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Electronic Nicotine Delivery System (ENDS) Use in Relation to Mental Health Conditions, Past-Month Serious Psychological Distress, and Cigarette Smoking Status, 2017

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Abstract

Background and Aims: Adults with mental health conditions (MHC) exhibit disproportionately high smoking prevalence and experience profound tobacco-related disparities. U.S. nationally representative surveys from 2012–2015 found relatively high usage of electronic nicotine delivery systems (ENDS; e.g., e-cigarettes) among adults with MHC. However, research has not examined these associations specifically among never smokers. Aims were to examine associations among MHC diagnosis, serious psychological distress (SPD), and ENDS use and to test whether associations varied by cigarette smoking status.

Design: Cross-sectional U.S. nationally representative survey.

Setting: United States, 2017.

Participants: 5,762 adults (52.0% female; 64.8% non-Hispanic White, 11.4% non-Hispanic Black, 15.9% Hispanic, 7.9% non-Hispanic other).

Measurements: Outcomes were lifetime, current, and current daily ENDS use. Predictors were lifetime MHC, past-month SPD, and cigarette smoking status, and covariates were gender, age, race/ethnicity, education, and annual household income.

Findings: Lifetime MHC and past-month SPD were each associated with higher likelihood of having ever used ENDS (p .001), currently using ENDS (p .001), and currently using ENDS

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daily ($p<.05$). There were interactions between MHC and smoking status in predicting ENDS use, such that MHC status predicted higher lifetime and current ENDS use specifically among never and current smokers. Never smokers with MHC had 2.62 higher odds (95% CI: 1.54, 4.45) of current ENDS use than those without MHC. Among never smokers, those with MHC indicated higher expectations that ENDS would improve relaxation and concentration ($p<.05$).

Conclusions: In 2017, U.S. adults with versus without mental health conditions (MHC) were more likely to use electronic nicotine delivery systems (ENDS). In particular, both never and current smokers with MHC reported disproportionately high rates of current ENDS use.

Keywords

Mental health conditions; psychological distress; electronic nicotine delivery systems; e-cigarettes

INTRODUCTION

Adults with mental health conditions (MHC) exhibit disproportionately high rates of cigarette smoking (1–7). Although smoking prevalence has declined substantially in the general population (8), reductions in smoking among people with MHC have been much less pronounced (9, 10). In 2016, 30.5% of U.S. persons with any mental illness and 38.7% of persons with serious mental illness were past-month cigarette smokers compared to 18.4% of persons without mental illness (11). Moreover, although adults with mental and/or substance use disorders comprise approximately one-quarter of the U.S. population, they account for 40% of cigarettes smoked by adults (12). Most smokers with MHC indicate interest in quitting (7, 13, 14), but tend to experience greater nicotine dependence and are less likely to successfully quit (2–4, 7, 15–18). Adults with MHC experience profound tobacco-related disparities in morbidity and mortality. Approximately half of deaths among patients hospitalized with a primary psychiatric diagnosis were caused by tobacco-related conditions (19). People with serious mental illness have lower life expectancy than the general population, which is attributed primarily to smoking (2, 20).

To address these disparities, it is crucial to identify innovative smoking cessation and harm reduction approaches for smokers with MHC. The global landscape of tobacco use has changed dramatically in recent years (21–23), and electronic nicotine delivery systems (ENDS; e.g., e-cigarettes) have emerged as products that could offer a lower-risk alternative to traditional cigarettes (24). ENDS could potentially reduce population harm from tobacco use if current smokers who would otherwise not quit smoking switch completely to ENDS (25–29). Researchers have suggested that ENDS might be useful for harm reduction among smokers with MHC, but that more research is needed before making recommendations (30, 31). So far, only small pilot studies indicate that ENDS may promote reducing or quitting smoking among smokers with MHC (32–34). The evidence for ENDS as an effective smoking cessation tool in the general population is inconclusive (35–37), and ENDS might potentially maintain addiction or hinder attempts to quit smoking (38, 39). Whereas switching from smoking to exclusive ENDS use is consistent with harm reduction, longer-term dual use of ENDS and combustible tobacco may not reduce health harms (40, 41).

Furthermore, ENDS experimentation could potentially increase compulsive nicotine use or serve as a gateway to smoking among non-smokers who might not otherwise take up smoking (42–45). This is particularly concerning among individuals with MHC, who may be more prone to addiction (46, 47). Regardless of gateway effects, recent research on ENDS toxicity suggests that exclusive ENDS use could have unique health consequences (48, 49). More research is needed on long-term effects of ENDS, but if non-smokers with MHC use ENDS at higher rates than those without MHC, this priority population could disproportionately experience ENDS health risks.

Two U.S. nationally representative surveys have examined rates of ENDS use among people with MHC. Based on 2012 data, Cummins et al. (50) found that current smokers with versus without MHC were more likely to have tried e-cigarettes. Using 2015 data, we (51) reported that former smokers with MHC were more likely to have used ENDS than those without MHC. In both of these studies (50, 51), MHC was defined by participants indicating whether they had ever been diagnosed with MHC, and thus participants may or may not have been currently experiencing symptoms. Using 2014 National Health Interview Survey (NHIS) data, Park et al. (52) found that greater past-month psychological distress was associated with higher likelihood of ever having used e-cigarettes and of currently using both e-cigarettes and traditional cigarettes (i.e., dual use). Similarly, based on 2015 NHIS data, past-month serious psychological distress (SPD) was associated with higher likelihood of current e-cigarette use as well as use of combustible cigarettes (53). However, neither of these studies presented associations between mental health and current use of e-cigarettes specifically among never smokers. Given potential gateway effects to smoking as well as possible health harms of exclusive ENDS use, it is critical to understand ENDS use among never smokers with MHC. Furthermore, updated data are needed given the rapidly evolving range of available ENDS product types and flavors (54, 55); industry marketing (56, 57); federal regulations (58); and public health communications (59) in recent years. To evaluate whether the emergence of ENDS will reduce or exacerbate tobacco-related disparities for individuals with MHC, it is important to monitor these trends over time, including any differences in the association between MHC and ENDS use by smoking status. Accordingly, the current study aimed to 1) examine associations among MHC diagnosis, serious psychological distress (SPD), and ENDS use in 2017, and 2) test whether associations varied by cigarette smoking status.

METHODS

Design

Data were drawn from the 2017 Tobacco Products and Risk Perceptions Survey conducted by the Georgia State University (GSU) Tobacco Center of Regulatory Science (TCORS). This is a cross-sectional, U.S. nationally representative survey. Data were collected between August–September 2017, and participants were provided with small, cash-equivalent compensation. This study was approved by the GSU Institutional Review Board.

Sample

Participants were recruited through GfK's KnowledgePanel (a probability-based web panel designed to be representative of non-institutionalized U.S. adults). KnowledgePanel members are selected via address-based sampling (60). The sample was drawn from KnowledgePanel using a probability proportional to size weighted sampling approach, with a representative oversample of cigarette smokers.

In total, 8,229 KnowledgePanel members were invited to participate. Of the 6,033 qualified completers, 22 cases were excluded for not answering more than half the survey items and 19 were removed due to low duration to survey completion (< 3 minutes) or highly improbable/incompatible responses, yielding a sample of 5,992. A final stage completion rate of 74.3% and qualification rate of 98.6% were obtained. A study-specific post-stratification weight was computed using an iterative proportional fitting procedure to adjust for survey non-response and oversampling of smokers. Demographic and geographic distributions from the March 2017 Current Population Survey (61) were utilized as benchmarks for adjustment, and included gender, age, race/ethnicity, census region, education, household income, and metropolitan area. Of the 5,992 participants, 5,762 had complete data on MHC and SPD and were included in the current study.

Measures

Demographic Characteristics.—Gender, age, race/ethnicity, education, and annual household income were obtained from GfK profile surveys.

Mental Health Condition (MHC).—In GfK profile surveys, participants were asked if they had ever been “diagnosed by a doctor or other qualified medical professional” with various medical conditions, including the following MHCs: “anxiety disorder,” “bipolar disorder,” “depression,” “mood disorder,” “schizoaffective disorder,” “schizophrenia,” and “other mental health condition not included in the above” (50, 51). Participants were classified as having a lifetime MHC if they reported any of these conditions.

Serious Psychological Distress (SPD).—Past-month psychological distress was assessed using the Kessler-6 (K6) scale (62). Participants were asked, “During the past 30 days, about how often did you feel the following symptoms:” “nervous,” “hopeless,” “restless or fidgety,” “so depressed that nothing could cheer you up,” “that everything was an effort,” and “worthless.” Response options range from 0 (none of the time) to 4 (all of the time), and ratings were summed for a total score. The K6 was developed as a screening measure for serious mental illness and is a widely used measure of nonspecific psychological distress. Based on past research (17, 18, 62), participants were classified as having current SPD if they had K6 scores of 13 or greater.

Smoking Status.—Participants who indicated having smoked at least 100 cigarettes in their lifetime were asked, “Do you currently smoke cigarettes every day, some days, or not at all?” Those who responded “every day” or “some days” were categorized as current smokers, and those who responded “not at all” as former smokers. Those who denied having smoked at least 100 cigarettes in their lifetime were categorized as never smokers.

ENDS Use.—Participants were provided a description of ENDS (e.g. e-cigarettes, e-cigars, e-hookahs, e-pipes, vape pens, hookah pens, personal vaporizers/mods) and shown pictures of example ENDS. Then they were asked whether they had ever used ENDS. Those who answered “yes” were asked, “Do you now use electronic vapor products every day, some days, rarely, or not at all?” Those who indicated now using ENDS “every day,” “some days,” or “rarely” were considered current ENDS users (51, 63). Those who noted using ENDS “every day” were considered current daily users.

ENDS Outcome Expectations.—Participants rated the chance of several outcomes happening to them (adapted from (64)) if they use ENDS “every day” or “only once in a while, say at parties or with friends” using a 7-point scale (1=No Chance, 7=Very Good Chance). Items relevant to mental health were “be more relaxed” and “have better concentration.” Respondents who answered “don’t know” were excluded.

Statistical Analyses

Weighted point estimates and 95% confidence intervals for lifetime and current ENDS use were obtained by mental health status and smoking status using SAS 9.4. Mental health status was determined based on self-reported lifetime MHC diagnoses and past-month SPD. Weighted logistic regression analyses controlling for demographic variables (gender, age, race/ethnicity, education, income) examined associations between MHC/SPD (in separate models) and ENDS use. Then, weighted logistic regression analyses were conducted to predict ENDS use from MHC/SPD (in separate models), smoking status, demographic characteristics, and the interaction between MHC/SPD and smoking status. For significant interactions, results are also presented with stratification by smoking status (current vs. former vs. never smoker). As an exploratory analysis regarding why adults with MHC/SPD may use ENDS at differential rates, weighted ANCOVAs predicted ENDS mental health-related outcome expectations from MHC/SPD status among current ENDS users, controlling for demographics. Weighted analyses are presented to account for the sampling design of the survey, survey non-response, and oversampling of smokers (65, 66). However, as a sensitivity analysis, unweighted logistic regression was conducted examining associations between MHC/SPD and ENDS use in the overall sample (controlling for demographics) and the pattern of results was identical.

RESULTS

Demographic characteristics and rates of lifetime MHC and past-month SPD by demographic variables are shown in Table 1. Overall, 19.9% (95% CI: 18.7, 21.1) of U.S. adults reported at least one lifetime MHC and 8.2% (95% CI: 7.3, 9.0) indicated past-month SPD. The prevalence of MHC and SPD was higher among women, younger participants, and those with lower levels of education and income. Among participants who reported lifetime MHC, 22.9% (95% CI: 20.0, 25.8) also reported past-month SPD (data not shown). Of participants indicating past-month SPD, 55.8% (95% CI: 50.1, 61.5) reported at least one MHC (data not shown).

The distribution of SPD and lifetime MHCs, along with smoking status by MHC and SPD, are shown in Table 2. Depression was the most commonly reported MHC, followed by

anxiety disorders. Smoking status varied by mental health status, with current smoking most prevalent among those with versus without MHC and SPD. Smoking rates were highest among participants reporting Schizoaffective Disorder, Mood Disorder, Bipolar Disorder, and Schizophrenia and higher among participants who reported having been diagnosed with multiple MHCs.

Prevalence of lifetime ENDS use, any current ENDS use, and current daily ENDS use by MHC status is shown in Table 3. Adults with versus without any MHC were more likely to have ever used ENDS (34.2% vs. 16.7%). The overall interaction between MHC and smoking status in predicting lifetime ENDS use was significant, Wald $\chi^2(2) = 7.71, p = .021$, and when stratified by smoking status the adjusted association between MHC and lifetime ENDS use was significant among never and current smokers, but not among former smokers. Participants with any MHC were also more likely to currently use ENDS than those without MHC (16.3% vs. 6.5%). The overall interaction between MHC and smoking status in predicting any current ENDS use was significant, Wald $\chi^2(2) = 7.92, p = .019$, and when stratified by smoking status the association between MHC and current ENDS use was significant among never and current smokers, but not among former smokers. Participants with MHC were more likely to report current daily ENDS use (3.3% vs. 1.6%), but the interaction between MHC and smoking status was not significant.

Prevalence of lifetime ENDS use, any current ENDS use, and current daily ENDS use by SPD is shown in Table 4. Adults with SPD were more likely to report lifetime ENDS use (40.1% vs. 18.4%), any current ENDS use (19.7% vs. 7.5%), and current daily ENDS use (4.7% vs. 1.7%). None of the interactions between SPD status and smoking status were statistically significant, and thus results were collapsed across smoking status.

Prevalence of ENDS use was also examined among the 277 participants (4.6% [95% CI: 3.9, 5.2]) who indicated both lifetime MHC and past-month SPD (data not shown). Among these participants, the rates of lifetime, current, and current daily ENDS use were 43.7% (95% CI: 36.5, 50.9), 24.9% (95% CI: 18.5, 31.4), and 4.4% (95% CI: 1.2, 7.6), respectively.

Table 5 shows rates of lifetime and current ENDS use by specific MHCs. All MHCs with the exception of schizophrenia were significantly associated with higher likelihood of both lifetime and current ENDS use. Rates of ENDS use were particularly high among participants reporting Bipolar Disorder (49.0% lifetime use, 25.4% current use) and Mood Disorder (47.7% lifetime use, 26.3% current use). Current daily use is not reported by specific MHC because of very small subsample sizes.

Table 6 shows ENDS outcome expectations by MHC status among current ENDS users. Among never smokers, those with MHC indicated higher expectations that ENDS use would improve relaxation and concentration. Among current smokers, those with versus without MHC indicated lower ENDS outcome expectations. There were no significant associations between SPD and outcome expectations.

DISCUSSION

Individuals with MHC experience profound tobacco-related disparities (2, 5, 20), and it is critical to understand whether the emergence of novel tobacco products will reduce or exacerbate these disparities. Consistent with earlier surveys (50, 51), rates of ENDS use were higher among participants with MHC in the overall sample. However, unlike past studies, differences in ENDS use by MHC status were most pronounced among both never and current smokers. The findings that non-smokers with MHC are using ENDS at disproportionate rates, and that these individuals have higher expectations that ENDS will improve relaxation and concentration, are particularly novel and important. Researchers have raised concerns about whether non-smokers with MHC will exhibit a “gateway effect” to traditional smoking (30), as has been found among adolescents (67–69). Moreover, ENDS contain harmful toxicants in addition to nicotine (48, 49). Our cross-sectional findings cannot speak to trajectories of ENDS use and smoking or other health consequences over time, and longitudinal cohort data are needed. While never smokers with MHC may use ENDS hoping to manage mental health symptoms, it is possible that disproportionate ENDS use in this population could lead to compulsive nicotine use, increase likelihood of combustible tobacco use, and/or create other health consequences, thus exacerbating tobacco-related mental health disparities.

The measures of MHC, smoking, and ENDS use were identical between the current 2017 survey and our (51) 2015 survey. Although both surveys were cross-sectional, it is useful to examine rates of ENDS use by MHC status across these two years. In 2015, lifetime ENDS use was significantly higher among former smokers with versus without MHC (24.8% vs. 17.0%), and this pattern remained relatively similar in 2017 (although rates went up overall, the proportionate difference between former smokers with and without MHC was similar: 29.1% vs. 20.1%). There were no significant associations between MHC and ENDS use among current or never smokers in 2015, but differences emerged in 2017. Specifically, the rates of lifetime ENDS use remained similar among current and never smokers without MHC between 2015 and 2017 (among those without MHC, 53.1% of current smokers had tried ENDS in 2015 vs. 53.8% in 2017, and 7.1% of never smokers without MHC had tried ENDS in 2015 vs. 7.5% in 2017). However, rates of ENDS use increased among current and never smokers with MHC over the 2-year period. Whereas just over half (57.1%) of current smokers with MHC had tried ENDS by 2015, three-quarters (75.3%) had tried ENDS by 2017. In addition, the proportion of never smokers with MHC who had tried ENDS almost doubled between 2015 (7.7%) and 2017 (14.1%). Similar patterns emerged regarding current ENDS use, such that never smokers with and without MHC did not differ in terms of current ENDS use in 2015, but in 2017, never smokers with MHC had 2.6 greater odds of currently using ENDS.

More information is needed regarding how adults with MHC perceive the risks and benefits of ENDS, as well as how they are using these products (e.g., for smoking cessation). Recent data (70) suggest that among current smokers, those with MHC reported thinking more about how ENDS might benefit their health. Similarly, among former smokers, those with MHC indicated thinking less about potential health consequences of ENDS use and gave higher ratings for various reasons for using ENDS, including for harm reduction purposes,

than their counterparts without MHC (70). Given that smokers with MHC tend to have more difficulty quitting (15, 71), it is possible that they are especially interested in novel products as sources of hope.

There is evidence that the tobacco industry has historically targeted people with MHC (72, 73), and it is possible that current ENDS marketing efforts appeal to this population. For example, ENDS advertisements have claimed benefits including improved depression (74) and sociability (75). This could be one explanation for the recent finding that current smokers with SPD reported more positive expectancies that ENDS would improve social interactions (76). Moreover, never smokers with MHC could be especially attuned to these communications if they are curious about ENDS as a novel way to manage MHC symptoms, which could potentially explain disproportionate use of ENDS by never smokers. In recent years ENDS companies have increased marketing expenditures and social media communications (57), with increased emphasis on claims that ENDS are healthier, less expensive, and can be used in more places than smoking (56). It is possible that these increased marketing efforts contributed to the higher prevalence of ENDS use among never smokers with MHC between 2015 and 2017. In fact, our 2017 data suggest that among never smokers who use ENDS, those with MHC were more likely to indicate that regularly using ENDS would make them feel more relaxed and improve their concentration. However, the opposite pattern was found among their current smoking counterparts. If non-smokers with MHC are particularly drawn to perceived mental health benefits of ENDS use, it will be important to encourage more adaptive coping strategies for this population. Continued surveillance of ENDS risk/benefit perceptions, responses to ENDS advertising and public health communications, and trajectories of ENDS use and smoking behavior is needed among adults with MHC.

This study has several strengths including a U.S. nationally representative sample, use of recent (2017) data, and inclusion of both self-reported lifetime MHC diagnoses and past-month SPD, but is subject to inherent limitations of cross-sectional data. Longitudinal cohort data are needed to examine temporal relationships between MHC and ENDS use over time. In addition, MHC status was based on participants' self-report of ever having been diagnosed with psychiatric disorders. Thus, participants reporting MHC may or may not currently meet criteria, and it is possible that some participants have indeed experienced clinical disorders but not been formally diagnosed. Moreover, our sample sizes for several individual MHCs were small (e.g., schizophrenia $n = 21$), which resulted in large confidence intervals and limited statistical power. However, the 0.4% schizophrenia prevalence rate in this study is consistent with rates from other recent U.S. nationally representative surveys (51) and an international systematic review of prevalence rates (median lifetime prevalence 0.48% (77)). The inclusion of self-reported past-month SPD provides more information on the association between more recent distress and ENDS use, regardless of specific diagnosis. However, because our survey represents noninstitutionalized U.S. adults, it is possible that adults with more severe acute symptoms are less well represented because of higher rates of psychiatric hospitalization and incarceration (78).

In conclusion, based on a 2017 U.S. nationally representative survey, ENDS use was disproportionately high among adults with mental health conditions. Both lifetime history of

psychiatric diagnoses and past-month serious psychological distress were related to higher rates of lifetime ENDS use, current ENDS use, and current daily ENDS use. Notably, although there were not significant differences between never smokers with and without MHC in past analyses of 2012 or 2015 data (50, 51), differences in ENDS use by MHC emerged among both never and current smokers in 2017. The finding that never smokers with MHC are more likely to currently use ENDS is important, and continued surveillance of this trend over time is warranted. Research should also continue to elucidate how and why adults with psychiatric distress are using ENDS; whether ENDS use serves as a gateway to smoking or other health consequences among non-smokers with MHC; and whether ENDS are an effective smoking cessation aid among current smokers with MHC. This knowledge will be critical for informing public health communication, prevention and intervention efforts related to ENDS and smoking for this priority population.

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Table 1.

Rates of Lifetime Mental Health Conditions (MHC) and Past-Month Serious Psychological Distress (SPD) by Demographic Characteristics, 2017.

		%MHC and SPD by Demographic Characteristics	
Demographic Characteristics (n = 5762)		% Mental Health Condition	% Serious Psychological Distress
Overall		19.9 (18.7, 21.1)	8.2 (7.3, 9.0)
Gender		***	
Female	52.0 (50.4, 53.5)	24.2 (22.4, 26.0)	9.0 (7.8, 10.2)
Male	48.0 (46.5, 49.6)	15.3 (13.7, 16.9)	7.2 (6.0, 8.5)
Age		***	***
18–29	20.7 (19.3, 22.0)	26.4 (23.1, 29.6)	15.1 (12.3, 17.9)
30–44	24.8 (23.4, 26.2)	22.7 (20.0, 25.5)	10.4 (8.4, 12.4)
45–59	26.4 (25.1, 27.7)	18.3 (16.2, 20.5)	6.0 (4.7, 7.2)
60+	28.2 (26.9, 29.4)	14.1 (12.4, 15.9)	3.1 (2.2, 4.0)
Race/Ethnicity		*	*
White, NH	64.8 (63.2, 66.4)	20.9 (19.5, 22.4)	7.3 (6.4, 8.2)
Black, NH	11.4 (10.4, 12.4)	16.3 (12.8, 19.7)	7.9 (5.3, 10.6)
Other, NH	7.9 (6.9, 8.9)	15.5 (11.0, 20.0)	8.1 (4.4, 11.9)
Hispanic	15.9 (14.6, 17.2)	20.5 (16.9, 24.2)	11.8 (8.7, 14.9)
Education		***	***
< High School	10.7 (9.5, 11.9)	32.0 (26.5, 37.6)	18.3 (13.6, 22.9)
High School	28.8 (27.3, 30.2)	20.4 (17.9, 22.9)	8.4 (6.6, 10.1)
Some College	28.8 (27.5, 30.1)	20.4 (18.4, 22.4)	7.8 (6.5, 9.1)
Bachelor's Degree+	31.8 (30.5, 33.1)	14.9 (13.2, 16.5)	4.9 (3.8, 6.0)
Income		***	***
<\$15,000	9.0 (8.2, 9.9)	38.7 (33.8, 43.7)	23.7 (19.3, 28.1)
\$15,000–\$24,999	5.6 (5.0, 6.3)	29.4 (24.1, 34.7)	12.1 (8.5, 15.7)
\$25,000–\$39,999	12.9 (11.9, 13.9)	22.2 (18.8, 25.7)	10.6 (7.7, 13.5)
\$40,000–\$59,999	15.2 (14.1, 16.3)	22.7 (19.3, 26.0)	8.6 (6.3, 10.9)
\$60,000–\$84,999	15.8 (14.7, 16.9)	17.9 (15.0, 20.8)	6.8 (4.7, 8.8)
\$85,000–\$99,999	7.4 (6.6, 8.2)	13.5 (9.8, 17.3)	4.5 (2.1, 6.9)
\$100,000+	34.1 (32.6, 35.6)	13.5 (11.6, 15.4)	3.7 (2.6, 4.8)

Weighted column percentages and 95% confidence intervals are reported in parentheses. Asterisks indicate statistically significant associations, as determined by Rao-Scott χ^2 tests (* $p < 0.05$; ** $p < 0.01$; *** $p < .001$).

Table 2.

Smoking Status Percentages by Lifetime Mental Health Condition and Past-Month Serious Psychological Distress, 2017.

Mental Health Condition (MHC)	n	% of Total with Each MHC	Smoking Status		
			% Never Smokers (n = 2943)	% Former Smokers (n = 1602)	% Current Smokers (n = 1217)
Any Mental Health Condition***	1209	19.9 (18.7, 21.1)	44.2 (40.8, 47.6)	30.4 (27.2, 33.6)	25.3 (22.5, 28.2)
No Mental Health Condition	4553	80.1 (78.9, 81.3)	59.5 (57.8, 61.1)	28.4 (26.9, 30.0)	12.1 (11.1, 13.1)
Number of MHCs***					
1 MHC	684	11.2 (10.2, 12.2)	48.1 (43.5, 52.6)	34.4 (29.9, 38.8)	17.6 (14.5, 20.6)
2 MHCs	351	5.7 (5.0, 6.4)	43.8 (37.6, 49.9)	28.3 (22.5, 34.1)	27.9 (22.6, 33.3)
3 MHCs	174	3.0 (2.4, 3.5)	30.7 (21.9, 39.5)	19.7 (12.5, 26.9)	49.6 (40.4, 58.8)
MHCs:					
Bipolar Disorder***	144	2.6 (2.1, 3.2)	30.9 (21.7, 40.2)	20.5 (12.2, 28.8)	48.6 (38.6, 58.5)
Schizoaffective Disorder ***	24	0.3 (0.2, 0.5)	21.6 (3.4, 39.8)	13.9 (0.0, 28.8)	64.5 (43.1, 85.9)
Schizophrenia ***	21	0.4 (0.2, 0.5)	18.9 (0.0, 39.0)	36.4 (12.5, 60.3)	44.8 (21.4, 68.2)
Anxiety Disorder***	724	11.9 (10.9, 12.9)	41.8 (37.4, 46.1)	29.1 (24.9, 33.2)	29.2 (25.3, 33.0)
Depression***	864	13.8 (12.8, 14.9)	44.3 (40.3, 48.3)	29.2 (25.5, 32.9)	26.5 (23.1, 29.9)
Mood Disorder***	104	1.9 (1.5, 2.3)	31.5 (20.8, 42.3)	19.2 (9.4, 29.0)	49.2 (37.8, 60.7)
Other MHC***	116	2.0 (1.5, 2.4)	47.9 (36.2, 59.7)	18.7 (10.8, 26.5)	33.4 (22.7, 44.1)
Serious Psychological Distress***	472	8.2 (7.3, 9.0)	48.4 (42.7, 54.0)	18.0 (13.8, 22.2)	33.6 (28.5, 38.8)
No Serious Psychological Distress	5290	91.8 (91.0, 92.7)	57.2 (55.6, 58.7)	29.7 (28.3, 31.2)	13.1 (12.1, 14.0)

Unweighted frequencies (n), weighted prevalence and confidence intervals are reported. MHC categories are not mutually exclusive (e.g., persons classified in the “depression” category also reported other MHCs); therefore, separate analyses were conducted for each (or any) MHC vs. no MHC. Asterisks indicate statistically significant associations between MHC/SPD and smoking status, as determined by Rao-Scott χ^2 tests, (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Weighted 95% confidence intervals provided within parentheses.

Table 3.

Lifetime and Current Use of Electronic Nicotine Delivery Systems (ENDS) by Lifetime Mental Health Condition and Smoking Status, 2017.

Mental Health Condition	Overall (n = 5762)	Never Smokers (n = 2943)	Former Smokers (n = 1602)	Current Smokers (n = 1217)
Lifetime ENDS use				
Any Mental Health Condition	34.2 (31.0, 37.4)	14.1 (10.5, 17.7)	29.1 (23.2, 35.0)	75.3 (70.3, 80.3)
No Mental Health Condition	16.7 (15.4, 18.0)	7.5 (6.3, 8.8)	20.1 (17.5, 22.7)	53.8 (49.4, 58.1)
Relative Risk (unadjusted)	2.04 (1.81, 2.31)	1.87 (1.37, 2.53)	1.45 (1.14, 1.84)	1.40 (1.26, 1.55)
Adjusted Odds Ratio	2.12 (1.77, 2.54)	1.68 (1.15, 2.46)	1.24 (0.85, 1.79)	2.65 (1.89, 3.73)
Current ENDS use (every day, some days, or rarely)				
Any Mental Health Condition	16.3 (13.7, 18.9)	6.7 (4.2, 9.3)	9.7 (5.5, 13.8)	40.8 (34.5, 47.2)
No Mental Health Condition	6.5 (5.7, 7.4)	2.3 (1.7, 3.0)	8.1 (6.3, 10.0)	23.3 (19.4, 27.2)
Relative Risk (unadjusted)	2.49 (2.03, 3.06)	2.87 (1.77, 4.63)	1.19 (0.73, 1.93)	1.75 (1.40, 2.20)
Adjusted Odds Ratio	2.22 (1.74, 2.84)	2.62 (1.54, 4.45)	0.96 (0.56, 1.65)	2.14 (1.50, 3.05)
Current Daily ENDS use				
Any Mental Health Condition	3.3 (1.9, 4.6)			
No Mental Health Condition	1.6 (1.2, 2.1)			
Relative Risk (unadjusted)	2.02 (1.23, 3.31)			
Adjusted Odds Ratio	1.77 (1.04, 3.00)			

Asterisks indicate significant associations, as determined by adjusted logistic regression, between MHC and ENDS use among the overall sample and by smoking status (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Stratified analyses for daily ENDS use are not shown because the overall interaction was not statistically significant. Boldface indicates a statistically significant relative risk. Adjusted odds ratios (significant if boldface) control for gender, age, race/ethnicity, education, and income. Weighted 95% confidence intervals provided within parentheses.

Table 4.

Lifetime and Current Use of Electronic Nicotine Delivery Systems (ENDS) by Serious Psychological Distress (SPD), 2017.

SPD Status	% ENDS Users
Lifetime ENDS use	

Serious Psychological Distress	40.1 (34.6, 45.6)
No Serious Psychological Distress	18.4 (17.2, 19.7)
Relative Risk (unadjusted)	2.18 (1.87, 2.53)
Adjusted Odds Ratio	1.95 (1.49, 2.56)
Current ENDS use (every day, some days, or rarely)	

Serious Psychological Distress	19.7 (15.3, 24.2)
No Serious Psychological Distress	7.5 (6.6, 8.3)
Relative Risk (unadjusted)	2.64 (2.05, 3.39)
Adjusted Odds Ratio	1.94 (1.37, 2.74)
Current Daily ENDS use	
*	
Serious Psychological Distress	4.7 (2.2, 7.2)
No Serious Psychological Distress	1.7 (1.3, 2.1)
Relative Risk (unadjusted)	2.76 (1.53, 4.95)
Adjusted Odds Ratio	2.37 (1.21, 4.64)

Asterisks indicate statistically significant associations, as determined by adjusted logistic regression, between SPD and ENDS use (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Analyses are shown for the overall sample because there were not statistically significant interactions between SPD and smoking status in predicting ENDS use. Boldface indicates a statistically significant relative risk (RR). Adjusted odds ratios (significant if boldface) control for gender, age, race/ethnicity, education, and income. Weighted 95% confidence intervals provided within parentheses.

Table 5.

Prevalence of Lifetime and Current Use of Electronic Nicotine Delivery Systems (ENDS) by Specific Lifetime Mental Health Conditions, 2017.

Mental Health Condition (MHC)	<i>n</i>	Lifetime ENDS Use	Current ENDS Use
Any Mental Health Condition	1209	34.2 (31.0, 37.4)***	16.3 (13.7, 18.9)***
Bipolar Disorder	144	49.0 (39.1, 59.0)***	25.4 (16.7, 34.1)***
Schizoaffective Disorder	24	39.6 (17.6, 61.6)*	24.4 (5.4, 43.5)*
Schizophrenia	21	25.1 (7.4, 42.9)	15.0 (1.5, 28.5)
Anxiety Disorder	724	37.8 (33.6, 42.0)***	19.1 (15.6, 22.7)***
Depression	864	35.1 (31.3, 38.9)***	17.5 (14.3, 20.6)***
Mood Disorder	104	47.7 (36.3, 59.2)***	26.3 (16.3, 36.3)***
Other MHC	116	39.0 (27.8, 50.1)***	18.1 (9.3, 27.0)**
No Mental Health Condition	4553	16.7 (15.4, 18.0)	6.5 (5.7, 7.4)

Unweighted frequencies (*n*), weighted prevalence rates and 95% confidence intervals are reported. Asterisks indicate statistically significant associations, as determined by Rao-Scott χ^2 tests (**p* < 0.05; ***p* = 0.01; ****p* = .001).

Table 6.**ENDS Outcome Expectations (among current ENDS users only)**

	Overall <i>M</i> (<i>SE</i>)	Never Smokers (<i>n</i> = 75)	Former Smokers (<i>n</i> = 104)	Current Smokers (<i>n</i> = 267)
Be More Relaxed (from daily ENDS use)				
Any Mental Health Condition	2.89 (0.19)	3.19 * (0.41)	3.28 (0.40)	2.73 (0.23)
No Mental Health Condition	2.96 (0.14)	2.43 (0.29)	3.26 (0.25)	2.96 (0.19)
Be More Relaxed (from occasional ENDS use)				
Any Mental Health Condition	2.23 (0.16)	2.79 ** (0.38)	2.93 (0.33)	1.94 ** (0.19)
No Mental Health Condition	2.43 (0.14)	1.65 (0.25)	2.47 (0.22)	2.79 (0.21)
	Overall <i>M</i> (<i>SE</i>)	Never Smokers (<i>n</i> = 69)	Former Smokers (<i>n</i> = 98)	Current Smokers (<i>n</i> = 259)
Have Better Concentration (from daily ENDS use)				
Any Mental Health Condition	2.18 (0.19)	2.29 (0.41)	2.59 (0.51)	2.07 (0.22)
No Mental Health Condition	2.08 (0.13)	1.94 (0.33)	2.07 (0.23)	2.17 (0.18)
Have Better Concentration (from occasional ENDS use)				
Mental Health Condition	1.61 (0.15)	1.84 ** (0.32)	2.23 (0.35)	1.43 * (0.19)
No Mental Health Condition	1.70 (0.13)	1.00 (0.21)	1.68 (0.22)	2.06 (0.21)

Mean ratings of the chance of each outcome happening when using ENDS either daily or occasionally are shown (0 = No Chance, 6 = Very Good Chance). Asterisks indicate significant associations between MHC status and outcome expectations, as determined by weighted ANCOVAs, controlling for gender, age, race/ethnicity, education, and income.

* $p < 0.05$;

** $p < 0.01$;

*** $p < .001$.