, Consumer Price Index for alcohol and tobacco products, real per capita personal disposable income, and unemployment rate); and γ_m = a vector of calendar month fixed effects, which included 11 dummies, 1 for each month from February to December, and omitted January as the reference month. The coefficients β_1 = trend in cigarette sales before the onset of the COVID-19 pandemic, β_2 = change in the level of cigarette sales immediately after the onset of the pandemic, and β_3 = change in the trend in cigarette sales after the onset of the pandemic. Data on the composition of age, sex, and race were sourced from the Basic Monthly Current Population Survey of the U.S. Census Bureau. The unemployment rates and Consumer Price Index for alcohol and tobacco products were sourced from the U.S. Bureau of Labor Statistics. The real per capita personal disposable income was sourced from the economic data of the Federal Reserve Bank of St. Louis. The expected sales were predicted on the basis of the pre–COVID-19 estimated trend (January 2007 to February 2020).

a 14.1% increase above the expected sales. Excess sales of cigarettes reported in this study align with findings from Nielsen retail tobacco sales data of increases in tobacco sales from April to June 2020 (4). However, this study shows that increases in cigarette sales went beyond the first 3 months of the COVID-19 pandemic and persisted in the 16 months after its onset in March 2020. This finding is also consistent with anecdotal claims by the tobacco industry about halting the long-term decline in cigarette sales during the COVID-19 pandemic (5).

One major limitation of the study is that the national-level data used for the analysis do not reflect individual- or state-level variations in cigarette sales. Second, the cigarette sales measure used in this study should be considered as only a proxy for actual consumption because unrecorded cross-border purchases and illicit trade may cause deviation between tax-paid

Figure 2. Mean difference between observed and expected monthly cigarette sales per capita.
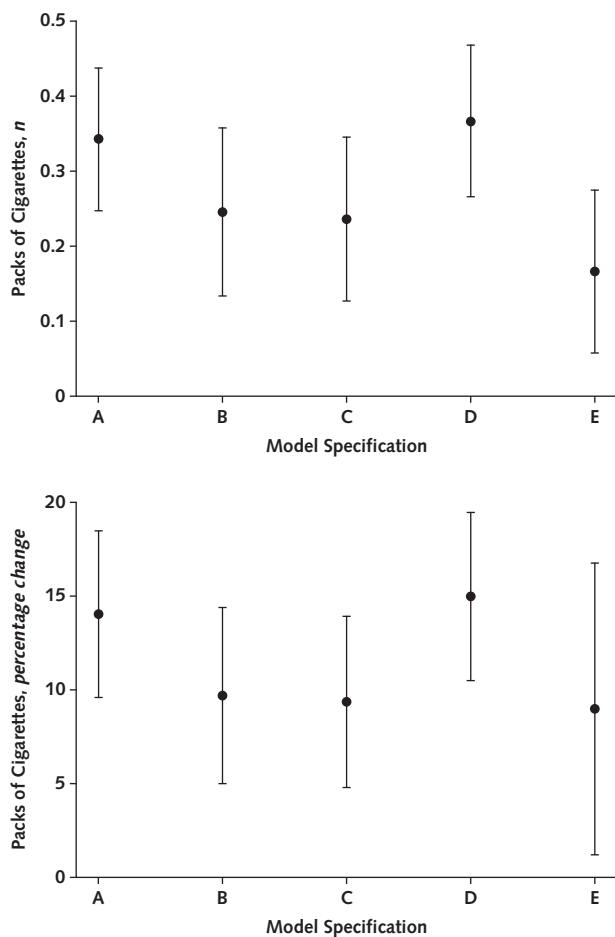
The point estimates (*circles*) with 95% CIs (*error bars*) are the average difference between the observed and expected monthly cigarette sales per capita based on the pre–COVID-19 trend. The average difference between the observed and expected monthly cigarette sales per capita was expressed as a count of packs in the top panel and a percentage change from the expected sales in the bottom panel. In each panel, we showed the difference between the observed and expected sales from 5 model specifications, all adjusting for seasonality by including 11 calendar month dummies (January as a baseline). Model specification A adjusted for all of the covariates (composition of age, sex, race, Consumer Price Index for alcohol and tobacco products, real per capita personal disposable income, and unemployment rate); model specification B did not adjust for any covariate; model specification C adjusted for only the composition of age, sex, and race; model specification D adjusted for Consumer Price Index for alcohol and tobacco products, real per capita personal disposable income, and unemployment rate; and model specification E used a 1-month lag of cigarette sales as the dependent variable and adjusted for all of the covariates in model specification A. Ramsey RESET test using Stata command ovtest showed that only model specification A is free from the omitted variable bias.

sales and actual consumption. Third, in the absence of a control group unaffected by the pandemic, our expected sales were predicted on the basis of the pre–COVID-19 monthly cigarette sales. Finally, some other factors not included in our models may have contributed to the difference between the observed and predicted sales during the COVID-19 pandemic.

Cigarette sales were greater than would have been expected during the pandemic, with slowing of the previous downward trend, suggesting persistent, overall changes in smoking behavior, although individual consumption was not directly measured.

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