Association of socio-demographic characteristics with alcohol use initiation among never users during the COVID-19 pandemic: a longitudinal study

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ABSTRACT

Background In this longitudinal cohort study, we examined the socio-demographic and psychological predictors of alcohol use initiation during the COVID-19 pandemic in a sample of never alcohol users aged ≥21 prior to COVID-19.

Methods Our study population consisted of 56 930 patients aged ≥21, as of 30 March 2019 were collected from a pre-COVID period of 1 year before 31 March 2020, and during-COVID, a period between 1 April 2020 and 30 March 2021. Univariable and multivariable logistic regression models were utilized to examine the roles of socio-demographic variables (gender, age, education, Area Deprivation Index and rural residence) changes in anxiety and depression severity as predictors of alcohol use initiation.

Results Age, gender, race, ethnicity, education and rural status were significant predictors in multivariable analysis. A subgroup analysis showed neither anxiety nor depression had a significant association with alcohol use initiation.

Conclusion Women, younger individuals, those living in a rural area and people who smoke cigarettes were more likely to initiate alcohol use during the pandemic. Our study has public health and clinical implications such as the need for targeted alcohol use screening and intervention for vulnerable individuals.

Keywords alcohol, longitudinal, socio-demographic, COVID-19
Introduction

The ongoing COVID-19 pandemic has not only caused great concern about physical health but has also negatively affected people’s well-being socially, economically and mentally. It has been widely documented that due to the lockdowns and social distancing, people’s daily routines, employment, family life and social relationships were greatly disturbed, which has contributed to stress and negative affective states. Stress, traumatic events and negative affective states increase vulnerability to alcohol and other substance use initiation, escalation and relapse.

The pre-pandemic literature on factors associated with alcohol initiation was mostly focused on adolescents and young adults as a significant number of adult substance users initiate substance use during their youth. The information derived from those studies shows that alcohol use initiation is associated with male gender, White ethnicity, single-family households, and rural status. Recently accumulated evidence indicates that people reported problematic alcohol use during the pandemic. However, that research on alcohol consumption during the COVID-19 pandemic focuses mainly on changes in alcohol use among those who consumed alcohol prior to the pandemic. No research exists on alcohol use initiation during COVID-19 among those who were not alcohol drinkers prior to the pandemic and are not adolescents. Prior studies examining trajectories of alcohol use during the pandemic found that stress, depressive states and boredom were associated with increased alcohol use. Inconsistencies were observed regarding the role of socio-demographic characteristics with increased alcohol use.

The current longitudinal study fills this gap by examining the uptake of alcohol during the pandemic among young adults and adults who did not use alcohol (‘never users’) pre-pandemic and socio-demographic and psychosocial characteristics associated with alcohol initiation. Because women report more stress and negative affect than men, we hypothesized that women would report increased alcohol initiation. Given the social isolation of rural residents, and increased stressors related to employment and housing among individuals of low socioeconomic status, we expected that alcohol initiation would be associated with these characteristics. Moreover, for a small subsample of these never users with available data on Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) scores, we explored the role of depressive and anxiety symptoms on the initiation of alcohol use.

Methods

Participants

Our study screened 284,523 Mayo Clinic patients aged ≥21, as of 30 March 2019. Of these, 219,322 had annual data on their alcohol use (as measured by self-reported surveys during their clinical visits) from 1 April 2019 to 30 March 2021. We partitioned data into two-time periods: ‘pre-COVID’, defined as the 1-year period on or before 31 March 2020, and ‘during-COVID’, defined as the period from 1 April 2020 to 30 March 2021. Our study population consisted of those 56,930 (26%) individuals who indicated ‘never’ consuming alcohol pre-COVID.

Study setting

Mayo Clinic consists of a large academic medical center and associated health system spanning five states (MN, WI, IA, FL and AZ) in the USA. The study was reviewed and was deemed exempt by the Mayo Clinic Institutional Review Board.

Measures

Primary outcome

Data were collected through self-reported responses to three questions about alcohol use during the clinical visit. In the electronic health record (EHR), the patient’s response to regularity of alcohol use was categorized as: Never, Monthly or less, two to four times a month, two to three times a week or four or more times a week. We were interested in the ‘initiation of alcohol use (primary outcome)’ during the COVID period, reflected by a response other than ‘never’ at clinic visits during the pandemic among those who noted ‘never’ to alcohol use regularity question during the pre-COVID period.

Predictor variables

Socio-demographic characteristics extracted from the EHRs were age, gender, race/ethnicity, education (highest level obtained during the study period) and smoking status (any cigarette smoking reported during study period). Rurality was ascertained from patient zip codes to identify corresponding Rural–Urban Commuting Area (RUCA) codes. Based on published definitions, the RUCA codes classified areas as urban or rural. Socioeconomic position was measured by the Area Deprivation Index (ADI). ADI scores were obtained from 5-year American Community Survey (ACS) estimates. ACS is an annual survey conducted by the US Census Bureau that provides population-level estimates representative of the noninstitutionalized US population. In-depth survey methods
can be found on the US Census Bureau website.24 We used 17 block-group indicators, representing income, employment, housing and education, to compute the ADI scores for all US Census block groups.25 All block groups were ranked by ADI scores. Each block group was assigned to a quintile of ADI scores from the least deprived 20% of block groups (Quintile 1) to the most deprived 20% of block groups (Quintile 5). Weights were assigned to each variable in the ADI. A geographic hot spot map of block group ADI scores in MN, IA and WI (n = 11 230) was created and has been previously described.26

Depression and anxiety symptoms were measured at clinic visits, pre-pandemic and during the pandemic by the PHQ-9 and GAD-7, respectively. Both are self-reported instruments with strong internal and test–retest reliability as well as construct and factor-structure validity.27–29 GAD-7 score was categorized as 0–4: minimal anxiety, 5–9: mild anxiety, 10–14: moderate anxiety, or 15–21: severe anxiety and PHQ-9 score as 0–4: none-minimal depression, 5–9: mild depression, 10–14: moderate depression, 15–19: moderately severe depression, or 20–27: severe depression.27–29

Statistical analyses
For each patient, we calculated the maximum value for alcohol regularity, PHQ and GAD measurement within each time period and then took the difference between time periods. We used univariable and multivariable logistic regression models to assess the individual effects on the risk of initiation of alcohol use from age, gender, race, ethnicity, ADI quintile, smoking status, changes in GAD (increased or not increased) and PHQ (increased or not increased) and rural status at the zip code with the longest duration during the study period. Since we did not have both GAD-7 and PHQ-9 measurements simultaneously for 90% of our sample, in our multivariable analyses, we excluded these variables as candidate predictors. We performed a subgroup analysis on those patients with both GAD-7 and PHQ-9 scores (N = 5909) and assessed the effect of each while adjusting for variables selected in multivariable models. Odds ratios (ORs) were adjusted for age, gender, race, ethnicity, education, smoking status and rural status using (N = 4089).

Statistical analyses were performed in SAS Studio 3.81 (SAS Institute Inc, Cary, NC) and R 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). In all cases, two-tailed P values <0.05 were considered as statistically significant.

Results
Table 1 presents the participant characteristics. The mean age was 57.9 years (standard deviation (SD) = 16.2) with 38% being ≥65 years (and 70% being ≥50 years), 29.3% were living rural areas, 61.3% women and 89.9% were White persons.

Age, gender, race, education, smoking status and rural status showed significant effects in the univariable models (all P < 0.001). Younger age groups (≥65 years as reference), women, White individuals (compared to Asian/Pacific Islander and Black/African American persons), those with an associate degree, some college or bachelor’s (compared to high school or advanced degree), people who smoke cigarettes and those living in a rural area were more likely to initiate alcohol use during COVID-19 period (all P ≤ 0.016). In the multivariable model, 37 493 (66%) patients had data available on all eight predictors. For 15 388 (27%), ADI quintile was the only predictor missing. In the sample of 37 493, age, gender, race, ethnicity, education, smoking status and rural status were significant (all P ≤ 0.002) (Table 2).

Among those who had GAD and PHQ at both time periods, increased PHQ was associated with alcohol use initiation during COVID-19 period (P = 0.023). After adjusting for variables selected in the final multivariable model, PHQ was no longer significant (P = 0.26). No association was found between increased GAD and alcohol use initiation (both P ≥ 0.13) (Table 3).

Discussion
Main finding of this study
This study examined longitudinal predictors for the onset of alcohol use during the COVID-19 period in a large sample of never alcohol using adults aged ≥21. Our novel findings address research gaps highlighted in previous systematic reviews on this topic.30,31 We observed that socio-demographic characteristics (younger age, women, White race, and advanced educational degree, rural residence and cigarette smoking) were associated with alcohol use initiation during the pandemic. Within a small subsample of those with depression and anxiety measures, our exploratory analysis did not find any association between the increase in anxiety or depression with alcohol use initiation during COVID-19 period. Overall, our study suggests that demographic characteristics were more strongly associated with alcohol use initiation. It is also possible that other, unmeasured psychosocial factors contributed to alcohol use initiation.

What is already known on this topic
Most studies during the pandemic assessed change (increase or decrease) in alcohol consumption among baseline alcohol users.15–19,30 In addition, earlier studies during this period focused on an individual’s emotional states (such as...
**Table 1** Summary statistics on patient characteristics ($N = 56,930$)

| Characteristic | Mean (SD) [min, max] or N (%) |
|----------------|-------------------------------|
| Age (as of 30 March 2019) | 57.9 (16.2) [21, 103] |
| 21 to <35 | 6815 (12.0%) |
| 35 to <50 | 10,174 (17.9%) |
| 50 to <65 | 18,184 (31.9%) |
| ≥65 | 21,759 (38.2%) |
| Gender | |
| Female | 34,880 (61.3%) |
| Male | 22,047 (38.7%) |
| Unknown | 3 (0.0%) |
| Race | |
| American Indian | 1865 (3.3%) |
| Asian or Pacific | 343 (0.6%) |
| Black or African American | 1877 (3.3%) |
| White | 51,177 (89.9%) |
| Unknown | 1668 (2.9%) |
| Ethnicity | |
| Hispanic | 2382 (4.2%) |
| Not Hispanic or Latino | 53,482 (93.9%) |
| Unknown | 1066 (1.9%) |
| Education level (highest)$^a$ | |
| HS | 12,898 (22.7%) |
| Some college | 6918 (12.2%) |
| Associates | 12,879 (22.6%) |
| Bachelor | 13,380 (23.5%) |
| Advanced | 10,459 (18.4%) |
| Declined to answer | 344 (0.6%) |
| ADI quintile ($1$ = least deprived, $5$ = most deprived)$^b$ | |
| 1 = least deprived | 11,266 (28.1%) |
| 2 | 12,863 (32.1%) |
| 3 | 9662 (24.1%) |
| 4 | 5022 (12.5%) |
| 5 = most deprived | 1275 (3.2%) |
| Change in PHQ category | |
| Not increased | 9691 (17.0%) |
| Increased | 2365 (4.2%) |
| Unknown | 44,874 (78.8%) |
| Change in GAD category | |
| Not increased | 6007 (10.7%) |
| Increased | 1394 (2.4%) |
| Unknown | 49,469 (86.9%) |
| Smoking status$^c$ | |
| No | 51,086 (91.9%) |
| Yes | 4493 (8.1%) |
| Rural$^d$ | |
| Urban | 40,176 (70.7%) |
| Rural | 16,641 (29.3%) |
| Alcohol initiation | |
| No initiation | 50,626 (88.9%) |
| Initiation | 6304 (11.1%) |

Changes reported from pre-COVID (1 April 2019–31 March 2020) to during-COVID (1 April 2020–30 March 2021).

$^aN = 52$ were missing an education level.

$^bN = 16,842$ were missing an ADI quintile.

$^cN = 1351$ were missing a smoking status.

$^dN = 113$ were missing a secondary RUCA code.
Table 2 OR estimates for effects of characteristics on drinking initiation from pre-COVID to COVID from univariable models and multivariable model among those who never consumed alcohol pre-COVID

| Characteristic | Level | Mean (SD) or No. (%) | Univariable | Multivariable |
|---------------|-------|---------------------|-------------|--------------|
|               |       | Increased | Not increased | P          | OR | P          | OR |
| Age (N = 56,586) | 21 to <35 | 1628 (23.9) | 5185 (76.1) | <0.001 | 3.90 (3.62, 4.21; P < 0.001) | <0.001 | 4.33 (3.94, 4.75; P < 0.001) |
|               | 35 to <50 | 1373 (13.5) | 8801 (86.5) | 1.94 (1.79, 2.09; P < 0.001) | 2.00 (1.82, 2.20; P < 0.001) |
|               | 50 to <65 | 1679 (9.2) | 16 505 (90.8) | 1.26 (1.17, 1.35; P < 0.001) | 1.26 (1.16, 1.38; P < 0.001) |
|               | ≥65 (ref) | 1624 (7.5) | 20 135 (92.5) | 1.0 | 1.0 |
| Gender (N = 56,927) | F (ref) | 4392 (12.6) | 30 488 (87.4) | <0.001 | 1.0 | <0.001 | 1.0 |
|               | M | 1912 (8.7) | 20 135 (91.3) | 0.66 (0.62, 0.70; P < 0.001) | 0.74 (0.69, 0.79; P < 0.001) |
| Race (N = 55,262) | American Indian | 29 (8.4) | 314 (91.6) | <0.001 | 0.73 (0.50, 1.06; P = 0.10) | <0.001 | 0.73 (0.44, 1.22; P = 0.23) |
|               | Asian or Pacific | 151 (8.0) | 1726 (92.0) | 0.69 (0.58, 0.81; P < 0.001) | 0.37 (0.14, 0.76; P < 0.001) |
|               | Black or African American | 177 (9.5) | 1688 (90.5) | 0.82 (0.70, 0.96; P = 0.016) | 0.75 (0.61, 0.93; P = 0.007) |
|               | White (ref) | 5778 (11.3) | 45 399 (88.7) | 1.0 | 1.0 |
| Ethnicity (N = 55,864) | Hispanic | 260 (10.9) | 2122 (89.1) | 0.77 | 0.98 (0.86, 1.12; P = 0.77) | 0.004 | 0.74 (0.61, 0.91; P = 0.004) |
|               | Not Hispanic or Latino (ref) | 5939 (11.1) | 47 543 (88.9) | 1.0 | 1.0 |
| Education (N = 56,534) | HS (ref) | 1241 (9.6) | 11 657 (90.4) | <0.001 | 1.0 | <0.001 | 1.0 |
|               | Some college | 819 (11.8) | 6099 (88.2) | 1.26 (1.15, 1.39; P < 0.001) | 1.16 (1.04, 1.31; P = 0.011) |
|               | Associates | 1496 (11.6) | 11 383 (88.4) | 1.23 (1.14, 1.34; P < 0.001) | 1.24 (1.12, 1.37; P < 0.001) |
|               | Bachelor | 1669 (12.5) | 11 711 (87.5) | 1.34 (1.24, 1.45; P < 0.001) | 1.32 (1.20, 1.46; P < 0.001) |
|               | Advanced | 1064 (10.2) | 9395 (89.8) | 1.06 (0.98, 1.16; P = 0.16) | 1.18 (1.06, 1.32; P = 0.004) |
| ADI quintile (N = 40,088) | 1 = least deprived (ref) | 1231 (10.9) | 10 035 (89.1) | 0.06 | 1.0 | 0.65 | 1.0 |
|               | 2 | 1443 (11.2) | 11 420 (88.8) | 1.03 (0.95, 1.12; P = 0.47) | 0.96 (0.88, 1.04; P = 0.31) |
|               | 3 | 1139 (11.8) | 8523 (88.2) | 1.09 (1.00, 1.19; P = 0.050) | 0.95 (0.86, 1.05; P = 0.30) |
|               | 4 | 622 (12.4) | 4400 (87.6) | 1.15 (1.04, 1.28; P = 0.007) | 0.99 (0.88, 1.11; P = 0.82) |
|               | 5 | 144 (11.3) | 1131 (88.7) | 1.04 (0.86, 1.25; P = 0.69) | 0.89 (0.73, 1.08; P = 0.24) |
| Smoking Status (N = 55,579) | No (ref) | 5535 (10.8) | 45 551 (89.2) | <0.001 | 1.0 | 0.03 | 1.0 |
|               | Yes | 640 (14.2) | 3853 (85.8) | 1.37 (1.25, 1.49; P < 0.001) | 1.13 (1.01, 1.26; P = 0.03) |
| Rural (N = 56,817) | Urban (ref) | 4246 (10.6) | 35 930 (89.4) | <0.001 | 1.0 | <0.001 | 1.0 |
|               | Rural | 2047 (12.3) | 14 594 (87.7) | 1.19 (1.12, 1.25; P < 0.001) | 1.17 (1.09, 1.27; P < 0.001) |

Reference categories are ≥65 years, females, Whites, not Hispanic or Latino, least deprived, non-smoker and urban. Multivariable sample size (n = 37,493). Abbreviations: F, female; M, male.

Table 3 Associations between change in GAD or PHQ and change in drinking initiation from pre-COVID to COVID (N = 5909)

| Clinical measure | Initiation, N (%) | Increased | Not increased | Univariable | Multivariable |
|------------------|------------------|-----------|---------------|-------------|--------------|
|                  |                  |           |               | P          | OR | P          | OR |
| GAD              |                  |           |               |            |    |            |    |
| Increased        | 186 (15.7)       | 1000 (84.3) | 1.000 | 4.063 (86.9) |
| Not increased    | 660 (14.0)       | 4.063 (86.9) | 1.000 |
| OR (95% CI)      | 1.15 (0.96, 1.37; P = 0.13) | 1.13 (0.92, 1.40; P = 0.24) |
| Adjusted OR (95% CI) | 1.13 (0.91, 1.40; P = 0.26) |
| PHQ              |                  |           |               |            |    |            |    |
| Increased        | 195 (16.4)       | 955 (83.6) | 1.000 | 4.068 (86.2) |
| Not increased    | 651 (13.8)       | 4.068 (86.2) | 1.000 |
| OR (95% CI)      | 1.23 (1.03, 1.46; P = 0.023) | 1.13 (0.91, 1.40; P = 0.26) |
| Adjusted OR (95% CI) | 1.13 (0.91, 1.40; P = 0.26) |

ORs adjusting for age, gender, race, ethnicity, education, smoking status and rural status. N = 4089. Abbreviation: CI, confidence interval.

depression and anxiety) and explored their association with change in alcohol use among those with a drinking history.30,31 Our study makes a novel contribution to the literature by exploring the socio-demographic factors associated with alcohol use initiation during the pandemic among never users prior to the pandemic.

What this study adds
We found that alcohol use initiation increased among females. It is possible that alcohol use initiation was high among the female gender because of the unexpected and abrupt workload increase during the pandemic.32,33 Further, with the closure of in-person schooling, females were predominantly
burdened with childcare-related duties.\textsuperscript{34,35} Alcohol may have served as a coping mechanism to deal with these stresses.\textsuperscript{36} Our study also observed that younger people, compared to older adults, and individuals which advanced degrees (an associate degree, some college or bachelor’s) were more likely to initiate alcohol use during the pandemic. A report by the US Census Bureau in 2021 reported that people aged 25–44 experienced a greater loss of employment than any other age group.\textsuperscript{37} It is plausible that loss of employment coupled with financial strain contributed to significant stress in this age group,\textsuperscript{38} leading to the initiation of alcohol use.\textsuperscript{39} In addition, the evidence shows that older age individuals are more resilient and practice better coping skills compared to younger individuals when dealing with a stressful situation (pandemic in this case).\textsuperscript{40,41} Thus, younger people faced greater risks of alcohol initiation during the pandemic. It is therefore imperative to effectively screen people with alcohol use for stress and to assess anxiety and depressive disorders simultaneously and longitudinally.

Our study found that individuals living in rural areas were more likely to engage in alcohol use initiation during the pandemic. To our knowledge, this is the first longitudinal study examining the association between residence (rural or urban) and alcohol use initiation during the pandemic. Rural communities are often dependent on self-employment, such as microbusiness (crafts, vending shops, small cafes and tourism) or manufacturing, which cannot be carried out solely at home, making them highly vulnerable to failure if cash flow is cut.\textsuperscript{42} Therefore, sustaining business operations during the pandemic was problematic at a micro-level, leading to financial uncertainty and stress.

We found that the use of cigarette smoking was associated with alcohol use initiation among patients during the pandemic. Cross-sectional studies conducted during the pandemic found that the use of tobacco and co-occurring alcohol use increased during the pandemic.\textsuperscript{43–46} Studies also show that individuals used tobacco or co-occurring alcohol as a coping strategy in response to the COVID-19 pandemic and lockdown.\textsuperscript{47} Our longitudinal study confirms these findings and adds to the literature on potential polysubstance use during the pandemic. In addition, our study informs clinicians to screen for other substance among those who have a history of prior substance use (tobacco use in this case).

**Limitations of this study**

We acknowledge several study limitations. Selection bias is a potential concern as the study sample consisted exclusively of patients receiving health care at two periods and completing the alcohol use questionnaires. Both the independent exposure variables and the alcohol use outcomes likely influence health care-seeking behaviors and may have resulted in a biased study population. Our study sample was selected based on patients who reported never consuming alcohol pre-COVID, which may confound true increased drinking with typical drinking irregularity, a reflection of regression to the mean. The severity of this limitation in our study may have been diminished from considering the maximum reported alcohol regularity in a 1-year time period. The study utilized existing medical records, which are vulnerable to errors, including missing data for the PHQ-9 and GAD-7 as observed for 90\% of the sample. The EHR in our health system does not utilize validated instruments to capture substance use among patients and relies on self-reported data obtained by nursing staff at clinic visits. The data are limited by biases in self-reporting alcohol use, which can affect the findings of the study.\textsuperscript{48} In addition, we did not include objective or self-report measures of stress. Our sample is a convenience sample that primarily comprised of Whites, females and adults > 50 years of age and thus not representative of the US population. Given these data is restricted to 2 years and two-time points, it is difficult to conclude that the associations we found are strictly due to ongoing pandemics. In addition, substance use (alcohol use in this case) could be associated with several other life factors that are not fully explored in our study. However, our study provides a preliminary indication of such an association. Longer longitudinal studies assessing these factors and trajectories over time could provide clearer answers.

Despite these limitations, strengths of the study include the longitudinal design and large sample size. Furthermore, we encompassed objective area-level characteristics (ADI and rurality) in our analysis to assess how the individuals’ environmental context might predict the initiation of alcohol use. Patients were seen at clinics at geographically diverse locations.

Our study has implications for clinical practice and research. Since the world is still experiencing the effects of COVID-19, albeit, at a lesser level compared to the initial days, the findings of our study provide a preliminary understanding of vulnerable groups at risk of alcohol use initiation. Health care providers can use these new findings to effectively screen, diagnose and treat the at-risk population.

**Conclusions**

This is the first longitudinal study to assess COVID-19 related initiation of alcohol use in a cohort of never alcohol users. Our study highlights that younger individuals, women, those living in rural areas and people who smoke were more likely to initiate alcohol use during the COVID-19 pandemic. Further longitudinal studies are required in a diverse sample to fully
understand the impact of the pandemic-associated substance use initiation. Longer longitudinal studies could also inform the course of alcohol use and psychopathology in new alcohol users during the pandemic. Additional research with representative samples is needed to assess different psychosocial constructs associated with alcohol use initiation during pandemics, including social connectivity and perceived stress. The findings could inform the policymakers and public health officials to create policies and provide recommendations for tailored alcohol use intervention for vulnerable groups. Our study highlights important characteristics to consider when studying persons who were most likely to initiate adverse health behaviors during the pandemic.

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