Changes in Alcohol Consumption by Beverage Type Attributable to the COVID-19 Pandemic for 10 States, March 2020 to November 2020: An Ecological Simulation-based Analysis

Jarratt D. Pytell, MD, MHS, Ashish P. Thakrar, MD, Geetanjali Chander, MD, MPH, and Elizabeth Colantuoni, PhD

Objectives: Consumption of high potency alcohol is associated with greater healthcare burden, yet little attention has been placed on the change in types of alcohol consumed during the COVID-19 pandemic. We estimate the change in alcohol consumption by beverage type attributable to the COVID-19 pandemic.

Methods: The National Institute on Alcohol Abuse and Alcoholism provided apparent alcohol consumption (“consumption”) by beverage type for 10 states for January 2017 through November 2020 based on sales and tax data. The 38-month period to February 2020 was used to train quasi-Poisson regression models. The models then predicted the monthly consumption based on the historical trends in the absence of the COVID-19 pandemic from March through November 2020. The difference between the observed and predicted is the change in consumption attributable to the COVID-19 pandemic.

Results: Beyond what was expected based on historical trends, spirits consumption increased significantly for 6 states (Colorado, Massachusetts, Missouri, North Dakota, Minnesota, and Tennessee) ranging from 4% (95% confidence interval [CI] 1%–6%) to 17% (95% CI 6%–28%) which is equivalent to 7 (95% CI 2–18) to 32 (95% CI 12–48) excess standard spirits drinks per-capita; Alaska, Florida, Illinois, and Kentucky had no significant change. Wine consumption increased 10% (95% CI 3%–18%) in Colorado and 8% (95% CI 3%–12%) in Tennessee. Wine consumption in Alaska decreased 6% (95% CI, 3%–10%) and beer consumption decreased 8% (95% CI 4%–11%).

Conclusions: During the COVID-19 pandemic, spirits consumption increased relative to wine and beer. Increased consumption of higher potency alcohol beverages could lead to higher alcohol-related healthcare and societal burden.

Key Words: alcohol, alcohol drinking, COVID-19

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NIAAA collects on- and off-premise alcohol sales and tax data to estimate total state-level alcohol consumption by gallons of pure alcohol (ethanol) by beverage type. Monthly consumption was available for 10 states (Table 1).

The analysis proceeded in 2 steps (see Supplement, http://links.lww.com/JAM/A345). First, we used regression models to describe the prepandemic monthly consumption during the 38 months January 2017 through February 2020. We developed (“trained”) 8 Poisson regression models allowing for over-dispersion, where each model included linear time (number of months since January 2017), 3 accounts of seasonality (using calendar month, harmonics, and natural cubic splines), and the interaction of time and seasonality. Two statistics determined the final regression model: leave-one-out cross-validated mean squared error and the mean model deviance (model deviance divided by model degrees of freedom). We repeated this process for each state and beverage type. The final model included a linear time trend and an indicator variable for calendar month.

Next, we used the final model to predict the counterfactual scenario of monthly gallons of alcohol, by beverage type, that would have been consumed in the absence of the COVID-19 pandemic from March 2020 through November 2020. Put differently, predicted consumption consistent with the factual scenario of monthly gallons of alcohol, by beverage type, that would have been consumed in the absence of the COVID-19 pandemic. The difference

### TABLE 1. Change in 9-month Cumulative Pure Alcohol Consumption Per-capita by State Attributable to the COVID-19 Pandemic, March 2020 to November 2020

| State         | Alcohol Type | Observed (Ounces Per Capita) | Relative Change (95%CI) | Absolute Change (95% CI) (Ounces Per Capita) | Standard Drink Equivalent Change (95% CI) |
|---------------|--------------|------------------------------|-------------------------|---------------------------------------------|------------------------------------------|
| Alaska        | Beer         | 105                          | -7.6% (-10.9% to -4.2%)  | -9 (-13 to -5)                              | -14 (-21 to -8)                          |
|               | Wine         | 50                           | -6.3% (-10.0% to -2.5%)  | -3 (-6 to -1)                               | -6 (-9 to -2)                            |
|               | Spirits      | 129                          | -2.9% (-7.3% to 1.6%)    | -4 (-10 to 2)                               | -7 (-17 to 3)                            |
|               | Total        | 283                          | -5.3% (-8.7% to -2%)     | -16 (-27 to -6)                             | -27 (-45 to -10)                         |
| Colorado      | Beer         | 117                          | -0.5% (-4.2% to 3.1%)    | -1 (-5 to 4)                                | -1 (-9 to 6)                             |
|               | Wine         | 50                           | 10.3% (2.8% to 17.7%)    | 5 (1 to 7)                                  | 8 (2 to 12)                              |
|               | Spirits      | 132                          | 16.6% (5.8% to 28.1%)    | 19 (7 to 29)                                | 31 (12 to 48)                            |
|               | Total        | 299                          | 8.4% (2.3% to 14.7%)     | 23 (7 to 38)                                | 38 (11 to 64)                            |
| Florida       | Beer         | 101                          | -1.4% (-4.2% to 1.5%)    | -1 (-4 to 2)                                | -2 (-7 to 3)                             |
|               | Wine         | 53                           | -0.1% (-3.6% to 3.4%)    | 0 (-2 to 2)                                 | 0 (-3 to 3)                              |
|               | Spirits      | 109                          | 3% (-1.2% to 7%)         | 3 (-1 to 7)                                 | 5 (-2 to 12)                             |
|               | Total        | 264                          | 0.7% (-1.8% to 3.4%)     | 2 (-5 to 9)                                 | 3 (-8 to 14)                             |
| Illinois      | Beer         | 105                          | -2.3% (-6.6% to 1.9%)    | -3 (-7 to 2)                                | -4 (-12 to 3)                            |
|               | Wine         | 46                           | 2.8% (-1.5% to 7.2%)     | 1 (-1 to 3)                                 | 2 (-1 to 5)                              |
|               | Spirits      | 87                           | -1.9% (-5.7% to 2%)      | -2 (-5 to 2)                                | -3 (-9 to 3)                             |
|               | Total        | 238                          | -1.2% (-4.9% to 2.3%)    | -3 (-12 to 5)                               | -5 (-20 to 9)                            |
| Kentucky      | Beer         | 90                           | -4.9% (-15.8% to 7.3%)   | -5 (-17 to 6)                               | -8 (-28 to 10)                           |
|               | Wine         | 23                           | 7% (4.1% to 19.4%)       | 1 (-1 to 4)                                 | 2 (-2 to 6)                              |
|               | Spirits      | 95                           | 5.9% (-4.9% to 18.1%)    | 5 (-5 to 15)                                | 8 (-8 to 24)                             |
|               | Total        | 208                          | 0.9% (-5.1% to 7.5%)     | 2 (-11 to 14)                               | 5 (-13 to 24)                            |
| Massachusetts | Beer         | 84                           | -7.3% (-11.3% to -3.2%)  | -7 (-11 to -3)                              | -11 (-18 to -5)                          |
|               | Wine         | 60                           | 2.8% (-2.5% to 8.5%)     | 2 (-2 to 5)                                 | 3 (-3 to 8)                              |
|               | Spirits      | 116                          | 7.2% (0.5% to 14.3%)     | 8 (1 to 15)                                 | 13 (1 to 24)                             |
|               | Total        | 261                          | 1.3% (-3% to 5.5%)       | 3 (-8 to 14)                                | 5 (-14 to 23)                            |
| Minnesota     | Beer         | 113                          | -0.3% (-4.5% to 4.1%)    | 0 (-5 to 4)                                 | -1 (-9 to 7)                             |
|               | Wine         | 43                           | 4.2% (0% to 8.4%)        | 2 (0 to 3)                                  | 3 (0 to 6)                               |
|               | Spirits      | 126                          | 3.6% (0.7% to 6.4%)      | 4 (1 to 8)                                  | 7 (1 to 13)                              |
|               | Total        | 282                          | 2.1% (-0.7% to 4.9%)     | 6 (-2 to 13)                                | 9 (-3 to 22)                             |
| Missouri      | Beer         | 109                          | 1.2% (-1.7% to 4.1%)     | 1 (-2 to 4)                                 | 2 (-3 to 7)                              |
|               | Wine         | 38                           | 5% (-2.8% to 12.6%)      | 2 (-1 to 4)                                 | 3 (-2 to 7)                              |
|               | Spirits      | 122                          | 6.8% (1.8% to 12.2%)     | 8 (2 to 13)                                 | 13 (4 to 22)                             |
|               | Total        | 268                          | 4.5% (1.3% to 7.7%)      | 11 (4 to 19)                                | 19 (6 to 32)                             |
| North Dakota  | Beer         | 147                          | -2.1% (-7% to 3.1%)      | -3 (-11 to 4)                               | -5 (-18 to 7)                            |
|               | Wine         | 32                           | 1% (-3.4% to 5.8%)       | 0 (-1 to 2)                                 | 1 (-2 to 3)                              |
|               | Spirits      | 142                          | 5.4% (1.2% to 9.7%)      | 7 (2 to 13)                                 | 12 (3 to 21)                             |
|               | Total        | 320                          | 1.5% (-2% to 5%)         | 5 (-7 to 15)                                | 8 (-11 to 26)                            |
| Tennessee     | Beer         | 97                           | -0.7% (-4.7% to 3.5%)    | -1 (-5 to 3)                                | -1 (-8 to 5)                             |
|               | Wine         | 33                           | 7.5% (2.9% to 12%)       | 2 (1 to 4)                                  | 4 (2 to 6)                               |
|               | Spirits      | 95                           | 8.5% (4.1% to 13.1%)     | 7 (4 to 11)                                 | 12 (6 to 18)                             |
|               | Total        | 225                          | 4.1% (0.7% to 7.3%)      | 9 (2 to 15)                                 | 15 (3 to 25)                             |

*National Institutes of Alcohol Abuse and Alcoholism (NIAAA) estimates the apparent total gallons of pure alcohol consumed by beverage type using state sales and tax data.

†Calculated by taking the difference of the observed and expected consumption. Expected alcohol consumption obtained by regression model predictions (see Methods). Values shown are per-capita ounces of pure alcohol. Monthly population estimates were provided by NIAAA from the U.S. Census Bureau to calculate per-capita values.

‡One standard drink equivalent is equal to 0.6 ounces of pure alcohol.

§Confidence interval (CI) rounded down to 0; the 95% CI is not inclusive of 0.
FIGURE 1. Cumulative 3-, 6-, and 9-month change of apparent pure alcohol consumed per-capita attributable to the COVID-19 pandemic by state and beverage type, March 2020 to November 2020. Difference between observed and expected pure alcohol consumption by beverage type was independently examined for each state. The cumulative per-capita difference and 95% confidence interval (CI) of ounces of pure alcohol consumed between the observed and expected (in the absence of COVID-19 pandemic) for the 3-month (March–May 2020), 6-month (March–August 2020), and 9-month (March–November 2020) period represent the change in consumption attributable to the COVID-19 pandemic are shown.
between the observed and predicted values is the change in consumption attributable to the COVID-19 pandemic. We repeated this process 2000 times to obtain a distribution of estimated change in consumption during the first 3, 6, and 9 months with the mean representing the point estimate of the difference and the 5th and 9th percentile as the limits to the 95% confidence interval (CI). Last, we converted the change in consumption to ounces of pure alcohol per-capita and standard drink equivalents (SDE) per-capita consumption using US Census monthly population estimates of people ≥14 years for each state.6 NIAAA defines 0.6 ounces of pure ethanol as one SDE.

Two states had outlier data for 2 consecutive months suggesting delayed reporting: wine and spirits consumption in September and October 2019 in Kentucky and beer consumption in February and March 2019 in Missouri. We imputed the values for these months using the prior 2-year average for that month and calculated a new monthly total (Supplement eFigure, http://links.lww.com/JAM/A345).

RESULTS

Beyond what was expected based on historical trends, for the period March 2020 to November 2020, cumulative spirits consumption increased for 6 states (Colorado, Massachusetts, Missouri, North Dakota, Minnesota, and Tennessee) ranging from 4% (95% CI 1%–6%) or 7 (95% 2–13) SDE per capita in Minnesota to 17% (95% CI 6%–28%) or 32 (95% 12–48) SDE per capita in Colorado (Table 1). There was no significant change in spirits consumption for Alaska, Florida, Illinois, and Kentucky. Wine consumption increased for 3 states (Colorado, Minnesota, and Tennessee) ranging from 2.2% (95% CI 0%–8%) or 3 (95% CI 0–5) SDE per capita in Minnesota to 10% (95% CI 3%–18%) or 8 (95% CI 2–12) SDE per capita in Colorado; Alaska had a 6% (95% CI 3%–10%) decrease. Beer consumption decreased 7% (95% CI 3–12) in Massachusetts and 8% (95% CI 4%–11%) in Alaska. Total alcohol consumption increased in 3 states; Colorado 8% (95% 2%–15%) or 38 (95% CI 12–63) excess SDE per capita; Missouri 5% (95% CI 1%–8%) or 18 (95% CI 7–32) SDE per capita; and Tennessee 4% (95% CI 1%–7%) or 15 (95% CI 3–25) SDE per capita (Table 1). Total consumption decreased in Alaska by 5% (95% CI 2%–9%).

The Figure 1 shows the 3-, 6-, and 9-month cumulative change in consumption by beverage type. Nine states (all except Illinois) generally had relatively increased spirits consumption compared to beer and wine, suggesting a shift in consumption from less to more potent beverage types. A sensitivity analysis using the reported rather than imputed data for Missouri and Kentucky resulted in less precision (wider 95% CI) but did not qualitatively change the results (see Supplement eTable, http://links.lww.com/JAM/A345).

DISCUSSION

In this ecological study of change in state-level apparent alcohol consumption for 10 states, there was excess spirits consumption ranging from 4% to 16% for 6 states after the start of the COVID-19 pandemic beyond what was expected based on historical trends for these states. Alcohol consumption increases after stressful events including natural disasters, social isolation, and mass-causality events. This increases the risk of alcohol use having a negative impact on an individual’s life and the development of an alcohol use disorder. High potency alcohol beverages have a stronger association with chronic liver disease, cancers, and rate of alcohol poisoning and injuries. The shift in consumption toward spirits in 3 states potentially contributed to the increased alcohol-related healthcare burden seen during this period.

Our use of population-level measures for a subset of states limits generalizability to individual consumption and other states. Additionally, we could not account for the decrease in tourism during the pandemic, which would lead to a reduction in observed alcohol consumption and underestimation of alcohol consumption by state residents, or the individual contributions of local alcohol policy changes and the societal, economic, or health effects of the COVID-19 influencing alcohol consumption. Strengths of our study are the inclusion of all consumption from all sources (on- and off-premise) and the use of a model-based approach to estimate the effect of COVID-19 on consumption which better accounts for latent trends compared to calculating change from the previous year alone.

CONCLUSIONS

We found increased consumption of higher potency alcohol beverages relative to lower potency alcohol beverages after the start of the COVID-19 pandemic beyond what was expected based on historical trends. Although the WHO recommended restricting alcohol sales during lockdowns, nearly every state in the US determined alcohol retailers were “essential businesses” and many increased access by allowing take-away alcohol sales. Clinicians should screen for unhealthy alcohol use, inquire about types of alcohol consumed, and engage patients to reduce consumption or transition to lower-potency beverages. Finally, it should be a national imperative to monitor and plan for individual and society-level consequences of increased consumption of high-potency alcohol in the post-COVID-19 pandemic era.

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