

Associations Between Non-Cigarette Tobacco Use Products, Mental Health Symptomology, and
Substance Use

BY

HANNA GHALYOUN

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THESIS

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Defense Committee:

Robin Mermelstein, Ph.D.

Jasmin Searcy-Pate, Ph.D., LCP

Loretta Hsueh, Ph.D.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
Tukey's HSD	Tukey's Honestly Significant Difference
M	Mean
SD	Standard Deviation
N	Sample Size
p	p-value
ENDS	Electronic nicotine delivery systems
ADHD	Attention Deficit/Hyperactivity Disorder

SUMMARY

A study of the associations between mental health, substance use, and different groups of tobacco use was carried out using a cross-sectional approach. Participants were 240 young adults who participated in a larger observational study on examining how, when and where people use these tobacco products and young adults' subjective experiences with those products. Baseline questionnaire with information on demographics, tobacco use patterns and history, nicotine dependence, other substance use (i.e., cannabis and alcohol), and various psychosocial measures were collected. Four primary tobacco use groups were identified; individuals who used hookah only (N = 22), individuals who used e-cigarettes only (N = 22), individuals who dual used both e-cigarettes and hookah (N = 62), and individuals who use cigarettes plus another tobacco product (N = 134).

Results showed that individuals who primarily used e-cigarettes had higher mean scores on attention deficit/hyperactive disorder (ADHD) symptoms than individuals who primarily use hookah. Additionally, individuals who used cigarettes plus another tobacco product had higher mean scores on cannabis use and cannabis dependence compared to individuals who used dual e-cigarettes and hookah. Lastly, individuals who used cigarettes plus another tobacco product had higher mean scores on alcohol dependence than those who only used hookah.

Although the present study did not identify group differences on mental health variables of interest other than ADHD, results warrant further investigation with larger sample sizes. Future research should be conducted that can further explain the relationship between dual or polytobacco use, non-traditional tobacco use products, and mental health or substance use related symptoms.

Introduction

Although the relationship between cigarette smoking and mental health symptoms is well established (Chan, Dennis, & Funk, 2008; Cohn et al., 2018; Plurphanswat, Kaestner, & Rodu, 2017), there is less research focused on mental health symptoms among individuals who use more than one tobacco product, especially those who use non-cigarette tobacco products. While there has been a significant decrease in the use of combustible cigarettes among both youth and adults, the changing landscape of tobacco products has been accompanied by an increase in the prevalence of the use of two or more tobacco products as well as non-cigarette tobacco products (Cornelius et al., 2020). Mental health symptoms and disorders may also be a risk factor for other forms of tobacco use besides cigarettes, although those relationships are not yet well established. The purpose of this study is to explore the associations between mental health symptoms and use of non-cigarette tobacco products (i.e., e-cigarette and hookah dual use) among young adults participating in an observational study.

Rates of Tobacco Product Use Among Young Adults

Young adulthood is a developmental period of increased risk for both substance use (Bachman et al., 2013; Palmer et al., 2009; Grant & Dawson, 1998) and mental health related problems (Blanco et al., 2008). This period encompasses many life transitions, with research documenting this developmental period as one in which individuals initiate substance use (Arnett, 2005; Substance Abuse and Mental Health Services Administration, 2019). Specifically, the young adult years are the period of greatest escalation in the use of tobacco products (Hu et al., 2016). However, there has been an overall generational decrease in smoking combustible cigarettes (Jamal et al., 2016) and an increase in the use of other forms of tobacco use, such as electronic nicotine delivery systems (ENDS; U.S. Department of Health and Human Services,

2016). ENDS use can include products such as vaporizers, hookah pens, vape pens, and e-cigarettes. In addition to the use of ENDS, young adults have also shown increasing use of hookah (U.S. Department of Health and Human Services, 2014).

Rates for different types of tobacco use have changed over the years. Data from the recent 2020 National Health Interview Survey showed that approximately 7.4% of young adults aged 18-24 use combustible cigarettes, and 9.4% used e-cigarettes (Cornelius et al., 2022). Looking closer at various longitudinal studies of tobacco use, hookah use was 25.8% among young adults in 2016 (Sharma et al., 2020) and in 2020, past year prevalence of hookah use was 11% for those aged 20-21 (Schulenberg et al., 2021). Young adults are reported to have some of the highest rates of past 12-month hookah use compared to youth and adults (Sharma et al., 2020) and from 2011-2017, studies noted an increase in lifetime hookah use (Grinberg & Goodwin, 2016; Pérez et al., 2021). In 2020, 18-22-year-olds had the highest rates of vaping nicotine compared to other age groups (Schulenberg et al., 2021) and from 2018-2020 an increase in the daily use of e-cigarettes among 21-24-year-olds was reported (Boakye et al., 2022).

As the tobacco product landscape has become increasingly varied, several nationally representative and longitudinal studies have documented the shift from combustible cigarettes to other forms of tobacco use and dual/polytobacco use (Stanton et al., 2020; Mattingly et al., 2021; Sharma et al., 2020; Vallone et al., 2020). Research revealed that exclusive ENDS use increased and exclusive cigarette use decreased from 2015-2019 (Mattingly et al., 2021). Additionally, studies reported that dual and poly use of tobacco without cigarettes increased from 2015-2019 (Mattingly et al., 2021) and in 2015, the most common tobacco use pattern was dual use of ENDS and cigarettes (Hirschtick et al., 2021). One study found that in 2013, dual use of hookah

and cigarettes was 16% among adolescents and young adults (Soneji, Sargent, & Tanski, 2016). From the recent 2020 National Health and Interview Survey data (NHIS), Cornelius et al. reported that 5.7% of young adults aged 18-24 used two or more tobacco products (2022).

Mental Health and Tobacco Use

Numerous studies have identified mental health problems among individuals who use tobacco. Tobacco use has historically been connected to anxiety, depressive, and stress-related symptomology, and while the research on traditional cigarettes and mental health is well-known, less research has been conducted on e-cigarette and hookah use. It is possible that traditional cigarette users and non-traditional tobacco users may not differ much in terms of mental health symptomology due to having similar risk profiles (i.e., shared vulnerability). One hypothesis to support this is the common liability theory, which implies that different types of tobacco users, (e.g., cigarette or e-cigarette users), may not differ in terms of underlying risk factors, such as impulsivity (Falconer, 1965; Vanyukov & Ridenour, 2014). These risk factors ultimately create a common liability or propensity to use tobacco products. Sawdey et al., (2019) considered this hypothesis in their study on known risk factors for cigarette smoking between cigarette and e-cigarette smoking among youth. Among new tobacco users at wave 2 compared to tobacco users at wave 1 of the PATH study, they found that new users showed similar experiences with risk factors, highlighting a shared vulnerability (Sawdey et al., 2019). Yet, it could also be that noncigarette tobacco users and cigarette users have different risk profiles, suggesting different underlying risk factors. For example, different risk profiles may be due to different motivations for use across products, different expectancies about the relative benefits or risks of products, and the relative social norms surrounding different products. Thus, it is important to understand

how cigarette users and noncigarette tobacco users differ in terms of mental health symptomology.

In a systematic review of e-cigarette use and mental health comorbidity in young adults and youth, results showed that among young adults, e-cigarette use was associated with higher rates of internalizing and externalizing mental health problems, depression, and perceived stress (Becker et al., 2021). In another study, King and colleagues found that among college-aged young adults, cigarette, e-cigarette, and waterpipe use was related to higher reported levels of past 30 day depression and stress symptoms (2018). Grant and colleagues (2019) identified significant associations between e-cigarette use and symptoms of posttraumatic stress disorder (PTSD), anxiety, and attention-deficit/hyperactivity disorder (ADHD). Additionally, research from wave 1 (year 2014) of the PATH study found associations between high severity internalizing problems and e-cigarette use among adults (Conway et al., 2017). Results from the Marketing and Promotions across Colleges in Texas Project (*M-PACT*) showed significant associations between e-cigarette use and depressive symptoms among college-aged young adults after controlling for other use of tobacco products (Bandiera et al., 2017). Thus, it may be that e-cigarette users and traditional cigarette users share many of the same risk profiles if e-cigarettes have simply replaced cigarette use among individuals traditionally vulnerable to cigarette/tobacco use.

However, research on mental health symptomatology among hookah users show mixed results. Two studies have identified increased depression symptoms in individuals who use hookah (Marsden et al., 2019; Primack et al., 2013) and one study noted increased stress among college-aged young adults (King et al., 2018). Another study examined subjective well-being and found that hookah users endorsed higher levels of sadness and stress compared to non-hookah

users (Grinberg, 2015). Yet, other studies have not identified associations between negative mental health symptoms and hookah use (Bandiera et al., 2016; Fielder et al., 2012; Goodwin et al., 2014). Hookah use may be used under different contexts than either cigarette or e-cigarettes, and as such, may also not share some of the same risk factors for use.

Additionally, while the research on dual and polytobacco use is still growing, not many studies have evaluated mental health symptomatology among young adults who co-use more than one tobacco product. In 2018, Conway and colleagues reported that participants who identified as polytobacco users from wave 1 (year 2015) of the PATH study, reported greater substance use problems, and internalizing and externalizing mental health symptoms compared to exclusive single tobacco users. Additionally, poor, or worse mental health symptoms among tobacco users is exacerbated by the use of additional substances (Cohn et al., 2018). It may be that individuals who use both cigarettes and another tobacco product show different mental health profiles than individuals who use two or more non-cigarette tobacco products, given perhaps the greatest association between cigarette use and more mental health symptomatology. Thus, it may be important to also tease apart the different combinations of product use.

Tobacco and Other Substance Use

The use of two or more substances (e.g., tobacco and another substance) is an important behavioral outcome to note for young adult tobacco users. Among all age groups, some of the highest rates of alcohol, cannabis, and tobacco co-use occur among young adults (Cohn et al., 2018; Substance Abuse and Mental Health Services Administration, 2019). One study found that among youth participants who reported substance use, 53% also reported using two or more substances (Zuckermann et al., 2020). Those who smoke cigarettes have higher rates of drinking, and those who drink have higher rates of smoking (Falk, Yi, & Hiller-Sturmhöfel, 2006).

Additionally, Cohn et al. (2018) found that among wave 1 PATH participants (year 2014), the greatest pattern of substance use among young adult and adult participants was dual or poly use (e.g., e-cigarettes, cigarettes, and alcohol use). Additionally, researchers also noted that non-cigarette tobacco products were often used with other substances (Cohn et al., 2018). Dual or poly substance use is noted to have increased rates of psychopathology. Researchers have identified greater rates of depression (Hindocha et al., 2021; King et al., 2018; Marmorstein, 2009), anxiety (Bailey, Farmer, & Finn, 2019; Hindocha et al., 2021; Kessler et al., 2005), externalizing mental health disorders (Bierhoff et al., 2019; Chan, Dennis, & Funk, 2008), and other internalizing mental health disorders (Kessler et al., 2005; Conway et al., 2017) among individuals who use one or more substances.

Aims and Hypotheses

This study examined associations between tobacco product use and negative mental health symptoms among young adults. The unique aspect of this study examines how mental health symptoms vary by the combination of tobacco product use, comparing young adults who use cigarettes in addition to another tobacco product (ENDS or hookah) compared to those who use either just ENDS or just hookah and not combustible cigarette products. Understanding more about how symptoms of psychological distress may be associated with different patterns of tobacco use is important to help inform both theoretical frameworks of tobacco use and potential interventions. It was hypothesized that individuals who use cigarettes plus another product will have higher mental health symptoms and other substance use problems (alcohol and cannabis) than individuals who use other non-cigarette tobacco products (hookah or ENDS).

Methods

Sample

Participants and Procedures

In 2013-2014, young adults who used non-cigarette tobacco products (such as little cigars, hookah, e-cigarettes) were recruited to participate in an observational study focused on examining how, when and where people use these tobacco products and young adults' subjective experiences with these products. Potential participants were recruited through social media, e-mail listservs, flyers, and paid advertisements. Inclusion criteria included: (a) aged 18-30; (b) identifying as a regular tobacco user (i.e., at least once/week for the past 30 days) of a non-cigarette tobacco product (i.e., snus, dissolvable, little cigars, hookah, e-cigarettes); and (c) ability to participate in the ecological momentary assessment (EMA) data collection. Eligible participants completed a baseline questionnaire covering (a) tobacco use and history, (b) nicotine dependence, (c) other alcohol and substance use, (d) perceptions of harm from product use, (e) tobacco marketing exposures, and (f) a variety of psychosocial measures, including mental health symptoms. Following the baseline survey, participants completed 7 days of ecological momentary assessments (EMA) that included both randomly prompted surveys and self-initiated tobacco use surveys. Participants then completed a follow-up survey, one month later. Data for the present study will come from the baseline questionnaire.

Participant Demographics

Participants were 253 young adults (mean age = 22.5 years, SD = 3.07); 36% female, 62.8% male, and 1.2% transgender. The sample was racially and ethnically diverse: 11.1% Hispanic; 21.3% Asian/Pacific Islander; 10.7% Black; 50.2% White; and 6.7% Other. Most (72.2%) were currently enrolled in some higher education (2 or 4-year college or grad school).

Measures

Tobacco Use

Participants self-reported past 30-day smoking, tobacco use behavior, and type of tobacco product used. Specific tobacco products included e-cigarettes, vaporizers, hookah, cigars, cigarillos, chewing tobacco, and snus. To query nicotine dependence, participants completed a shortened, 10-item version of the Nicotine Dependence Syndrome Scale (NDSS; Shiffman, Waters, & Hickcox, 2004). Participants responded to each of the items on a 4-point Likert-scale ranging from 1 (not at all true) to 4 (very true). The NDSS assesses an array of dependence symptomatology, including smoking to avoid withdrawal symptoms, craving, and increasing smoking to achieve similar effects (tolerance).

Alcohol Use and Marijuana Use

Current alcohol and marijuana use was assessed using a modified version of the Adolescent Alcohol and Drug Involvement Scale (AADIS; Moberg, 2000). Participants were asked about the frequency of their use of alcohol and marijuana over the past 3 months with response options of: 0 times; once a month or less; more than once a month but less than once a week; one or more times a week but not every day; and every day. Alcohol problems were assessed using the Young Adult Alcohol Problem Scale, a 5-item scale asking participants: 1) how often they had drinks containing alcohol, 2) how many alcoholic drinks they consumed on a typical day they drank, 3) the largest number of alcoholic beverages consumed in a single day, 4) how often they consumed that largest amount of alcohol, and 5) how often they had more than 4 or 5 drinks in a two hour period for females and males respectively, all during the course of the previous year. These 5 items were derived from the NIAAA Task Force 6-item list of recommended alcohol question for researchers (National Institute on Alcohol Abuse and

Alcoholism, 2002). Response ranges for each item varied according to the items. The Cannabis Use Disorder Identification Test – Revised (CUDIT-R; Adamson et al., 2010) was used to assess the extent of cannabis use, that is, consumption, problems, dependence, and psychological features, utilizing a 4-point likert scale.

Mental Health Outcomes

Anxiety. The Mood and Affect Symptom Questionnaire (MASQ; Watson & Clark, 1991; Watson, Weber, Assenheimer, Clark, Strauss, & McCormick, 1995) was used to assess symptoms of anxiety. The MASQ has three subscales assessing (a) general distress symptoms that are theorized as nonspecific to depression or anxiety, (b) anxious arousal, with items addressing specific anxiety symptoms of somatic tension and hyperarousal, and (c) anhedonic depression symptoms specific to depressive disorders. For the purpose of this study, only the anxious subscale was used. Participants rated the extent to which they had experienced each symptom in the past week according to a 5-point Likert-type scale, ranging from 1 (not at all) to 5 (extremely). Research supports the reliability and validity of the MASQ with adults (Keogh & Reidy, 2000; Reidy & Keogh, 1997) and with youth (Richey, Lonigan, & Phillips, 2002).

Depression. The Center for Epidemiological Studies-Depression (CES-D; Radloff, 1977), was used to measure the frequency of symptoms associated with depression (e.g., depressed affect, happiness, somatic symptoms, interpersonal difficulties, etc.) experienced in the past week from 0 (rarely or none of the time) to 3 (most or all of the time).

Perceived Stress. The Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) was used to assess participant degree of subjective stress and impact of stressful situations. The PSS utilizes a 5-point scale according to the frequency of occurrence in the previous month, from 1 (never) to 5 (very often). Substantial internal reliability, test-retest reliability, and

validity have been documented for the original, 14-item measure as well as the 4-item version of the PSS (Cohen, Kamarck, & Mermelstein, 1983).

Impulsivity. Participant temperament and personality was assessed using the modified Barratt Impulsivity Scale (BIS-11; Patton et al., 1995). Questions regarding impulsive and non-impulsive behaviors on the BIS-11 are scored on a 4-point likert scale, from 1 (rarely/never) to 4 (almost always/always).

ADHD Symptoms. Participants completed the World Health Organization adult ADHD self-report screener (ASRS; Kessler et al., 2005). The screener consists of 6 items answered on a 1 (never) to 5 (very often) scale (e.g., “How often do you have difficulty getting things in order when you have to do a task that requires organization?”).

Negative Mood Regulation. Participant affect, coping, and stress were assessed using the modified Negative Mood Regulation Expectancies Scale (NMR; Catanzaro & Mearns, 1990). Participants answered 14 questions pertaining relating to various coping strategies and how they might change their negative moods on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Analytic Plan

Participants were divided into groups based on their combination of tobacco product use. Preliminary analyses showed that: 1) 128 of the 253 participants were individuals who used cigarettes plus at least one other tobacco product; 2) 31 individuals used primarily ENDS and not cigarettes; 3) 22 individuals used primarily hookah and not cigarettes; and 4) 64 individuals used both ENDS and hookah but not cigarettes.

Chi Square tests were run to examine background characteristics and demographics of the tobacco use groups of interest (i.e., race/ethnicity, income level, education level, and tobacco use

history). Differences between types of tobacco use products (i.e., hookah only users, e-cigarette only users, and e-cigarette and hookah dual users) on mental health and substance use outcomes were examined with Analyses of Variance (ANOVA), adjusting for background characteristics and demographic differences.

Results

Preliminary Analyses

Table 1 presents the demographic characteristics of the sample by tobacco use groups. Participants across groups were similar in age (overall Mean Age = 22.45; SD = 3.04); gender distribution; sexual orientation; and educational background. Thirteen participants were removed from the analyses due to differing patterns of tobacco use (e.g., individuals who only use cigars or did not use tobacco products). The final group distribution included 1) 134 participants who used cigarettes plus at least one other tobacco product; 2) 22 individuals used primarily ENDS and not cigarettes; 3) 22 individuals used primarily hookah and not cigarettes; and 4) 62 individuals used both ENDS and hookah but not cigarettes. The overall sample was 50.0% White; 21.8% Asian; 11.8% Hispanic; 9.7% Black; 5.9% Other (including multiracial); and 0.01% Alaskan Native/American Indian. Across the tobacco use groups, there was a trend for differences in the racial/ethnic distribution of the sample, which can be seen primarily among hookah users. The hookah only group had relatively more Asians (31.8%) and Blacks (18.2%) and fewer Hispanics (45%) compared to the overall sample. The dual e-cigarette and hookah use group similarly showed a higher relative percentage of Asians (32.26%).

Past 30 day use of tobacco products (i.e., cigarettes, e-cigarettes, and hookah) and past 3 month alcohol and cannabis use are shown in Table 2. It is important to note that the cigarette plus group are participants who use multiple tobacco products, but primarily cigarettes. Of those who used cigarettes, most reported using cigarettes for 20-30 days (N = 55) in the past month. Among participants who used e-cigarettes, most reported using e-cigarettes for 20-30 days (N = 40) in the past month. Lastly, participants who reported using hookah, most reported using hookah in fewer than 10 days (N = 36) in the past month. Of those who endorsed alcohol use,

most participants reported using alcohol greater than once a month but less than once a week ($N = 76$) and more than once a week but not every day ($N = 103$). Of those who endorsed cannabis use, participants reported having never used it before ($N = 98$), more than once a week but not every day ($N = 47$), and once a month or less ($N = 44$).

Correlations among the mental health and substance use variables are shown in Table 3. As expected, all mental health variables were positively correlated with one another, with the exception of negative mood regulation. Negative mood regulation was negatively correlated with the other mental health variables, suggesting that the higher participants rated their mental health symptoms, the lower they rated their ability to regulate their negative mood. Alcohol related problems was positively correlated with self-reports of impulsivity and cannabis dependency. Cannabis dependency was positively correlated with all mental health variables, with the exception of negative mood regulation, which was negatively correlated with cannabis dependency. Of note, the overall sample reported higher rates of depression ($M = 12.35$, $SD = 8.31$), nearing clinical significance (i.e., cutoff score of 16; Radloff, 1997), of anxiety ($M = 24.77$, $SD = 7.09$), and showed higher levels of impulsivity ($M = 32.19$, $SD = 7.03$).

Mental Health

A one-way between subjects ANOVA was conducted to compare groups on their self-reported anxiety, depression, perceived stress, and ability to regulate negative mood, as well as their impulsivity and ADHD scores as shown in Table 4. The tobacco use groups differed significantly on ADHD symptoms, $F(3, 236) = 2.80$, $p = 0.04$, $\eta^2_g = 0.03$. Pairwise comparisons using the Tukey HSD test indicated that the mean score of ADHD among individuals who use e-cigarettes ($M = 0.32$, $SD = 0.48$) was higher than that of individuals who use hookah ($M = 0.09$, $SD = 0.29$), $t(236) = 2.64$, $p = 0.04$, $d = 0.80$. Pairwise comparisons did not reveal any other

significant group differences for ADHD symptoms. However, groups did not significantly differ on anxiety, depression, perceived stress, and negative mood regulation or impulsivity scores.

Substance Use

A one-way between subjects ANOVA was conducted to compare groups on their self-reported alcohol use, alcohol related problems, cannabis use, and cannabis dependence as shown in Table 5. Groups significantly differed on cannabis use, $F(3, 236) = 2.72, p = 0.045, \eta^2_g = 0.03$. Specifically, pairwise comparisons using the Tukey HSD test indicated that the cigarette plus group endorsed higher rates of cannabis use than the dual e-cigarette and hookah only groups. Pairwise comparisons did not reveal any other significant group differences for cannabis use. Additionally, groups did not significantly differ on alcohol use. There was a significant effect of tobacco use group on alcohol related problems, $F(3, 236) = 4.31, p = 0.006, \eta^2_g = 0.05$. Pairwise comparisons using the Tukey HSD test indicated that the mean score of alcohol related problems among the cigarette plus group ($M = 3.33, SD = 1.38$) was higher than that of the hookah only group ($M = 2.34, SD = 1.34$), $t(236) = 3.11, p = 0.01, d = 0.72$. Pairwise comparisons did not reveal any other significant group differences for alcohol related problems. Additionally, there was a significant effect of tobacco use group on cannabis dependence, $F(3, 236) = 3.28, p = 0.022, \eta^2_g = 0.04$. Pairwise comparisons using the Tukey HSD test indicated that the mean score of cannabis dependence among the cigarette plus group ($M = 6.63, SD = 6.61$) was higher than that of the dual e-cigarette and hookah use group ($M = 4.11, SD = 5.04$), $t(236) = 2.68, p = 0.04, d = 0.07$. Pairwise comparisons did not reveal any other significant group differences for cannabis dependency.

Exploratory Analyses

Exploratory analyses evaluated mental health somatology and problematic substance use between individuals who use dual tobacco products (the cigarette plus and dual e-cigarette and hookah groups) and single tobacco products (only e-cigarette or hookah). An independent samples *t*-test was conducted to compare the dual and single use groups of tobacco products on self-reported anxiety, depression, perceived stress, and negative mood regulation, as well as their impulsivity and ADHD scores using as shown in Table 6. Results did not yield any significant differences between the dual and single use groups of tobacco products and their self-reported mental health symptomology. Additionally, An independent samples *t*-test was conducted to compare the dual and single use groups of tobacco products on their self-reported alcohol use, alcohol related problems, cannabis use, and cannabis dependence as shown in Table 7. There was a significant difference between the groups on self-reported alcohol problems, $t(236) = 2.47$, $p = 0.014$, such that individuals who use two or more tobacco products ($M = 3.20$, $SD = 1.43$) reported higher levels of alcohol-related problems than individuals who use only one tobacco product ($M = 2.54$, $SD = 1.26$). Pairwise comparisons did not reveal any other significant group differences for alcohol related problems. Lastly, the groups did not significantly differ on alcohol use, cannabis use, or cannabis dependence.

Discussion

The current study examined how different patterns of tobacco product use relate to self-reported mental health symptomology and substance use behaviors and related problems. There is robust literature surrounding cigarette use and associations with mental health and other substance use, while newer forms of tobacco product use (e.g., ENDS) are less studied or have mixed findings (e.g., hookah). Thus, it was hypothesized that individuals who used cigarettes plus another tobacco use product (i.e., e-cigarettes, hookah, cigars, and dip) would have higher rates of mental health symptoms and substance use problems compared to individuals who primarily use other non-cigarette tobacco products. Overall, there were few significant differences in mental health symptoms across the groups, with the one exception found for ADHD symptoms. Among participants who only used e-cigarettes, their self-reported ADHD symptoms were significantly higher than participants who only used hookah. However, substance use, and associated problems did vary by tobacco use pattern. Results indicated that among individuals who used multiple tobacco products, but primarily cigarettes, self-reported cannabis use, alcohol related problems, and cannabis dependency were significantly higher than those levels of the other tobacco use groups. Specifically, the cigarette plus group used cannabis more and had higher levels of cannabis dependency than the dual e-cigarette and hookah group and endorsed greater alcohol related problems than the hookah only group.

The finding that young adults who only use e-cigarettes have higher rates of ADHD than individuals who only use hookah adds to literature on ADHD and tobacco use. The literature is lacking on ADHD symptoms and differences between individuals who use e-cigarettes or hookah, however, one longitudinal study on youth identified a significant association for later e-cigarette use among participants with ADHD, but no association was found for hookah use

(Goldenson et al., 2018). Hookah use has frequently been noted to be a social experience (Braun et al., 2021; Holtzman, Babinski, & Merlo, 2013). Thus, it is possible that individuals who used hookah in our sample had lower levels of ADHD compared to other groups for different reasons (e.g., social use or to combat boredom versus symptom or inattention management). This finding is surprising as the literature around cigarette use, and ADHD symptoms has documented a strong association (McClernon & Kollins, 2008; Milberger et al., 1997). Overall, other group differences were not observed for e-cigarette users in this study, this is consistent with literature on e-cigarette use and ADHD symptoms overall, such that ADHD symptoms are associated with e-cigarette use (Grant et al., 2019; Kaplan et al., 2021; Xu et al., 2021).

Other than the one difference in ADHD symptoms, the tobacco use groups were similar in other measures of mental health symptoms. Of note, this sample of young adults reported levels of depression symptoms that were elevated compared to norms, although at a subthreshold level. This elevation in self-reported depression levels is not surprising given the robust literature documenting the strong association between depression and tobacco use, with one systematic review identifying bidirectional relationships between cigarette smoking and depression, heavier rates of smoking among those with depression, and later tobacco dependence among those with baseline depression (Fluharty et al., 2017). In addition to cigarette smoking, research has also documented strong associations between vaping, e-cigarette, and ENDS use and elevated mental health symptomology (Becker et al., 2021). One literature review identified higher rates of depression, suicidal ideation, and suicide attempts among individuals who used e-cigarettes (Javed et al., 2022). Another study noted that dual users of e-cigarettes and cigarettes, and non-smoking users of e-cigarettes reported poor mental health symptoms (e.g., anxiety and mood related symptoms; Pham et al., 2020). Additionally, all groups were elevated in anxiety

symptoms, with individuals who use both e-cigarettes and hookah and multiple tobacco products endorsing the elevated mean levels of self-reported anxiety. Research has frequently noted a strong association between symptoms of anxiety and cigarette smoking (Patton et al., 1998) and more recently, e-cigarette usage (Masaki et al., 2022; Pham et al., 2020) and poly use of tobacco products (Cwalina et al., 2021). Lastly, all groups showed mean score elevations on impulsivity. This finding is consistent with prior literature on impulsivity and tobacco use, such that individuals who use tobacco are also more likely to have higher levels of impulsivity (Doran et al., 2013). Additionally, one study noted that impulsivity components (e.g., sensation seeking versus negative urgency) may be tobacco product specific (Doran & Tully, 2018). Thus, while all groups may experience impulsivity at higher levels, it may be that individuals who use multiple tobacco and non-traditional tobacco products have different underlying impulsivity components.

Although our results did not reveal significant group differences or showcase elevation for those who use multiple tobacco products (cigarettes plus another tobacco product) on all mental health variables, our findings extend current literature by affirming that individuals who use tobacco report elevated levels of mental health symptomology. Beyond showcasing consistent support for elevated mental health symptoms among individuals who use tobacco, these findings also add to the literature on individuals who use alternative or multiple tobacco products experience with mental health. These findings also provide support for the shared vulnerability hypothesis, such that individuals who use tobacco or nicotine products may share underlying risk factors (Falconer, 1965; Sawdey et al., 2019; Vanyukov & Ridenour, 2014).

Consistent with prior literature on combustible cigarette use and other substance use related problems (i.e., alcohol and cannabis), our results showed that those who primarily used

cigarettes endorsed higher levels of alcohol related problems (Falk, Yi, & Hiller-Sturmhöfel, 2006), cannabis use (Agrawal et al., 2021), and cannabis dependency (Hindocha et al., 2021). Additionally, exploratory analyses, which evaluated use of multiple tobacco products compared to single tobacco product use, revealed greater alcohol related problems and dual tobacco product users, consistent with prior findings on polytobacco use (Conway et al., 2017). Using multiple substances has been and continues to be a major public health concern and behavioral outcome for young adults due to the notable mental and physical health consequences.

Limitations

This study should be interpreted with consideration for certain limitations. The sample sizes for the single product use groups were small, limiting the power to find differences between groups. Given the cross-sectional nature of the data, directionality of effects cannot be determined. Additionally, the data were collected between 2014 – 2015 and since then, the tobacco product landscape and patterns of use have shifted dramatically, with greater reductions in combustible cigarette smoking. Thus, these findings may not be an accurate reflection of current alternative and poly tobacco use and mental health or substance use associations. While there are limitations to this study, it is also important to note the strengths. First, the literature on polytobacco use and non-cigarette tobacco products- is still growing, particularly with understanding mental health symptoms and other behavioral outcomes of interest (e.g., impulsivity and substance use). Second, this study utilized a wide range of mental health questionnaires, allowing us to look more closely at specific internalizing or externalizing disorders.

Conclusion

This study found that young adults who used cigarettes plus another tobacco product had higher levels of substance use and substance use related problems, while those who used e-cigarettes had higher self-reported ADHD symptoms. Although the present study did not identify group differences on other mental health variables of interest, results warrant further investigation with larger sample sizes. Given partial support for our hypothesis, that cigarette plus smokers showed higher endorsement of mental health symptoms and substance use related problems, future research should employ longitudinal methods and collect data that can further explain the relationship between dual or polytobacco use, non-traditional tobacco use products, and mental health or substance use related symptoms. To inform theoretical prevention and intervention models, it is important to understand risk factors, antecedents, and consequences of tobacco use.

References

- Adamson, S. J., Kay-Lambkin, F. J., Baker, A. L., Lewin, T. J., Thornton, L., Kelly, B. J., & Sellman, J. D. (2010). An improved brief measure of cannabis misuse: the Cannabis Use Disorders Identification Test-Revised (CUDIT-R). *Drug and alcohol dependence*, 110(1-2), 137-143.
- Agrawal, A., Budney, A. J., & Lynskey, M. T. (2012). The co-occurring use and misuse of cannabis and tobacco: a review. *Addiction* (Abingdon, England), 107(7), 1221–1233. <https://doi.org/10.1111/j.1360-0443.2012.03837.x>
- Arnett, J. J. (2005). The developmental context of substance use in emerging adulthood. *Journal of drug issues*, 35(2), 235-254.
- Bailey, A. J., Farmer, E. J., & Finn, P. R. (2019). Patterns of polysubstance use and simultaneous co-use in high risk young adults. *Drug and alcohol dependence*, 205, 107656.
- Bachman, J. G., Wadsworth, K. N., O'Malley, P. M., Johnston, L. D., & Schulenberg, J. E. (2013). *Smoking, drinking, and drug use in young adulthood: The impacts of new freedoms and new responsibilities*. Psychology Press.
- Bandiera, F. C., Loukas, A., Li, X., Wilkinson, A. V., & Perry, C. L. (2017). Depressive symptoms predict current e-cigarette use among college students in Texas. *Nicotine & Tobacco Research*, 19(9), 1102-1106.
- Becker, T. D., Arnold, M. K., Ro, V., Martin, L., & Rice, T. R. (2021). Systematic review of electronic cigarette use (vaping) and mental health comorbidity among adolescents and young adults. *Nicotine and Tobacco Research*, 23(3), 415-425.
- Bierhoff, J., Haardörfer, R., Windle, M., & Berg, C. J. (2019). Psychological risk factors for alcohol, cannabis, and various tobacco use among young adults: a longitudinal

- analysis. *Substance use & misuse*, 54(8), 1365-1375.
- Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S. M., & Olfson, M. (2008). Mental health of college students and their non-college-attending peers: results from the national epidemiologic study on alcohol and related conditions. *Archives of general psychiatry*, 65(12), 1429-1437.
- Braun, R. E., Glassman, T., Wohlwend, J., Whewell, A., & Reindl, D. M. (2012). Hookah use among college students from a Midwest University. *Journal of community health*, 37, 294-298.
- Boakye, E., Osuji, N., Erhabor, J., Obisesan, O., Osei, A. D., Mirbolouk, M., ... & Blaha, M. J. (2022). Assessment of patterns in e-cigarette use among adults in the US, 2017-2020. *JAMA Network Open*, 5(7), e2223266-e2223266.
- Catanzaro, S. J., & Mearns, J. (1990). Measuring generalized expectancies for negative mood regulation: Initial scale development and implications. *Journal of Personality Assessment*, 54(3-4), 546-563.
- Chan, Y. F., Dennis, M. L., & Funk, R. R. (2008). Prevalence and comorbidity of major internalizing and externalizing problems among adolescents and adults presenting to substance abuse treatment. *Journal of substance abuse treatment*, 34(1), 14-24.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of health and social behavior*, 385-396.
- Cohn, A. M., Johnson, A. L., Rose, S. W., Pearson, J. L., Villanti, A. C., & Stanton, C. (2018). Population-level patterns and mental health and substance use correlates of alcohol,

- marijuana, and tobacco use and co-use in US young adults and adults: Results from the population assessment for tobacco and health. *The American Journal on Addictions*, 27(6), 491-500.
- Conway, K. P., Green, V. R., Kasza, K. A., Silveira, M. L., Borek, N., Kimmel, H. L., ... & Compton, W. M. (2017). Co-occurrence of tobacco product use, substance use, and mental health problems among adults: Findings from Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study. *Drug and alcohol dependence*, 177, 104-111.
- Conway, K. P., Green, V. R., Kasza, K. A., Silveira, M. L., Borek, N., Kimmel, H. L., ... & Compton, W. M. (2018). Co-occurrence of tobacco product use, substance use, and mental health problems among youth: Findings from wave 1 (2013–2014) of the population assessment of tobacco and health (PATH) study. *Addictive behaviors*, 76, 208-217.
- Cornelius, M. E., Wang, T. W., Jamal, A., Loretan, C. G., & Neff, L. J. (2020). Tobacco product use among adults—United States, 2019. *Morbidity and Mortality Weekly Report*, 69(46), 1736.
- Cornelius, M. E., Loretan, C. G., Wang, T. W., Jamal, A., & Homa, D. M. (2022). Tobacco product use among adults—United States, 2020. *Morbidity and Mortality Weekly Report*, 71(11), 397.
- Cwalina, S. N., Pacek, L. R., Barrington-Trimis, J. L., Tackett, A. P., & Pentz, M. A. (2021). Cross-sectional associations of multiple tobacco product use with depressive and anxiety symptoms among young adult e-cigarette users. *Substance use & misuse*, 56(12), 1807-1814.

- Doran, N., & Tully, L. (2018). Impulsivity and tobacco product use over time. *Addictive behaviors*, 85, 153-157.
- Falconer, D. S. (1965). The inheritance of liability to certain diseases, estimated from the incidence among relatives. *Annals of human genetics*, 29(1), 51-76.
- Falk, D. E., Yi, H. Y., & Hiller-Sturmhöfel, S. (2006). An epidemiologic analysis of co-occurring alcohol and tobacco use and disorders: findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Alcohol Research & Health*, 29(3), 162.
- Fielder, R. L., Carey, K. B., & Carey, M. P. (2012). Predictors of initiation of hookah tobacco smoking: a one-year prospective study of first-year college women. *Psychology of Addictive Behaviors*, 26(4), 963.
- Fluharty, M., Taylor, A. E., Grabski, M., & Munafò, M. R. (2017). The Association of Cigarette Smoking With Depression and Anxiety: A Systematic Review. *Nicotine & tobacco research : official journal of the Society for Research on Nicotine and Tobacco*, 19(1), 3–13. <https://doi.org/10.1093/ntr/ntw140>
- Grant, B. F., & Dawson, D. A. (1998). Age of onset of drug use and its association with DSM-IV drug abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *Journal of substance abuse*, 10(2), 163-173.
- Grant, J. E., Lust, K., Fridberg, D. J., King, A. C., & Chamberlain, S. R. (2019). E-cigarette use (vaping) is associated with illicit drug use, mental health problems, and impulsivity in university students. *Annals of clinical psychiatry: official journal of the American Academy of Clinical Psychiatrists*, 31(1), 27.
- Grinberg, A. (2015). Subjective well-being and hookah use among adults in the United States: a

- nationally-representative sample. *Drug and alcohol dependence*, 153, 242-249.
- Grinberg, A., & Goodwin, R. D. (2016). Prevalence and correlates of hookah use: a nationally representative sample of US adults ages 18–40 years old. *The American journal of drug and alcohol abuse*, 42(5), 567-576.
- Goldenson, N. I., Khoddam, R., Stone, M. D., & Leventhal, A. M. (2018). Associations of ADHD symptoms with smoking and alternative tobacco product use initiation during adolescence. *Journal of pediatric psychology*, 43(6), 613-624.
- Goodwin, R. D., Grinberg, A., Shapiro, J., Keith, D., McNeil, M. P., Taha, F., ... & Hart, C. L. (2014). Hookah use among college students: prevalence, drug use, and mental health. *Drug and alcohol dependence*, 141, 16-20.
- Hindocha, C., Brose, L. S., Walsh, H., & Cheeseman, H. (2021). Cannabis use and co-use in tobacco smokers and non-smokers: prevalence and associations with mental health in a cross-sectional, nationally representative sample of adults in Great Britain, 2020. *Addiction*, 116(8), 2209-2219.
- Hirschtick, J. L., Mattingly, D. T., Cho, B., Arciniega, L. Z., Levy, D. T., Sanchez-Romero, L. M., ... & Fleischer, N. L. (2021). Exclusive, dual, and polytobacco use among US adults by sociodemographic factors: Results from 3 nationally representative surveys. *American Journal of Health Promotion*, 35(3), 377-387.
- Holtzman, A. L., Babinski, D., & Merlo, L. J. (2013). Knowledge and attitudes toward hookah usage among university students. *Journal of American College Health*, 61(6),
- Hu SS, Neff L, Agaku IT, et al. Tobacco Product Use Among Adults — United States, 2013–2014. *MMWR Morb Mortal Wkly Rep* 2016;65:685–691.
- Jamal, A., King, B. A., Neff, L. J., Whitmill, J., Babb, S. D., & Graffunder, C. M. (2016).

- Current cigarette smoking among adults—United States, 2005–2015. *Morbidity and mortality weekly report*, 65(44), 1205-1211.
- Javed, S., Usmani, S., Sarfraz, Z., Sarfraz, A., Hanif, A., Firoz, A., Baig, R., Sharath, M., Walia, N., Chérrez-Ojeda, I., & Ahmed, S. (2022). A Scoping Review of Vaping, E-Cigarettes and Mental Health Impact: Depression and Suicidality. *Journal of community hospital internal medicine perspectives*, 12(3), 33–39. <https://doi.org/10.55729/2000-9666.1053>
- Kaplan, B., Marcell, A. V., Kaplan, T., & Cohen, J. E. (2021). Association between e-cigarette use and parents' report of attention deficit hyperactivity disorder among US youth. *Tobacco induced diseases*, 19, 44. <https://doi.org/10.18332/tid/136031>
- Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E. V. A., ... & Walters, E. E. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. *Psychological medicine*, 35(2), 245-256.
- Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry*, 62(6), 617-627.
- King, J. L., Reboussin, D., Ross, J. C., Wiseman, K. D., Wagoner, K. G., & Sutfin, E. L. (2018). Polytobacco use among a nationally representative sample of adolescent and young adult e-cigarette users. *Journal of Adolescent Health*, 63(4), 407-412.
- King, J. L., Reboussin, B. A., Spangler, J., Ross, J. C., & Sutfin, E. L. (2018). Tobacco product use and mental health status among young adults. *Addictive behaviors*, 77, 67-72.
- Kollins, S. H., McClernon, F. J., & Fuemmeler, B. F. (2005). Association between smoking and attention-deficit/hyperactivity disorder symptoms in a population-based sample of young

- adults. *Archives of general psychiatry*, 62(10), 1142–1147.
<https://doi.org/10.1001/archpsyc.62.10.1142>
- Lambert, N. (2005). The contribution of childhood ADHD, conduct problems, and stimulant treatment to adolescent and adult tobacco and psychoactive substance abuse. *Ethical Human Psychology and Psychiatry*, 7(3), 197-221.
- Marmorstein, N. R. (2009). Longitudinal associations between alcohol problems and depressive symptoms: early adolescence through early adulthood. *Alcoholism: Clinical and Experimental Research*, 33(1), 49-59.
- Masaki, K., Taketa, R. M., Nakama, M. K., Kawamoto, C. T., & Pokhrel, P. (2022). Relationships Between Depressive Symptoms, Anxiety, Impulsivity and Cigarette and E-cigarette Use Among Young Adults. *Hawai'i journal of health & social welfare*, 81(3), 51–57.
- Marsden, D. G., Loukas, A., Chen, B., Perry, C. L., & Wilkinson, A. V. (2019). Associations between frequency of cigarette and alternative tobacco product use and depressive symptoms: A longitudinal study of young adults. *Addictive behaviors*, 99, 106078.
- Mattingly, D. T., Zavala-Arciniega, L., Hirschtick, J. L., Meza, R., Levy, D. T., & Fleischer, N. L. (2021). Trends in exclusive, dual and polytobacco use among US adults, 2014–2019: results from two nationally representative surveys. *International Journal of Environmental Research and Public Health*, 18(24), 13092.
- McClernon, F. J., & Kollins, S. H. (2008). ADHD and smoking: from genes to brain to behavior. *Annals of the New York Academy of Sciences*, 1141, 131–147.
<https://doi.org/10.1196/annals.1441.016>
- Milberger, S., Biederman, J., Faraone, S. V., Chen, L., & Jones, J. (1997). ADHD is associated

- with early initiation of cigarette smoking in children and adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, 36(1), 37-44.
- Moberg, D. P. (2000). The Adolescent Alcohol and Drug Involvement Scale. *Retrieved from*.
https://rhyclearinghouse.acf.hhs.gov/sites/default/files/docs/15972/Adolescent_Alcohol_and_Drug_Involvement_Scale.pdf
- National Institutes of Health (2002). Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism. *Retrieved from*.
<https://www.collegedrinkingprevention.gov/media/TaskForceReport.pdf>
- Palmer, R. H. C., Young, S. E., Hoffer, C. J., Corley, R. P., Stallings, M. C., Crowley, T. J., & Hewitt, J. K. (2009). Developmental epidemiology of drug use and abuse in adolescence and young adulthood: Evidence of generalized risk. *Drug and alcohol dependence*, 102(1-3), 78-87.
- Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of clinical psychology*, 51(6), 768-774.
- Pérez, A., Kuk, A. E., Bluestein, M. A., Chen, B., Sterling, K. L., & Harrell, M. B. (2021). Age of initiation of hookah use among young adults: Findings from the Population Assessment of Tobacco and Health (PATH) study, 2013–2017. *PLoS one*, 16(10), e0258422.
- Pham, T., Williams, J. V., Bhattarai, A., Dores, A. K., Isherwood, L. J., & Patten, S. B. (2020). Electronic cigarette use and mental health: a Canadian population-based study. *Journal of Affective Disorders*, 260, 646-652.
- Plurphanswat, N., Kaestner, R., & Rodu, B. (2017). The effect of smoking on mental health. *American journal of health behavior*, 41(4), 471-483.

- Pomerleau, O. F., Downey, K. K., Stelson, F. W., & Pomerleau, C. S. (1995). Cigarette smoking in adult patients diagnosed with attention deficit hyperactivity disorder. *Journal of substance abuse*, 7(3), 373–378. [https://doi.org/10.1016/0899-3289\(95\)90030-6](https://doi.org/10.1016/0899-3289(95)90030-6)
- Primack, B. A., Land, S. R., Fan, J., Kim, K. H., & Rosen, D. (2013). Associations of mental health problems with waterpipe tobacco and cigarette smoking among college students. *Substance use & misuse*, 48(3), 211-219.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement*, 1(3), 385-401.
- Sawdey, M. D., Day, H. R., Coleman, B., Gardner, L. D., Johnson, S. E., Limpert, J., ... & Ambrose, B. K. (2019). Associations of risk factors of e-cigarette and cigarette use and susceptibility to use among baseline PATH study youth participants (2013–2014). *Addictive behaviors*, 91, 51-60.
- Schulenberg, J. E., Patrick, M. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Miech, R. A. (2021). Monitoring the Future National Survey Results on Drug Use, 1975-2020. Volume II, College Students & Adults Ages 19-60. *Institute for social research*.
- Sharma, E., Bansal-Travers, M., Edwards, K. C., Halenar, M. J., Taylor, K. A., Kasza, K. A., ... & Stanton, C. A. (2020). Longitudinal pathways of exclusive and polytobacco hookah use among youth, young adults, and adults in the USA: findings from the PATH Study Waves 1–3 (2013–2016). *Tobacco control*, 29(Suppl 3), s155-s162.
- Soneji, S., Sargent, J., & Tanski, S. (2016). Multiple tobacco product use among US adolescents and young adults. *Tobacco control*, 25(2), 174-180.
- Stanton, C. A., Sharma, E., Seaman, E. L., Kasza, K. A., Edwards, K. C., Halenar, M. J., ... & Hyland, A. (2020). Initiation of any tobacco and five tobacco products across 3 years

among youth, young adults, and adults in the USA: findings from the PATH Study Waves 1–3 (2013–2016). *Tobacco control*, 29(Suppl 3), s178-s190.

Substance Abuse and Mental Health Services Administration. (2020). Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health (HHS Publication No. PEP20-07-01-001, NSDUH Series H-55). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. *Retrieved from* <https://www.samhsa.gov/data/>

Symmes, A., Winters, K. C., Fahnhorst, T., Botzet, A., Lee, S., August, G., & Realmuto, G. (2015). The Association Between Attention-Deficit Hyperactivity Disorder and Nicotine Use Among Adolescents and Young Adults. *Journal of child & adolescent substance abuse*, 24(1), 37–45. <https://doi.org/10.1080/1067828X.2012.756442>

Thompson, K., Holley, M., Sturgess, C., & Leadbeater, B. (2021). Co-use of alcohol and cannabis: longitudinal associations with mental health outcomes in young adulthood. *International journal of environmental research and public health*, 18(7), 3652.

US Department of Health and Human Services. (2014). The health consequences of smoking—50 years of progress: a report of the Surgeon General.

U.S. Department of Health and Human Services. E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2016.

Vallone, D. M., Cuccia, A. F., Briggs, J., Xiao, H., Schillo, B. A., & Hair, E. C. (2020). Electronic cigarette and JUUL use among adolescents and young adults. *JAMA*

- pediatrics*, 174(3), 277-286.
- Vanyukov, M. M., & Ridenour, T. A. (2012). Common liability to drug addictions: theory, research, practice. *Drug and alcohol dependence*, 123(0 1), S1.
- Wahl, S. K., Turner, L. R., Mermelstein, R. J., & Flay, B. R. (2005). Adolescents' smoking expectancies: Psychometric properties and prediction of behavior change. *Nicotine & Tobacco Research*, 7(4), 613-623.
- Watson, D., & Clark, L. A. (1991). Mood and anxiety symptom questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry*.
- Watson, D., Weber, K., Assenheimer, J. S., Clark, L. A., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. *Journal of abnormal psychology*, 104(1), 3.
- Xu, G., Snetselaar, L. G., Strathearn, L., Ryckman, K., Nothwehr, F., & Torner, J. (2021). Association of attention-deficit/hyperactivity disorder with E-cigarette use. *American journal of preventive medicine*, 60(4), 488-496.
- Zuckermann, A. M., Williams, G. C., Battista, K., Jiang, Y., de Groh, M., & Leatherdale, S. T. (2020). Prevalence and correlates of youth poly-substance use in the COMPASS study. *Addictive behaviors*, 107, 106400.

Table 1. *Participant Demographics by Group*

Variable	Cigarette Plus (N = 134)		E-Cigarette (N = 22)		Hookah (N = 22)		Dual E-Cigarette & Hookah (N = 62)		Total Sample (N = 240)			
	N(%)	M(SD)	N(%)	M(SD)	N(%)	M(SD)	N(%)	M(SD)	N(%)	M(SD)		
Age (In Years)	134 (55.83)	22.62 (3.23)	22 (9.17)	23.68 (2.92)	22 (9.17)	22.55 (2.96)	64 (26.67)	21.60 (2.48)	240 (100)	22.45 (3.04)		
	N	%	N	%	N	%	N	%	N	%	X^2	p
Race/Ethnicity												
Alaskan Native/ American Indian	0	0	1	4.55	0	0	1	1.61	2	0.01	24.45	0.056
Asian/Pacific Islander	22	16.42	3	13.64	7	31.82	20	32.26	42	21.8		
Black	12	8.96	2	9.10	4	18.20	7	11.30	25	9.7		
Hispanic	17	12.69	1	4.55	1	4.55	9	14.52	28	11.8		
White	76	56.72	12	54.55	10	45.50	21	33.87	119	50.0		
Other	7	5.22	3	13.64	0	0	4	6.45	14	5.9		
Gender												
Female	49	36.57	7	31.81	10	45.45	23	37.10	89	37.08	3.32	0.81
Male	82	61.19	15	68.18	12	54.54	39	62.90	148	61.67		
Transgender	3	2.24	0	0	0	0	0	0	3	1.25		
Sexual Orientation												
Heterosexual/ Straight	119	88.81	16	72.73	19	86.36	57	91.93	211	87.91	11.21	0.29
Gay/Lesbian	6	4.48	1	4.55	2	9.09	2	3.23	11	4.58		

Bisexual	8	5.97	5	22.73	1	4.55	3	4.84	17	7.08		
Education Level												
Some High School, No Diploma/GED	1	7.46	0	0	0	0	3	4.84	4	1.67	18.93	0.38
High School Diploma or GED	18	13.43	1	4.55	2	9.10	6	9.68	27	11.25		
Vocational/Technical School	6	4.48	0	0	0	0	0	0	6	2.50		
Some College	72	53.73	15	68.18	14	63.64	39	62.90	140	58.33		
2-Year Associate Degree	11	8.21	1	4.55	1	4.55	4	6.45	17	7.08		
4-Year Bachelor's Degree	24	17.91	5	22.73	5	22.73	7	11.29	41	17.08		
Graduate Degree	2	1.49	0	0	0	0	3	4.83	5	2.08		

Table 2. Substance Use by Group

	Cigarette Plus (N = 134)		E-Cigarette (N = 22)		Hookah (N = 22)		Dual E-Cigarette & Hookah (N = 62)	
	N	%	N	%	N	%	N	%
Past 30 Day Cigarette Use								
0 Days	0	0	22	100	22	22	62	62
1 – 2 Day	28	20.90	0	0	0	0	0	0
3 – 9 Days	29	21.64	0	0	0	0	0	0
10 – 19 Days	22	16.41	0	0	0	0	0	0
20 – 30 Days	55	41.04	0	0	0	0	0	0
Past 30 Day E-Cigarette Use								
0 Days	29	21.64	0	0	22	22	0	0
1 – 2 Day	14	10.45	1	45.45	0	0	9	14.52
3 – 9 Days	30	22.39	1	45.45	0	0	24	38.71
10 – 19 Days	21	15.67	1	45.45	0	0	9	14.52
20 – 30 Days	40	29.85	19	86.36	0	0	20	32.26
Past 30 Day Hookah Use								
0 Days	50	37.31	22	100	0	0	0	0
1 – 2 Day	19	14.18	0	0	4	18.18	19	30.65
3 – 9 Days	36	26.87	0	0	8	36.36	21	33.87
10 – 19 Days	17	12.69	0	0	3	13.64	10	16.13
20 – 30 Days	12	8.96	0	0	7	31.81	12	19.35
Past 3 Month Alcohol Use								
0 Times	10	7.46	2	9.10	3	13.64	9	14.52

Once a Month/Less	17	12.69	7	31.81	6	27.27	4	6.45
> Once a month, < Once a Week	41	30.60	4	18.18	7	31.81	24	38.71
1+ Time a Week	63	47.01	9	40.91	6	27.27	25	40.32
Every Day	3	2.24	0	0	0	0	0	0
Past 3 Month Cannabis Use								
0 Times	46	34.33	12	54.55	13	59.09	27	43.55
Once a Month/Less	21	15.67	3	13.65	2	9.09	18	29.03
> Once a month, < Once a Week	19	14.18	0	0	1	4.55	7	11.29
1+ Time a Week	32	23.88	3	13.64	5	22.73	7	11.29
Every Day	15	11.19	4	18.18	1	4.55	2	3.23

Table 3. Mental Health Correlations ($N = 240$)

Variable	1	2	3	4	5	6	7
1 Alcohol Problems							
2 CUDIT	.248**						
3 Perceived Stress	0.004	.145*					
4 Impulsivity	.179**	.143*	.286**				
5 ADHD	0.053	.156*	.239**	.503**			
6 Negative Mood Regulation	-0.072	-.194**	-.539**	-.242**	-.313**		
7 Depression	0.052	.272**	.594**	.323**	.328**	-.681**	
8 Anxiety	0.062	.205**	.627**	.335**	.353**	-.636**	.807**

Note. *. Correlation is significant at the 0.05 level (2-tailed), **. Correlation is significant at the 0.01 level (2-tailed).

Table 4. *Mental Health by Group*

	Cigarette Plus (N = 134)		E-Cigarette (N = 22)		Hookah (N = 22)		Dual E-Cigarette & Hookah (N = 62)		ANOVA Results	
	M	SD	M	SD	M	SD	M	SD	<i>f</i>	<i>p</i>
Anxiety	24.57	7.54	23.27	6.93	23.57	5.40	26.03	6.88	1.20	0.311
Depression	12.57	9.22	9.95	7.67	11.20	5.82	13.34	7.62	1.04	0.374
Perceived Stress	2.35	0.79	2.24	0.89	2.33	0.68	2.31	0.75	0.14	0.939
Negative Mood Regulation	3.85	0.73	3.84	0.70	3.79	0.43	3.87	0.65	0.08	0.970
Impulsivity	31.87	7.35	34.36	5.57	31.36	5.06	32.21	7.38	0.89	0.449
ADHD	0.15	0.36	0.32 ^a	0.48	0.09 ^a	0.29	0.21	0.41	2.80	0.041*

Note. *. ANOVA is significant at the 0.05 level, **. ANOVA is significant at the 0.01 level.

Table 5. *Substance Use by Group*

	Cigarette Plus (N = 134)		E-Cigarette (N = 22)		Hookah (N = 22)		Dual E-Cigarette & Hookah (N = 62)		ANOVA Results	
	M	SD	M	SD	M	SD	M	SD	<i>f</i>	<i>p</i>
Alcohol Use	3.24	0.97	2.91	1.06	2.73	1.03	3.04	1.03	2.19	0.089
Alcohol Problems	3.33 ^a	1.38	2.75	1.17	2.34	1.34 ^a	2.91	1.50	4.31	0.006**
Cannabis Use	2.54 ^b	1.67	2.27	1.67	2.05	1.43	1.85 ^b	1.62	2.72	0.045*
CUDIT	6.63 ^c	6.61	4.32	6.07	4.05	5.55	4.11 ^c	5.04	3.28	0.022*

Note. *. ANOVA is significant at the 0.05 level, **. ANOVA is significant at the 0.01 level.

Table 6. *Mental Health Among Dual and Single Tobacco Product Users*

	Dual Users (N = 196)		Single Users (N = 44)		<i>t</i>-test Results	
	M	SD	M	SD	<i>t</i>	<i>p</i>
Anxiety	25.03	7.35	23.42	6.14	1.552	0.1221
Depression	12.82	8.73	10.58	6.76	1.669	0.0964
Perceived Stress	2.33	0.77	2.28	0.79	0.321	0.7486
Negative Mood Regulation	3.85	0.70	3.81	0.58	0.376	0.7074
Impulsivity	31.98	7.34	32.86	5.47	-0.690	0.4907
ADHD	0.17	0.37	0.20	0.41	-0.282	0.7783

Note. *. *t*-test is significant at the 0.05 level, **. *t*-test is significant at the 0.01 level.

Table 7. *Substance Use Among Dual and Single Tobacco Product Users*

	Dual Users (N = 196)		Single Users (N = 44)		<i>t</i>-test Results	
	M	SD	M	SD	<i>t</i>	<i>p</i>
Alcohol Use	3.18	0.99	2.82	1.04	1.926	0.0553
Alcohol Problems	3.20 ^{<i>a</i>}	1.43	2.54 ^{<i>a</i>}	1.26	2.466	0.0144*
Cannabis Use	2.33	1.68	2.16	1.54	0.147	0.8830
CUDIT	5.83	6.25	4.18	5.75	1.152	0.2506

Note. *. *t*-test is significant at the 0.05 level, **. *t*-test is significant at the 0.01 level.

CURRICULUM VITAE
(Last Revised October 2023)

Hanna Ghalyoun
630-362-0362 | hghaly2@uic.edu

EDUCATION

University of Illinois (UIC), Chicago, Illinois
Fall 2022 — Present
Clinical Psychology Doctoral Candidate
Expected Graduation: Spring 2028

University of Illinois (UIC), Chicago, Illinois
Fall 2018 — Spring 2022
Major in Applied Psychology, Minor in Public Health
Honors College
GPA: 4.00/4.00

HONORS & AWARDS

Summa Cum Laude
University of Illinois at Chicago
Spring 2022

Highest Departmental Distinction
University of Illinois at Chicago, Psychology Department
Spring 2022

Honors College Capstone Thesis
“Trauma, Identity, and Alcohol”
University of Illinois at Chicago, Honors College
Summer 2021 — Spring 2022

Summer Research Opportunities Program (SROP)
University of Illinois at Chicago, Graduate College
Summer 2020 & Summer 2021

Graduate Pathways to Success (GPS)
University of Illinois at Chicago, Graduate College
Fall 2020 — Spring 2022

Psychology Undergraduate Research Readiness (PURR) Program
University of Illinois at Chicago, Psychology Department
Fall 2019 — Spring 2021

Dean’s List
University of Illinois at Chicago
Fall 2018 — Spring 2022

Psi Chi International Honor Society in Psychology

University of Illinois at Chicago

RESEARCH GRANTS

Honors College Undergraduate Research Grant, \$1,000

University of Illinois at Chicago, Honors College

Mentor: Erin Berenz, Ph.D.

Awarded in Spring 2021

MANUSCRIPTS UNDER REVIEW

1. Hallihan, H. *, **Ghalyoun, H. ***, Moilanen, K., Rospenda, K., (2023). Negative Affect, Harassment and Problematic Alcohol Use in Young Adults. Submitted to the Journal of Substance Use and Misuse.
(*dual first authors)

CONFERENCE PRESENTATIONS

7. **Ghalyoun, H. ***, Hallihan, H. *, K. L. Moilanen L.K., Rospenda M., K. (2023). The Mediating Role of Negative Affect in Harassment-Induced Alcohol-Related Issues Among Young Adults: Evidence from a Longitudinal Study. Poster at 14th Annual Department of Psychiatry Research Forum. UIC, Chicago, IL.
(*dual first authors)

6. Bing-Canar, H., **Ghalyoun, H.**, Uribe, V., & Berenz, E. C. (2021). Influence of childhood trauma on trauma and alcohol cue reactivity. Virtual poster presentation at the 44th annual meeting of the Research Society on Alcoholism, San Antonio, TX.

5. **Ghalyoun, H.**, Paltell, K., Cox, C., Uribe, V., Gonzalez, S., Job, G., and Berenz, E. C. (2021). Racial and ethnic differences in interpersonal trauma exposure. Virtual poster presentation at the University of Illinois at Chicago's Impact and Research Week for the Honors College, Chicago, IL.

4. Hallihan, H., Bing-Canar, H., Paltell, K., Job, G., **Ghalyoun, H.**, and Berenz, E. C. (2021). Negative urgency as a moderator of associations between PTSD symptoms and alcohol risk in college students. Virtual poster presentation at the 2021 Center for Alcohol Research in Epigenetics, Chicago, IL.

3. Job, G., Bing-Canar, H., Uribe, V., **Ghalyoun, H.**, and Berenz, E. C. (2020). Examination of posttraumatic stress disorder symptoms and family history of alcohol use disorder on behavioral impulsivity in trauma exposed young adult drinkers. Abstract submitted for poster presentation at the 36th annual meeting of the International Society for Traumatic Stress Studies, Atlanta, GA.

2. Uribe, V., Edalatian Zakeri, S., **Ghalyoun, H.**, Job, G., & Berenz, E. C. (2020). High-intensity binge drinking and impulsivity among trauma-exposed college students. Abstract submitted for poster presentation at the 36th annual meeting of the International Society for Traumatic Stress Studies, Atlanta, GA.

1. **Ghalyoun, H.**, & Berenz, E. C. (2020). The interaction between PTSD and panic attack history on predicting alcohol risk. Virtual Presentation for the Summer Research Opportunities Program symposium, Chicago, IL.

RESEARCH EXPERIENCE

University of Illinois at Chicago (UIC), Department of Psychology
Graduate Research Assistant, Institute for Health Research and Policy

Chicago, IL
Fall 2022 — Present

Principle Investigator: Robin Mermelstein, Ph.D.

- Work on various lab projects, including (a) an observational study on the co-use of cannabis and tobacco among young adults and (b) a randomized controlled trial (RCT) evaluating a behavioral intervention for adult smokers to reduce cigarette smoking by switching to a standardized research e-cigarette.
- Responsibilities include: Working with participants as a behavioral coach to reduce their cigarette smoking; administering questionnaires; training participants to use a daily diary device for ecological momentary assessment (EMA) research design; screening participants for eligibility; conducting interviews about participant experience with EMA devices and subjective experience with both tobacco and cannabis.

University of Illinois at Chicago (UIC), Department of Psychology

Chicago, IL

PSCH 399: Independent Research Study

Summer 2021 — Spring 2022

Mentor: Erin Berenz, Ph.D.

- Created and conducted a project for my Honors college capstone that evaluates the relationship between racial trauma, racial and ethnic identity, and subsequent alcohol use as a form of coping among young adults in the greater Chicago area.
- Responsibilities included: Principal investigator; Creating an exempt survey study; creating and compiling Institutional Review Board (IRB) forms; applying for the Honors College Research Grant; creating survey project on REDCap including digitizing self-report measures, screening measures, consent and debrief forms, and payment methods; conducting data analyses on SPSS.

University of Illinois at Chicago (UIC), Department of Psychology

Chicago, IL

Undergraduate Research Assistant, Chicago Alcohol and Trauma Laboratory

Fall 2019 — Spring 2022

Principle Investigator: Erin Berenz, Ph.D.

- Worked on various graduate student milestone projects (i.e., dissertations and masters), overall lab projects, various conference, and poster presentations revolving around the experience of alcohol risk and disorder in trauma exposed young adults or trauma exposed individuals.
- Responsibilities include: Creating and adapting screening measures on REDCap; creating REDCap survey study projects; training other undergraduate research assistants; assisting on various IRB amendments and forms; creating and formatting psychoeducational models of trauma, PTSD symptoms, and Cognitive Behavioral Therapy (CBT) for trauma exposed women, 8-16 weeks of gestation; assisting in the development of a dissertation project to establish the influences of childhood trauma and adolescent alcohol binge exposures on reward functioning among young adult drinkers.

CLINICAL EXPERIENCE

United Support Network, UIC Counseling Center

Chicago, IL

Peer Paraprofessional

Fall 2019 — Spring 2022

Advisors: Robert Ballantyne, Psy.D. & Luis Salas, MSW.

- Clinically trained peer paraprofessional through the UIC Crisis Counseling Techniques (PSCH: 386) course to lead support groups on UIC campus for both undergraduate and graduate students to create a safe, confidential space for students to connect around life's struggles.
- Responsibilities include: lead weekly support groups during the school year and summer with approximately 8-12 undergraduate and graduate students as well as attend weekly supervision; identify suicidality, homicidality, and other concerning experiences students may be presenting and act accordingly (e.g., direct students to counseling center or police for further support); assess for, and aid with, any struggles students at UIC may be experiencing whether academically, mentally, emotionally, or physically.

UIC Neuropsychiatric Institute, UI Health**Chicago, IL***Intern**Spring 2021*

- Triage and intake intern for the Neuropsychiatric Institute at UI Health.
- Responsibilities included: Clear voicemails and calls; complete appointment reminder calls; contact individuals on the waitlist and gauge presenting needs or offer research opportunities, for both adult and child services; retrieve patient information consisting of demographics, health care, services being requested, and verification of benefits to input into Epic Healthcare system; respond to potential new patients with cultural sensitivity as well as to act appropriately when a patient is presenting with any suicidal or homicidal ideation.

TEACHING EXPERIENCE

Psychological Testing Course (PSCH 340), UIC Psychology Department**Chicago, IL***Teaching Assistant**Spring 2020**Professor: Christopher Baker, Ph.D.*

- Provided support to students to help improve understanding of principles in psychological assessment, objective tests, representative concepts, and related materials covered in class lectures.
- Responsibilities included: Holding weekly office hours; prepare study sessions for exams and quizzes; facilitate in-class discussions and in-class extra credit opportunities; supervise in-class quizzes and exams alongside professor.

LEADERSHIP & SERVICE

Trauma, Health Equity, and Neurobiology (THEN) Center, Hektoen Institute of Medicine**Chicago, IL***Volunteer**Fall 2021— Present**Mentors: Audrey Stillerman, MD. & Pat Rush, MD.*

- Undergraduate volunteer at the THEN Center engaging in trauma education and the development of projects to address the unique intersection of trauma, adversity, health disparities, and neurobiology utilizing a public health focus. The goal is to translate findings regarding trauma and implement them in healthcare and educational settings.
- Responsibilities include: weekly meetings with mentors to develop a holistic understanding of trauma; weekly project development (e.g., editing and creating learning material surrounding trauma and trauma informed care); provide a new perspective on learning materials to be distributed virtually.

United Support Network, UIC Counseling Center**Chicago, IL***Vice President**Summer 2020 — Fall 2021*

- Acting Vice President for the United Support Network, an initiative of the UIC Counseling Center. Co-executive board officers consist of graduate students in the UIC Jane Adams Social Work program.
- Responsibilities included: Leading student placement process for support groups; distribute surveys before and after a student participates in support groups; collect and manage data for end of semester statistics; assist with supervision (i.e., answer student questions, direct leaders towards further developing their own groups, and assist with any difficulties).

Muslim Student Association (MSA), UIC**Chicago, IL***Member**Fall 2018 — Spring 2022*

- Member of the MSA at UIC, attending monthly dinners and events to build a strong community of Muslims on UIC campus.

PROFICIENCIES

- Statistical Software: REDCap; SPSS; Qualtrics; R
- Languages: Arabic (conversational)