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Disposable pod use among vape shop customers: Does the flavor preference matter?

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3 **Disposable pod use among vape shop customers: Does the flavor preference matter?**
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Abstract

Objectives: In February 2020 the US Food and Drug Administration issued guidance restricting the sales and distribution of cartridge-based e-cigarettes with flavors other than tobacco and menthol. Disposable devices were exempted from this guidance. As a response to the rapid proliferation of disposable pods, we examined the prevalence of disposable pod use and flavor preference among vape shop customers, compared to refillable pod and other e-cigarette users.

Design: A cross-sectional study.

Setting: In July 2019 - March 2020, trained data collectors visited 44 vape shops in California with permission to recruit customers from shop owners.

Participants: Intercept interviews with 276 customers were conducted

Outcomes and procedures: Disposable pod, refillable pod, and other e-cigarette users were compared on demographics, flavor preference, daily e-cigarette use, preferred nicotine concentration levels and cigarette use.

Results: Of the 276 customers surveyed, 12.7% used disposable pods in the past 30-days. Fruit/candy (80.7%), mint (77.4%) and menthol flavors (67.7%) were prevalent among disposable pods users, while tobacco flavors were less prevalent (19.4%). Compared with refillable pod and other e-cigarette users, disposable pod users were younger, used higher nicotine concentration levels, were more likely to prefer mint and menthol flavors, while were less likely to use cigarettes in their lifetime and e-cigarettes daily.

Discussion: Disposable pod users were more likely to prefer mint and menthol flavors, while were also younger and preferred to use higher nicotine levels compared to the other e-cigarette users. Further, disposable pod users were more likely to be never smokers, with lower odds for

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3 daily vaping. Future regulatory efforts should consider limiting non-tobacco flavors, as well as
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5 the maximum nicotine content in disposable pod devices. Future research evaluating the
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7 prevalence of disposable pod use among youth and their flavor preference is warranted.
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10 11 12 **Strengths and limitations of this study**

- 14
15 • This is one of the first studies to examine the consumer preferences for e-cigarette
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17 product characteristics and flavor preference of disposable pod users.
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19 • Fruit-related, mint and menthol flavors are highly prevalent among disposable pod users,
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21 while tobacco-related flavors are less prevalent. Implications for future regulatory
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23 changes are discussed
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25 • This study is limited in sample size, and our findings might not be generalizable to vapers
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INTRODUCTION

Sales of electronic cigarettes (e-cigarettes) have rapidly increased in recent years, and their prevalence has surpassed combustible tobacco use among youth and young adults¹. One factor that may contribute to the surge of e-cigarette use is a rapid evolution and diversity of vaping products. Within the last 10 years vaping devices have progressed from thin, cig-a-like disposable and tubular, refillable vape pen devices (i.e., 1st and 2nd generation) to box mod (3rd generation) and to pod mod (JUUL type) devices². In particular, pod mods are small, low-powered, high-nicotine devices that are available in numerous flavors (such as mint, fruit), which have become prevalent among minors and emerging adults^{3,4}. To counteract the youth e-cigarette use epidemic, in February 2020 the US Food and Drug Administration (FDA) issued guidance indicating that the manufacture, distribution, and sale of pre-filled cartridge-based (i.e., JUUL, Phix) e-cigarettes without marketing authorization in flavors other than tobacco and menthol would be prioritized for enforcement of unlawful marketing of unauthorized products⁵. Nonetheless, public health professionals have raised concerns because language in the guidance indicated that disposable devices were excluded⁶.

Disposable pod-style devices (i.e., Puff Bar, Posh Plus, Cali Bar) are compact, sleek, ready-to-use, prefilled vaping devices that contain 20-70 mg/ml of nicotine salt and are marketed to deliver 200-300 puffs per device⁷. They are priced as low as \$4.60 USD and are available in mango, mint, strawberry and many other fruit/candy novel flavors with attractive packaging that may be appealing to minors⁷. While there is some evidence suggesting that more e-cigarette users may be replacing the flavored cartridge-based vaping devices with disposable pods⁸, little is known regarding the flavor preferences of disposable pod users.

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3 As a response to the rapid proliferation of disposable pods and to inform future flavor and
4 other regulations of pod-style devices, we assessed the prevalence of disposable pod use and
5 flavor preference among vape shop customers utilizing intercept interviews, in real time, as
6 customers completed their visit to the vape shop. Additionally, the differences in consumer
7 preference for e-cigarette product characteristics between disposable pod users, refillable pod
8 product users, and other e-cigarette users were examined. We hypothesize that disposable pod
9 users will use higher nicotine concentration levels and will be more likely to prefer mint and
10 menthol flavors compared to refillable pod and other e-cigarette device users.
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22 **METHODS**

23 **Participants and procedures**

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25 An exhaustive list of eligible vape shops located in Southern California was generated
26 from Google Maps and Yelp in locations with ethnically diverse populations ⁹. From July 2019 -
27 March 2020 (prior to COVID-19 shutdowns) two or three trained data collectors visited 44 vape
28 shops (between 10 am and 5 pm during workdays) with permission to recruit customers from
29 shop owners. All vape shop customers present at the time of data collection were approached by
30 data collectors as they exited the vape shop (n=425). Eligible participants were those who
31 reported having vaped in the past 30 days and consented to participate in a 15-minute interview
32 taking place immediately directly outside the shop. Upon survey completion, participants
33 received a \$35 gift card. A total of 401 eligible customers were invited to participate in this
34 study, 276 of them (69%) agreed and were recruited for participation in the customer interviews.
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50 The study was approved by the university's Institutional Review Board
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Measures

Participants were asked to indicate the first nicotine-containing product they used in their life and the most preferred type of e-cigarette device they used in the past 30-days (forced-choice options: pen, box mod, disposable pod style, refillable pod mod or other). Only 3 (1.0%) participants selected “other” and reported (equally) using both refillable pods and box mods; for analyses purposes they were classified as box mod users. Responses were re-coded into a primary exposure variable with three mutually exclusive categories (disposable pod vs. refillable pod vs. other devices [pen and box mod]). Participants’ e-liquid flavor preference was assessed with the question, “Which types of e-juices do you like the most? (Check all that apply)”. The response categories included: “fruit/candy”, “dessert”, “minty flavors”, “menthol”, and “tobacco flavor”. Additionally, we evaluated the preferred e-liquid nicotine level by asking participants: “How many mg per ml of nicotine does your favorite brand/flavor have?”. Past 30-day e-cigarette use was assessed with the item: “In the past 30 day, on how many days did you use e-cigarettes?” (1-30 days). Self-reported measures of gender, age and ethnicity were obtained from each participant.

Data Analysis

The prevalence of use, demographic characteristics, and flavor preference of disposable pod users are reported. The three groups of users (disposable pod users, refillable pod users, and users of other e-cigarette products) were compared on demographics, flavor preference, daily e-cigarette use, preferred nicotine concentration levels and cigarette use. Statistical significance was set at $P < .05$ (2-tailed), Benjamini-Hochberg multiple-testing corrections were applied to control the false-discovery rate at .05. All statistical analyses were conducted using Stata software (version 15.1; Stata Corp, College Station, Texas, USA).

RESULTS

Of the 276 customers surveyed, 76.5% were males, with a mean age of 31.8 years (SD=10.5, range 18-66); 35.9% were non-Hispanic White, 18.1% were Asian, 19.2% were Hispanic/Latino, 9.4% were African American/Black, and 17.4% were of other ethnicities (e.g., Middle Eastern or multiracial). Most participants (77.9%) reported using e-cigarettes every day in the past 30-days. Responses regarding the type of e-cigarette device used in past 30-days in total sample illustrated that 31 (11.2%) used disposable pods, 102 (40.0%) used refillable pods, and 143 (51.8%) used other e-cigarette devices, with the latter category including 129 (46.7%) box mod users and 14 (5.1%) vape pen users. type ^a

Compared with refillable pod users and other e-cigarette users, disposable pod users tended to be younger (mean age: 26.1 vs. 29.7 vs. 34.5 years, $p<.001$), used higher nicotine concentration levels (mean nicotine level: 41.6 vs. 26.4 vs. 5.2 mg/ml, $p<.001$), but were less likely to use e-cigarettes daily (OR=0.22 and OR=0.15, $p<.001$). Fruit/candy (80.7%), mint (77.4%) and menthol (67.7%) were the most preferred flavors among disposable pod users, while tobacco flavor (19.4%) was the least preferred. In fact, disposable pod users compared to refillable pod users and other e-cigarette users were more likely to prefer mint (OR=5.5 and OR=7.7, $p<.001$) and menthol (OR=3.5 and OR=5.1, $p<.001$) flavors. Additionally, disposable pod users were more likely to report e-cigarette as their first nicotine containing product (OR=4.03, $p=.01$) and were less likely to use cigarettes in their lifetime (OR=0.36, $p=.02$) compared to the other e-cigarette device users (see Table 1 for percentages).

DISCUSSION

In this sample of e-cigarette users who visited the vape shops in Southern California and self-reported using disposable pods, fruit/candy, mint and menthol were the most preferred

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3 flavors. In fact, disposable pod users were more likely to prefer mint and menthol flavors
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5 compared to the other e-cigarette users. Our results support findings from past studies that fruit-
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7 related, mint and menthol flavors are highly prevalent among e-cigarette users, while tobacco-
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9 related flavors are less prevalent ³. Additionally, our results indicate that disposable pod users
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11 preferred to use higher nicotine levels compared to the other e-cigarette users. This may be
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13 because such devices (e.g., Puff Bar) are usually prefilled with 20-70 mg/ml salt nicotine e-
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15 liquid⁷, while other e-cigarette devices can be used with either free-based (0-12 mg/ml) or salt-
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17 based nicotine (>20 mg/ml) e-liquid ². Further, our data indicated that disposable pod users were
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19 younger, were less likely to use cigarettes in their lifetime, and more likely to report e-cigarette
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21 as their first nicotine containing product than other e-cigarette users. This might suggest that Puff
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23 Bar-like devices are highly appealing to emerging adults and also to minors ⁴. Moreover, it is
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25 unlikely that young vapers are using disposable pods as a means of harm reduction.
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31 This study has several limitations. Our findings might not be generalizable to vapers who
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33 obtain their e-cigarette products online, or through other types of brick-and-mortar retail outlets,
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35 and do not visit vape shops, including youth (< 18 years of age) and those outside the Southern
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37 California. Given the nature of the data, recall and social desirability biases may also have
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39 affected the results. The data collection halted because of COVID-19 human subject restrictions
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41 placed on research procedures; thus, it is unclear whether the same results will be observed post-
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43 COVID-19 period. Despite the limitations, our study adds to the existing literature, providing a
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45 valuable source of information about the flavor preferences of disposable pod users.
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50 In conclusion, these findings indicate that mint and menthol flavors are prevalent among
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52 disposable pod users, while their nicotine use is relatively high. Future regulatory efforts should
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54 consider limiting non-tobacco flavors, as well as the maximum nicotine content in disposable
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3 pod devices, as this may be helpful in curbing the nicotine addiction among younger vapers. A
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5 few of our study participants were 21 years or younger, hence more comprehensive undercover
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7 inspections¹⁰ are needed to insure that tobacco retailers (including vape shops) are not selling
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9 these or other vaping products to minors. Future research evaluating the prevalence of disposable
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11 pod use among youth and their flavor preference is warranted.
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15 16 **Acknowledgments**

17 18 **Declaration of Interests**

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20 The Authors declare that there is no conflict of interest. The Authors alone are responsible for
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22 the content and writing of this paper.
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27 28 **Contributors**

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30 All authors took an active role in the manuscript. SS and LB-G designed the research. AG and
31
32 LM conducted research under SS supervision. LM coordinated the project. AG, AL and JH
33
34 chose the main directions for data analysis and participated in the interpretation of results. AG
35
36 performed the statistical analyses and drafted the manuscript. AL, LM, JU, JH, LB-G, and SS
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38 provided critical revision to the manuscript. AG, AL, LM, JU, JH, LB-G, and SS revised the
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40 manuscript before submission. All authors approved the final manuscript submitted.
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Role of Funder

TRDRP, NCI, or the FDA had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Patient consent for publication

Not required.

Data availability statement

Data are available on reasonable request. The data that support the findings of this study are available on request from the corresponding author.

Table 1. Participant characteristics for the total sample and by e-cigarette device type ^a

	Total n=276	E-cigarette device type				
		Disposable Pod (n=31)	Refillable Pod (n=102)	p-value ^b	Other ^c (n=143)	p-value ^d
Demographics						
Age, mean (SD)	31.8 (10.5)	26.1 (7.9)	29.7 (9.5)	.08	34.5 (10.9)	<.001 ^e
Male	211 (76.5%)	26 (83.9%)	82 (80.4%)	.67	103 (72.0%)	.18
Race/Ethnicity						
- Asian	50 (18.1%)	6 (19.4%)	28 (27.5%)	.43	16 (11.1%)	.34
- African American/Black	26 (9.4%)	2 (6.5%)	7 (6.9%)		17 (11.9%)	
- Hispanic/Latino	53 (19.2%)	5 (16.1%)	19 (18.6%)		29 (20.3%)	
- White	99 (35.9%)	9 (29.0%)	34 (33.3%)		56 (39.2%)	
- Other	48 (17.4%)	9 (29.0%)	14 (13.7%)		25 (17.5%)	
Daily-e-cigarette use (yes vs. no)	215 (77.9%)	14 (45.2%)	80 (78.3%)	.001 ^e	121 (84.6%)	<.001 ^e
Lifetime cigarette use (yes vs. no)	209 (75.7%)	19 (61.3%)	83 (81.4%)	.02 ^e	107 (74.8%)	.13
Past 30-day cigarette use (yes vs. no)	61 (22.1%)	7 (22.6%)	28 (27.5%)	.59	26 (18.2%)	.57
Preferred nicotine level (mg/ml), mean (SD)	17.0 (18.7)	41.6 (17.7)	26.4 (18.0)	<.001 ^e	5.2 (6.9)	<.001 ^e
First nicotine containing product						
- E - cigarette	32 (11.6%)	11 (35.5%)	9 (8.8%)	.01 ^{ef}	12 (8.4%)	.11 ^f
- Cigarette or other tobacco product	244 (88.4%)	20 (64.5%)	93 (91.2%)		131 (91.6%)	
Flavor preference:						
- Fruit/Candy (yes vs. no)	201 (72.8%)	25 (80.7%)	75 (73.5%)	.42	101 (70.6%)	.26
- Dessert (yes vs. no)	91 (33.0%)	8 (25.8%)	26 (25.5%)	.97	57 (39.9%)	.15
- Mint (yes vs. no)	107 (38.8%)	24 (77.4%)	39 (38.2%)	<.001 ^e	44 (30.8%)	<.001 ^e
- Menthol (yes vs. no)	101 (36.6%)	21 (67.7%)	38 (37.2%)	.004 ^e	42 (29.4%)	<.001 ^e
- Tobacco (yes vs. no)	23 (8.3%)	6 (19.4%)	6 (5.9%)	.03	11 (7.7%)	.06

^a Data are expressed as No. (%) unless otherwise indicated

^b For the difference between past 30-day disposable pod users and past 30-day refillable pod users

^c Other devices include box mods and vape pens

^d For the difference between past 30-day disposable pod users and other device type users

^e Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false-discovery rate at .05 (based on 2-tailed corrected P value).

^f Adjusted for age

REFERENCES

1. Schulenberg J, Johnston L, O'Malley P, et al. Monitoring the Future national survey results on drug use, 1975-2019: Volume II, college students and adults ages 19-60, 2020.
2. Galstyan E, Galimov A, Sussman S. Commentary: The Emergence of Pod Mods at Vape Shops. *Evaluation & the health professions* 2019;42(1):118-24. doi: 10.1177/0163278718812976 [published Online First: 2018/11/28]
3. Leventhal AM, Miech R, Barrington-Trimis J, et al. Flavors of e-cigarettes used by youths in the United States. *Jama* 2019;322(21):2132-34.
4. US Food and Drug A. PATH Study Findings Give Insight into Flavored Tobacco, Health Effects of E-Cigarettes, and Adult Use of Cigars and Hookah 2020 [Available from: <https://www.fda.gov/tobacco-products/research/path-study-findings-give-insight-flavored-tobacco-health-effects-e-cigarettes-and-adult-use-cigars> accessed November, 05 2020.
5. US Food and Drug A. FDA finalizes enforcement policy on unauthorized flavored cartridge-based e-cigarettes that appeal to children, including fruit and mint 2020 [Available from: <https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children> accessed November, 05 2020.
6. Hemmerich N. Flavoured pod attachments score big as FDA fails to enforce premarket review. *Tobacco Control* 2020
7. Williams R. The rise of disposable JUUL-type e-cigarette devices. *Tobacco Control* 2019
8. Dai H, Hao J. Online popularity of JUUL and Puff Bars in the USA: 2019–2020. *Tobacco Control* 2020

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3 9. Galimov A, Galstyan E, Yu S, et al. Predictors of vape shops going out of business in
4
5 Southern California. *Tobacco Regulatory Science* 2020;6(3):187-95.
6
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8 10. Sussman S, Galimov A, Delnevo CD. Vape-only versus vape-and-smoke shops: sales to
9
10 minors in four states. *Tobacco Control* 2020
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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	N/A
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, describe analytical methods taking account of sampling strategy	5
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7

		(b) Report category boundaries when continuous variables were categorized	7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	7-8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-9
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	9

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence of disposable pod use and consumer preference for e-cigarette product characteristics among vape shop customers in Southern California: a cross-sectional study

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3 **Prevalence of disposable pod use and consumer preference for e-cigarette product**
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5 **characteristics among vape shop customers in Southern California: a cross-sectional study**
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Abstract

Objectives: In February 2020 the US Food and Drug Administration issued a guidance restricting the sales and distribution of cartridge-based e-cigarettes with flavors other than tobacco and menthol. Disposable devices were exempt from this guidance. This study examined the prevalence of disposable pod use and flavor preference compared to refillable pod and other e-cigarette users among vape shop customers.

Design: Cross-sectional study.

Setting: In July 2019 - March 2020, trained data collectors visited 44 vape shops in California with permission to recruit customers from shop owners.

Participants: Intercept interviews with 276 customers were conducted.

Outcomes and procedures: Customers were grouped based on self-reported device type used most often (Disposable pod, refillable pod, and other e-cigarettes). Groups were compared on self-reported were compared on demographics, flavors preferred, daily e-cigarette use, preferred nicotine concentration levels and cigarette use.

Results: Of the 276 customers surveyed, 12.7% used disposable pods in the past 30-days. Among disposable pod users, fruit/candy (80.7%), mint (77.4%) and menthol (67.7%) were common preferred flavors among disposable pods users, while tobacco flavors were less commonly preferred (19.4%). When compared to refillable pod and other non-pod e-cigarette device users, disposable pod users were younger, used higher nicotine concentration levels, were more likely to prefer mint and menthol flavors and use e-cigarettes as their first product, while less likely to ever use cigarettes and use e-cigarettes daily.

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3 **Discussion:** Despite using higher nicotine levels and preferred menthol/mint flavors more often
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5 than users of other devices, disposable pod users reported lower prevalence of lifetime smoking
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7 and daily vaping and were younger. Given the current findings, regulations addressing non-
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9 tobacco flavors and nicotine concentration in disposable pod devices merit consideration in
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11 efforts to reduce vaping in younger adult never smokers.
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16 **Strengths and limitations of this study**

- 17
18 • This is one of the first studies to examine the consumer preferences for e-cigarette
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20 product characteristics and flavor preference of disposable pod users.
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- 23 • The presented results are suitable to guide future regulatory changes that would limit
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25 non-tobacco flavors, as well as the maximum nicotine concentration in disposable pod
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27 devices.
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- 30 • This study is limited in sample size, and our findings might not be generalizable to vapers
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32 outside the Southern California area.
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INTRODUCTION

Sales of electronic cigarettes (e-cigarettes) have rapidly increased in recent years, and their prevalence has surpassed combustible tobacco use among youth and young adults.¹ One factor that may contribute to the surge of e-cigarette use is a rapid evolution and diversity of vaping products. Within the last 10 years vaping devices have progressed from thin, cig-a-like disposable devices (1st generation), to tubular, refillable vape pen devices (2nd generation), to box mod (3rd generation), and to pod mod (JUUL type) devices.² In particular, pod mods are small, low-powered, high-nicotine devices that are available in numerous flavors (such as mint, fruit), which have become prevalent among minors and emerging adults.^{3 4} To counteract the youth e-cigarette use epidemic, in February 2020 the US Food and Drug Administration (FDA) issued a final guidance indicating that the manufacture, distribution, and sale of pre-filled cartridge-based (i.e., JUUL, Phix) e-cigarettes without marketing authorization in flavors other than tobacco and menthol would be prioritized for enforcement of unlawful marketing of unauthorized products.⁵ Nonetheless, public health professionals have raised concerns because language in the guidance failed to include disposable pod devices.⁶

Disposable pod-style devices (i.e., Puff Bar, Ignite, Lush) are compact, sleek, ready-to-use, prefilled vaping devices that contain 20-70 mg/ml of nicotine salt and are marketed to deliver 200-300 puffs per device.⁷ They are priced as low as \$4.60 USD and are available in mango, mint, strawberry and many other fruit/candy novel flavors with attractive packaging that may be appealing to minors and young adults.⁷ While there is some evidence suggesting that more e-cigarette users may be replacing the flavored cartridge-based vaping devices with disposable pod devices⁸, and their prevalence is increasing among middle and high school youth,⁹ little is known regarding the flavor preferences of disposable pod users.

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3 To inform future flavor and other regulations of pod-style devices, we assessed the
4 prevalence of disposable pod use and flavor preference among vape shop customers utilizing
5 intercept interviews, in real time, as customers exited the vape shop. Additionally, we examined
6 the differences in consumer preference for e-cigarette product characteristics between disposable
7 pod users, refillable pod product users, and other e-cigarette users. We hypothesized that
8 disposable pod users would prefer higher nicotine concentration levels and would be more likely
9 to prefer mint and menthol flavors compared to refillable pod and other e-cigarette device users.
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19 20 **METHODS**

21 **Participants and procedures**

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25 A list of eligible vape shops located in Southern California was generated from Google
26 Maps and Yelp in locations with relatively high proportion of residents representing four ethnic
27 groups (based on U.S. Census data).¹⁰ From July 2019 - March 2020 (prior to COVID-19
28 shutdowns) two or three trained data collectors visited a subsample of 44 vape shops between 10
29 am and 5 pm during workdays with permission to recruit customers from shop owners. All vape
30 shop customers present at the time of data collection were approached by data collectors as they
31 exited the vape shop (n=425). Eligible participants were those who reported having vaped in the
32 past 30-days and agreed to participate in a 15-minute interview. Participants provided verbal
33 consent prior to taking the survey and were informed that their responses would be kept
34 anonymous. Upon survey completion, participants received a \$35 gift card. A total of 401
35 eligible customers were invited to participate in this study, 276 of them (69%) agreed and were
36 recruited for participation in the customer interviews. The participants that took the survey did
37 not differ from those who refused to participate in the study by any sociodemographic factor
38 except for age. That is, subjects that participated in the study were significantly younger than
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3 those who refused to take the survey ($p=0.001$). The study was approved by the USC
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5 Institutional Review Board (#HS-18-00732).
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7 8 **Measures**

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10 Self-reported measures of gender, age and ethnicity were obtained from each participant.
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12 Past 30-day e-cigarette use was assessed with the item: *“In the past 30 day, on how many days*
13 *did you use e-cigarettes?”* (1-30 days). The most frequently used type of e-cigarette device (used
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15 in the past 30-days) was assessed by asking participants: *“What type of e-cigarette device do you*
16 *use most often?”* (open-ended and further coded into the following categories: pen, box mod,
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18 disposable pod style, refillable pod mod or other). Only 3 (1.0%) participants selected “other”
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20 and reported (equally) using both refillable pods and box mods; for analyses purposes they were
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22 classified as box mod users. Responses were re-coded into a primary exposure variable with
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24 three mutually exclusive categories (disposable pod vs. refillable pod vs. other devices [pen and
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26 box mod]). Additionally, participants were asked to indicate the first nicotine-containing product
27
28 they used in their life (i.e., e-cigarette, cigarette, or other tobacco product).
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36 Participants’ e-liquid flavor preference was assessed with the question, *“Which types of*
37 *e-juices do you like the most? (Check all that apply)”*. The response categories included:
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39 *“fruit/candy”, “dessert”, “minty flavors”, “menthol”, and “tobacco flavor”*. Additionally, we
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41 evaluated the preferred e-liquid nicotine level by asking participants: *“How many mg per ml of*
42 *nicotine does your favorite brand/flavor have?”* (Open-ended, e.g., 0, 3, 6, 9, 12, 18, 24, 25, 50
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44 *mg/ml*).
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49 **Data Analysis**

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51 The prevalence of e-cigarette use, demographic characteristics, and flavor preference of
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53 disposable pod users were reported for the full sample of participants. Further, the three groups
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3 of users (disposable pod users, refillable pod users, and users of other e-cigarette products) were
4 compared regarding demographics, flavor preference, daily e-cigarette use, preferred nicotine
5 concentration levels and cigarette use. Pearson's chi-square tests were calculated for categorical
6 study variables, while ANOVA tests were calculated for continuous variables. Statistically
7 significant variables were then included as dependent variables in multilevel regression analyses
8 with type of device used (i.e., disposable pods, refillable pod users, and other e-cigarette devices)
9 as a predictor, while controlling for the nesting of vape shop customers (Level 1) within 44 vape
10 shops (Level 2). All models were adjusted for sociodemographic factors. Maximum likelihood
11 estimation was used to account for non-normal distributions and missing data. Odds ratios (ORs)
12 and Beta coefficients (β s) with 95% CIs were reported with statistical significance set at $p < .05$
13 (2-tailed). Benjamini-Hochberg multiple-testing corrections were applied to control the false-
14 discovery rate at .05. All statistical analyses were conducted using Stata software (version 15.1;
15 Stata Corp, College Station, Texas, USA).

32 **Patient and public involvement**

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35 Patients or the public were not involved in the design, conduct, reporting, or
36 dissemination plans of this study.
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42 **RESULTS**

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44 Of the 276 customers surveyed, 76.5% were males, with a mean age of 31.8 years
45 (SD=10.5, range 18-66); 35.9% were non-Hispanic White, 18.1% were Asian, 19.2% were
46 Hispanic/Latino, 9.4% were African American/Black, and 17.4% were of other ethnicities (e.g.,
47 Middle Eastern or multiracial). Most participants (77.9%) reported using e-cigarettes every day
48 in the past 30-days. Responses regarding the type of e-cigarette device used in past 30-days in
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3 the total sample illustrated that 31 (11.2%) used disposable pods, 102 (40.0%) used refillable
4 pods, and 143 (51.8%) used other e-cigarette devices, with the latter category including 129
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6 (46.7%) box mod users and 14 (5.1%) vape pen users.
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10 Bivariate comparisons between study variables and the type of e-cigarette device used by
11 vape shops customers in past 30-days are reported in Table 1. Disposable pod users tended to be
12 younger than other (non-pod) device type users (mean age: 26.1 [SD=7.9] vs. 34.5 [10.9],
13
14 p<.001). Disposable pod users also preferred to use higher nicotine concentration levels (mean
15 nicotine level: 41.6 [17.7] mg/ml) than refillable pod users (26.4 [18.0] mg/ml) and other device
16 type users (5.2 [6.9] mg/ml, both p<.001). Lifetime cigarette use was more prevalent among
17 refillable pod users (81.4%) compared to disposable pod users (61.3%, p=0.02). Refillable pod
18 users (78.3%) and other device type users (84.6%) reported higher prevalence of daily e-cigarette
19 use compared to disposable pod users (45.2%, both p<.001). Additionally, disposable pod users
20 reported higher prevalence of using e-cigarettes as their first nicotine containing product (35.5%)
21 than refillable pod (8.8%) and other device type users (8.4%, both p ≤ .001).
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35 Fruit/candy (80.7%), mint (77.4%) and menthol (67.7%) were the most preferred flavors
36 among disposable pod users, while tobacco flavor (19.4%) was the least preferred. In fact, a
37 flavor preference of mint and menthol was more prevalent among disposable pod users
38 compared to refillable pod users and other e-cigarette users (see Table 1). Tobacco flavor
39 preference was more prevalent among disposable pod users (19.3%), compared to the other
40 groups (see Table 1). Post-hoc analyses demonstrated that all disposable users who preferred
41 tobacco flavors reported using combustible tobacco in their lifetime, and their mean age was 30.2
42 (SD=8.4) years.
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3 The multilevel regression models (Table 2) demonstrated that after adjusting for
4 sociodemographic factors, refillable pod users (OR, 3.79 [95% CI, 1.57 - 9.11]) and other e-
5 cigarette device type users (OR, 5.80 [95% CI, 2.38 - 14.13]) were more likely to report daily e-
6 cigarette use compared to disposable pod users. Further, e-liquid nicotine concentration
7 preference was significantly lower among refillable pod users ($\beta = -14.90$ [95% CI, 1(-20.34; -
8 9.46]) and other e-cigarette users ($\beta = -35.87$ [95% CI, -41.25; -30.48]) than among disposable
9 pod users. Additionally, refillable pod users were less likely to report e-cigarette as their first
10 nicotine containing product (OR, 0.27 [95% CI, 0.09 - 0.81]) than disposable pod users. Finally,
11 it was shown that refillable pod users (OR, 0.17 [95% CI, 0.06 - 0.46]) and other e-cigarette
12 users (OR, 0.16 [95% CI, 0.06 - 0.43]) were less likely to prefer mint flavors compared to
13 disposable pod users.
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28 DISCUSSION

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31 In this sample of e-cigarette users who visited the vape shops in Southern California and
32 self-reported using disposable pod devices, fruit/candy, mint and menthol were the most
33 common preferred flavors. In fact, mint and menthol flavors were more prevalent among
34 disposable pod users compared to the other e-cigarette users. Our results support findings from
35 past studies that fruit-related, mint and menthol flavors are highly prevalent among e-cigarette
36 users, while tobacco-related flavors are less prevalent³, and extend results to vape shop
37 customers that use disposable pod devices. Tobacco flavor was the least preferred e-liquid flavor
38 among disposable pod users but was also more prevalent among these users compared to
39 refillable pod users and other e-cigarette users. However, the comparison of tobacco flavor was
40 not significant after controlling for multiple test correction and is qualified by the caveat of small
41 cell size (n=6). As a post-hoc sensitivity analysis, we found that all 6 of these disposable pod
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3 users that reported liking tobacco flavors were former combustible tobacco users. This finding
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5 raises the possibility that some vape shop customers might use disposable pod devices with
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7 tobacco flavors as a means to quit smoking combustible tobacco, although the cross-sectional
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9 design and small size precludes definitive conclusion. Future research investigating whether
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11 smokers switch to disposable pod devices that might be less harmful alternative to smoking
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13 combustible cigarettes is warranted.
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17 Additionally, our results indicate that disposable pod users reported using products with
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19 higher nicotine levels compared to the other e-cigarette users. This may be because such devices
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21 (e.g., Puff Bar) are usually prefilled with 20-70 mg/ml salt-based nicotine e-liquid,⁷ while other
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23 e-cigarette devices can be used with either free-based (0-12 mg/ml) or salt-based nicotine (>20
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25 mg/ml) e-liquid.² Further, our data indicated that disposable pod users were younger, were less
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27 likely to use cigarettes in their lifetime, and more likely to report e-cigarette as their first nicotine
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29 containing product than other e-cigarette users. This might suggest that Puff Bar-like devices are
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31 highly appealing to emerging adults, and other research indicates that disposable devices may
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33 also appeal to minors.⁴ For instance, one study demonstrated that the relative search volume for
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35 Puff Bar on Google Search has surpassed that of JUUL since February 2020, which may suggest
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37 that e-cigarette users are switching from cartridge-based e-cigarettes to disposable vaping
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39 products.⁸ Further, another study demonstrated that the prevalence of disposable pod use has
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41 increased from 3.0% in 2019 to 15.2% in 2020 among middle school students and increased
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43 from 2.4% in 2019 to 26.5% in 2020 among high school students.⁹
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49 This study has several limitations. Our findings might not be generalizable to vapers who
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51 obtain their e-cigarette products online, or through other types of brick-and-mortar retail outlets,
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53 and do not visit vape shops, including youth (< 18 years of age) and those outside the Southern
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3 California. Subjects participated in the study were significantly younger than those who refused to
4 take the survey, thus our study findings may have limited generalizability to older vapers. Given
5 the nature of the data, recall and social desirability biases may also have affected the results. The
6 data collection halted because of COVID-19 human subject restrictions placed on research
7 procedures; thus, it is unclear whether the same results will be observed in the post-COVID-19
8 period. The actual number of participants who used disposable pods was relatively small (n=31
9 [11.2%]), while the data were collected during a time of changing federal regulation of e-
10 cigarette products⁵ (which led to the surge in disposable use prevalence); thus it is also not clear
11 whether the same results will be observed 1 year after the data were collected. Despite the
12 limitations, our study adds to the existing literature, providing a valuable source of information
13 about the flavor preferences of disposable pod users.
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28 In conclusion, these findings indicate that disposable pod users reported using products
29 with higher nicotine levels and preferred mint and menthol flavors more often than users of other
30 devices; nonetheless, disposable pod users reported lower prevalence of lifetime smoking and
31 daily vaping, while they were also younger. Given the current findings and previous studies showing
32 sizeable proportions of youth use disposable pod e-cigarettes, future regulatory efforts addressing
33 non-tobacco flavors and nicotine concentration in disposable pod devices merit consideration in
34 efforts to reduce vaping in young populations and never smokers. Future research evaluating
35 whether disposable pod use causes a greater risk for e-cigarette use experimentation and
36 development of nicotine dependence is warranted.
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Acknowledgments

Declaration of Interests

The Authors declare that there is no conflict of interest. The Authors alone are responsible for the content and writing of this paper.

Contributors

All authors took an active role in the manuscript. SS and LB-G designed the research. AG and LM conducted research under SS supervision. LM coordinated the project. AG, AL and JH chose the main directions for data analysis and participated in the interpretation of results. AG performed the statistical analyses and drafted the manuscript. AL, LM, JU, JH, LB-G, and SS provided critical revision to the manuscript. AG, AL, LM, JU, JH, LB-G, and SS revised the manuscript before submission. All authors approved the final manuscript submitted.

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Role of Funder

TRDRP, NCI, or the FDA had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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3 **Patient consent for publication**
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5 Not required.
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10 **Data availability statement**
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12 The data that support the findings of this study are available on request from the corresponding
13 author.
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For peer review only

Table 1. Participant characteristics for the total sample and by e-cigarette device type ^a

	Total n=276	E-cigarette device type				
		Disposable Pod (n=31)	Refillable Pod (n=102)	p-value ^b	Other ^c (n=143)	p-value ^d
Demographics						
Age, mean (SD)	31.8 (10.5)	26.1 (7.9)	29.7 (9.5)	.08	34.5 (10.9)	<.001 ^e
Male	211 (76.5%)	26 (83.9%)	82 (80.4%)	.67	103 (72.0%)	.18
Race/Ethnicity						
- Asian	50 (18.1%)	6 (19.4%)	28 (27.5%)	.43	16 (11.1%)	.34
- African American/Black	26 (9.4%)	2 (6.5%)	7 (6.9%)		17 (11.9%)	
- Hispanic/Latino	53 (19.2%)	5 (16.1%)	19 (18.6%)		29 (20.3%)	
- White	99 (35.9%)	9 (29.0%)	34 (33.3%)		56 (39.2%)	
- Other	48 (17.4%)	9 (29.0%)	14 (13.7%)		25 (17.5%)	
Daily-e-cigarette use	215 (77.9%)	14 (45.2%)	80 (78.3%)	.001 ^e	121 (84.6%)	<.001 ^e
Lifetime cigarette use	209 (75.7%)	19 (61.3%)	83 (81.4%)	.02 ^e	107 (74.8%)	.13
Past 30-day cigarette use	61 (22.1%)	7 (22.6%)	28 (27.5%)	.59	26 (18.2%)	.57
Preferred nicotine level (mg/ml), mean (SD)	17.0 (18.7)	41.6 (17.7)	26.4 (18.0)	<.001 ^e	5.2 (6.9)	<.001 ^e
First nicotine containing product						
- E - cigarette	32 (11.6%)	11 (35.5%)	9 (8.8%)	.001 ^e	12 (8.4%)	<.001 ^e
- Cigarette or other tobacco product	244 (88.4%)	20 (64.5%)	93 (91.2%)		131 (91.6%)	
Flavor preference:						
- Fruit/Candy	201 (72.8%)	25 (80.7%)	75 (73.5%)	.42	101 (70.6%)	.26
- Dessert	91 (33.0%)	8 (25.8%)	26 (25.5%)	.97	57 (39.9%)	.15
- Mint	107 (38.8%)	24 (77.4%)	39 (38.2%)	<.001 ^e	44 (30.8%)	<.001 ^e
- Menthol	101 (36.6%)	21 (67.7%)	38 (37.2%)	.004 ^e	42 (29.4%)	<.001 ^e
- Tobacco	23 (8.3%)	6 (19.4%)	6 (5.9%)	.03	11 (7.7%)	.06

^a Data are expressed as No. (%) unless otherwise indicated

^b For the difference between past 30-day disposable pod users and past 30-day refillable pod users

^c Other devices include box mods and vape pens

^d For the difference between past 30-day disposable pod users and other device type users

^e Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false-discovery rate at .05 (based on 2-tailed corrected P value).

Table 2. Multilevel regression models examining the associations between type of e-cigarette device used and study variables.

Dependent variables	E-cigarette device type				
	Disposable Pod Use	Refillable Pod Use		Other Device Type Use ^a	
	OR (95% CI)	OR (95% CI)	p-value	OR (95% CI)	p-value
Daily-e-cigarette use	ref	3.79 (1.57 - 9.11)	.003*	5.80 (2.38 - 14.13)	<.001*
Lifetime cigarette use	ref	1.86 (0.63 - 5.56)	.26	0.76 (0.26 - 2.25)	.61
Preferred nicotine level (mg/ml)	ref				
First nicotine containing product					
- E - cigarette	ref	0.27 (0.09 - 0.81)	.02*	0.37 (0.12 - 1.12)	.08
Flavor preference:					
- Mint	ref	0.17 (0.06 - 0.46)	<.001*	0.16 (0.06 - 0.43)	<.001*
- Menthol	ref	0.34 (0.11 - 0.99)	.05	0.36 (0.12 - 1.04)	.06
Dependent variables	β (95% CI)	β (95% CI)	p-value	β (95% CI)	p-value
Preferred nicotine level (mg/ml)	ref	-14.90 (-20.34; -9.46)	<.001*	-35.87 (-41.25; -30.48)	<.001*

All models were adjusted for age, gender, and ethnicity. Abbreviations: OR=Odds Ratio; CI=Confidence Interval; ref=reference

* Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false-discovery rate at .05 (based on 2-tailed corrected P value)

^a Other devices include box mods and vape pens

REFERENCES

1. Schulenberg J, Johnston L, O'Malley P, et al. Monitoring the Future national survey results on drug use, 1975-2019: Volume II, college students and adults ages 19-60, 2020.
2. Galstyan E, Galimov A, Sussman S. Commentary: The Emergence of Pod Mods at Vape Shops. *Evaluation & the health professions* 2019;42(1):118-24. doi: 10.1177/0163278718812976 [published Online First: 2018/11/28]
3. Leventhal AM, Miech R, Barrington-Trimis J, et al. Flavors of e-cigarettes used by youths in the United States. *Jama* 2019;322(21):2132-34.
4. US Food and Drug Administration. PATH Study Findings Give Insight into Flavored Tobacco, Health Effects of E-Cigarettes, and Adult Use of Cigars and Hookah. 2020; <https://www.fda.gov/tobacco-products/research/path-study-findings-give-insight-flavored-tobacco-health-effects-e-cigarettes-and-adult-use-cigars> Accessed July, 12 2021.
5. US Food and Drug Administration. FDA finalizes enforcement policy on unauthorized flavored cartridge-based e-cigarettes that appeal to children, including fruit and mint. 2020; <https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children> Accessed July, 12 2021.
6. Hemmerich N. Flavoured pod attachments score big as FDA fails to enforce premarket review. *Tobacco Control* 2020
7. Williams R. The rise of disposable JUUL-type e-cigarette devices. *Tobacco Control* 2019
8. Dai H, Hao J. Online popularity of JUUL and Puff Bars in the USA: 2019–2020. *Tobacco Control* 2020

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2
3 9. Wang TW, Gentzke AS, Neff LJ, et al. Disposable E-Cigarette Use among US Youth—An
4
5 Emerging Public Health Challenge. *New England Journal of Medicine*
6
7 2021;384(16):1573-76.
8
9
10 10. Galimov A, Galstyan E, Yu S, et al. Predictors of vape shops going out of business in
11
12 Southern California. *Tobacco Regulatory Science* 2020;6(3):187-95.
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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6-7
		(b) Describe any methods used to examine subgroups and interactions	7
	(c) Explain how missing data were addressed	7	
	(d) If applicable, describe analytical methods taking account of sampling strategy	5	
	(e) Describe any sensitivity analyses	N/A	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7-8
Outcome data	15*	Report numbers of outcome events or summary measures	7-8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

		(b) Report category boundaries when continuous variables were categorized	7-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10-11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.