Supplementary Online Content

Lim CCW, Sun T, Leung J, et al. Prevalence of adolescent cannabis vaping: a systematic review and meta-analysis of US and Canadian studies. *JAMA Pediatr.* Published online October 25, 2021. doi:10.1001/jamapediatrics.2021.4102

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This supplementary material has been provided by the authors to give readers additional information about their work.

Section and Topic		#	Checklist item	Page
eAppendix 1. Updated PRISMA 2020 Statement checklist				
TITLE	Title	1	Identify the report as a systematic review.	1
ABSTRACT	Abstract	2	Title, Background, Methods, Results, Discussion, Other Funding, Registration	1
INTRODUCTION	Rationale	3	Describe the rationale for the review in the context of existing knowledge.	2
	Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	2
METHODS	Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	2
	Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	2
	Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	E3
	Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	2
	Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	2
	Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	3
		10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	3
	Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	3
	Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	3
	Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis.	2-3
		13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	3
		13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	3
		13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	3
		13e	Describe any methods used to explore possible causes of heterogeneity among study results.	3
		13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	5

	Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	3
	Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	3
RESULTS	Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (see Figure 1).	Fig1
		16b	Cite studies that met many but not all inclusion criteria ('near-misses') and explain why they were excluded.	3
	Study characteristics	17	Cite each included study and present its characteristics.	3,5
	Risk of bias in studies	18	Present assessments of risk of bias for each included study.	T1
	Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	T2
	Results of syntheses	20a	For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies.	5
		20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	5
		20c	Present results of all investigations of possible causes of heterogeneity among study results.	5
		20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	5
	Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	n/a
	Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	5
DISCUSSION	Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	6-8
		23b	Discuss any limitations of the evidence included in the review.	8
		23c	Discuss any limitations of the review processes used.	8
		23d	Discuss implications of the results for practice, policy, and future research.	8
OTHER INFORMATION	Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	1
		24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	1
		24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
	Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	8
	Competing interests	26	Declare any competing interests of review authors.	8
	Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	3

eAppendix 2. MOOSE Guideline checklist	
Items	**Page**
1) Reporting of background should include	
Problem definition	2
Hypothesis statement	N/A
Description of study outcome(s)	2
Type of exposure or intervention used Type of study designs used	2
Study population	2
2) Reporting of search strategy should include	
Qualifications of searchers (eg, librarians and investigators)	1,8
Search strategy, including time period included in the synthesis and keywords	eAppendix 3
Effort to include all available studies, including contact with authors	3
Databases and registries searched	2
Search software used, name and version, including special features used (eg, explosion)	3
Use of hand searching (eg, reference lists of obtained articles)	2
List of citations located and those excluded, including justification	eAppendix 6-7
Method of addressing articles published in languages other than English	2
Method of handling abstracts and unpublished studies	2
Description of any contact with authors	2
3) Reporting of methods should include	
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	N/A
Rationale for the selection and coding of data (eg, sound clinical principles or convenience) Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	2
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	N/A
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	3
Assessment of heterogeneity	5
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	3
Provision of appropriate tables and graphics	Yes
4) Reporting of results should include	
Graphic summarizing individual study estimates and overall estimate Table giving descriptive information for each study included	Yes
Results of sensitivity testing (eg, subgroup analysis)	eAppendix 5

Indication of statistical uncertainty of findings	Table 2
5) Reporting of discussion should include	
Quantitative assessment of bias (eg, publication bias)	eFig1
Justification for exclusion (eg, exclusion of non–English-language citations) Assessment of quality of included studies	N/A
6) Reporting of conclusions should include	
Consideration of alternative explanations for observed results	6-8
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	8
Guidelines for future research	8
Disclosure of funding source	8

eAppendix 3. Search terms for each database	
Database	**Search terms for original studies**
PUBMED Search Query	((cannabis[Title/Abstract]) OR (marijuana [Title/Abstract]) OR (marihuana[Title/Abstract]) OR cannabis[MeSH Terms] OR marijuana use[MeSH Terms])) AND ((ecig*[Title/Abstract]) OR (e-cig*[Title/Abstract]) OR ("electronic cigarette"[Title/Abstract]) OR ("electronic cigarettes"[Title/Abstract]) OR ("electronic nicotine delivery"[Title/Abstract]) OR (eliquid*[Title/Abstract]) OR (e-liquid*[Title/Abstract]) OR (vape[Title/Abstract]) OR (vaping[Title/Abstract]) OR (vaporize*[Title/Abstract]) OR (EVALI[Title/Abstract]) OR ("vaping associated lung injury"[Title/Abstract]) OR (Electronic nicotine delivery systems[MeSH Terms]) OR (vaping[MeSH Terms]) OR ("vaping/adverse effects"[MeSH Terms])) Filters: from 2003 - 2020
SCOPUS Search Query	(TITLE-ABS-KEY (ecig*) OR TITLE-ABS-KEY (e-cig*) OR TITLE-ABS-KEY ("electronic cigarette") OR TITLE-ABS-KEY ("electronic cigarettes") OR TITLE-ABS-KEY ("electronic nicotine delivery") OR TITLE-ABS-KEY (eliquid*) OR TITLE-ABS-KEY (e-liquid*) OR TITLE-ABS-KEY (vape*) OR TITLE-ABS-KEY (vaping) OR TITLE-ABS-KEY (vaporize*) OR TITLE-ABS-KEY (EVALI) OR TITLE-ABS-KEY ("vaping associated lung injury")) AND (TITLE-ABS-KEY (cannabis) OR TITLE-ABS-KEY (marijuana) OR TITLE-ABS-KEY (marihuana)) AND (PUBYEAR > 2002)
PsycInfo Search Query	(((title: (cannabis) OR title: (marijuana) OR title: (marihuana)) OR (abstract: (cannabis) OR abstract: (marijuana) OR abstract: (marihuana)) OR (Index Terms: (cannabis)) OR (Index Terms: (marijuana))) AND ((Year: [2003 TO 2020]))) AND (((title: (ecig*) OR title: (e-cig*) OR title: ("electronic cigarette") OR title: ("electronic cigarettes") OR title: ("electronic nicotine delivery") OR title: (eliquid*) OR title: (e-liquid*) OR title: (vape*) OR title: (vaping) OR title: (vaporize*) OR title: (EVALI) OR title: ("vaping associate lung injury")) OR (abstract: (ecig*) OR abstract: (e-cig*) OR abstract: ("electronic cigarette") OR abstract: ("electronic cigarettes") OR abstract: ("electronic nicotine delivery") OR abstract: (eliquid*) OR abstract: (e-liquid*) OR abstract: (vape*) OR abstract: (vaping) OR abstract: (vaporize*) OR abstract: (EVALI) OR abstract: ("vaping associate lung injury")) OR (Index Terms: (electronic cigarettes))) AND ((Year: [2003 TO 2020])))
Web of Science Search Query	TOPIC: ((ecig* OR e-cig* OR "electronic cigarette" OR "electronic cigarettes" OR "electronic nicotine delivery" OR eliquid* OR e-liquid* OR vape* OR vaping OR vaporize* OR EVALI OR "vaping associated lung injury")) AND TOPIC:((cannabis OR marijuana OR marihuana)) Timespan: 2003-2020
Database	**Search terms for existing reviews**
PUBMED Search Query	(Meta-review [TIAB]) OR (Meta-Analysis [TIAB]) OR (meta-ana [TIAB]) OR (meta analysis [TIAB]) OR (meta ana [TIAB]) OR (metaanalysis [TIAB]) OR (metaana* [TIAB]) OR (Review [TIAB]) OR (Systematic Review [TIAB]) OR (META-ANALYSIS AS TOPIC [MeSH Terms]) OR (SYSTEMATIC REVIEWS AS TOPIC [MeSH Terms])
SCOPUS Search Query	(TITLE-ABS-KEY("meta-review") OR TITLE-ABS-KEY("meta-analysis") OR TITLE-ABS-KEY("meta-ana") OR TITLE-ABS-KEY("meta analysis") OR TITLE-ABS-KEY(meta ana) OR TITLE-ABS-KEY(metaanalysis) OR TITLE-ABS-KEY(metaana*) OR TITLE-ABS-KEY(review) OR TITLE-ABS-KEY("systematic review"))
PsycInfo Search Query	(title: (meta-review OR meta-analysis OR meta-ana OR "meta analysis" OR "meta ana" OR metaanalysis OR metaana* OR review OR "systematic review) OR Abstract:(meta-review OR meta-analysis OR meta-ana OR " meta analysis " OR " meta ana " OR metaanalysis OR metaana* OR review OR " systematic review) OR (Index Terms: ("systematic review")) OR (Index Terms: (review)) OR (Index Terms: ("meta analysis"))
Web of Science Search Query	meta-review OR meta-analysis OR meta-ana OR 'meta analysis' OR 'meta ana' OR metaanalysis OR metaana* OR 'systematic review' OR review

eAppendix 4. Cannabis vaping questions in each study			
Study	**Survey**	**Year**	**Question**
Trivers (2018)	NYTS	2016	*Cannabis use in e-cigarettes was determined by the response "Yes, I have used an e-cigarette device with marijuana, THC [tetrahydrocannabinol] or hash oil, or THC wax," to the question "Have you ever used an e-cigarette device with a substance besides nicotine?" Other response options included using another substance other than cannabis, using nicotine only, or never using an e-cigarette device.*
Dai (2020)	NYTS	2017-18	*"Have you ever used marijuana, marijuana concentrates, marijuana waxes, THC, or hash oils in an e-cigarette?*
Miech (2020)	MTF	2017-19	*"On how many days (if any) have you vaped marijuana?" with the time periods of "during the last 30 days," "during the last 12 months," and "in your lifetime."*
Bentivegna (2020)	PATH (Wave 3)	2015-16	*"Have you ever used marijuana, marijuana concentrates, marijuana waxes, THC, or hash oils in an [electronic product]? (0 occasions, 1–2, 3–5, 6–9, 10–19, 20–39, and 40 or more). Two dichotomous marijuana measures were coded for analysis: any marijuana use prevalence (0,1)"*
Morean (2015)	-	2014	*"Which of the following have you used to smoke marijuana?" Answer choices included "e-cigarettes filled with hash oil," "e-cigarettes filled with a wax plug," "portable vaporizers filled with dried marijuana (like a G-pen)," and "other."*
Mammen (2016)	OSDUHS	2015	*"Used e-cigarettes in the previous 12 months for marijuana, hash oil, liquid, or wax."*
Wardell (2021)	OSDUHS	2016-17	*"Participants reported cannabis used were also asked routes of cannabis administration they used in the past 12 months"*
Kowitt (2019)	NCYTS	2017	*Have you ever used an e-cigarette device with a substance besides nicotine? Participants could choose one or more of the following response options: (1) Yes, I have used an e-cigarette device with marijuana, THC or hash oil, or THC wax; (2) Yes, I have used an e-cigarette device with another substance that is not marijuana, THC or hash oil, or THC wax; (3)*
Doggett (2020)	COMPASS	2017-18	*'If you have used marijuana or cannabis in the last 12 months, how did you use it?' Response options included 'I have used it by smoking it (e.g. in a joint, a pipe, a bong),' 'I have used it by vaping it,' 'I have used it by eating or drinking it (e.g. in brownies, cookies, candies, tea)' and 'I have not used marijuana or cannabis in the last 12 months.'*
Eggers (2017)	FYTS	2015	*"Have you ever used an electronic vapor product with marijuana oil(also called hash oil)? [I have never used an electronic vapor product/Yes/No]"*
Barrington-Trimis (2020)		2013	*Participants reported past 6-month use and past 30-day use of 5 cannabis products using questions derived from validated national survey items.3 Cannabis products included "(1) combustible cannabis (eg, pot, weed, hash, reefer, or bud); (2) blunts (ie, cannabis rolled in tobacco leaf or cigar casing); (3) electronic device to vape cannabis or hash oil (eg, liquid pot, weed pen) [vaporized cannabis]; (4) cannabis or THC food or drinks (eg, pot brownies, edibles, butter, oil) [edible cannabis]; and (5) dabbing (eg, wax, shatter, budder, butane hash oil, BHO) [cannabis concentrate].*
Johnson (2016)	HKCS	2013	*During the past 30 days, how did you most often use marijuana?" and the response options were (a) I did not use marijuana during the past 30 days, (b) I smoked it, (c) I ate it (in an edible, candy, tincture, or other food), (d) I used a vaporizer, and (e) I consumed it in some other way*

Peters (2018)	HHS	2015	*"Have you ever used the following substances in your life?" and "In the last 30 days, how many total days have you used…?" (0 occasions, 1–2, 3–5, 6–9, 10–19, 20–39, and 40 or more). Two dichotomous marijuana measures were coded for analysis: any marijuana use prevalence (0,1)*
Leventhal (2020)	HHS	2015	*"Have you ever used the following substances in your life?" and "In the last 30 days, how many total days have you used…?" (0 occasions, 1–2, 3–5, 6–9, 10–19, 20–39, and 40 or more). Two dichotomous marijuana measures were coded for analysis: any marijuana use prevalence (0,1)*
Nguyen (2019)	HHS	2016-17	*"Have you ever used the following substances in your life?" and "In the last 30 days, how many total days have you used…?" (0 occasions, 1–2, 3–5, 6–9, 10–19, 20–39, and 40 or more). Two dichotomous marijuana measures were coded for analysis: any marijuana use prevalence (0,1)*
Hammond (2021)	ITC (Wave 1,2,3)	2017-19	*"In the last 30 days, did you: 1. Smoke marijuana/cannabis without tobacco 2. Smoke marijuana/cannabis with tobacco in a joint or blunt 3. Use a waterpipe/bong to smoke marijuana/cannabis 4. Use a vaporizer to heat dried marijuana/cannabis leaves or herb 5. Use an e-cigarette to vape marijuana/cannabis oil or liquid 6. eat or drink marijuana in a food or beverage 7. use marijuana/ cannabis extracts including oil, wax or shatter and 8. Use another form of marijuana/cannabis*
Knapp (2019)		2016	*Adolescents were asked if they had ever used marijuana (pot, weed, and herb) and given the reminder that marijuana could include things such as leaf and buds, and also extracts and concentrates. Specific questions about vaping included type of vaporizer used most frequently to vape marijuana, whether they owned or bought a vaporizer, and types of marijuana vaped.*
Abbreviations: **FYTS,** *Florida Youth Tobacco Survey*; **HHS,** *Happiness and Health Study;* **HKCS,** *Health Kids Colorado Survey;* **ITC,** *International Tobacco Control;* **MTF,** *Monitoring the Future*; **NCYTS,** *North Carolina Youth Tobacco Survey;* **NYTS**, *National Youth Tobacco Survey;* **OSDUHS**, *Ontario Student Drug Use and Health Survey;* **PATH**, *Population Assessment of Tobacco and Health;*		

eAppendix 5. Study quality based on modified Newcastle-Ottawa Scale for cross-sectional studies							
Study	Study design	Representativeness of the study sample[a]	Adequacy of sample size[b]	Non-respondents[c]	Assessment of cannabis vaping[d]	Appropriate reporting of prevalence and sample size[e]	Total score (out of 6)
Trivers (2018)[33]	**CS**	**	*	*	*	*	**6**
Peters (2018)[32]	**CS[f]**	*	*	*	*	*	**5**
Nguyen (2019)[31]	**CS[f]**	*	*	*	*	*	**5**
Morean (2015) [7]	**CS**	*	*		*	*	**4**
Miech (2020)[6]	**CS**	**	*	*	*	*	**6**
Mammen (2016)[5]	**CS**	*	*		*	*	**4**
Leventhal (2020)[30]	**CS[f]**	*	*	*	*	*	**5**
Kowitt (2019)[4]	**CS**	*	*		*	*	**4**
Johnson (2016)[29]	**CS**	*	*		*	*	**4**
Eggers (2017)[28]	**CS**	*	*		*		**3**
Doggett (2020)[34]	**CS[f]**	*	*	*	*	*	**5**
Dai (2020)[10]	**CS**	**	*		*	*	**5**
Wardell (2021)[35]	**CS**	*	*		*	*	**4**
Hammond (2021)[36]	**CS[f]**	*	*		*	*	**5**
Bentivegna (2020)[27]	**CS[f]**	**	*	*	*	*	**6**
Barrington-Trimis (2020) [26]	**CS[f]**	*	*	*	*	*	**5**
Knapp (2019)[37]	**CS**		*		*	*	**3**

[a]*Representativeness of the sample:* i) Truly representative of the average in the target population. ** (all subjects or random sampling) ii) Somewhat representative of the average in the target group. * (non-random sampling) iii) Selected group of users iv) No description of the derivation of the included subjects.

[b]*Adequacy of sample size:* i) Justified and satisfactory (n>100). * ii) Not justified iii) No information provided

[c]*Non-respondents:* i) Comparability between respondents and non-respondent characteristics is justified in the study, or the response rate is satisafactory (>70%). * ii) Unsatisfactory response rates, no summary data on non-respondents. Iii) No information provided

[d]*Assessment of cannabis vaping:* i) detailed definition of cannabis vaping provided (i.e actual wording of the question). * ii) No information provided

[e]*Appropriate reporting of prevalence and sample size:* i) number of cases and total sample used is reported along with the prevalence. * ii) No information provided

[f]*Prospective cohort study but prevalence is from a specific wave of the study.*

eAppendix 6. Meta-analysis of prevalence by survey year and age-groups (U.S. ONLY)															
	Grade 6-9			Grade 10			Grade 11			Grade 12			All[a]		
	k	%	95% CI	k	%	95% CI	k	%	95% CI	k	%	95% CI	k	%	95% CI
Lifetime															
2013-16	16	3.4	2.6-4.6	4	10.5	8.1-13.6	4	13.2	10.2-16.9	4	14.6	11.3-18.6	18	6.1	4.8-7.7
2017-18	14	3.9	2.9-5.1	7	11.7	9.0-15.1	5	15.6	11.4-20.8	7	17.0	13.4-21.2	30	6.5	5.4-7.9
2019-20	13	7.2	5.0-10.1	4	22.9	17.3-29.6	3	26.9	18.2-37.9	4	28.1	21.5-35.8	25	13.6	10.9-16.8
12-month															
2013-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017-18	2	3.6	2.5-5.3	2	10.1	6.6-15.1	-	-	-	2	11.2	8.1-15.2	7	7.2	5.1-10.2
2019-20	1	7.0	6.4-7.6	1	19.4	18.6-20.2	-	-	-	1	20.8	19.9-21.7	3	14.4	8.1-24.4
30-day															
2013-16	1	0.5	0.3-0.8	1	1.0	0.7-1.4	1	1.3	1.0-1.7	1	2.3	1.8-3.0	7	1.6	0.8-2.9
2017-18	2	2.1	1.3-3.3	2	5.5	3.4-8.8	-	-	-	2	6.2	4.1-9.1	8	4.6	3.2-6.5
2019-20	1	3.9	3.5-4.3	1	12.6	11.9-13.3	-	-	-	1	14.0	13.3-14.8	4	8.4	5.0-13.8

[a]*k* do not sum across the row as some surveys administered questions to all age groups.

eAppendix 7. Studies included for full-text screening (n = 290)

Study	Title	Decision
Vangipuram et al (2020)	Cannabis vape induced bronchitis	EXCLUDE
Tyacke et al (2011)	Effects of acute inhalation of vaporized cannabis or placebo on cardiovascular and saccadic eye movement measures: a pilot study	EXCLUDE
Taffe et al (2016)	Inhalation Self-Administration of Addictive Drugs via E-Cigarette Technology in Rats	EXCLUDE
Pearlson et al (2016)	Effects of Inhaled, Vaporized Cannabis on Functional MRI Signal and Behavior in a Simulated Driving Program	EXCLUDE
Miller (2018)	In search of efficacy: A self-reported patient study identifying effective THC: CBD ratios for sleep, pain and arousal based on dose-controlled delivery of vaporized cannabis oil	EXCLUDE
Liu et al (2019)	Impairment of Endothelial Function by Aerosol From Marijuana Leaf Vaporizers	EXCLUDE
Linder et al (2016)	Treatment of pediatric intractable epilepsy with vaporized cannabidiol (cbd) and delta(9)-tetrahydrocannabinol (thc)-preliminary findings of the israeli pediatric medical cannabis (mc) cohort	EXCLUDE
Kloft et al (2020)	Hazy memories: cannabis vaping amplifies the creation of false memory	EXCLUDE
Holub (2019)	Pulmonary Toxicity Associated with Vaping Marijuana	EXCLUDE
Cuccia et al (2020)	Cannabis use through e-cigarettes, including juul	EXCLUDE
Canales & Valverde (2020)	Perceived harm and vaping/marijuana dual-use among latino and non-latino high school students in colorado	EXCLUDE
Bouhlal et al (2017)	Effects of Smoked, Vaporized, and Oral Cannabis Administration on Appetitive Hormones and Relationships With Subjective Effects: A Clinical Study	EXCLUDE
Hamel-Senecal et al (2018)	E-cigarette: a new fashionable, discreet, but risky way to misuse drugs	EXCLUDE
Albrektson et al (2019)	The Dangers of Dabbing: A Case of ARDS Following Inhalation of Vaporized Butane-Extracted Cannabis Product	EXCLUDE
Abdallah et al (2018)	Effect of inhaled vaporized cannabis on dynamic airway function, breathlessness and exercise intolerance in adults with advanced COPD: A randomized controlled trial	EXCLUDE
Swortwood et al (2017)	On-site oral fluid Δ9-tetrahydrocannabinol (THC) screening after controlled smoked, vaporized, and oral cannabis administration	EXCLUDE
Spindle et al (2020)	Urinary Excretion Profile of 11-Nor-9-Carboxy-Δ9-Tetrahydrocannabinol (THCCOOH) Following Smoked and Vaporized Cannabis Administration in Infrequent Cannabis Users	EXCLUDE
Spindle et al (2018)	Acute Effects of Smoked and Vaporized Cannabis in Healthy Adults Who Infrequently Use Cannabis: A Crossover Trial	EXCLUDE
Sempio et al (2018)	Optimization of recombinant β-glucuronidase hydrolysis and quantification of eight urinary cannabinoids and metabolites by liquid chromatography tandem mass spectrometry	EXCLUDE
Ponzoni et al (2019)	Increased sensitivity to Δ(9)-THC-induced rewarding effects after seven-week exposure to electronic and tobacco cigarettes in mice	EXCLUDE
Pomahacova et al (2009)	Cannabis smoke condensate III: the cannabinoid content of vaporised Cannabis sativa	EXCLUDE
Nguyen et al (2018)	Tolerance to hypothermic and antinoceptive effects of Δ9-tetrahydrocannabinol (THC) vapor inhalation in rats	EXCLUDE
Nguyen et al (2020)	Lasting effects of repeated Δ(9) -tetrahydrocannabinol vapour inhalation during adolescence in male and female rats	EXCLUDE
Nguyen et al (2020)	Explication of CB(1) receptor contributions to the hypothermic effects of Δ(9)-tetrahydrocannabinol (THC) when delivered by vapor inhalation or parenteral injection in rats	EXCLUDE
Nguyen et al (2016)	Inhaled delivery of Δ(9)-tetrahydrocannabinol (THC) to rats by e-cigarette vapor technology	EXCLUDE
Hazekamp et al (2006)	Evaluation of a vaporizing device (Volcano) for the pulmonary administration of tetrahydrocannabinol	EXCLUDE
Budney & Borodovsky (2017)	The potential impact of cannabis legalization on the development of cannabis use disorders	EXCLUDE
Carlos et al (2019)	Vaping-associated Pulmonary Illness (VAPI)	EXCLUDE
Tashkin (2018)	Vaping Cannabis and Chronic Obstructive Pulmonary Disease	EXCLUDE
Solowij (2018)	Peering Through the Haze of Smoked vs Vaporized Cannabis-To Vape or Not to Vape?	EXCLUDE
Smith, & Goniewicz (2020)	The role of policy in the EVALI outbreak: solution or contributor?	EXCLUDE
Singh & Lippmann (2018)	Vaping medical marijuana	EXCLUDE
Ryan (2019)	Use of cannabis concentrates by adolescents	EXCLUDE
Printz (2020)	Fighting the teen vaping epidemic: With rates of adolescent vaping on the rise, experts caution that new federal rules targeting e-cigarettes may not be strong enough	EXCLUDE
Mahase (2019)	Marijuana use in e-cigarettes increases among US teens, studies find	EXCLUDE
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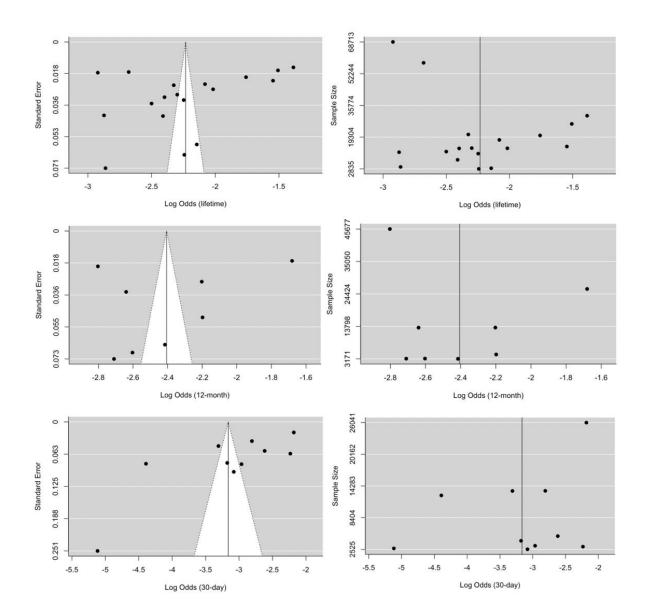|		
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Johnson et al (2016)	Usual modes of marijuana consumption among high school students in Colorado	INCLUDE
Jackson et al (2020)	Do youth who vape exhibit risky health lifestyles? Monitoring the future, 2017	EXCLUDE
Hoffenberg et al (2018)	Marijuana Use by Adolescents and Young Adults with Inflammatory Bowel Disease	EXCLUDE

Hindocha et al (2016)	No Smoke without Tobacco: A Global Overview of Cannabis and Tobacco Routes of Administration and Their Association with Intention to Quit	EXCLUDE
Highet et al (2020)	Tetrahydrocannabinol and Cannabidiol Use in an Outpatient Palliative Medicine Population	EXCLUDE
Hazekamp et al (2013)	The Medicinal Use of Cannabis and Cannabinoids - An International Cross-Sectional Survey on Administration Forms	EXCLUDE
Frohe et al (2018)	Correlates of cannabis vape-pen use and knowledge among U.S. college students	EXCLUDE
Fataar & Hammond (2019)	The Prevalence of Vaping and Smoking as Modes of Delivery for Nicotine and Cannabis among Youth in Canada, England and the United States	EXCLUDE
Boisvert et al (2020)	Subjective effects of combustible, vaporized, and edible cannabis: Results from a survey of adolescent cannabis users	EXCLUDE
Etter (2015)	Electronic cigarettes and cannabis: An exploratory study	EXCLUDE
Eggers et al (2017)	Youth use of electronic vapor products and blunts for administering cannabis	INCLUDE
Earleywine & Barnwell (2007)	Decreased respiratory symptoms in cannabis users who vaporize	EXCLUDE
Dugas et al (2020)	Type of e-liquid vaped, poly-nicotine use and nicotine dependence symptoms in young adult e-cigarette users: A descriptive study	EXCLUDE
Doggett et al (2020)	Modes of cannabis use among Canadian youth in the COMPASS study; using LCA to examine patterns of smoking, vaping, and eating/drinking cannabis	INCLUDE
Dai & Siahpush (2020)	Use of E-Cigarettes for Nicotine, Marijuana, and Just Flavoring Among U.S. Youth	EXCLUDE
Dai et al (2020)	Self-reported Marijuana Use in Electronic Cigarettes among US Youth, 2017 to 2018	INCLUDE
Cuttler et al (2016)	Sex Differences in Cannabis Use and Effects: A Cross-Sectional Survey of Cannabis Users	EXCLUDE
Cranford et al (2016)	Prevalence and correlates of "Vaping" as a route of cannabis administration in medical cannabis patients	EXCLUDE
Costiniuk et al (2019)	Cannabis Consumption in People Living with HIV: Reasons for Use, Secondary Effects, and Opportunities for Health Education	EXCLUDE
Cassidy et al (2018)	Initiation of vaporizing cannabis: Individual and social network predictors in a longitudinal study of young adults	EXCLUDE
Campbell et al (2020)	Correlates of lifetime blunt/spliff use among cigarette smokers in substance use disorders treatment	EXCLUDE
Borodovsky et al (2017)	U.S. cannabis legalization and use of vaping and edible products among youth	EXCLUDE
Borodovsky et al (2016)	Smoking, vaping, eating: Is legalization impacting the way people use cannabis?	EXCLUDE
Boehnke et al (2019)	Cannabis Use Preferences and Decision-making Among a Cross-sectional Cohort of Medical Cannabis Patients with Chronic Pain	EXCLUDE
Bentivegna et al (2020)	Electronic Cigarettes Associated With Incident and Polysubstance Use Among Youth	INCLUDE
Barrington-Trimis et al (2020)	Risk of Persistence and Progression of Use of 5 Cannabis Products After Experimentation Among Adolescents	INCLUDE
Baldassarri et al (2020)	Marijuana Vaping in U.S. Adults: Evidence From the Behavioral Risk Factor Surveillance System	EXCLUDE
Aston et al (2019)	A qualitative analysis of cannabis vaporization among medical users	EXCLUDE
Hakkarainen (2016)	Vaporizing the pot world - easy, healthy, and cool	EXCLUDE
Goodman et al (2020)	Prevalence and forms of cannabis use in legal vs. illegal recreational cannabis markets	EXCLUDE

eAppendix 8. Included studies from citation screening

Study	Title	Decision
Daniulaityte et al (2018)	A Twitter-based survey on marijuana concentrate use	EXCLUDE
Daniulaityte et al (2017)	Characterizing marijuana concentrate users: A web-based survey	EXCLUDE
Miech et al (2017)	What are kids vaping? Results from a national survey of US adolescents	EXCLUDE
Sutherland et al (2016)	Tobacco and e-cigarette use amongst illicit drug users in Australia	EXCLUDE
Johnson et al (2016)	Usual Modes of Marijuana Consumption Among High School Students in Colorado	EXCLUDE
Pergam et al (2017)	Cannabis use among patients at a comprehensive cancer center in a state with legalized medicinal and recreational use	EXCLUDE
Reynolds et al (2018)	Characteristics and Patterns of Marijuana Use in Community-Dwelling Older Adults	EXCLUDE
Chan et al (2017)	User characteristics and effect profile of Butane Hash Oil: An extremely high-potency cannabis concentrate	EXCLUDE
Wardell et al (2021)	Prevalence and Correlates of Medicinal Cannabis Use Among Adolescents	INCLUDE
Kritikos et al (2021)	Past 30–Day Marijuana Vaping: Prevalence and Predictors of Use in a Nationally Representative Study of U.S. Youth	EXCLUDE
Sharma et al (2021)	Electronic Vaping Product Use among Young Adults Who Receive Care at a Major Medical Institution	EXCLUDE
Hammond et al (2021)	Prevalence and modes of cannabis use among youth in Canada, England, and the US, 2017 to 2019	INCLUDE
Sexton et al (2016)	A Cross-Sectional Survey of Medical Cannabis Users: Patterns of Use and Perceived Efficacy	EXCLUDE

eFigure. Funnel plot lifetime, 12-month and 30-day prevalence