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## Young adult perspectives on their respiratory health symptoms since vaping

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### Abstract

**Background:** Vaping among young adults (YA) has been associated with adverse respiratory health outcomes. However, key gaps remain in the literature including perspectives from YA vapers on perceived respiratory health symptoms since vaping, how they describe those symptoms and related experiences, and factors to which they attribute their respiratory health symptoms.

**Methods:** Participants ( $N=35$ ) were 18–25 years old and self-reported as currently vaping at least once per week. In-depth, semi-structured qualitative interviews were conducted using an open-ended interview guide designed to elicit respondents' subjective vaping-related experiences. We used a thematic analysis to interpret the transcripts.

**Results:** Participants reported adverse respiratory health symptoms (e.g., phlegm, cough, pain in lungs) that some attributed to vaping. Participants compared what is known about vaping to what is known about combustible cigarettes and described continued use of vaping products despite perceived adverse respiratory health consequences. Some participants attributed their symptoms to preexisting medical conditions (e.g., asthma) and to heavy vaping. Some described a decline in exercise-related endurance since vaping. Some participants also reported that they experienced worse respiratory symptoms when using specific brands and products (e.g., JUUL and nicotine salt formulation).

**Conclusions:** This study provides powerful accounts from YA vapers about their experience of respiratory health symptoms that they ascribe to vaping. Future research is needed to evaluate the prevalence and severity, as well as the risk and protective factors, of adverse respiratory health symptoms associated with vaping. Addiction prevention and treatment efforts for YA vapers may help curtail adverse respiratory health impact from vaping.

### Keywords

Vaping; respiratory health; risk perceptions; young adult

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#### Contributions

AK conducted qualitative interviews, analyzed transcripts, coded themes, drafted and edited the manuscript. SJS conducted qualitative interviews and revised/edited the manuscript. KAS conducted qualitative interviews and revised/edited the manuscript. JLB revised/edited manuscript. RM revised/edited manuscript. AML provided feedback to themes and revised/edited the manuscript. JLB-T developed the study, received funding, supervised qualitative interviews, created Table 1, and edited the manuscript.

## Introduction

There is increasing evidence that vaping among young adults (YA) is associated with adverse respiratory health symptoms.<sup>1-4</sup> However, no qualitative assessments of respiratory health have been conducted with YA vapers, leaving a gap in the literature regarding individual experiences with vaping and perceived respiratory health effects. The current study reports on YA perspectives of perceived respiratory health symptoms since vaping, how they describe those symptoms and related experiences, and factors to which they attribute their respiratory health symptoms.

## Methods

We recruited participants ( $N = 35$ ) from Southern California with advertisements on social media. Participants were screened via phone and were eligible if they were 18–25 years of age and self-reported vaping nicotine weekly for at least 6 months. We conducted one-on-one, in-depth, semi-structured qualitative interviews between 2018 and 2019 using an interview guide designed to elicit information regarding participants' vaping experiences. A subset of questions specifically inquired about vaping experiences related to respiratory health (i.e., shortness of breath during exercise, persistent cough, unusual mucus or phlegm or bronchitis, other self-perceived respiratory problems since starting to vape). For the current study, we analyzed participants' responses to questions about their respiratory health since vaping. We started with an initial learning period that allowed us to identify and organize respiratory health related quotations into two key categories: report of respiratory health symptoms occurring since vaping and factors participants believed influenced those symptoms. One author coded transcripts using an inductive analytic approach<sup>5</sup> and discussed with the team to identify emergent themes. Following the interviews, we collected participants' sociodemographic and substance use data by questionnaire (see Table 1 footnote for measure details). The University of Southern California Institutional Review Board approved this study.

## Results

The majority of participants were male (80%), and currently enrolled in higher education (57%; Table 1). Participants were on average 21.5 years of age and represented a diverse sample of self-identified racial and ethnic backgrounds, and a range of socioeconomic statuses. Roughly half of the sample reported use of JUUL as their primary device (48%) and more than half reported e-cigarette dependence (66%). The mean number of days used in past month was highest for vaping nicotine ( $M[SD] = 24.7 [7.4]$ ) followed by vaping cannabis ( $M[SD] = 12.2 [9.9]$ ) and then smoking cigarettes ( $M[SD] = 7.1 [9.3]$ ).

Seven descriptive themes emerged from participants' narrative discussions of their respiratory health in relation to vaping, which were grouped under two main categories. The first category describes topography of adverse respiratory health symptomatology related to vaping with two descriptive themes: "experience of adverse respiratory health symptoms related to vaping" and "continued use despite adverse respiratory health consequences." The second category further contextualizes these symptoms and contributing factors by

exploring how participants explain and ascribe meaning to these adverse respiratory health symptoms. These attributing factors were grouped under the following five descriptive themes: “exacerbation of medical conditions,” “connection with heavier vaping,” “impact on physical activity,” “role of brand and product characteristics,” and “vaping compared to smoking.” Given the integrated nature of these components, some quotations overlapped themes and are exemplified based on the primary point. See Table 2 for additional quotations by theme.

### **Topography of adverse respiratory health symptomatology related to vaping**

#### **Experience of adverse respiratory health symptoms related to vaping—**

Participants reported adverse respiratory health symptoms (e.g., phlegm, mucus, cough, congestion, difficulty breathing, and/or pain in the lungs) that they ascribed to vaping.

I’ve noticed that I feel more phlegmy [since starting to vape].

My lungs ... they feel thick, like right now ... they feel like there’s stuff in there.

**Continued vaping despite adverse respiratory health consequences:** Participants reported continued use despite adverse respiratory health consequences. One participant described trying to quit vaping due to adverse respiratory health consequences:

[I try to quit vaping] all the time. It’s usually right before I go to bed after a long day of hitting [my vape] all day. My lungs or my throat hurts, and my chest hurts and I’m thinking I need to stop right now. So I’ll go to bed and then I’ll wake up and vape again.

### **Contexts and contributing factors that explain and ascribe meaning to adverse respiratory health symptoms**

**Exacerbation of medical conditions—**Participants with medical conditions that predate their vaping, such as asthma or other breathing problems, often reported that vaping exacerbated those preexisting conditions.

During midterms and finals [exams] I use [my vaping device] a bunch and then I’ll feel like oh my god my asthma hurts.

Participants also noted, that while they were regularly vaping, small illnesses, like the common cold, often turned into multi-week illnesses that were more serious.

It’s really bad. I mean – when I get sick, if I get a cold, I’ll be sick for 3 weeks or a month. As opposed to a few day[s], it always turns into something worse and there’s been many times – at least 2 or 3 times – that I’ve gotten pneumonia, bronchitis, just from a cold.

Others reported a similar experience of an exacerbated “cold/flu” but did not attribute it to vaping. For example, when an interviewer acknowledged a participant’s cough during the interview the participant responded:

That's from the cold, not from [vaping] ... I had strep throat a few days ago and then that went away, and it turned into a cold and I've been coughing and sneezing for 3 or 4 days - it's terrible.

Similarly, another participant said:

I did have bronchitis, but I don't think that was related at all.

**Connection with heavier vaping**—Some participants felt that vaping more frequently and in larger volumes was related to greater adverse respiratory health symptoms, suggesting a dose response.

When I vape real heavily [in a] short amount of time, it's like my lungs get saturated with the [vape] juice, and I just have to cough it up a little bit.

**Impact on physical activity**—Participants mentioned respiratory symptoms in relation to their physical activity.

I feel like my breathing's tighter ... especially when I exercise. It takes me awhile to really get all that [phlegm] out and [for my lungs] to be able to feel loose again. I feel like [vaping] definitely does something to my ability to breathe.

Some participants reported poorer physical abilities due to vaping.

I know that [vaping] has had negative effects. [Vaping] definitely decreased my lungs' capacity.

However, other participants reported neither adverse respiratory health symptoms nor poorer physical abilities since vaping. These participants commonly connected this with their high intensity physical activity.

I'm a cross-country runner too and I don't see any effects [on my running performance].

**Role of brand and product characteristics**—Participants discussed characteristics of vaping brands and products that they thought influenced their respiratory health symptoms. For example, using a JUUL was mentioned by a number of participants in relation to adverse respiratory health symptoms and described by some to produce more phlegm and cough compared to other devices.

The JUUL is very powerful so you have to take it easy because you don't necessarily want to hack up a lung.

Another participant mentioned "knock off" brands as causing worse symptoms after using:

I feel like those knock off [vapes] definitely give you a cough ... the lower quality definitely [gives you] more than a cough. You feel like something is stuck in your throat [when you use those].

Some participants specifically mentioned nicotine salt products being very potent and causing a deep lung sensation and coughing.

[Salt nicotine e-liquids] are typically 50 mg or 35, so 10–15 times stronger than this [device], but it burns a lot hotter, and it burns such a small amount [of e-liquid] ... If I were to put [nicotine salt] juice in [my device], it would destroy my lungs [because it is so strong].

**Vaping compared to smoking**—Overall, participants were curious about the scientific evidence of vaping-related health consequences, particularly as compared to cigarettes. One participant talked about how he researched and understood vaping (vs. smoking combustible cigarettes) as having less impact on his respiratory system:

From what I could tell, the downside of vaping is that it leaves vapor particles on your lungs that can make it harder to breathe over time. But, other than that, you don't get the thousands of chemicals from the cigarette. And that was the appeal when I started [vaping].

Another participant spoke passionately about his distrust for the vaping manufacturing companies believing they have poor regulation and feeling like the chemicals in vaping products were worse for his lungs than cigarettes:

We just need to find out how we're making this s\*\*t and get it down to a science, and make sure everybody's doing it the same way ... I don't think [this process has been] developed yet. I still think there are parts of chemicals in that juice f\*\*\*ing my lungs up more than cigarettes ...

## Discussion

Our findings indicate that YA vapers report experiencing a variety of respiratory health symptoms—such as phlegm/mucus, cough, shortness of breath, and poorer physical abilities—that some attribute to vaping. Participants explained that having preexisting respiratory problems, vaping more frequently and increased volumes, or vaping specific brands and products contributed to worse respiratory symptoms. Across all emergent themes, perhaps the most critical finding is that these participants had an awareness of their adverse respiratory health symptoms and identified vaping to be a contributing factor, yet continued to vape—demonstrating a disconnection between awareness and behavior. Continued use despite adverse consequences is commonly an indication of addiction and a relevant framework for understanding experiences reported by the YAs in the current study. A deeper understanding of the role of addiction prevention and treatment for YA vapers may be of high priority in minimizing respiratory health impacts from vaping.

The specific factors and themes identified in the current study support previously documented claims of adverse respiratory health symptoms among YA vapers and offer a number of new participant generated hypotheses regarding why this may be happening (which varied across participants). Some e-cigarette flavoring components have been shown to contain diacetyl<sup>6</sup>—a known respiratory toxin—and have thus been hypothesized to be a risk factor for development of respiratory problems.<sup>7</sup> However, with so many different vaping products and other sources of nicotine that are commonly co-used with e-cigarettes, understanding what products and characteristics are causing adverse effects is

critical, yet extremely challenging. For example, the e-cigarette or vaping associated lung injury (EVALI) outbreak has been closely linked to tetrahydrocannabinol (THC) products containing Vitamin E acetate.<sup>8</sup> It is also well-established that smoking cigarettes causes pulmonary problems.<sup>9</sup> Given that 57% of the sample reported vaping cannabis in the past month and 46% reported smoking cigarettes in the past month, it is plausible that poly-users experienced compounded respiratory effects. Future studies are needed to examine product dosage and interactions. Given the likely complex nature of these relationships, the combination of scientific evidence and individual perspectives has the potential to offer new ideas about the relationship between respiratory health and vaping.

### Limitations and future directions

It is possible that participants may not have connected respiratory health symptoms to their vaping if interviewers did not directly ask. However, some participants mentioned these symptoms without being prompted. The generalizability of these findings may be limited by a small sample from Southern California and replication is warranted. Therefore, no conclusions can be drawn from this study about the prevalence or cause of respiratory symptoms among vapers. Future research is needed to systematically evaluate the prevalence and severity of adverse respiratory health symptoms associated with vaping, and to evaluate individual differences in risk and protective factors for the occurrence of such symptoms. There are three specific factors that emerged from this study that future research should investigate. First, it is possible that YAs with preexisting respiratory conditions are more likely to worsen those conditions by vaping. Second, it is unclear whether the reported cold and flu symptoms are misidentified vaping-related respiratory health symptoms or commonly reported among YA vapers. Third, it is unclear whether high intensity physical activity may serve as a protective factor against declining lung functioning and physical abilities among YA vapers.

### Conclusion

This study provides perspectives from YA vapers regarding the specific adverse respiratory health symptoms they have experienced and factors to which they attribute these symptoms. The current study contributes unique findings on how YA vapers describe (“feels like there’s stuff in my lungs”) and make sense of (“vapor particles on lungs make it harder to breathe”) respiratory symptoms. The YA perspective on vaping was compared to what is known about/experienced from using combustible cigarettes (“vaping is more dangerous than cigarettes” vs. “vaping has less chemicals than cigarettes”). While continued research is needed to confirm components of vaping products and e-liquid solutions that increase the risk of adverse respiratory symptoms in order to remove/regulate such formulations—immediate efforts to educate youth on the current science of vaping on health and illness is imperative to combat the vaping epidemic.

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**Table 1.**Sociodemographic characteristics ( $N=35$ ).

	Overall sample $N$ (%) or $M$ (SD)
Gender, $N$ (%)	
Male	28 (80%)
Female	7 (20%)
Age, $M$ (SD)	21.5 (1.4)
Race/Ethnicity $N$ (%)	
Asian	6 (17%)
Black or African American	1 (3%)
Native Hawaiian or Pacific Islander	1 (3%)
White	10 (29%)
Multi-ethnic or Multi-racial	5 (14%)
Hispanic	9 (26%)
Other	3 (9%)
Currently enrolled in higher ed $N$ (%)	
No	12 (34%)
Yes	20 (57%)
Don't know/Missing	3 (9%)
Current subjective financial status $N$ (%)	
Live comfortably	13 (37%)
Meet needs with a little left	12 (34%)
Just meet basic expenses	8 (23%)
Don't meet basic expenses	1 (3%)
Missing	1 (3%)
E-cigarette dependence, <sup>a</sup> $N$ (%)	23 (66%)
JUUL Use, <sup>b</sup> $N$ (%)	15 (48%)
Past 30-day use, $N$ (%)	
Vaping nicotine	32 (91%)
Vaping cannabis	20 (57%)
Smoking cigarettes	16 (46%)
Frequency of past 30-day use (days, $M$ [SD]) <sup>c</sup>	
Vaping nicotine	24.7 (7.4)
Vaping cannabis	12.2 (9.9)
Smoking cigarettes	7.1 (9.3)

Note.

<sup>a</sup>Participants completed the 10-item Hooked on Nicotine Checklist<sup>10</sup> adapted for vaping to assess nicotine dependence; participants were considered to have any e-cigarette dependence if they reported one or more dependence symptom.

<sup>b</sup>Participants were asked to bring in the vaping device they were currently using so the research team could photograph the device.  $N=31$  participants (88.6%) provided a device to be photographed.

<sup>c</sup>Participants reported the number of days they had used each product in the past 30 days (0 days, 1–2 days, 3–5 days, 6–9 days, 10–19 days, 20–29 days, all 30 days, treated as a continuous variable in analyses using the median for each category); reported frequency is among those who had used on at least 1 of the past 30 days.

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**Table 2.**

Additional quotations by themes.

Categories and themes	Additional quotations
1) Topography of adverse respiratory health symptomatology related to vaping	<p>"I definitely get short of breath quicker [after I've been vaping]."</p> <p>"I just noticed I was coughing a lot for a couple days and I asked my friend and she's like pretty smart about her research on it because she's using [e-cigarettes] to stop [smoking cigarettes] so she's like it's just because your cilia is being paralyzed so you need to cough a lot. It made sense to me, so it didn't really freak me out ..."</p>
Experience of adverse respiratory health symptoms related to vaping	<p>"It's not that I can't breathe it's almost like a clenching, like something is holding [the] inside of my lungs [and my chest] and it's reminding me I'm missing something ... [it feels like] there's a knot there and when I [vape] the knot gets unwound ... It's definitely still bad for you and I'm sure it's scarring my lungs and going to cause like pleural issues if I keep it up for a while."</p>
Continued vaping despite adverse respiratory health consequences	<p>"[Vaping] is probably not the best for me ... I have had nasal problems from a while ago and I had a deviated septum and sometimes I'll have allergies and I just can't really breathe. I don't think [vaping] helps it that much."</p>
2) Contexts and contributing factors that explain and ascribe meaning to adverse respiratory health symptoms	<p>"Yeah, I have a cough ... It's not that bad, it'll be more of a clear throat type thing, but when I get sick, it's constant."</p>
Exacerbation of medical conditions	<p>"If I'm running after [vaping] too much, I'm like 'I should stop' because my lungs don't feel up to par."</p>
Connection with heavier vaping	<p>"I'm not sure if it's related to the side that stopped playing football or that I vape a lot or a combination, but I've had trouble breathing."</p>
Impact on physical activity	<p>"I feel more mucus going up. I would notice it especially during cardio."</p>
Role of brand and product characteristics	<p>"I was on a dance team for 8 years and I haven't really seen any changes [to my breathing when dancing]."</p>
Vaping compared to smoking	<p>"I've been having the worst ... phlegm ... like thicker saliva. I'll get that every time I hit a JUUL ... [When I use] the Suorin [vape], not so much. I don't know what's different about those [vape] juices but a JUUL will make my throat feel like my saliva's thicker, but Suorin makes me salivate more which is weird ... I really don't like the feeling in my throat after the JUUL."</p>
Vaping compared to smoking	<p>"[Vaping is] a lot more dangerous than actual cigarettes. You're better off smoking cigarettes than vapes. Most of them. Another reason is that it damages your throat more than actual cigarettes."</p>
	<p>"Mucus all the time, like every morning ... but when I was smoking cigarettes it was like all throughout the day. But now, it's just mucus in the morning still."</p>