The association between internalizing and externalizing severity with current use of cigarettes, e-cigarettes, and alcohol in adults: Wave 1 of the Population Assessment of Tobacco and Health (PATH) study

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Abstract

Introduction: Concurrent tobacco/alcohol use is common in adults, and associated with the severity of symptoms experienced by those with mental health disorders. However, few studies have explored this relationship across different combinations of tobacco products [i.e., conventional cigarette (CC) and electronic cigarette (EC)] and alcohol.

Methods: Data from the Wave 1 (2013–2014) Population Assessment of Tobacco and Health study were used. A total of 15,947 adults aged 18 years or older with complete study information were included. Multinomial logistic regression analyses were performed to determine the relationship between lifetime internalizing/externalizing severity and past 30-day use of tobacco and alcohol, adjusting for nicotine dependence (ND), sex, age, race, education, and income.

Results: Internalizing severity was more strongly associated with CC and alcohol use (moderate AOR = 1.47, 95% CI = 1.22–1.77; high AOR = 1.29, 95% CI = 1.03–1.61) as well as alcohol-exclusive use (moderate AOR = 1.58, 95% CI = 1.27–1.96; high AOR = 1.31, 95% CI = 1.05–1.64) while externalizing severity was more strongly associated with EC and alcohol use (high AOR = 2.97, 95% CI = 1.84–4.81, moderate AOR = 2.29, 95% CI = 1.53–3.43) when accounting for ND compared to none. The relationship between externalizing severity with EC use was dependent on alcohol being used with EC.

Conclusions: The associations between psychopathology (internalizing vs. externalizing severity) varies by different combinations of alcohol, CC, and EC. Further, these relationships

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may be mediated through ND. Future investigations into the comorbidity between mental disorder symptoms with tobacco and alcohol use should consider use of specific substances as well as their combination.

Keywords

Cigarette; E-cigarette; Alcohol; Nicotine dependence; Internalizing symptoms; Externalizing symptoms

1. Introduction

Tobacco and alcohol are two of the most common substances used in the United States (US) (Bobo & Husten, 2000; Institute, 2007). In 2018, approximately 20.9% of US adults were current conventional cigarette (CC) smokers and 55.3% reported drinking alcohol in the past month (Centers for Disease Control and Prevention, 2019; Creamer, Wang, & Babb, 2019; SSAMHSA, 2019). Among individuals with alcohol use disorder, 23.8% also had nicotine dependence and 12.9% of individuals with nicotine dependence also had alcohol use disorder (National Insitute on Drug Abuse, 2018). Concurrent use of CC and alcohol represents a major public health concern because they have been associated with more negative health outcomes such as increased risk of cardiovascular disease, cirrhosis, head and neck cancers, liver cancer, pancreatitis, and psychiatric comorbidity than the exclusive use of either substance (Adams, 2017; Cross, Lotfipour, & Leslie, 2017; Verplaetse & McKee, 2017). To date, it is unclear whether the factors associated with co-occurring tobacco and alcohol use are specific to CC or extend to electronic cigarettes (EC).

Although dual use of EC and CC is common and increasing in the US (Maglia, Caponnetto, Di Piazza, La Torre, & Polosa, 2018), the trends related to this form of tobacco use with alcohol remain unclear. In 2018, 57.3% and 25.2% of former CC users were engaged in ever-use and current-use of ECs, respectively (Villarroel, Ph, Cha, Ph, Vahratian, & Ph, 2020). Approximately 9.7% of current EC users also engaged in CC use (Villarroel et al., 2020). In 2014, about 16% of current smokers were also current EC users (Schoenborn & Gindi, 2015). Recent studies have reported that current EC users are at an increased risk of harmful alcohol use compared to EC non-users (Hershberger, VanderVeen, Karyadi, & Cyders, 2016; Roberts et al., 2018), with dual CC and EC use resulting in more past-month total drinks compared to exclusive-EC users (Roberts, Verplaetse, Peltier, Moore, Gueorguieva, & McKee, 2020). However, compared to studies of CC use and alcohol, there is far less knowledge regarding the co-occurring use of EC and alcohol. Consequently, there is a need to examine the use of EC, CC, and alcohol, which may be associated with more severe or different risk factors than dual or exclusive use of any of these three substances.

Internalizing (e.g., depression and anxiety) and externalizing [e.g., attention-deficit hyperactivity disorder (ADHD) and conduct disorder] psychopathology (American Psychiatric Association, 2013; Conway, Green, Kasza, Silveira, Borek, & Kimmel, 2017; Hasin & Grant, 2015; McClernon & Kollins, 2008; Smith, Mazure, & McKee, 2014; Ziedonis et al., 2008) are important mental health factors that have been consistently associated with exclusive use of either CC or alcohol. A meta-analysis reported that current

CC smokers had a two-fold increased risk of depression relative to never and former CC users (Luger, Suls, & Weg, 2014). Further, adults with depression are more likely to smoke and are less likely to be successful at quitting than adults without depression (Mathew, Hogarth, Leventhal, Cook, & Hitsman, 2017). Whether this bidirectional association is maintained among EC users is unclear. The relationship between the use of alcohol, CC, and EC, and internalizing and externalizing psychopathology is currently undetermined. Prior studies of the relationship between psychopathology and tobacco products, specifically EC, as well as alcohol typically focus on youth and young adults. These findings indicate that ECs are commonly used with other substances (i.e., CC, alcohol, marijuana and opiates) and associated with mental health symptomatology (i.e., diagnosis of ADHD, PTSD, anxiety, and substance use disorders) (Grant, Lust, Fridberg, King, & Chamberlain, 2019; Hefner, Sollazzo, Mullaney, Coker, & Sofuoglu, 2019; Vallone et al., 2020; Wong, Lin, Piper, Siddiqui, & Buu, 2019). However, it is unclear if these associations are specific to youth and young adults, or if they also occur across adulthood.

This study addresses the aforementioned knowledge gaps by examining the association of lifetime mental disorder symptom severity and past 30-day combinations of CC, EC, and alcohol use. We asked the following questions: (1) is there an association between internalizing/externalizing severity across combinations of CC, EC, and alcohol use in US adults, and (2) is there a difference in severity based on tobacco product type (CC vs. EC)? We expect (1) a significant, positive association between internalizing/externalizing severity across all combinations of CC, EC, and alcohol use. For exploratory aim (2), we expect that this association varies with type and number of tobacco products used (i. e., CC associated with internalizing; EC associated with externalizing/internalizing; CC + EC associated with internalizing/externalizing).

2. Materials and methods

2.1. Study material and participants

Data from 32,320 adults aged 18 years and older participating in the first wave (2013–2014) of the Population Assessment of Tobacco and Health (PATH) study were used (United States Department of Health and Human Services. National Institutes of Health, 2019). PATH is a nationally representative longitudinal cohort study of the civilian, noninstitutionalized adult household population of the US, and as such, participants engaged in all levels of tobacco use (Hyland et al., 2017). The household screener response rate was 54% (United States Department of Health and Human Services. National Institutes of Health, 2019). The weighted response rate among participants was 74% (Conway et al., 2017).

2.2. Study representativeness

Participants with missing data on tobacco and alcohol measures, mental health symptoms, or covariates were not included in the analysis (N = 16,373). Survey respondents of the analytic sample endorsed greater substance use overall, internalizing/externalizing severity, and nicotine dependence (ND) than those not included in the analytic sample. The participants in the analytic sample were more likely to be men, aged 25–54 with lower levels of education and lower annual household income than those who were missing.

2.3. Measures

2.3.1. Current tobacco and alcohol use—Current tobacco and alcohol use was measured as an aggregate variable indicating the degree of past-month use of CC, EC, and alcohol, and was developed from individual current-use items defined according to the National Health Interview Survey (2017) and listed in Supplemental Table 1 (National Center for Health Statistics, Centers for Disease Control and Prevention, 2013).

The outcome variable was developed as an eight-level categorical variable: (1) alcohol-exclusive; (2) CC-exclusive; (3) EC-exclusive; (4) CC and alcohol; (5) EC and alcohol; (6) CC and EC; (7) alcohol, CC, and EC; and (8) non-use. This variable allowed us to evaluate the relationships between all combinations of alcohol, CC, and EC use and internalizing/externalizing severity, with non-users as a reference group.

2.3.2. Internalizing/externalizing severity—Internalizing and externalizing severity was measured in PATH using the Global Appraisal of Individual Needs—Short Screener (GAIN-SS) (Conway et al., 2017). The GAIN-SS is derived from the full GAIN instrument assessing individuals at risk for mental disorders using a continuous measure of severity. The full GAIN assessment is a reliable and validated biopsychosocial assessment recommended for use in epidemiologic samples (Conway et al., 2017; Dennis, Chan, & Funk, 2006; Garner, Belur, & Dennis, 2013). There was good internal consistency among the internalizing (Cronbach's $\alpha = 0.85$) and externalizing (Cronbach's α 0.80) items in the analytic sample.

Items used to measure internalizing/externalizing symptoms are listed in Supplemental Table 2. Responses were measured across four time periods: past month, 2–12 months, over a year ago, and never. Lifetime internalizing/externalizing scale scores (i.e., participants indicating past month, 2–12 months, or over a year ago) were categorized and treated as ordinal variables with low (0), moderate (1–2), and high (3+) symptom severity. These cut points were previously recommended on the basis of validation analyses of the dimensional measures and have high predictive validity in other samples (Conway et al., 2017; Dennis et al., 2006; Garner et al., 2013). Higher scores indicate increased severity, a greater likelihood for diagnosis with a mental health disorder, and increased need for services (Conway et al., 2017). Internalizing/externalizing severity were highly correlated with one another ($r = 0.68$, $ASE = 0.0051$, $p < 0.001$).

2.3.3. Covariates—The role of nicotine dependence (ND) was included as a potential confounder. Adults with mental health disorders may have higher levels of ND as a result of tobacco product use (Goodwin, Zvolensky, Keyes, & Hasin, 2012; Grant, Hasin, Chou, Stinson, & Dawson, 2004). Similarly, there is a strong association between ND and all levels of alcohol use (Drobes, 2002). People who engage in EC and CC dual use have greater ND than exclusive use of either EC or CC (Jankowski et al., 2019; Rostron, Schroeder, & Ambrose, 2016). Sixteen items [8 from Wisconsin Inventory of Smoking Dependence Motives (WIDSM): Primary, 3 from WISDM: Secondary, 4 from Nicotine Dependence Syndrome Scale (NDSS), 1 from Diagnostic and Statistical Manual of Mental Disorders (DSM): Impaired Control] were used to measure ND and are listed in Supplemental Table

2. These 16 items were recommended to use as a common instrument to assess ND across different kinds of tobacco product users from a differential item function analysis (Strong et al., 2017). The items were summed into one continuous variable ranging from 0 to 76, with higher values indicating greater ND.

Sex, age, race/ethnicity, education, and annual household income were also included as covariates because they are consistently associated with mental health, and tobacco and alcohol use (Ames, Stevens, Chudley, Carlson, Schroeder, Kiros, & Kenneth, 2010; Bizzarri et al., 2016; Cance, Talley, Morgan-Lopez, & Fromme, 2017; Caton, Xie, Drake, & McHugo, 2014; Choi, DiNitto, & Marti, 2015; Colder et al., 2013; Conway et al., 2017; Galea, Ahern, Tracy, & Vlahov, 2007; Hrywna, Bover Manderski, & Delnevo, 2014; Karriker-jaffe, 2013; Keyes et al., 2015; Peiper & Rodu, 2013).

Age, measured in PATH as a seven-level categorical variable, was re-categorized to have uniform distribution with six levels (18–24, 25–34, 35–44, 45–54, 55–64, and 65 years or older). Education, measured in PATH as a six-level categorical variable, was re-categorized as a five-level categorical variable with a uniform distribution [less than high school, GED/high school graduate, some college (no degree) or Associate's degree, Bachelor's degree, and Advanced degree]. Race/ethnicity was measured as a four-level categorical race variable and included information from a separate variable that accounted for Hispanic ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other, and Hispanic Multicultural). The significance of the association between these variables and tobacco and alcohol use was tested as a series of unadjusted multinomial logistic regressions (Table 2).

2.4. Statistical analyses

Chi-square tests were used to test for significant differences between each variable. Unadjusted multinomial logistic regression was used to test the association between tobacco and alcohol use and internalizing/externalizing severity. Tests were repeated after adjustment for sex, age, race, education, and annual household income. Two adjusted multinomial regression models were considered: the first model included only internalizing/externalizing severity, adjusting for the correlation between the two factors, while the second model also included ND to determine the degree to which ND explained the association between mental health severity and substance use. Odds ratios (OR) or adjusted odds ratios (AOR) and 95% confidence intervals (95% CI), profiled from estimates of standard error, are reported. All analyses were performed in SAS software, Version 9.4 (SAS Institute Inc, Cary, NC) and accounted for complex survey design and sampling weight using PROC SURVEYFREQ and PROC SURVEYLOGISTIC. Fay's method, a variant of balanced repeated replication method, was used to form replication weights in variance estimation in all analyses.

3. Results

3.1. Descriptive statistics

Data from 15,947 participants with complete information were analyzed. Almost one quarter of the population engaged in alcohol-exclusive use (24.0%), 22.4% in CC-exclusive use, and 1.3% in EC-exclusive use (Table 1). Across the different combinations of tobacco and

alcohol use, 33.3% engaged in CC and alcohol use, 1.7% engaged in EC and alcohol use, 2.0% engaged in CC and EC, and 3.2% engaged in alcohol, CC, and EC use. Almost half of the sample endorsed high internalizing (47.9%) and high externalizing (44.7%) severity. The mean ND was 37.0 (range 1–76, standard deviation 0.23) for the sample (Table 1).

3.2. Unadjusted multinomial logistic regression analysis

Compared to subjects with low internalizing severity, those with high internalizing severity were significantly more likely to engage in alcohol, CC, and EC use (OR = 3.42, 95% CI = 2.48–4.72), CC and EC use (OR = 2.24, 95% CI = 1.63–3.08), EC and alcohol use (OR = 2.20, 95% CI = 1.57–3.09), CC and alcohol use (OR = 2.28, 95% CI = 1.97–2.65), CC-exclusive use (OR = 1.69, 95% CI = 1.42–2.02), and alcohol-exclusive use (OR = 1.42, 95% CI = 1.20–1.69) than no use. Relative to those with low externalizing severity, subjects with high externalizing severity were more likely than not to engage in every level of tobacco and alcohol use except EC use, especially alcohol, CC, and EC use (OR = 4.56, 95% CI = 3.31–6.30) and EC and alcohol use (OR = 4.23, 95% CI = 2.84–6.29). There were significant, positive associations between ND and alcohol, CC, and EC use (OR = 1.05, 95% CI = 1.05–1.06), CC and EC use (OR = 1.08, 95% CI = 1.07–1.08), CC and alcohol use (OR = 1.05, 95% CI = 1.04–1.05), and CC-exclusive use (OR = 1.06, 95% CI = 1.06–1.07). Females, relative to males, had significantly increased odds for CC and EC use (OR = 1.74, 95% CI = 1.35–2.25), CC and alcohol use (OR = 1.21, 95% CI = 1.06–1.38), EC-exclusive use (OR = 1.99, 95% CI = 1.45–2.74), and CC-exclusive use (OR = 1.65, 95% CI = 1.43–1.90), except for alcohol-exclusive use (OR = 0.71, 95% CI = 0.61–0.84). There were significant associations by age, race, education, and annual household income (Table 2).

3.3. Adjusted multinomial logistic regression analysis

3.3.1. Model 1: Internalizing/externalizing severity—Compared to subjects with low internalizing severity, those with high internalizing severity were significantly more likely to engage in alcohol, CC, and EC use (AOR = 2.01, 95% CI = 1.30–3.09), CC and alcohol use (AOR = 1.61, 95% CI = 1.30–2.00), and CC-exclusive use (AOR = 1.42, 95% CI = 1.13–1.79) than none (Table 3). Participants with moderate internalizing severity, compared to low, were significantly more likely to engage in CC and alcohol use (AOR = 1.52, 95% CI = 1.27–1.81), CC-exclusive use (AOR = 1.26, 95% CI = 1.01–1.58), and alcohol-exclusive use (AOR 1.53, 95% CI 1.24–1.90) than none. Participants with high externalizing severity, compared to low, had 113% greater odds of alcohol, CC, and EC use (AOR = 2.13, 95% CI = 1.36–3.34), 54% greater odds of CC and EC use (AOR = 1.54, 95% CI = 1.04–2.28), 196% greater odds of EC and alcohol use (AOR = 2.96, 95% CI = 1.82–4.80), 74% greater odds of CC and alcohol use (AOR = 1.74, 95% CI = 1.38–2.20), and 69% greater odds of alcohol-exclusive use (AOR 1.69, 95% CI 1.33–2.14) than no use. Participants with moderate externalizing severity, compared to low, were significantly more likely to engage in alcohol, CC, and EC use (AOR = 1.56, 95% CI = 1.02–2.40), EC and alcohol use (AOR = 2.32, 95% CI = 1.55–3.46), CC = and alcohol use (AOR = 1.54, 95% CI = 1.26–1.88), alcohol-exclusive use (AOR 1.60, 95% CI 1.32–1.94) than no use.

Participants with high internalizing severity, compared to low, had the greatest odds for alcohol, CC, and EC use rather than no use while adjusting for externalizing severity, sex, age, race, education, and annual household income. Participants with high externalizing severity, compared to low, had the greatest odds for EC and alcohol use rather than no use while adjusting for internalizing severity, sex, age, race, education, and annual household income.

3.3.2. Model 2: internalizing, externalizing, and ND—Compared to subjects with low internalizing severity, those with high internalizing severity were more likely to engage in CC and alcohol use (AOR = 1.29, 95% CI = 1.03–1.61) and alcohol-exclusive use (AOR = 1.31, 95% CI = 1.05–1.64) than no use (Table 4). Similar associations were found between moderate internalizing severity, relative to low, and CC and alcohol use (AOR = 1.47, 95% CI = 1.22–1.77) and alcohol-exclusive use (AOR = 1.58, 95% CI = 1.27–1.96) than no use. Participants with high externalizing severity, compared to low, had 79% greater odds for alcohol, CC, and EC use (AOR = 1.79, 95% CI = 1.15–2.78), 197% greater odds of EC and alcohol use (AOR = 2.97, 95% CI = 1.84–4.81), 53% greater odds of CC and alcohol use (AOR = 1.53, 95% CI = 1.21–1.92), and 75% greater odds of alcohol-exclusive use (AOR = 1.75, 95% CI = 1.38–2.22) than no use. Subjects with moderate externalizing severity, compared to low, were more likely to engage in EC and alcohol use (AOR = 2.29, 95% CI = 1.53–3.43), CC and alcohol use (AOR = 1.41, 95% CI = 1.16–1.72), and alcohol-exclusive use (AOR 1.62, 95% CI = 1.33–1.97) than no use when adjusting for ND. ND was significantly associated with all combinations of tobacco and alcohol use, compared to none, except for EC and alcohol use (AOR = 1.00, 95% CI = 0.99–1.01) and EC-exclusive use (AOR = 1.00, 95% CI = 0.99–1.01).

Participants with high internalizing severity, compared to low, had the greatest odds for alcohol-exclusive use rather than no use while adjusting for externalizing severity, ND, sex, age, race, education, and annual household income. Participants with high externalizing severity, compared to low, had the greatest odds for EC and alcohol use rather than no use while adjusting for internalizing severity, ND, sex, age, race, education, and annual household income.

Additional models compared results across all categories of reference groups to establish differences for each category of tobacco/alcohol use (Supplemental Table 3). All significant associations between internalizing/externalizing severity and tobacco and alcohol combinations were significantly lower when referencing alcohol, CC, and EC as well as EC and alcohol use. Conversely, significant positive associations were found between internalizing/externalizing severity and tobacco and alcohol combinations when referencing CC and EC use, EC-exclusive, and CC-exclusive. Results were mixed when referencing CC and alcohol use, and alcohol-exclusive use.

4. Discussion

Our study is one of the first to examine the relationships between internalizing/externalizing severity and combinations of CC, EC, and alcohol use across adulthood. There were three major results. First, strong, positive associations with internalizing/externalizing severity at

various levels of CC, EC, and alcohol use were detected. Overall, internalizing severity was more strongly associated with CC and alcohol use as well as alcohol-exclusive use while externalizing severity was more strongly associated with EC and alcohol use when accounting for ND. Second, the relationship between externalizing severity with EC use is dependent on alcohol being used with EC. Alcohol was significantly associated with psychopathology when EC was included. Third, ND may mediate the relationship between internalizing/externalizing severity and various levels of CC, EC, and alcohol use.

4.1. Patterns of tobacco and alcohol use vary by internalizing/externalizing severity

We detected specific patterns of association between tobacco and alcohol use with internalizing/externalizing severity. Specifically, high internalizing severity had a higher magnitude of association with CC and alcohol use as well as alcohol-exclusive use. In contrast, externalizing severity was more strongly associated with EC and alcohol use. These results expand on recent positive associations that were detected between mental disorder symptoms and exclusive use of tobacco products in adults (Conway et al., 2017). Specifically, the presence of multiple mental disorder symptoms (i.e., higher severity) was generally associated with use of more than one substance, with the exception of alcohol. To date, individuals with co-occurring mental health disorders have been reported to have a more severe course of illness, health and social consequences, more difficulties when seeking and in treatment, or worse treatment outcomes than people with a single disorder (Morisano, Babor, & Robaina, 2014). Additionally, tobacco use has been reported to be higher among people with mental health problems (e.g., major depressive disorder, generalized anxiety, schizophrenia, and/or antisocial personality/conduct disorder) (Andreas, Lauritzen, & Nordfjaern, 2015; Bandiera et al., 2015; Smith et al., 2014). These results suggest that patterns, rather than a dose–response, of tobacco and alcohol use are associated with internalizing/externalizing severity and require further investigation.

4.2. EC use associated with externalizing severity with co-occurring alcohol use

Internalizing/externalizing severity were not significantly associated with EC-exclusive use. This is inconsistent with previous work, perhaps due to differences in defining EC use (Conway et al., 2017). Specifically, we expanded our study of "EC use" to include a commonly occurring form of tobacco use-dual use of EC and CC. Our results provide a more detailed and nuanced description of the relationship between internalizing/ externalizing psychopathology and EC use by parsing out co-occurring CC and alcohol use from EC.

Concurrent EC and alcohol use, however, was significantly associated with externalizing severity. Further, compared to low externalizing severity, high and moderate externalizing severity showed stronger association with alcohol use of any kind (i.e., alcohol, CC, and EC use; EC and alcohol use; CC and alcohol use; and alcohol-exclusive use). This association between externalizing and alcohol is consistent with prior studies (Carragher, Krueger, Eaton, & Slade, 2015; Eaton, Rodriguez-Seijas, Carragher, & Krueger, 2015; Krueger, 1999), and this association remains when ECs are used with alcohol. This finding builds upon previous work that has established more harmful alcohol use with EC use in that externalizing symptoms are associated with this pattern of use. More research is needed to

better understand the relationship between different combinations of tobacco and alcohol, including EC, and psychopathology.

4.3. ND may mediate the relationship between internalizing/externalizing severity and current tobacco and alcohol use in adults

The magnitude of the associations between internalizing/externalizing severity and levels of tobacco/alcohol use were reduced, although generally remained significant, when ND was included. The associations between internalizing severity and alcohol, CC, and EC use and CC-exclusive use as well as externalizing severity and CC and EC use were no longer statistically significant. ND may explain more of the relationship between internalizing severity and alcohol, CC, and EC use as well as CC-exclusive use. Previous work has indicated that externalizing behaviors act as a precursor or factor involved in substance use especially alcohol use (Carragher et al., 2015; Eaton et al., 2015; Krueger, 1999). Therefore, the relationship between externalizing severity and alcohol use in adults, whether exclusive or with tobacco, is expected to be mediated through ND. In an ad hoc mediation analysis (Rosseel, 2012), ND was determined to be a significant mediator between internalizing/ externalizing and tobacco and alcohol use. We also included a test for SUD severity (GAIN-SS) as a mediator in models including ND since it measures broader substance use behavior, including alcohol. However, no significant direct or indirect effect of SUD was detected. As mediation is inherently a causal hypothesis, we recommend future researchers to confirm this with a longitudinal analysis to accurately model a mediation pathway in context of the transactional effect between tobacco initiation and ND development.

4.4. Strengths and limitations

These results should be interpreted while considering the following points. First, these data were collected in 2013–2014, so these analyses do not capture more recent EC products (i.e., pod-mods). Consequently, these findings may not be generalizable to the current generation of EC devices. Second, the analytic sample size was reduced from the Wave 1 sample after removing participants with missing data. Many participants (N = 13,865) were removed due to a skip pattern identified for the ND items used to calculate the composite ND item. If a participant was not a current tobacco user, a former 12-month tobacco user, or a current experimental tobacco user, they were not asked the ND items. ND is contingent upon tobacco initiation (Maes et al., 2004); therefore, it was inappropriate to code these missing observations as 0. Therefore, there is systematic bias introduced; however, results from sensitivity analyses did not demonstrate differences that would alter the overall study conclusions. Third, use of self-reported data has the potential to introduce misclassification bias, which may underestimate the magnitude of associations. However, this would lead to an attenuation of effect sizes, rather than an overestimation. Fourth, the GAIN-SS measures internalizing/externalizing symptom severity rather than psychiatric diagnoses. We recognize use of symptom data as a strength as we are more likely to capture true rates of mental health disorders without relying on disease-specific diagnoses. There is growing support for the use of subthreshold or transdiagnostic symptoms over traditional diagnoses to better explain the high rates of comorbidity among common mental disorders, particularly when characterizing population-based samples (Rodriguez-Seijas, Stohl, Hasin, & Eaton, 2015). Therefore, these results represent the full distribution of severity across

several mental health domains. Fifth, to answer our research questions this study focused on current CC, EC, and alcohol use, and ND. We were unable to determine if ND was due to the CC or EC use or another tobacco product that was not included in these analyses. Future studies are encouraged to explore direct associations with other tobacco products and ND. Sixth, by using only data from Wave 1, direction of causation cannot be determined and future longitudinal studies are needed.

5. Conclusions

Internalizing and externalizing severity was strongly associated with multiple levels of CC, EC, and alcohol use in this study. The magnitude of association varied by the tobacco product used. Overall, internalizing severity was more strongly associated with CC and alcohol use as well as alcohol-exclusive use while externalizing severity was more strongly associated with EC and alcohol use when accounting for ND. Alcohol is responsible for the externalizing psychopathology when EC is included. The magnitudes of these associations were reduced when ND was included in the model, indicating that ND likely mediates the association between internalizing/externalizing severity and current tobacco and alcohol use. Future work is encouraged to investigate the different patterns of tobacco and alcohol use since our results suggest patterns of use rather than a dose–response relationship between tobacco and alcohol use and internalizing/externalizing severity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

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Table 1

Overall Frequencies of the Analytic Sample (n = 15,947, Weighted N = 61,482,491)—PATH Wave 1 (2013–2014).

	n (Weighted %)		n (Weighted %)
Sex *		**Internalizing Severity** *	
Male	9039 (59.6)	Low	4310 (28.1)
Female	6908 (40.4)	Moderate	3731 (24.0)
Age *		High	7906 (47.9)
18–24 years old	4304 (17.7)	**Externalizing Severity** *	
25–34 years old	3580 (24.3)	Low	4058 (26.8)
35–44 years old	2696 (18.3)	Moderate	4436 (28.5)
45–54 years old	2579 (18.5)	High	7453 (44.7)
55–64 years old	1871 (14.1)	**Nicotine Dependence**	
65 years or older	917 (7.1)		37.0 (0.23) [a]
Race *		**Tobacco and Alcohol Use** *	
Non-Hispanic White	10,257 (68.2)	Alcohol only	3603 (24.0)
Non-Hispanic Black	2305 (13.8)	CC only	3678 (22.4)
Non-Hispanic Other	1218 (6.4)	EC only	219 (1.3)
Hispanic Multiracial	2167 (11.7)	CC and Alcohol	5387 (33.3)
Education *		EC and Alcohol	288 (1.7)
Less than high school	2304 (13.4)	CC and EC	336 (2.0)
GED/High school graduate	5385 (35.5)	Alcohol, CC, and EC	558 (3.2)
Some college (no degree) or Associate's degree	5931 (34.9)	None	1878 (12.2)
Bachelor's degree	1685 (11.9)		
Advanced degree	642 (4.3)		
Annual Household Income *			
Less than $10,000	3532 (19.5)		
$10,000 to $24,999	4120 (24.8)		
$25,000 to $49,999	3746 (24.2)		
$50,000 to $99,999	2974 (20.2)		
$100,000 or more	1575 (11.4)		

*
Indicates a significant difference at p < 0.05.

[a]Indicates mean and standard deviation (95% CL for the mean = 36.6–37.5)

Table 2

Summary of Unadjusted Bivariate Associations by Level of Current Tobacco and Alcohol Use (n = 15,947, Weighted N = 61,482,491).

Variable	Alcohol, Cigarette, and E-cigarette OR (95% CI)	Cigarette and E-cigarette OR (95% CI)	E-cigarette and Alcohol OR (95% CI)	Cigarette and Alcohol OR (95% CI)	E-cigarette Only OR (95% CI)	Cigarette Only OR (95% CI)	Alcohol Only OR (95% CI)
Internalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	1.71 (1.14–2.56)	1.50 (0.96–2.36)	1.36 (0.89–2.08)	1.79 (1.52–2.11)	1.12 (0.71–1.77)	1.37 (1.10–1.71)	1.66 (1.36–2.01)
High	3.42 (2.48–4.72)	2.24 (1.63–3.08)	2.20 (1.57–3.09)	2.28 (1.97–2.65)	1.30 (0.89–1.88)	1.69 (1.42–2.02)	1.42 (1.20–1.69)
Externalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	2.32 (1.59–3.39)	1.67 (1.15–2.42)	2.84 (1.91–4.23)	2.00 (1.68–2.38)	1.01 (0.67–1.52)	1.21 (1.01–1.43)	2.04 (1.70–2.44)
High	4.56 (3.31–6.30)	2.22 (1.61–3.05)	4.23 (2.84–6.29)	2.58 (2.19–3.03)	1.31 (0.89–1.94)	1.31 (1.11–1.55)	2.29 (1.91–2.76)
Nicotine Dependence	1.05 (1.05–1.06)	1.08 (1.07–1.08)	1.00 (0.99–1.01)	1.05 (1.04–1.05)	1.00 (0.99–1.01)	1.06 (1.06–1.07)	0.97 (0.96–0.97)
Sex							
Male	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Female	1.24 (0.98–1.56)	1.74 (1.35–2.25)	1.26 (0.94–1.69)	1.21 (1.06–1.38)	1.99 (1.45–2.74)	1.65 (1.43–1.90)	0.71 (0.61–0.84)
Age							
18–24 years old	Reference	Reference	Reference	Reference	Reference	Reference	Reference
25–34 years old	1.75 (1.37–2.25)	3.62 (2.53–5.20)	1.69 (1.21–2.35)	2.42 (2.02–2.89)	1.86 (1.08–3.20)	2.53 (2.04–3.12)	1.40 (1.17–1.67)
35–44 years old	1.28 (0.87–1.88)	2.93 (2.00–4.31)	0.84 (0.55–1.30)	1.95 (1.57–2.42)	1.49 (0.89–2.51)	2.27 (1.81–2.86)	0.90 (0.72–1.12)
45–54 years old	0.57 (0.41–0.79)	1.78 (1.15–2.75)	0.69 (0.44–1.10)	1.55 (1.28–1.87)	2.01 (1.26–3.21)	2.25 (1.89–2.68)	0.76 (0.63–0.93)
55–64 years old	0.46 (0.32–0.66)	1.99 (1.31–3.02)	0.64 (0.38–1.07)	1.21 (0.98–1.49)	1.04 (0.60–1.80)	2.02 (1.64–2.49)	0.63 (0.48–0.83)
65 years or older	0.16 (0.07–0.35)	1.42 (0.70–2.88)	0.31 (0.14–0.66)	0.60 (0.47–0.76)	1.03 (0.51–2.11)	1.90 (1.47–2.47)	0.47 (0.36–0.61)
Race							
White	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Non-Hispanic Black	0.23 (0.16 0.35)	0.35 (0.23–0.55)	0.45 (0.27–0.73)	0.61 (0.51–0.73)	0.37 (0.20–0.67)	0.50 (0.42–0.60)	0.63 (0.51–0.77)
Non-Hispanic Other	0.70 (0.44–1.12)	0.60 (0.38–0.94)	0.98 (0.56–1.72)	0.72 (0.56–0.91)	1.00 (0.57–1.76)	0.66 (0.53–0.82)	0.81 (0.62–1.06)
Hispanic Multicultural	0.32 (0.23–0.46)	0.32 (0.20–0.52)	0.35 (0.22–0.57)	0.48 (0.40–0.57)	0.58 (0.40–0.86)	0.50 (0.41–0.61)	0.67 (0.53–0.83)
Education							

Variable	Alcohol, Cigarette, and E-cigarette OR (95% CI)	Cigarette and E-cigarette OR (95% CI)	E-cigarette and Alcohol OR (95% CI)	Cigarette and Alcohol OR (95% CI)	E-cigarette Only OR (95% CI)	Cigarette Only OR (95% CI)	Alcohol Only OR (95% CI)
Less than high school	Reference	Reference	Reference	Reference	Reference	Reference	Reference
GED/High school	**2.30 (1.61–3.28)**	1.15 (0.75–1.78)	**2.22 (1.16–4.26)**	**1.50 (1.24–1.81)**	1.51 (0.90–2.53)	0.96 (0.80–1.17)	**1.74 (1.39–2.17)**
Some college	**4.79 (3.28–6.99)**	**1.72 (1.16–2.56)**	**4.75 (2.60–8.67)**	**2.13 (1.78–2.56)**	**2.31 (1.46–3.64)**	0.96 (0.80–1.15)	**3.58 (2.89–4.43)**
Bachelor's degree	**4.91 (3.26–7.39)**	1.68 (0.99–2.86)	**5.04 (2.47–10.32)**	**2.34 (1.85–2.97)**	**1.86 (1.00–3.46)**	**0.65 (0.48–0.88)**	**7.16 (5.41–9.49)**
Advanced degree	**3.67 (1.98–6.82)**	0.69 (0.28–1.69)	2.32 (0.62–8.63)	**1.50 (1.07–2.10)**	1.85 (0.75–4.56)	**0.40 (0.27–0.59)**	**6.73 (4.80–9.44)**
Income							
<$10,000	Reference	Reference	Reference	Reference	Reference	Reference	Reference
$10,000–24,999	**1.94 (1.42–2.64)**	**1.49 (1.05–2.12)**	1.31 (0.82–2.09)	**1.33 (1.09–1.62)**	1.07 (0.62–1.83)	**1.26 (1.03–1.54)**	**1.30 (1.07–1.59)**
$25,000–49,000	**2.59 (1.85–3.62)**	1.41 (0.98–2.02)	**2.00 (1.41–2.83)**	**1.63 (1.36–1.97)**	1.21 (0.77–1.92)	1.08 (0.89–1.31)	**1.66 (1.35–2.05)**
$50,000–99,999	**2.95 (2.01–4.32)**	1.33 (0.86–2.05)	**3.03 (2.06–4.46)**	**1.98 (1.58–2.48)**	**1.82 (1.07–3.08)**	0.90 (0.71–1.14)	**3.04 (2.42–3.82)**
$100,000	**2.88 (1.83–4.53)**	1.06 (0.59–1.91)	**3.37 (2.16–5.24)**	**1.72 (1.38–2.14)**	1.33 (0.68–2.62)	**0.53 (0.38–0.72)**	**5.07 (3.91–6.57)**

Bolded values indicate estimate significant a p < 0.05

The "none" category is used in reference for the tobacco and alcohol use outcome.

Table 3

Model 1 - Multinomial Logistic Regression for Level of Current Tobacco and Alcohol Use (n = 15,947, Weighted N = 61,482,491).

Variable	Alcohol, Cigarette, and E-cigarette AOR (95% CI)	Cigarette and E-cigarette AOR (95% CI)	E-cigarette and Alcohol AOR (95% CI)	Cigarette and Alcohol AOR (95% CI)	E-cigarette Only AOR (95% CI)	Cigarette Only AOR (95% CI)	Alcohol Only AOR (95% CI)
Internalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	1.37 (0.88–2.13)	1.23 (0.77–1.98)	0.98 (0.61–1.56)	**1.52 (1.27–1.81)**	1.03 (0.64–1.67)	**1.26 (1.01–1.58)**	**1.53 (1.24–1.90)**
High	**2.01 (1.30–3.09)**	1.46 (0.99–2.14)	1.20 (0.78–1.83)	**1.61 (1.30–2.00)**	1.00 (0.62–1.61)	**1.42 (1.13–1.79)**	1.21 (0.97–1.51)
Externalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	**1.56 (1.02–2.40)**	1.33 (0.90–1.97)	**2.32 (1.55–3.46)**	**1.54 (1.26–1.88)**	0.88 (0.57–1.37)	1.04 (0.86–1.25)	**1.60 (1.32–1.94)**
High	**2.13 (1.36–3.34)**	**1.54 (1.04–2.28)**	**2.96 (1.82–4.80)**	**1.74 (1.38–2.20)**	1.15 (0.69–1.93)	1.04 (0.82–1.32)	**1.69 (1.33–2.14)**
Sex							
Male	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Female	1.11 (0.87–1.40)	**1.57 (1.19–2.06)**	1.23 (0.91–1.66)	1.12 (0.98–1.29)	**2.01 (1.45–2.79)**	**1.52 (1.30–1.78)**	0.72 (0.61–0.84)
Age							
18–24 years old	Reference	Reference	Reference	Reference	Reference	Reference	Reference
25–34 years old	**1.72 (1.33–2.23)**	**3.95 (2.73–5.71)**	**1.70 (1.22–2.39)**	**2.44 (2.03–2.93)**	**1.97 (1.12–3.47)**	**2.74 (2.21–3.40)**	1.21 (0.99–1.47)
35–44 years old	1.22 (0.85–1.76)	**3.25 (2.17–4.87)**	0.80 (0.52–1.23)	**1.93 (1.55–2.42)**	1.54 (0.90–2.64)	**2.53 (2.00–3.20)**	**0.70 (0.55–0.89)**
45–54 years old	**0.57 (0.41–0.80)**	**1.90 (1.20–3.00)**	0.70 (0.43–1.12)	**1.54 (1.27–1.87)**	**2.08 (1.28–3.39)**	**2.32 (1.92–2.80)**	**0.65 (0.53–0.80)**
55–64 years old	**0.48 (0.33–0.70)**	**2.13 (1.39–3.28)**	0.68 (0.40–1.17)	1.23 (0.98–1.54)	1.11 (0.63–1.94)	**2.07 (1.65–2.60)**	**0.55 (0.41–0.73)**
65 years or older	**0.19 (0.09–0.40)**	1.58 (0.76–3.30)	**0.38 (0.17–0.85)**	**0.66 (0.50–0.88)**	1.13 (0.53–2.42)	**1.89 (1.41–2.54)**	**0.43 (0.32–0.59)**
Race							
White	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Non-Hispanic Black	**0.32 (0.21–0.48)**	**0.36 (0.23–0.57)**	0.64 (0.38–1.08)	**0.73 (0.60–0.88)**	**0.40 (0.22–0.73)**	**0.44 (0.37–0.53)**	1.00 (0.81–1.25)
Non-Hispanic Other	**0.59 (0.38–0.93)**	**0.60 (0.38–0.94)**	0.89 (0.51–1.56)	**0.69 (0.55–0.88)**	1.06 (0.62–1.81)	**0.72 (0.58–0.89)**	**0.64 (0.49–0.84)**
Hispanic	**0.36 (0.25–0.52)**	**0.33 (0.20–0.54)**	**0.43 (0.26–0.73)**	**0.54 (0.44–0.66)**	**0.66 (0.44–0.99)**	**0.47 (0.38–0.59)**	0.90 (0.71–1.14)
Multicultural							
Education							
Less than high school	Reference	Reference	Reference	Reference	Reference	Reference	Reference

Variable	Alcohol, Cigarette, and E-cigarette AOR (95% CI)	Cigarette and E-cigarette AOR (95% CI)	E-cigarette and Alcohol AOR (95% CI)	Cigarette and Alcohol AOR (95% CI)	E-cigarette Only AOR (95% CI)	Cigarette Only AOR (95% CI)	Alcohol Only AOR (95% CI)
GED/High school	**1.68 (1.15–2.44)**	0.98 (0.62–1.53)	1.63 (0.83–3.22)	**1.23 (1.01–1.50)**	1.32 (0.79–2.22)	0.90 (0.73–1.10)	**1.43 (1.12–1.82)**
Some college	**2.65 (1.77–3.97)**	1.32 (0.85–2.05)	**2.62 (1.39–4.97)**	**1.51 (1.23–1.86)**	**1.79 (1.12–2.86)**	0.89 (0.72–1.09)	**2.46 (1.94–3.13)**
Bachelor's degree	**2.48 (1.63–3.77)**	1.25 (0.69–2.28)	**2.25 (1.07–4.72)**	**1.50 (1.15–1.96)**	1.31 (0.72–2.40)	**0.63 (0.46–0.87)**	**4.13 (3.04–5.62)**
Advanced degree	**2.05 (1.07–3.90)**	0.53 (0.21–1.35)	1.06 (0.29–3.95)	0.97 (0.68–1.40)	1.29 (0.53–3.15)	**0.41 (0.28–0.59)**	**3.82 (2.59–5.63)**
Income							
<$10,000	Reference	Reference	Reference	Reference	Reference	Reference	Reference
$10,000–24,999	**1.78 (1.28–2.48)**	1.28 (0.88–1.85)	1.22 (0.76–1.97)	**1.25 (1.01–1.56)**	0.95 (0.56–1.61)	1.12 (0.90–1.40)	**1.26 (1.03–1.54)**
$25,000–49,000	**2.05 (1.44–2.93)**	1.05 (0.72–1.53)	**1.70 (1.17–2.48)**	**1.38 (1.12–1.71)**	0.98 (0.61–1.57)	0.92 (0.74–1.14)	**1.39 (1.12–1.73)**
$50,000–99,999	**2.17 (1.46–3.23)**	0.94 (0.59–1.48)	**2.47 (1.62–3.77)**	**1.61 (1.24–2.07)**	1.37 (0.81–2.32)	**0.76 (0.59–0.99)**	**2.22 (1.74–2.82)**
$100,000	**2.04 (1.26–3.29)**	0.80 (0.43–1.50)	**2.76 (1.72–4.41)**	**1.43 (1.11–1.85)**	1.03 (0.51–2.06)	**0.51 (0.36–0.72)**	**3.13 (2.33–4.22)**

Bolded values indicate estimate significant a p < 0.05

The "none" category is used in reference for the tobacco and alcohol use outcome.

Table 4

Model 2 - Multinomial Logistic Regression for Level of Current Tobacco and Alcohol Use (Including Nicotine Dependence) (n = 15,947, Weighted N = 61,482,491).

Variable	Alcohol, Cigarette, and E-cigarette AOR (95% CI)	Cigarette and E-cigarette AOR (95% CI)	E-cigarette and Alcohol AOR (95% CI)	Cigarette and Alcohol AOR (95% CI)	E-cigarette Only AOR (95% CI)	Cigarette Only AOR (95% CI)	Alcohol Only AOR (95% CI)
Internalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	1.33 (0.85–2.07)	1.21 (0.74–1.97)	0.97 (0.61–1.56)	**1.47 (1.22–1.77)**	1.04 (0.64–1.68)	1.22 (0.96–1.55)	**1.58 (1.27–1.96)**
High	1.53 (1.00–2.36)	1.02 (0.68–1.53)	1.19 (0.78–1.81)	**1.29 (1.03–1.61)**	1.00 (0.62–1.60)	1.08 (0.85–1.38)	**1.31 (1.05–1.64)**
Externalizing Severity							
Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Moderate	1.42 (0.93–2.17)	1.16 (0.77–1.74)	**2.29 (1.53–3.43)**	**1.41 (1.16–1.72)**	0.87 (0.56–1.37)	0.92 (0.76–1.13)	**1.62 (1.33–1.97)**
High	**1.79 (1.15–2.78)**	1.23 (0.82–1.85)	**2.97 (1.84–4.81)**	**1.53 (1.21–1.92)**	1.16 (0.69–1.95)	0.88 (0.70–1.11)	**1.75 (1.38–2.22)**
Nicotine							
Dependence	**1.06 (1.05–1.07)**	**1.08 (1.07–1.09)**	1.00 (0.99–1.01)	**1.05 (1.04–1.05)**	1.00 (0.99–1.01)	**1.06 (1.05–1.06)**	**0.97 (0.97–0.98)**
Sex							
Male	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Female	1.17 (0.92–1.48)	**1.65 (1.26–2.16)**	1.22 (0.91–1.65)	**1.17 (1.01–1.35)**	**2.02 (1.46–2.80)**	**1.58 (1.34–1.86)**	**0.71 (0.60–0.83)**
Age							
18–24 years old	Reference	Reference	Reference	Reference	Reference	Reference	Reference
25–34 years old	**1.30 (1.01–1.68)**	**2.76 (1.92–3.97)**	**1.74 (1.23–2.46)**	**1.96 (1.63–2.37)**	**2.01 (1.12–3.60)**	**2.11 (1.69–2.63)**	**1.32 (1.09–1.61)**
35–44 years old	0.76 (0.53–1.09)	**1.74 (1.15–2.63)**	0.82 (0.53–1.29)	**1.34 (1.07–1.68)**	1.58 (0.90–2.76)	**1.62 (1.28–2.06)**	0.82 (0.64–1.04)
45–54 years old	**0.33 (0.24–0.45)**	0.92 (0.60–1.42)	0.72 (0.44–1.16)	1.00 (0.83–1.20)	**2.12 (1.31–3.43)**	**1.38 (1.13–1.68)**	**0.77 (0.62–0.95)**
55–64 years old	**0.28 (0.19–0.41)**	1.06 (0.67–1.68)	0.70 (0.41–1.20)	0.81 (0.64–1.03)	1.12 (0.64–1.98)	1.26 (0.99–1.60)	**0.65 (0.48–0.86)**
65 years or older	**0.12 (0.06–0.27)**	0.90 (0.43–1.92)	**0.39 (0.17–0.89)**	**0.48 (0.36–0.64)**	1.16 (0.53–2.53)	1.31 (0.96–1.77)	**0.51 (0.37–0.70)**
Race							
White	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Non-Hispanic Black	**0.40 (0.26–0.61)**	**0.48 (0.30–0.77)**	0.64 (0.38–1.08)	0.87 (0.71–1.06)	**0.40 (0.22–0.73)**	**0.55 (0.45–0.67)**	0.95 (0.76–1.19)
Non-Hispanic Other	0.69 (0.44–1.09)	0.75 (0.48–1.18)	0.89 (0.51–1.57)	0.79 (0.62–1.00)	1.06 (0.62–1.83)	0.85 (0.67–1.08)	**0.63 (0.48–0.83)**
Hispanic Multicultural	**0.55 (0.38–0.81)**	**0.57 (0.35–0.94)**	**0.43 (0.25–0.73)**	**0.77 (0.62–0.95)**	**0.65 (0.43–1.00)**	**0.73 (0.58–0.91)**	0.79 (0.62–1.01)

Variable	Alcohol, Cigarette, and E-cigarette AOR (95% CI)	Cigarette and E-cigarette AOR (95% CI)	E-cigarette and Alcohol AOR (95% CI)	Cigarette and Alcohol AOR (95% CI)	E-cigarette Only AOR (95% CI)	Cigarette Only AOR (95% CI)	Alcohol Only AOR (95% CI)
Education							
Less than high school	Reference	Reference	Reference	Reference	Reference	Reference	Reference
GED/High school	**1.82 (1.24–2.66)**	1.10 (0.70–1.71)	1.60 (0.82–3.15)	**1.31 (1.07–1.60)**	1.31 (0.78–2.20)	0.97 (0.78–1.20)	**1.39 (1.09–1.78)**
Some college	**3.41 (2.26–5.14)**	**1.77 (1.13–2.76)**	**2.55 (1.33–4.87)**	**1.82 (1.46–2.25)**	**1.79 (1.12–2.85)**	1.09 (0.87–1.37)	**2.23 (1.73–2.85)**
Bachelor's degree	**4.40 (2.83–6.85)**	**2.48 (1.37–4.52)**	2.16 (1.00–4.67)	**2.32 (1.76–3.06)**	1.32 (0.72–2.40)	1.04 (0.75–1.46)	**3.33 (2.43–4.56)**
Advanced degree	**3.98 (2.09–7.59)**	1.16 (0.46–2.92)	1.02 (0.27–3.84)	**1.60 (1.11–2.31)**	1.29 (0.52–3.19)	0.70 (0.48–1.03)	**3.02 (2.02–4.52)**
Income							
<$10,000	Reference	Reference	Reference	Reference	Reference	Reference	Reference
$10,000–24,999	**1.86 (1.34–2.58)**	1.39 (0.96–2.01)	1.22 (0.75–1.97)	**1.30 (1.05–1.61)**	0.94 (0.56–1.59)	1.18 (0.95–1.46)	**1.26 (1.02–1.55)**
$25,000–49,000	**2.32 (1.62–3.32)**	1.27 (0.86–1.88)	**1.69 (1.16–2.47)**	**1.52 (1.24–1.87)**	0.96 (0.60–1.54)	1.04 (0.85–1.29)	**1.37 (1.10–1.70)**
$50,000–99,999	**2.45 (1.64–3.67)**	1.12 (0.71–1.78)	**2.44 (1.59–3.74)**	**1.76 (1.38–2.25)**	1.35 (0.80–2.28)	0.86 (0.67–1.10)	**2.15 (1.68–2.76)**
$100,000	**2.57 (1.56–4.25)**	1.09 (0.57–2.08)	**2.74 (1.70–4.42)**	**1.74 (1.34–2.26)**	1.02 (0.51–2.03)	**0.65 (0.45–0.92)**	**2.87 (2.12–3.89)**

Bolded values indicate estimate significant a p < 0.05

The "none" category is used in reference for the tobacco and alcohol use outcome.