Over One Year Later – Smokers' EVALI Awareness, Knowledge and Perceived Impact on E-cigarette Interest

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Abstract

Objectives: The e-cigarette or vaping product use-associated lung injury (EVALI) outbreak caused serious lung injuries in over 2800 people in the USA in 2019. By February 2020, most cases were determined as linked with vaping tetrahydrocannabinol (THC), including black market products using vitamin E acetate. This study examined smokers' EVALI awareness, knowledge and perceived impact on their e-cigarette interest approximately 16 months after its peak.

Design: Between January-February 2021, we surveyed 1018 adult current smokers from a nationally representative US research panel. Participants were asked if they had heard about EVALI prior to COVID-19, knew its main cause, and if EVALI had impacted their interest in future e-cigarette use.

Results: Approximately 54% of smokers had heard of EVALI. Among those who had heard of EVALI (n=542), 37.3% believed its *main* cause was e-cigarettes used to vape nicotine, like JUUL. Fewer (16.6%) thought the main cause was products for vaping marijuana/THC, and 20.2% did not know. About 29% had heard vitamin E acetate was associated with EVALI, and 50.9% indicated EVALI made them less interested in using e-cigarettes in the future. EVALI awareness was significantly associated with e-cigarette risk perceptions (i.e., that e-cigarettes are as harmful as smoking).

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Conclusions: Despite the passage of time, considerable lack of knowledge and misperceptions about EVALI remain among those who smoke. Our findings suggest the need for continued efforts to promote better understanding of EVALI and appropriate behavioral and policy responses.

INTRODUCTION

In the United States, an outbreak of serious vaping-related lung injuries (dubbed "EVALI") emerged in June 2019, peaked in September 2019, and led to over 2,800 hospitalized cases by February 2020.[1] Although emerging cases suggested an important link with vaping tetrahydrocannabinol (THC), the main psychoactive ingredient of cannabis, communications from the Centers for Disease Control and Prevention (CDC) through October 2019 urged concerned individuals to consider refraining from using *all* e-cigarette and vaping products during its investigation, in addition to warning about THC vaping products, particularly those from informal sources.[2] The CDC subsequently identified vitamin E acetate, an additive in some THC vaping products, as a "chemical of concern"[3] and by January 2020 had confirmed that most EVALI patients had used THC-containing vaping devices, rather than nicotine-based e-cigarettes/vapes.[4]

The extent to which the public followed and understood the EVALI investigation is unclear. Although EVALI received substantial news coverage during its peak,[5,6] coverage declined with the subsequent fall in cases and the onset of COVID-19. The CDC posted its last EVALI web page update on February 25, 2020,[1] shortly before COVID-related shutdowns across the US in March 2020. Furthermore, early news discussion of EVALI often simultaneously discussed the high prevalence of youth vaping and JUUL popularity, potentially conflating these issues and products.[6,7] A US poll assessing EVALI awareness in January 2020, four months after its peak, found more respondents linked EVALI with using e-cigarettes like JUUL (66%) than with vaping THC (28%).[8]

Studies in the US and elsewhere have documented increases in e-cigarette harm perceptions after EVALI.[9–14] However, limited research has focused on knowledge of EVALI itself or EVALI's impact on *smokers'* e-cigarette perceptions and intentions. This is important given e-cigarettes' potential to reduce adverse health effects in smokers who switch to them.[15] We aimed to explore US smokers' recall and knowledge of EVALI over a year after the outbreak, and to assess any lasting effects on perceptions of and interest in using e-cigarettes.

METHODS

Participants and Procedures

Data came from a broader online survey about modified risk products and messages (conducted January-February 2021) with 1018 adult current smokers (aged 18+, smoked at least 100 lifetime cigarettes and now smoke every day or some days). Participants were recruited by Ipsos from their *KnowledgePanel,* a commercial web panel designed to be representative of the US population, using probability-based panel recruitment (address sampling via the US Postal Service's Delivery Sequence File) and survey weighting procedures.[16] To recruit 1000 smokers, Ipsos invited a sample of 1852 panel participants

believed to be smokers; 1171 (63%) completed eligibility questions, and 1018 confirmed smokers completed the survey.

Measures

As part of the broader study, four EVALI-related measures were developed and refined through cognitive interviews with 15 smokers and young adult non-smokers.[17] To assess EVALI awareness/recall, participants were asked, "Before COVID-19, did you hear about people getting very sick or dying from an outbreak of serious lung illnesses caused by vaping?" (yes, no, not sure). Those answering yes were asked three follow-up questions. The first asked, "To the best of your knowledge, which type of product was the MAIN cause of these vaping-related illnesses and deaths?" Response options were: 1) E-cigarettes used to vape nicotine, like JUUL; 2) Vaping products used for vaping marijuana or THC; 3) Both were responsible; 4) I don't know. The second asked, "Have you heard of vitamin E acetate as being associated with this outbreak of vaping lung illnesses?" (yes, no, not sure). The third follow-up question asked, "What effect, if any, has this outbreak of vaping-related lung illnesses had on your interest in using e-cigarettes/vaping products in the future?" Response options were: 1) Because of these vaping illnesses, I am <u>less</u> interested in using e-cigarettes in the future; 2) Because of these vaping illnesses, I am <u>more</u> interested in using e-cigarettes in the future; 3) The vaping lung illness outbreak has had <u>no effect</u> on my interest in using e-cigarettes in the future. The survey also asked about ever and past 30-day use of e-cigarettes/vaping products, and perceived harm of e-cigarettes/vaping products relative to cigarette smoking (less harmful, about the same, more harmful, don't know).

Analyses

We provided weighted prevalence estimates (with 95% confidence intervals) of responses about EVALI awareness, knowledge and impact on e-cigarette interest. Chi-square tests examined associations between EVALI awareness and 1) participant demographics, 2) e-cigarette risk perceptions (significance levels at 0.05). Among those aware of EVALI, Chi-square tests also examined associations between e-cigarette use (never, former and past 30-day use) and 1) EVALI knowledge and 2) EVALI-related e-cigarette use interest.

RESULTS

Most participants smoked daily (79.1%), 55.7% had tried an e-cigarette/vape before and 11.3% had vaped in the past 30 days (see Table 1 for additional demographics).

EVALI Awareness and Knowledge

Approximately 54% of smokers had heard of EVALI (Table 1). Awareness was significantly associated with e-cigarette use and highest among former e-cigarette users (59.8%). Among those who had heard of EVALI, 37.3% believed that its *main* cause was e-cigarettes used to vape nicotine, like JUUL (Table 2). Fewer (16.6%) indicated that products used for vaping marijuana/THC were the main cause. Perceived main cause of EVALI was significantly associated with e-cigarette use, with current users more frequently indicating vaping marijuana/THC as the main cause (47.8%, Table 2). Among smokers aware of

EVALI, 29.4% had heard of the association with vitamin E acetate (Table 2). This awareness was more prevalent among those who had vaped in the past 30 days (67.4%).

Having heard of EVALI was also associated with e-cigarette risk perceptions ($p<.0001$). Most smokers thought e-cigarettes were about as harmful (40.0%) or more harmful than cigarettes (22.0%), and the perception that e-cigarettes are *more* harmful was more prevalent among those who were aware of EVALI (26.6%) versus not (16.8%) (see Supplemental Table 1). Smokers who had heard of EVALI were also less likely to indicate uncertainty about the risks of e-cigarettes compared to cigarettes, relative to those not aware of EVALI (20.3% versus 31.4%).

Perceived Impact of EVALI on Interest in using E-cigarettes

Among smokers who had heard of EVALI, 50.9% indicated that it made them less interested in using e-cigarettes in the future (Table 2). E-cigarette use was significantly associated with perceived EVALI impact, with never (51.1%) and former e-cigarette users (53.9%) more likely to indicate reduced interest in e-cigarettes following the EVALI outbreak than those who used e-cigarettes currently (33.4%) (Table 2). Further, what smokers believed to be the main cause of EVALI was also associated with perceived EVALI impact (p<.0001). Those who thought e-cigarettes used to vape nicotine were the main cause of EVALI were more likely to indicate reduced interest in e-cigarettes following the EVALI outbreak (58.5%) compared to those who thought products for vaping THC were the main cause (34.9%) (see Supplemental Table 2).

DISCUSSION

Approximately a year after the CDC's last EVALI webpage update and 16 months after the outbreak's peak, about half of US smokers recalled hearing about EVALI prior to COVID-19. Considerable uncertainty and misperceptions remained, with about one third of smokers believing that e-cigarettes used to vape nicotine, like JUUL, were the main cause of EVALI, and one-fifth indicating they did not know what the main cause was. A minority of participants correctly identified vaping marijuana/THC as the main cause. The common belief that nicotine-containing products were the main cause of EVALI (despite exclusive use of these products being self-reported by only 14% of cases[4]) implies a substantial misperception of the evidence.

These findings may have been shaped by early CDC/official communications that warned about use of *any* e-cigarette/vaping products, as well as public exposure to media coverage simultaneously discussing other e-cigarette issues - including growing e-cigarette use among youth, attributed to flavored products and JUUL.[6,7,9] Additionally, lawmakers passed numerous local and state bans on flavored e-cigarettes in the wake of EVALI,[18] likely reinforcing conflation of these issues for the public. It has also been argued that misperceptions may have been reinforced by the outbreak's assigned name, EVALI, which begins with the term "e-cigarettes" even though this term is not typically used by consumers who vape THC.[19]

Perceptions of EVALI may also relate to perceived issue relevance. Most smokers in this study did not currently use e-cigarettes, and EVALI knowledge was lower among these participants compared to those who also vaped. Dual processing communication theories suggest people process less personally relevant messages more "peripherally", often making judgments using superficial heuristics,[20] which, in the current case, may have included simultaneous headlines around EVALI and other e-cigarette issues (JUUL, e-cigarette bans).

Overall, these findings add to concerns that EVALI-related misperceptions may discourage tobacco smokers from switching to less harmful products,[10,11,15] as about half the smokers in this study reported being less interested in future e-cigarette use because of EVALI. Findings may lend support to efforts to correct EVALI misperceptions, such as, for example, a recent letter from a large group of experts petitioning the CDC to rename EVALI (proposing "Adulterated THC Vaping Associated Lung Injury"), dropping e-cigarettes from the name [19](a proposal subsequently denied).[21] More careful attention to terminology may help avoid similar misperceptions in the future. Furthermore, given that e-cigarette harm misperceptions had been increasing among US adults prior to EVALI,[22] broader efforts around e-cigarettes may be needed (e.g., more balanced news reporting, health care provider training, statements from officials/health organizations) if the potential risks and benefits of such products are to be clearly communicated to the public[15] Moving forward, similar efforts may be appropriate for other new nicotine products that may have harm-reduction potential (e.g., tobacco-free nicotine pouches).

Limitations include use of cross-sectional data, a focus on US smokers (limiting generalizability), and a relatively small number of past 30 day e-cigarette users (resulting in some small cell sizes in e-cigarette use comparisons), among whom the behavior of vaping THC was not specifically assessed. While the study included a question about EVALI's impact on future e-cigarette interest, it did not assess how EVALI may have already impacted e-cigarette use (past behavior). Also, the question asking directly about vitamin E acetate could have resulted in overestimates of its connection to EVALI, rather than including it in a list of items.

At our current moment where trust in scientific findings is vital but often called into question, it is important that the public receives accurate information about health issues like EVALI, as well as e-cigarettes/vaping products in general and other newer nicotine products. Appropriate responses among the public and action at the policy level depend upon such informational accuracy and appropriate risk perceptions. Looking forward, public health experts may be able to promote better understanding of EVALI – and of other emergent issues in tobacco control – through collaborations with key public-facing actors including media and lawmakers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

Data Availability Statement

Study instrument (survey) and data are available upon reasonable request to the corresponding author.

REFERENCES

1. Centers for Disease Control, Office on Smoking and Health. Outbreak of Lung Injury Associated with the Use of E-Cigarette, or Vaping, Products. 2020; Available at: https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html. Accessed Jane 22, 2022.

2. Centers for Disease Control, Office on Smoking and Health. Outbreak of Lung Injury Associated with the Use of E-Cigarette, or Vaping, Products. October 2019; Available at: https://web.archive.org/web/20191031113527/https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/need-to-know/index.html

3. Centers for Disease Control, Office on Smoking and Health. Outbreak of Lung Injury Associated with the Use of E-Cigarette, or Vaping, Products. November 2019; Available at: https://web.archive.org/web/20191116013510/https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease/need-to-know/index.html

4. Krishnasamy VP, Hallowell BD, Ko JY, Board A, et al. Update: characteristics of a nationwide outbreak of e-cigarette, or vaping, product use–associated lung injury—United States, August 2019–January 2020. Morb Mortal Weekly Rep 2020;69(3):90.

5. Leas EC, Nobles AL, Caputi TL, et al. News coverage of the E-cigarette, or Vaping, product use Associated Lung Injury (EVALI) outbreak and internet searches for vaping cessation. Tob Control 2021;30(5):578–582. [PubMed: 33051278]

6. Jeong M, Singh B, Wackowski OA, et al. Content analysis of e-cigarette news articles amidst the 2019 vaping-associated lung injury (EVALI) outbreak in the U.S. Nicotine Tob. Res.2021; doi: 10.1093/ntr/ntab203. Online ahead of print.

7. Algiers O, Wang Y, Laestadius L. Content analysis of US newspaper coverage of causes and solutions to vaping-associated lung injury. Subst Use Misuse 2021;56(4):522–528. [PubMed: 33627031]

8. Wilson S Electronic Cigarettes Increasingly Blamed by Public for Lung Illnesses -- Even as Evidence Points Elsewhere. 2020; Available at: https://morningconsult.com/2020/02/05/electronic-cigarettes-increasingly-blamed-by-public-for-lung-illnesses-even-as-evidence-points-elsewhere/. Accessed Jul 8, 2021.

9. Dave D, Dench D, Kenkel D, et al. News that takes your breath away: risk perceptions during an outbreak of vaping-related lung injuries. J Risk Uncertain. 2020;60(3):281–307. [PubMed: 34504389]

10. Tattan-Birch H, Brown J, Shahab L, et al. Association of the US outbreak of vaping-associated lung injury with perceived harm of e-cigarettes compared with cigarettes. JAMA Netw. Open 2020;3(6):e206981. [PubMed: 32539148]

11. Moustafa AF, Rodriguez D, Mazur A, et al. Adolescent perceptions of E-cigarette use and vaping behavior before and after the EVALI outbreak. Prev Med 2021;145:106419. [PubMed: 33422576]

12. Kreslake JM, Diaz MC, Shinaba M, et al. Youth and young adult risk perceptions and behaviours in response to an outbreak of e-cigarette/vaping-associated lung injury (EVALI) in the USA. Tob Control 2022;31(1):88–97. [PubMed: 33441461]

13. Wackowski OA, Rashid M, Greene KL, et al. Smokers' and young adult non-smokers' perceptions and perceived impact of snus and e-cigarette modified risk messages. Int. J. Environ. Res. Public Health 2020;17(18):6807. [PubMed: 32961924]

14. Morgan JC, Silver N, Cappella JN. How did beliefs and perceptions about e-cigarettes change after national news coverage of the EVALI outbreak? PLoS ONE 2021;16(4): e0250908. [PubMed: 33930093]

15. Balfour DJK, Benowitz NL, Colby SM, et al. Balancing consideration of the risks and benefits of e-cigarettes. Am J Public Health 2021;111(9):1661–1672. [PubMed: 34410826]

16. IPSOS Public Affairs KnowledgePanel. Available at: https://www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel. Accessed Jul 8, 2021.

17. Willis GB. Cognitive interviewing: A tool for improving questionnaire design. Thousand Oaks, CA. Sage Publications; 2004.

18. Juul & E-Cig Bans: City & State Vaping Bans Available at: https://www.drugwatch.com/e-cigarettes/juul-ban/. Accessed Jul 8, 2021.

19. Miller T, Iowa Department of Justice, Office of the Attorney General. Petition letter to the CDC. August, 2021. Available at: https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdrive.google.com%2Ffile%2Fd%2F1o0mlqZaMMUeD7Eapc1H0CdSsTz4HsuxE%2Fview&data=04%7C01%7Cwackowol%40cts.rutgers.edu%7C2257d8f379ff42178da208d9cfcf6ff9%7Cb92d2b234d35447093ff69aca6632ffe%7C1%7C0%7C637769313181875382%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C2000&sdata=X1w8RyXbj5A7Ouh1XwRndPpUUblFbIY2Fbaej%2BSWgSc%3D&reserved=0

20. Petty RE, Cacioppo JT, Goldman R. Personal involvement as a determinant of argument-based persuasion. J Pers Soc Psychol 1981;41(5):847.

21. Briss P Centers for Disease Control and Prevention. Response to Attorney General Miller et al. EVALI renaming petition letter. September 2021. Available at: https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdrive.google.com%2Ffile%2Fd%2F13QvkPs5oK8MF_CWmO5SL9mCwUcTmFMwR%2Fview&data=04%7C01%7Cwackowol%40cts.rutgers.edu%7C2257d8f379ff42178da208d9cfcf6ff9%7Cb92d2b234d35447093ff69aca6632ffe%7C1%7C0%7C637769313181875382%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C2000&sdata=FMJuYMveHc0N41gIhYgN57ccBHkjz%2FcU6fyd2rwVvwc%3D&reserved=0

22. Huang J, Feng B, Weaver SR, et al. Changing perceptions of harm of e-cigarette vs. cigarette use among adults in 2 US national surveys from 2012 to 2017. JAMA Netw. Open 2019;2(3):e191047. [PubMed: 30924893]

WHAT THIS PAPER ADDS

- Limited research exists on the public's knowledge surrounding the cause of the 2019 vaping-related lung illness outbreak (EVALI) and how this may have impacted e-cigarette perceptions and use

- This survey study of smokers in the United States finds that, about 16 months after EVALI's peak, most smokers still did not know it was mainly caused by vaping marijuana.

- This study also provides new data about the impact of EVALI on smokers' interest in using e-cigarettes/vaping products.

Table 1.

Sample Characteristics and Prevalence and Correlates of Smokers having heard of EVALI (n=1018)

	Sample Demographics (%)[a]	% of Smokers who heard of EVALI[b]	(95% CI)	p-value[c]
Total heard of EVALI		53.9	50.2–57.6	
Sex				
Male	52.7	53.8	48.6–59.1	0.96
Female	47.3	54.0	48.8–59.2	
Age				
18–29	17.3	57.8	44.4–71.3	0.18
30–44	29.6	51.8	45.3–58.3	
45–59	29.8	58.7	52.9–64.4	
60+	23.3	47.5	42.0–53.1	
Race/Ethnicity				
White, Non-Hispanic	70.7	56.9	52.5–61.3	0.1
Black, Non-Hispanic	12.4	48.3	38.6–58.1	
Other, Non-Hispanic	5.1	40.1	20.2–60.0	
Hispanic	10.5	46.5	34.9–58.2	
2+ Races, Non-Hispanic	1.3	57.4	39.5–75.3	
Education				
Less than high school	17.9	43.1	33.1–53.1	0.05
High school	38.4	54.9	48.8–61.0	
Some college	31.6	56.0	50.0–62.0	
Bachelor's degree or higher	12.1	61.0	51.5–70.5	
Sexual Orientation				
Straight	94.2	53.6	49.8–57.5	0.86
Gay or lesbian	1.2	56.6	39.3–73.8	
bisexual	2.3	56.2	39.5–73.0	
Something else	0.8	72.2	40.4–100.0	
Smoking Frequency				0.12
Smoke daily	79.1	54.6	50.5–58.8	
Smoke some days	20.9	51.2	42.8–59.6	
Quitting Plans				0.34
No plans to quit smoking	37.2	52.0	45.5–58.5	
Planning to quit in next 30 days	11.4	52.6	42.7–62.4	
Planning to quit in next 6 mo.	19.3	61.0	52.3–69.6	
Planning to quit in future/beyond 6 mo.	32.0	52.5	46.2–58.8	
E-cigarette use				
Never tried e-cigarettes	44.4	49.6	44.3–54.9	**0.03**
Former user/trier, not in past 30 days	44.3	59.8	54.3–65.4	
Current user, past 30 days	11.3	47.0	34.0–60.0	

[a]Read as column percentages

*b*Read as row percentages

*c*p-value is based on bivariate Chi-square tests of association between EVALI awareness (yes vs. no/not sure) and demographic/tobacco use variables

Table 2.

EVALI knowledge and perceived impact on e-cigarette interest among smokers aware of EVALI (n=542), by e-cigarette use status

	Among all smokers aware of EVALI (n=542)		By E-cigarette Use Status						
			Never E-cigarette Users		Former E-cigarette Users/Triers		Current, Past 30 Day E-cig Users		
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	p-values
E-cigarettes used to vape nicotine, like JUUL	37.3	(32.2–42.3)	37.9	(30.5–45.4)	40.0	(32.5–47.4)	22.4	(6.6–38.1)	**<.0001**
Vaping products used for vaping marijuana/THC	16.6	(12.6–20.6)	10.0	(5.8–14.2)	15.7	(10.0–21.3)	47.8	(29.1–66.5)	
Both were responsible	25.9	(21.6–30.2)	30.8	(24.0–37.5)	24.3	(18.2–30.4)	14.5	(1.4–27.7)	
I don't know	20.2	(16.4–24.0)	21.3	(15.5–27.2)	20.0	(14.5–25.6)	15.3	(4.3–26.4)	
Heard of Vitamin E Acetate as associated with EVALI									
Yes	29.4	(24.5–34.2)	25.0	(18.1–31.9)	25.4	(19.0–31.9)	67.4	(52.3–82.6)	**<.0001**
No	48.7	(43.6–53.8)	52.3	(44.8–59.8)	49.8	(42.3–57.2)	27.7	(13.7–41.7)	
Not sure	22.0	(17.7–26.2)	22.7	(16.3–29.0)	24.9	(18.3–31.4)	4.9	(0.0–10.9)	
Perceived impact of EVALI on e-cigarette interest									
Less interested in using e-cigarettes in future	50.9	(45.8–56.0)	51.1	(43.6–58.6)	53.9	(46.4–61.3)	33.4	(15.5–51.3)	**0.04**
More interested in using e-cigarettes in future	3.9	(1.5–6.3)	2.9	(0.1–5.8)	2.8	(0.0–5.5)	13.5	(0.0–29.0)	
No effect on interest in using e-cigarettes in future	45.2	(40.1–50.3)	46.0	(38.5–53.4)	43.4	(36.0–50.8)	53.1	(34.3–71.9)	

Note: p-values are based on bivariate Chi-square tests of association between EVALI knowledge/impact variable and e-cigarette use