Past-Month Nicotine versus THC E-Cigarette Use and Moderate-to-Severe Anxiety Symptoms Among U.S. Adults: A Cross-Sectional Analysis of the 2024 National Survey on Drug Use and Health

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Research Article

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Abstract

Purpose.

The 2024 National Survey on Drug Use and Health (NSDUH) introduced the seven-item Generalized Anxiety Disorder scale (GAD-7) for adults, enabling the first nationally representative comparison of nicotine versus tetrahydrocannabinol (THC) e-cigarette use with anxiety symptoms.

Methods.

Cross-sectional analysis of adults aged ≥ 18 years in the 2024 NSDUH public-use file (n = 47,299; weighted ≈ 262 million). Past-month e-cigarette use was classified as none, nicotine-only, THC-only, or dual use. The outcome was moderate-to-severe anxiety symptoms (GAD-7 ≥ 10). Survey-weighted logistic regression estimated crude and adjusted odds ratios (aOR) controlling for demographic, socioeconomic, insurance, and past-month cigarette and alcohol covariates; pre-specified sensitivity models additionally adjusted for marijuana use and major depressive episode.

Results.

Moderate-to-severe anxiety prevalence was 7.4% overall, and 5.9%, 15.8%, 17.3%, and 21.6% among non-vapers, nicotine-only, THC-only, and dual vapers. Nicotine-only (aOR 1.65, 95% CI 1.39–1.95), THC-only (aOR 2.45, 1.90–3.15), and dual (aOR 2.23, 1.82–2.73) use were each associated with higher odds of anxiety symptoms (joint $p = 3.1\times10^{-9}$). After additional adjustment for marijuana use and depression, the nicotine-only association persisted (aOR 1.50, 1.24–1.80), THC-only was borderline (aOR 1.51, 1.06–2.15), and dual use was non-significant (aOR 1.21, 0.88–1.65). Associations were stronger in women (interaction p = 0.012).

Conclusion.

Past-month e-cigarette use was associated with higher odds of moderate-to-severe anxiety symptoms. The nicotine-only association was most robust; the THC-vaping association was largely shared with marijuana use and depression, although adjusting for marijuana use may over-control because THC vaping is itself a form of marijuana use. Cross-sectional associations cannot establish causation.

1. Background

Anxiety symptoms are common among contemporary U.S. adults and frequently co-occur with depression and with substance use—so intertwined that they may share a common liability rather than behaving as fully separate disorders. For treatment, the shared root may matter more than the label; but

for identifying which subgroups are most vulnerable, and which substances they reach for, those distinctions are precisely what we need to recover. [1–3]

The e-cigarette complicates this. It is a delivery device, not a single exposure: the same device can carry nicotine, THC, or both. Treating all "vaping" as one exposure therefore collapses behaviorally and pharmacologically distinct groups into one category and invites exposure misclassification. [4, 5]

Prior work has linked e-cigarette use to mental-health indicators, and some studies have begun to separate nicotine vaping, cannabis vaping, and their combination. [4, 5] The closest prior study, by Salinas and colleagues, provided important early evidence on GAD-7 and other mental-health symptoms in nicotine and cannabis vapers, but relied on a small online convenience sample (Amazon Mechanical Turk; N = 492, only 40 of whom vaped cannabis only), collected in 2020–2021, with symptoms scored continuously and, by the authors' own statement, limited generalizability. [6] It could not estimate, at the level of the U.S. adult population and with survey weights, the moderate-to-severe anxiety burden (GAD-7 ≥ 10) associated with nicotine-only, THC-only, and dual vaping relative to non-users.

The 2024 NSDUH created a new opportunity by adding the GAD-7 to the adult interview. The GAD-7 is a widely used, validated anxiety-symptom screen, with a score ≥ 10 commonly used to denote moderate-to-severe symptoms; NSDUH's nationally representative design and survey weights permit weighted, population-level prevalence and association estimates. [7–9] The 2024 NSDUH thus lets us compare, within one nationally representative dataset, the anxiety-symptom burden associated with nicotine versus THC/marijuana vaping, and to further separate THC-only from dual nicotine-and-THC use.

Vaping is also a socially patterned behaviour—concentrated among younger adults and varying by sex, education, and income—so its anxiety-symptom correlates are a question for psychiatric epidemiology and public mental health, not only for substance-use research. [4, 5]

We used the 2024 NSDUH adult public-use file to estimate the association between past-month nicotine-only, THC-only, and dual e-cigarette use and moderate-to-severe anxiety symptoms (GAD-7 ≥ 10). We asked three questions. First, are nicotine-only and THC vaping each associated with higher odds of anxiety symptoms? Second, how does the pooled THC-vaping association change once THC-only and dual use are separated? Third, do these associations persist after additional adjustment for overall marijuana use and past-year major depressive episode? Because this is a cross-sectional analysis, all results are interpreted as associations and symptom burden, not as causal effects or temporal sequence.

2. Methods

Data and design. Cross-sectional analysis of the 2024 NSDUH public-use file (PUF), a nationally representative survey of the U.S. civilian, non-institutionalized population. The analysis used publicly available, de-identified data; ethics review and informed consent were not required.

Population. Adults aged ≥ 18 years (CATAG6 categories 2–6), analyzed as a survey subpopulation/domain (unweighted n = 47,299).

Outcome. Moderate-to-severe anxiety symptoms in the past two weeks, defined as a GAD-7 total score ≥ 10 (AGADTOTSC; cross-checked against the derived severity variable AGADMODOSEV). The GAD-7 is a validated screening instrument; scores indicate symptom burden and are not diagnostic of generalized anxiety disorder.

Exposure. Past-month e-cigarette use was operationalized at two resolutions. The primary three-group measure (reference = none) comprised non-vaper; nicotine-only (NICVAPMON = 1, MJVAPMON = 0); and THC/marijuana vaping (MJVAPMON = 1, including concurrent nicotine use). To separate pure-THC use from dual use, a four-group breakdown distinguished THC-only (MJVAPMON = 1, NICVAPMON = 0) from dual (both = 1); the three-group "THC vaping" category is the union of the THC-only and dual groups. The three-group measure was retained for comparability with prior two- and three-level vaping literature; the four-group breakdown was the primary contamination-adjusted analysis.

Covariates. Age category, sex, race/ethnicity, education, poverty level, marital status, health insurance, past-month cigarette use, and past-month alcohol use. Because marijuana use and depression may each confound, or lie on the pathway to, the vaping–anxiety association, past-month marijuana use of any route (IRMJRC = use within the past 30 days) and past-year major depressive episode (AMDEYR) were each added in pre-specified sensitivity models rather than the primary model.

Statistical analysis. Survey-weighted analyses used the person-level analysis weight (ANALWT2_C), stratum (VESTR_C), and primary sampling unit (VEREP) with Taylor-series linearization. We estimated weighted prevalence and survey-weighted logistic-regression crude (unadjusted) and adjusted odds ratios with 95% confidence intervals, reporting a joint Wald test (F statistic with numerator and denominator degrees of freedom) before interpreting individual group estimates; crude odds ratios were computed with the same survey design in the same complete-case analytic sample as the adjusted models (estimates in the full adult domain were essentially identical). The two exposure contrasts relative to non-vapers in the primary four-group model were the pre-specified primary comparisons; the recency, dose, sex-stratified, and marijuana- and depression-adjusted analyses were pre-specified sensitivity or exploratory analyses. Given this structure, individual confidence intervals are reported without family-wise multiplicity correction, and exploratory findings are interpreted as hypothesis-generating. Pre-specified sensitivity analyses: (1) additional adjustment for past-month marijuana use; (2) additional adjustment for past-year major depressive episode; (3) lifetime and past-year exposure recency windows; (4) nicotine vaping intensity (past-30-day days, NICVAP30N) as an ordinal dose trend; and (5) exploratory sex-stratified models with a formal interaction test. The pre-specified primary estimand was the set of adjusted odds ratios for the four-group exposure (model 1); the persistence of associations under additional adjustment for marijuana use and depression was a pre-specified sensitivity question, not a re-selection of the primary result. For the THC-only estimate we computed E-values [10] for the point estimate and the confidence limit closer to the null (treating the outcome as

non-rare; the E-value addresses unmeasured confounding only, not reverse causation, misclassification, or over-adjustment). Adjusted models used complete cases within the adult domain (n = 47,163; 136 adults excluded for covariate missingness); models additionally adjusting for major depressive episode included 45,526 adults (a further 1,637 excluded for missing depression data). Missing data were minimal (0.29%, confined to household income), the outcome and exposure had no missing values, and missingness did not differ across exposure groups ($\chi^2 = 1.28$, $p = 0.53$), making it unlikely to materially affect the estimates. Analyses were conducted in R (survey package); primary and sensitivity-analysis point estimates were independently reproduced in a second implementation in Python (pandas/statsmodels) as a dual verification, with agreement to two decimal places across all models. Design-based inference is reported from the R implementation. Generative artificial-intelligence tools were used, under the author's direction, to assist with drafting analysis code and language editing; the full disclosure appears in the Statements and Declarations.

3. Results

Sample. Among 47,299 adults (weighted ≈ 262 million), 7.4% (95% CI 7.0–7.8) had moderate-to-severe anxiety symptoms. E-cigarette users were younger and more likely to use cigarettes and alcohol than non-users (Table 1). Weighted anxiety-symptom prevalence rose across exposure groups: 5.9% (non-vapers), 15.8% (nicotine-only), 17.3% (THC-only), and 21.6% (dual).

Primary four-group association (Table 2). In unadjusted models, crude odds ratios were 2.99 (95% CI 2.55–3.51) for nicotine-only, 3.35 (2.68–4.20) for THC-only, and 4.41 (3.70–5.27) for dual use. After covariate adjustment, nicotine-only (aOR 1.65, 95% CI 1.39–1.95), THC-only (aOR 2.45, 95% CI 1.90–3.15), and dual (aOR 2.23, 95% CI 1.82–2.73) past-month vaping remained each associated with higher odds of moderate-to-severe anxiety symptoms (joint Wald $p = 3.1\times10^{-9}$). For comparability with prior literature, the three-group model (THC vaping including dual) yielded nicotine-only aOR 1.65 (1.39–1.96) and THC aOR 2.34 (1.96–2.78). Separating the groups showed that the pooled THC estimate was an average of a higher THC-only and a somewhat lower dual estimate.

Marijuana-use adjustment. Adding past-month marijuana use attenuated the THC-only (aOR 1.68, 95% CI 1.27–2.23) and dual (aOR 1.55, 95% CI 1.21–2.00) associations, while nicotine-only was largely unchanged (aOR 1.60, 95% CI 1.35–1.90).

Depression adjustment. Past-year major depressive episode was strongly associated with anxiety symptoms (aOR 14.0, 95% CI 12.1–16.3) and was more prevalent among vapers (6.7%, 15.3%, and 21.4% in the none, nicotine-only, and THC groups). After further adjustment for depression (in addition to marijuana use), the nicotine-only association remained significant (aOR 1.50, 95% CI 1.24–1.80), the THC-only association was borderline (aOR 1.51, 95% CI 1.06–2.15), and the dual association was no longer significant (aOR 1.21, 95% CI 0.88–1.65).

THC-only versus dual. On the multiplicative scale, the dual estimate did not exceed the THC-only estimate; additive-scale interaction was not assessed, so no inference is made regarding super-additivity

of combined nicotine-and-THC use.

Recency. The pattern was consistent across windows (Supplementary Table S1): past-year (nicotine 1.40, THC 2.26) and lifetime (nicotine 1.38, THC 2.16), with the strongest associations for current (past-month) use.

Dose. Among nicotine vapers, more past-month vaping days showed a significant increasing trend in anxiety odds (Supplementary Table S2; adjusted OR 1.17 per ordinal category of 1–5, 6–20, or 21–30 days; p = 0.028; an independently implemented continuous per-day model concurred in direction), although the categorical gradient was not strictly monotonic.

Sex (exploratory). In exploratory sex-stratified analyses (Supplementary Table S3), associations were stronger in women (THC-only 3.16, dual 2.22) than men (THC-only 1.83, dual 2.29), with a significant exposure-by-sex interaction (p = 0.012). Cell sizes were moderate (~900 per sex in the THC-only and dual groups) and confidence intervals overlapped between sexes; this pattern is suggestive and was not used to draw firm conclusions.

Unmeasured confounding (E-value; Supplementary Table S4). For the THC-only association, the E-value was 2.51 (point estimate) and 2.10 (lower confidence limit) before depression/marijuana adjustment, and 1.92 (point) and 1.51 (limit) after marijuana adjustment — indicating moderate, not definitive, robustness to unmeasured confounding.

4. Discussion

Using the 2024 NSDUH adult GAD-7, we compared past-month nicotine-only, THC-only, and dual nicotine-and-THC e-cigarette use with moderate-to-severe anxiety symptoms in a nationally representative sample. Weighted prevalence of moderate-to-severe symptoms rose across groups: 5.9% in non-users, 15.8% in nicotine-only, 17.3% in THC-only, and 21.6% in dual users. After adjustment for demographic, socioeconomic, insurance, and past-month cigarette and alcohol variables, all three vaping groups were associated with higher odds of moderate-to-severe anxiety symptoms (THC-only aOR 2.45, dual 2.23, nicotine-only 1.65; joint test significant). The anxiety-symptom burden of vaping was therefore not confined to one substance class but appeared across nicotine-only, THC-only, and dual use.

Separating THC-only from dual use is a central contribution. A three-group classification folds pure-THC and nicotine/THC dual users into a single "THC vaping" category; here, roughly half of that category was dual use. Once separated, the THC-only estimate was slightly higher than the pooled THC estimate—so dual use was not artificially inflating the pooled association; rather, the lumped category obscured potentially distinct patterns for THC-only and dual users. Notably, although dual users had the highest unadjusted symptom prevalence (21.6%), their adjusted odds ratio (2.23) was not the highest of the four groups, because dual users also carried more of the adjusted covariates (e.g., cigarette and alcohol use); covariate adjustment therefore attenuated the dual estimate more than the THC-only estimate. Exposures labelled identically as "THC vaping" may therefore contain groups differing in motives, co-

used substances, and mental-health background, which is relevant for future work. That dual use is common is unsurprising: using one substance through the device may facilitate co-use of another, though this was not measured here and remains hypothetical.

Sensitivity analyses give a more conservative reading. After additional adjustment for past-month marijuana use, the THC-only association attenuated from 2.45 to 1.68 and dual from 2.23 to 1.55, while nicotine-only was essentially unchanged. After further adjustment for past-year major depressive episode, the nicotine-only association remained near 1.5 and statistically significant; THC-only fell to borderline significance, and dual use was no longer significant. Nicotine-only vaping thus showed the most robust association with anxiety symptoms—consistent with the established link between smoking/nicotine and anxiety [11]—whereas a substantial part of the THC-vaping burden was shared with overall marijuana use, itself associated with anxiety [12], and with depression comorbidity.

This attenuation should not be read as "THC vaping has no association." THC vaping is a component of marijuana use (THC vaping $\subseteq$ marijuana use), so adjusting the THC-vaping estimate for overall marijuana use is, by construction, an over-adjustment: it conditions on a superset of the exposure itself, and much of the association is removed as a mathematical consequence rather than as evidence against an effect. [13] The marijuana-adjusted THC-only estimate (aOR 1.68) should therefore be read as an extreme conservative lower bound, not a refutation. The internal consistency of the models supports this interpretation: the nicotine-only estimate is essentially unchanged under the same adjustment, because nicotine vaping is not part of the marijuana-use construct. Anxiety and depression are likewise highly comorbid, so adjustment for major depressive episode may similarly over-control. We present these adjustments to show how the association changes as overall marijuana use and depression comorbidity are added in turn, not to prove a mechanism. The entanglement of anxiety, depression, and substance use seen here is consistent with a transdiagnostic, internalizing-spectrum view of shared liability; a cross-sectional analysis cannot adjudicate this, but longitudinal work could test it.

We also address a gap in the literature. Salinas and colleagues showed that, among nicotine/cannabis vape users, dual use may carry a higher mental-health symptom burden; but theirs was a convenience sample without population-level weighted inference. [6] Recent route-of-administration work in other national surveys—for example, decomposing cannabis smoking, cannabis vaping, and their dual use in the PATH study—likewise indicates that collapsing distinct use patterns obscures meaningful heterogeneity in mental-health correlates. [14] We use nationally representative NSDUH data, the adult GAD-7, survey weights and the complex sampling design, and a GAD-7 $\geq$ 10 threshold for moderate-to-severe symptoms. We therefore do not contradict the earlier work; we place nicotine-only, THC-only, dual use, and non-users in a single population-level analytic frame.

Other results support a descriptive, layered, conservative reading. Past-year and lifetime exposures pointed the same direction, with stronger associations for past-month use, consistent with recent use tracking more closely with recent symptom burden. Nicotine vaping days showed a significant trend, suggesting higher use frequency may carry higher symptom burden, but the categorical gradient was not

strictly monotonic and should not be over-interpreted as a clear dose-response. In sex-stratified analysis, nicotine-only and THC-only estimates were higher in women and the exposure-by-sex interaction was significant; however, cell sizes were only moderate and confidence intervals overlapped between sexes, so this is best regarded as an exploratory signal rather than an established sex difference.

Clinically and for public health, vaping status alone may be insufficient: where possible, clinicians can ascertain whether the patient vapes nicotine, THC/marijuana, or both, and ideally the product type, as device types proliferate. These categories may correspond to different anxiety-symptom burdens and comorbidity backgrounds. Nicotine-only vaping, whose association persisted after adjustment for marijuana use and depression, may warrant attention to anxiety-symptom screening in adults who vape nicotine; THC vapers may additionally warrant assessment of overall marijuana use, depressive symptoms, and other substance use. One pattern worth noting, though cross-sectional data cannot confirm it, is that individuals with greater symptom burden may use an additional substance as a form of self-medication. [3] These are screening- and risk-identification points, not causal claims.

Several strengths support these findings. Although this was a single-author analysis without a research team, all primary and sensitivity point estimates were independently reproduced in two separate software implementations (R and Python), agreeing to two decimal places. The data are a large, nationally representative NSDUH adult sample permitting weighted, population-level inference; the 2024 introduction of the adult GAD-7 provided a validated symptom measure with the standard ≥ 10 threshold for moderate-to-severe symptoms; we separated THC-only from dual nicotine-and-THC use rather than collapsing distinct exposures; and we pre-specified the sensitivity analyses for marijuana use, major depressive episode, recency, nicotine intensity, and sex.

5. Limitations

This is a single-year cross-sectional analysis: it cannot establish the temporal order of vaping and anxiety symptoms, nor exclude that anxious individuals self-medicate with nicotine or THC vaping. [3] The two-week GAD-7 recall window is moreover nested within the 30-day exposure window, which further limits temporal inference. Exposure and outcome are self-reported, with possible recall and social-desirability bias; in particular, the nicotine/THC classification rests on respondents' report of the substance vaped, and users may not always know the composition of their e-liquids—such misclassification, if non-differential, would generally bias group contrasts toward the null. The GAD-7 is a screen, not a diagnosis; results denote moderate-to-severe anxiety symptoms, not diagnosed anxiety disorder. Past-month cigarette use was adjusted only as a binary indicator, so residual confounding by smoking intensity or former smoking remains possible, particularly for the nicotine-only estimate. Because the outcome is not rare (7.4% overall and up to 21.6% among dual users), odds ratios overstate the corresponding prevalence ratios and should not be read as risk ratios. Despite adjustment for many covariates, unmeasured confounding remains possible—trauma history, other psychiatric conditions, substance-use-disorder severity, motives for use, and product concentration among them. Only the 2024 NSDUH carries the adult GAD-7, so trend analysis and within-NSDUH replication are not currently

possible. Finally, the sex-stratified THC-only and dual cells are limited in size, so those results should be considered exploratory.

6. Conclusions

In 2024 NSDUH adult data, past-month nicotine-only, THC-only, and dual nicotine-and-THC e-cigarette use were each associated with higher odds of moderate-to-severe anxiety symptoms. The nicotine-only association was the most robust, persisting after adjustment for marijuana use and major depressive episode; the higher crude THC-vaping association was largely shared with overall marijuana use and depression comorbidity. These results cannot establish causation, but they support future longitudinal work distinguishing nicotine, THC, and dual use alongside comorbid mental-health states, and they suggest that clinicians and public-health screening may benefit from not treating all vaping as one homogeneous exposure.

Abbreviations

aOR
adjusted odds ratio
CI
confidence interval
GAD-7
7-item Generalized Anxiety Disorder scale
MDE
major depressive episode
NSDUH
National Survey on Drug Use and Health
PUF
public-use file
THC
tetrahydrocannabinol.

Declarations

Funding. This research received no external funding.

Competing interests. The author declares that he has no competing interests.

Ethics approval. This study is a secondary analysis of the publicly available, fully de-identified 2024 NSDUH public-use data file and was conducted in accordance with the principles of the Declaration of Helsinki. Analysis of publicly available, de-identified data does not constitute human-subjects research; ethics review was not required.

Consent to participate. Not applicable; the study analysed publicly available, de-identified survey data.

Consent for publication. Not applicable.

Data availability. The dataset analysed in this study is the publicly available 2024 NSDUH public-use file, available from the Substance Abuse and Mental Health Services Administration (SAMHSA) at https://www.datafiles.samhsa.gov/.

Code availability. The analysis code (R) supporting this study will be made openly available in a public repository (GitHub/Zenodo) upon publication.

Author contributions. KAOFEI SAYION is the sole author. He conceived the research program and the research question, directed the literature and variable search, chose the study design and analytic strategy, made all interpretive and framing decisions, verified all reported results, and revised and approved the final manuscript. Generative AI tools were used, under the author's direction, to assist with English-language writing and analysis code (detailed in the AI-use statement below); the author takes full responsibility for the content.

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Supplementary Information. Supplementary Tables S1–S4 (exposure-recency robustness, nicotine vaping intensity, exploratory sex-stratified estimates, and E-values) and a missing-data summary.

Use of generative AI. Generative AI tools were used substantially in the preparation of this work, disclosed here for full transparency. Claude (Anthropic) was used to assist with topic ideation, verification of variable names and value codes against the data codebook, drafting and running of the statistical analysis code (R), interpretation and synthesis of results, drafting of the manuscript, and language editing. Codex (OpenAI, based on GPT-5) was used to independently re-implement the statistical analysis in Python as a cross-check of the primary and sensitivity results and to provide independent methodological and statistical critique. Grok (xAI) was used to cross-check the novelty of the research question against the existing literature during topic selection. The primary and sensitivity point estimates were independently reproduced across the two analytic implementations (R and Python), with agreement to two decimal places. The research program, the research question, the study design, and all analytic and interpretive decisions were determined by the sole author; the AI tools were used, under the author's direction, to assist with tasks of language and code execution. The author reviewed and verified all AI-assisted outputs, including every reported numerical result, and takes full responsibility for the integrity, accuracy, and content of this work. None of these tools is an author, and none bears responsibility for the work.

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Tables

Table 1. Weighted sample characteristics by past-month e-cigarette group (column %), with unweighted n

	Overall	Non-vaper	Nicotine-only	THC-only	Dual
Unweighted n	47,299	38,656	4,824	1,873	1,946
Weighted n (millions)	262.3	227.6	18.8	8.6	7.3
Age 18–25 (%)	13.3	11.1	28.7	17.6	39.5
Female (%)	51.3	52.2	47.6	41.1	44.5
Past-month cigarette (%)	14.3	11.4	35.4	22.1	40.6
Past-month alcohol (%)	50.2	48.0	60.0	70.8	71.5
GAD-7 ≥ 10 (%)	**7.4**	**5.9**	**15.8**	**17.3**	**21.6**

Unweighted GAD-7 ≥ 10 counts: non-vaper 2,998/38,656; nicotine-only 837/4,824; THC-only 356/1,873; dual 471/1,946. The three-group "THC vaping" category is the union of THC-only and dual. Dual users were the youngest and the heaviest cigarette and alcohol users; this contributes to their lower adjusted odds ratio despite their highest crude symptom prevalence.

Table 2. Adjusted odds ratios for moderate-to-severe anxiety symptoms by past-month e-cigarette group

Exposure	Crude OR (95% CI)	Primary aOR (95% CI)	+ Marijuana use	+ Depression	+ Marijuana + depression
Nicotine-only	2.99 (2.55–3.51)	1.65 (1.39–1.95)	1.60 (1.35–1.90)	1.52 (1.26–1.83)	1.50 (1.24–1.80)
THC-only	3.35 (2.68–4.20)	2.45 (1.90–3.15)	1.68 (1.27–2.23)	1.94 (1.40–2.69)	1.51 (1.06–2.15)
Dual	4.41 (3.70–5.27)	2.23 (1.82–2.73)	1.55 (1.21–2.00)	1.53 (1.19–1.97)	1.21 (0.88–1.65)
Model n	47,163	47,163	47,163	45,526	45,526

Outcome: moderate-to-severe anxiety symptoms (GAD-7 ≥ 10); reference = non-vapers. Crude odds ratios are unadjusted survey-weighted estimates computed with the same survey design in the same complete-case sample as the adjusted models; estimates in the full adult domain (n = 47,299) were

essentially identical. The crude, primary, and +marijuana models include 47,163 adults; models adjusting for depression include 45,526 (a further 1,637 excluded for missing past-year major depressive episode). The primary model adjusts for age, sex, race/ethnicity, education, poverty, marital status, insurance, past-month cigarette use, and past-month alcohol use; the joint Wald test was $F = 36.1$ (df 3, 25), $p = 3.1\times10^{-9}$. Past-year major depressive episode was itself strongly associated with anxiety symptoms (aOR 14.0, 95% CI 12.1–16.3). For the three-group measure (in which the "THC vaping" category is the union of THC-only and dual), the crude nicotine-only OR was 2.99 (2.55–3.51) and the crude THC-vaping OR was 3.82 (3.30–4.44); the adjusted nicotine-only aOR was 1.65 (1.39–1.96) and the THC-vaping aOR was 2.34 (1.96–2.78), attenuating to 1.62 (1.29–2.02) after marijuana adjustment.

Supplementary Files

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- GAD7supplementary.docx