Heliyon 11 (2025) e42657

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Differences in vaping frequency and negative health effects experienced from vaping in a sample of vapers from three Middle Eastern countries

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ARTICLE INFO

Keywords:
Regular vapers
Middle east
Vaping frequency
Tobacco use status
Device type
Age

ABSTRACT

Aim: To examine differences in the likelihood of higher vaping frequency and experiencing negative effects from vaping in a sample of vapers from three Middle Eastern countries.
Methods: Adult vapers completed an online cross-sectional survey through a link on social media using paid advertisements. Using logistic regression, we tested the relationship between country of residence with number of days vaped in a week (daily or nondaily), vaping episodes in a day [regular use (1–16 episodes) versus compulsive use (>16 episodes)], puffs per episode [moderate (1–9 puffs) versus binge (>9 puffs)], and experienced negative health effects (yes versus no), while controlling for sociodemographic variables.
Results: In total, 386 vapers were included in the logistic regression analyses. Compared to vapers in Qatar, those in Egypt were more likely to vape daily, and those in Iraq were more likely to experience negative health effects. Male vapers had lower likelihood of experiencing negative effects than female vapers. Vapers with past quit attempts had a lower likelihood of vaping daily and higher likelihood of experiencing negative health effects compared to vapers who did not attempt quitting. Compared to regular vapers, compulsive vapers were more likely to vape daily, and daily vapers were more likely to vape compulsively relative to non-daily vapers. Compared to vapers that never used tobacco, vapers who used tobacco in the past were more likely to vape daily and compulsively, and vapers who are current tobacco users were more likely to vape compulsively.
Conclusion: Country-based differences reflect policy stringency as more strict ones (Qatar) had lower vaping frequency. Higher vaping frequency was more evident in compulsive vapers, daily vapers, and vapers with past tobacco use history. Negative health outcomes were more common among females and in those with past quit attempts, which signifies the need for targeted vaping cessation for these populations.

1. Background

Vapes are devices that consist of a cartridge containing an e-liquid (normally propylene glycol, flavors, and may contain nicotine), a heating vaporizer and a battery [1]. Concerns regarding the harm reduction potential of vaping, the acquisitions of vaping companies by the tobacco industry and their propensity to renormalize tobacco were voiced a decade ago [2].Vaping devices are projected to the

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https://doi.org/10.1016/j.heliyon.2025.e42657
Received 20 February 2024; Received in revised form 9 February 2025; Accepted 11 February 2025
Available online 14 February 2025

public as an aid for quitting smoking, yet evidence shows that only 14.9 % of all young vapers use it for smoking cessation [3]. Further, the smoking abstinence rates associated with its use as a cessation aid are only between 8 % and 12 % [4] in comparison to safer methods of quitting such as varenicline (21.8 %) [5].

Adult vaping prevalence have increased in recent years especially among young adults [6]. For example, a population-based study of adults in England reported an increase in vaping from 1.3 % in 2013 to 10 % in 2023, with the sharpest increases in 2021—the highest rise being among tobacco users and former tobacco users, yet substantial uptake of vaping among young adults who never smoked tobacco was observed during this period [7]. Further, heavy vaping has been related to the co-use of other drugs such as alcohol and cannabis in young adults [8]. Several factors are associated with vaping among individuals who previously or currently smoke conventional cigarettes; these include perceiving the products as safer alternative to tobacco, believing that vaping devices will aid in quitting smoking, the perceived freedom of the individual to vape in areas where tobacco use is normally restricted, and the availability of diverse flavor options [3]. Research has shown that gender (being male) and parental and peer influences are associated with both vaping and dual vaping and cigarette use, and older age is associated with dual use [3].

Adult vapers have reported negative health outcomes. In a large sample of adult vapers in the United States, vapers with no history of tobacco use (OR = 1.47), those who are vapers and ex-smokers (OR = 3.24), and those who are vapers and current tobacco smokers (OR = 4.39) all reported higher odds of self-reported chronic obstructive pulmonary disease (COPD) relative to never smokers [9]. Similarly, a study of a representative sample of Korean adults revealed that individuals who are dual user are at an higher risk of COPD, specifically among males older than 65 years, relative to middle-aged adults (aged 40–64 years) [10].In addition to increased risk for COPD, dual users of vaping devices and conventional cigarettes have 36 % higher odds of self-reporting cardiovascular disease relative to conventional cigarette smokers who never used vaping devices [11].

1.1. Vaping prevalence by age, tobacco use status and country of residence

Vaping prevalence differs among countries—those with stringent regulations for the sale, distribution, and advertising of vaping devices and also use penalties as part of enforcement have lower prevalence [12,13]. For instance, regulation for vaping sales is stricter in Qatar and UAE relevant to Egypt and Saudi [13] and vaping prevalence is lower in Qatar (14 %) [14],and UAE (15.1 %) [15]; relative to Egypt (18 %) [16],and Saudi (26 %) [17].There is limited information on vaping prevalence among subgroups by tobacco use status and age. One study conducted with university students residing in the UAE reported that the prevalence of dual users of cigarette and vaping devices was 28.8 % [15]. In a national level in Saudi Arabia, the findings revealed higher percentages of vaping within the sample (26 %), particularly among individuals aged between 18 and 24 years old [17]. In a study with a university student sample of 18–30 year old adults, Qatar's prevalence of vaping was found to be 14 % (males: 16.2 % and females: 12.8 %) [14]. In Egypt the prevalence of vaping among the general population is 18 %, with a higher prevalence in males (22.5 %) relative to females (7.5 %), and of all vapers, 21.5 % also used tobacco [16].

1.2. Vaping device type preferences

Early generation vaping models look like cigarettes and are sometimes referred to as "cigalikes". More advanced models were developed afterwards such as modifiable devices that use tanks or cartridges and the latest type of vapes known as mod and pod devices [18]. Each device varies in their size and shape, design, power output, the amount of aerosols produced, amount of e-liquid and nicotine strength, available flavors, and whether they are disposable or refillable devices [18]. The quick growth of the vaping devices industry coupled with the diverse characteristics across various device types has resulted in limited research examining the differences in vaping frequencies, tobacco use status and vaping device types among different age groups. Nonetheless, one study has reported a trend where pod devices are increasingly becoming popular among youth [19, 20. The popularity of the products stems from their diverse flavours, compact design that allows discrete use, and easy to use features [21]. A nationally reprehensive study in the United States found that the proportion of late generation device use (58%–86 %) was much higher than the proportion of early-generation device use (under 15 %). [22]. Most adult vapers use e-liquid products that contain nicotine (80.7 %) [23].

1.3. Gaps and the objective of the current study

Although, past studies have looked at differences in vaping frequency by country of residence in western countries [24], no studies have been conducted in the Middle East to compare vaping frequency in regular vapers among countries in this region. Secondly, past studies have found that age, gender, tobacco use status, and device type are all associated with aspects that influence use or vaping frequency [25–28], yet no studies have looked at the effect of these variables in a Middle Eastern sample. The current study rectifies past gaps by examining the effect of different sociodemographic characteristics including age, sex, country of residence, type of vaping device, employment status, attempts to quit vaping, and tobacco use status with vaping frequency measures (vaped days per week, vaping episodes per day, and puff taken per episode) and experienced negative health effects in a sample of Middle Eastern countries.

2. Methods

2.1. Data collection

The cross-sectional survey study was promoted through paid advertisements across various social media platforms, including

Facebook and Instagram. Social media users of young and older adults who are interested in vaping activities and tobacco use met the eligibility criteria for the study. Data was collected during February and May 2023 using the Blue online survey platform.

2.2. Sample

The eligibility criteria for this study included adults who are not seniors, which was defined as being between the age of 18 and 60 years old. Individuals above the age of 60 were not included given that they are unlikely to be vapers [29]. Further, participants had to be regular vapers, which was defined as using a vaping device at least once weekly for the past three months. Finally, participants had to be residents of Arab Middle Eastern countries. Participants who engaged in the survey and opted to be included in the optional draw were considered for the prize draw, offering them the opportunity to win a $300 gift card.

2.3. Study instrument

Participants completed a questionnaire of demographic questions and vaping use, where the majority of questions were published in previous studies [26]. A pilot test was performed to test the survey's length and clarity of questions. The pilot data were collected from five participants. Responses from pilot test showed that the survey length and questions clarity were appropriate, and survey's average completion time was determined. Additionally, questions were asked to compare study results by age, country of residence, tobacco use status to differentiate between never use, current use (that is dual use of tobacco in addition to vaping) or past use, and type of vaping device. The type of device included e-cigarettes, vape pen, mod and pod, and country of residence listed 14 countries that were collapsed into three countries and an "other" category due to the small cell sizes for some countries. For the questions used in this study please refer to the supplemental file.

2.4. Data analysis

Logistic regression was used to examine differences in vaping frequency and experienced negative effect by country of residence while controlling for sociodemographic variables. Vaping frequency consisted of number of vaping days in a week, number of episodes during which a vaper used their device in a day, and number puffs within each episode. All vaping frequency outcomes were collapsed to categories due to the violation of homogeneity of variance for all the variables and very high standard deviations for the episodes and puffs per episode variables. Days vaped per week were collapsed to two categorical levels 1–6 days, and every day as most participants vaped every day and breaking down the variables further would generate cell sizes that are too small to analyze. Vaping episodes per vaped day were collapsed to two categorical levels regular use (1–16 episodes) and compulsive use (>16 episodes) where compulsive use referred to the number of episodes that exceed the average number of typical waking hours. This suggests the number of episodes for a compulsive user is higher than their typical number of waking hours, whereas the number of episodes for someone who uses their vaping device less than the typical number of waking hours is described as a regular user. Moreover, the number of puffs was condensed to two categorical levels: moderate (1–9 puffs) and binge (>9 puffs). This categorization aligns with past research indicating that smokers take nine puffs per cigarette [30], and one cigarette is typically smoked by smokers in a session.

The sample size calculation for the logistic regression tests was done through G*Power3.1 [31]. The calculation was based on the potential to detect a significant effect with an OR of 2.25, a power = 0.8, alpha level = 0.05 and a binomial distribution. In the calculation, the average proportion of higher vaping frequency of 0.4 was set for the control group of the main tested variable (Qatar), and an average proportion of higher vaping frequency of 0.60 for the comparison groups (Egypt/Iraq). The R-square contribution was set to be 0.3 by other predictors in the model. This suggested that a minimum sample size of 222 is needed in total.

Ethical statement

This study was reviewed and approved by the Institutional Review Board at Qatar University (QU-IRB), on January 19, 2023, with the approval number: [#QU-IRB 1806-E/23]. The participants reviewed an electronic informed consent that included detailed information about the purpose, benefits, and risks, confidentiality, and data storage procedures. Only individuals that agreed to participate, after reviewing the electronic informed consent, were able to proceed and participate in the survey. Agreement was indicated by clicking on "By clicking next, you agree to participate in the survey".

3. Results

3.1. Sample characteristics

A total of 428 vapers completed the study. In the logistic regression analysis that examined the association between country of residence and demographic variables with vaping frequency and negative health effects, 386 participants were included from Qatar, Iraq and Egypt as those from "other countries" (N = 42) were removed because the result won't be interpretable since many countries are included in that category. Out of all vapers in this study, 56 % were young adults, 25.9 % were adults, and 18 % were older adults. Of the entire sample of vapers, 7 % were females, and 93 % were males. Out of the entire sample, 72.3 % were employed. Further, 49.7 % were from Egypt, 37 % were from Iraq, and 13.2 % were from Qatar. Of all the vapers, most were past tobacco users (65 %), the majority used either pods or mods (71.1 %), vaped daily (81.3 %), and regularly (1–16 episodes per day; 56.7 %), and half binge vaped,

that is, they took a high number of puffs per episode (>9 puffs per episode; 50.3 %). Furthermore, regular vapers spent an average of $30 US per week. The average amount of US dollars spent per week for each country were: Egypt (M = 25.72, SD = 73.79), Iraq (M = 11.04, SD = 17.70), and Qatar (M = 88.18, SD = 130.61). The sample characteristics of the sample are displayed in Table 1.

3.1.1. Model for predicting days vaped per week

Table 2 displays the model for the effect of country of residence and sociodemographic variables on days vaped per week (daily vs non-daily). The model had a significant effect on days vaped per week (χ^2 [16, n = 386] = 91.43, p < .001), explained 41.4 % of the variance (Nagelkerke R2 = 0.414), and correctly classified cases 85.4 % of the time. In this model, vapers who are residents of Egypt were more likely to vape on a daily basis relative to vapers who reside in Qatar (OR = 5.06). Additionally, vapers who tried to quit vaping were less likely to vape on a daily basis relative to vapers who didn't try to quit vaping (OR = 0.42). Furthermore, vapers who are past tobacco users were more likely to vape on a daily basis compared to vapers who never used tobacco (OR = 3.01). Moreover, vapers who were compulsive users were more likely to vape on a daily basis compared to vapers who were regular users (OR = 8.14).

3.1.2. Model for predicting episodes of use per day

Table 3 displays the model for the effect of country of residence and sociodemographic variables on vaping episode per day (compulsive use = >16 episodes) versus (regular = 1–16 episodes). The model containing the country of residence and sociodemographic variables had a significant effect on vaping episode per day (χ^2 [16, n = 386] = 59.72, p < .001), explained 23.6 % of the variance (Nagelkerke R^2 = 0.236), and correctly classified cases 67 % of the time. Within this model, vapers who are current (OR = 5.67) and past tobacco users (OR = 3.47) exhibited a higher likelihood of vaping compulsively relative to vapers who never used tobacco. Furthermore, daily vapers were more inclined to vape compulsively relative to non-daily vapers (OR = 8.25).

3.1.3. Model for predicting the number of puffs within an episode

Table 4 displays the model for the effect of country of residence and sociodemographic variables on puffs per episode [(binge (>9 puffs) versus moderate (1–9 puffs)]. The model containing the country of residence and sociodemographic variables did not show a significant effect on the number of puffs per episode; therefore, no additional analysis was conducted (χ^2 [16, n = 386] = 24.83, p =

Table 1
Sample characteristics of the vapers in this study.

Variables		*n*	%	Median	IQR
Expenditure on vaping/week				8	16
Age	Young Adults (18–29)	216	56.0		
	Adults (30–39)	100	25.9		
	Older Adults (40–60)	70	18.1		
Sex	Female	27	7.0		
	Male	359	93.0		
Employed	No	107	27.7		
	Yes	279	72.3		
Country of Residence	Egypt	192	49.7		
	Iraq	143	37.0		
	Qatar	51	13.2		
Type of Vaping Device	E-cigarette	55	14.2		
	Mod	132	34.2		
	Pod	141	36.5		
	Vape pen	58	15.0		
Tobacco use Status	Current user	97	25.1		
	Never user	38	9.8		
	Past user	251	65.0		
Days Vaped/Week	Non-Daily	72	18.7		
	Daily	314	81.3		
Episodes	Regular use (1–16)	219	56.7		
	Compulsive use (>16)	166	43.0		
Number of Puffs	Moderate (1–9 puffs)	192	49.7		
	Binge (>9 puffs)	194	50.3		
Experienced negative health effects	No	194	50.3		
	Yes	116	30.1		
	I don't know	76	19.6		
Specified negative health effect[a]	Respiratory (phlegm, difficulty breathing, sinus pains)	56	52.8		
	Irregular heart beat and/or blood pressure	10	9.4		
	Gastrointestinal (nausea, stomachaches etc.)	15	14.2		
	Teeth/gum pain	10	9.4		
	Addiction (headache, dizziness and/or cravings)	15	14.2		
Tried to Quit Vaping	No	207	53.6		
	Yes	179	46.4		

Note. n = number, Median and IQR for expenditure per week due to non-normality.
[a] Specified negative health effect was only answered by a subset of those who answered "yes" to experiencing negative health effects (106 out of 116).

Table 2
The effect of country of residence and sociodemographic variables on days vaped per week (daily vs nondaily).

Predictor	Wald χ^2	*df*	*p*	Odds ratio	95 % CI	
					Lower	Upper
Country of Residence	11.7	2	**0.00**			
Egypt	6.90	1	**0.00**	5.06	1.51	16.95
Iraq	0.21	1	0.64	1.31	0.41	4.18
Age	0.08	2	0.58			
30-39	0.90	1	0.34	1.56	0.62	3.96
40-60	0.00	1	0.93	0.96	0.31	2.89
Employment status	0.04	1	0.82	1.10	0.46	2.60
Sex	0.08	1	0.76	1.22	0.32	4.60
Tried to Quit Vaping	4.94	1	**0.02**	0.42	0.20	0.90
Type of Vaping Device	7.29	3	0.06			
Mod	7.27	1	0.00	4.89	1.54	15.54
Pod	2.09	1	0.14	2.09	0.76	5.70
Vape pen	1.62	1	0.20	2.06	0.67	6.29
Tobacco Use Status	14.21	2	**0.00**			
Current user	0.47	1	0.49	0.68	0.23	2.00
Past user	4.39	1	**0.03**	3.01	1.07	8.47
Episodes	19.47	1	**0.00**	8.14	3.21	20.68
Number of Puffs	0.43	1	0.51	1.27	0.61	2.66
Experienced negative health effects	2.82	1	0.09	1.94	0.89	4.21
Expenditure on vaping/week	0.88	1	0.34	1.00	0.99	1.00

Note. Country of residence reference group = Qatar. Age reference group = Youth (18–29). Employment status reference group = Not employed. Sex reference group = Female. Tried to quit vaping reference group = No. Type of vaping device reference group = E-cigarette. Tobacco use status reference group = Never used tobacco. Episodes reference group = regular use (1–16 episodes). Number of puffs reference group = Moderate (1–9 Puffs). Experienced negative health effects reference group = No. N = 386.

Table 3
The effect of country of residence and sociodemographic variables on vaping episodes per day (compulsive vs regular use).

Predictor	Wald χ^2	*df*	*p*	Odds ratio	95 % CI	
					Lower	Upper
Country of Residence	3.54	2	0.17			
Egypt	0.04	1	0.83	0.88	0.28	2.75
Iraq	0.54	1	0.46	1.54	0.48	4.84
Age	0.59	2	0.74			
30-39	0.51	1	0.47	0.79	0.41	1.50
40-60	0.00	1	0.99	0.99	0.49	2.01
Employment status	0.20	1	0.64	1.16	0.60	2.26
Sex	0.59	1	0.43	1.78	0.41	7.72
Tried to Quit Vaping	2.51	1	0.11	0.64	0.38	1.10
Type of Vaping Device	3.82	3	0.28			
Mod	0.08	1	0.77	1.13	0.48	2.65
Pod	1.99	1	0.15	1.81	0.79	4.15
Vape pen	0.00	1	0.94	1.03	0.37	2.84
Tobacco Use Status	8.24	2	**0.01**			
Current user	7.94	1	**0.00**	5.67	1.69	18.94
Past user	4.60	1	**0.03**	3.47	1.11	10.82
Days Vaped/Week	19.68	1	**0.00**	8.25	3.24	20.95
Number of Puffs	3.41	1	0.06	0.61	0.36	1.03
Experienced negative health effects	2.17	1	0.14	1.50	0.87	2.60
Expenditure on vaping/week	0.06	1	0.80	1.00	0.99	1.00

Note. Country of residence reference group = Qatar. Age reference group = Youth (18–29). Employment status reference group = Not employed. Sex reference group = Female. Tried to quit vaping reference group = No. Type of vaping device reference group = E-cigarette. Tobacco use status reference group = Never used tobacco. Days vaped per week reference group = non-daily (1–6 days). Number of puffs reference group = Moderate (1–9 Puffs). Experienced negative health effects reference group = No. N = 386.

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3.1.4. Model for predicting the likelihood for experiencing negative health effects from vaping

Table 5 displays the model for the effect of country of residence and sociodemographic variables on negative health effects from vaping. The model containing the country of residence and sociodemographic variables had a significant effect on the likelihood of experiencing negative health effects from vaping (χ^2 [16, n = 386] = 42.16, $p < .001$), explained 17.4 % of the variance (Nagelkerke $R^2 = 0.174$), and correctly classified cases 68.3 % of the time. Vapers residing in Iraq exhibited a higher likelihood of experiencing

Table 4
The effect of country of residence and sociodemographic variables on number of puffs per episode (binge vs moderate vaping).

Predictor	Wald χ^2	*df*	*p*	Odds ratio	95 % CI	
					Lower	Upper
Country of Residence	5.69	2	0.05			
Egypt	5.03	1	0.02	3.29	1.16	9.35
Iraq	5.49	1	0.019	3.41	1.22	9.51
Age	5.10	2	0.078			
30-39	0.16	1	0.68	0.88	0.48	1.61
40-60	4.89	1	0.02	0.46	0.23	0.91
Employment status	0.04	1	0.83	0.93	0.50	1.73
Sex	1.05	1	0.30	0.52	0.15	1.79
Tried to Quit Vaping	0.26	1	0.60	1.14	0.68	1.88
Type of Vaping Device	1.24	3	0.74			
Mod	0.95	1	0.32	1.49	0.66	3.34
Pod	0.97	1	0.32	1.47	0.68	3.20
Vape pen	0.15	1	0.69	1.20	0.48	2.99
Tobacco Use Status	5.92	2	0.05			
Current user	0.00	1	0.93	0.96	0.373	2.48
Past user	2.25	1	0.13	0.50	0.20	1.23
Days Vaped/Week	0.97	1	0.32	1.42	0.70	2.85
Episodes	3.96	1	0.04	0.59	0.35	0.99
Experienced negative health effects	0.08	1	0.77	0.92	0.55	1.55
Expenditure on vaping/week	0.19	1	0.66	0.99	0.99	1.00

Note. Country of residence reference group = Qatar. Age reference group = Youth (18–29). Employment status reference group = Not employed. Sex reference group = Female. Tried to quit vaping reference group = No. Type of vaping device reference group = E-cigarette. Tobacco use status reference group = Never used tobacco. Days vaped per week reference group = non-daily (1–6 days). Episodes reference group = regular use (1–16 episodes). Experienced negative health effects reference group = No. N = 386.

negative health effects compared to vapers residing in Qatar (OR = 3.40). Moreover, vapers with past quit attempts showed a greater likelihood of experiencing negative health effects relative to vapers who did not attempt to quit (OR = 3.40). With respect to sex, male vapers had a lower likelihood of experiencing negative health effects in contrast to female vapers (OR = 0.19).

4. Discussion

In this study, regular nicotine-based vaping users were assessed for their differences in vaping frequency, in terms of the number of

Table 5
The effect of country of residence and sociodemographic variables on vaping negative health effects model (Yes vs No).

Predictor	Wald χ^2	*df*	*p*	Odds ratio	95 % CI	
					Lower	Upper
Country of Residence	6.71	2	**0.03**			
Egypt	1.10	1	0.29	1.90	0.57	6.35
Iraq	4.12	1	**0.04**	3.40	1.04	11.09
Age	0.77	2	0.67			
30-39	0.09	1	0.75	1.10	0.58	2.08
40-60	0.41	1	0.51	0.78	0.37	1.64
Employment status	0.11	1	0.73	1.12	0.57	2.21
Sex	5.66	1	**0.01**	0.19	0.05	0.74
Tried to Quit Vaping	20.98	1	**0.00**	3.40	2.01	5.75
Type of Vaping Device	3.76	3	0.28			
Mod	3.22	1	0.07	0.46	0.20	1.07
Pod	3.13	1	0.07	0.48	0.21	1.08
Vape pen	1.91	1	0.16	0.51	0.20	1.31
Tobacco Use Status	0.11	2	0.94			
Current user	0.03	1	0.86	0.91	0.35	2.41
Past user	0.09	1	0.75	0.86	0.34	2.14
Days Vaped/Week	2.9	1	0.08	1.95	0.90	4.20
Episodes	1.959	1	0.16	1.47	0.85	2.54
Number of Puffs	0.12	1	0.72	0.91	0.54	1.52
Expenditure on vaping/week	0.97	1	0.32	0.99	0.99	1.00

Note. Country of residence reference group = Qatar. Age reference group = Youth (18–29). Employment status reference group = Not employed. Sex reference group = Female. Tried to quit vaping reference group = No. Type of vaping device reference group = E-cigarette. Tobacco use status reference group = Never used tobacco. Days vaped per week reference group = non-daily (1–6 days). Episodes reference group = regular use (1–16 episodes). Number of puffs reference group = Moderate (1–9 Puffs). N = 386.

days, number of vaping episodes, and number of puffs within an episode in addition to experienced negative health effects, by country of residence and other sociodemographic variables. With respect to the models pertaining to the three vaping frequency measures, the study revealed one notable finding on the effect of country of residence. Specifically, vapers residing in Egypt exhibited a greater probability of vaping daily compared to vapers in Qatar. This finding aligns logically with the fact that in Qatar, the sale, distribution, and advertising of vaping devices are prohibited, and the enforcement of vaping behavior entails behavior penalties relative to the other two countries [13]. The results have implications for policy as they suggest that gaps in legislation for Egypt may require strengthening legislations to be on par with Qatar in order to reduce vaping frequency. Alternatively, Egypt could implement nicotine cap policies to reduce vaping frequency, as high nicotine concentration is associated with higher vaping frequency [32].

The study also identified two significant differences in vaping frequency based on vaping episodes per day. Firstly, compulsive vapers (>16 episodes per vaped day) were more likely to engage in daily vaping compared to regular vapers (1–16 episodes per vaped day). Secondly, daily vapers were more likely to engage in compulsive vaping (>16 episodes per vaped day) compared to non-daily vapers. This highlights that daily vaping and compulsive vaping both contribute to increased nicotine delivery which can be associated with stronger dependency. As a result, users may feel the need to vape more often throughout the day to maintain their desired nicotine levels, reinforcing habitual usage patterns. This has implications for practice as it calls for nicotine restriction policies to reduce vaping frequency use to reduce daily and compulsive use.

In this study, two significant differences in vaping frequency based on tobacco use status were identified. Firstly, vapers who are past tobacco users were more prone to engage in daily vaping compared to vapers who had never used tobacco. Secondly, both current and past tobacco users exhibited a higher likelihood of vaping compulsively relative to vapers who never used tobacco. Differences in days vaped and vaping episodes in a day by tobacco use status reveals that current and ex-tobacco users are highly dependent on nicotine as they vape more frequently relative to vapers with no history of tobacco use. This is in line with previous findings, which suggest that vapers who are past or current users of tobacco were found to be more nicotine dependent and may vape more to maintain nicotine use in order to reduce nicotine cravings [33]. An important implication for this result is to focus on current and past tobacco user interventions such as behavioral counselling and nicotine replacement therapy, as they may be very useful to support them in quitting vaping [34].

Vapers with past quit attempts displayed a reduced likelihood of vaping daily compared to those who did not attempt to quit. This observation logically aligns with the fact that the attempt to cease vaping necessitates a decrease in daily vaping. Concerning the likelihood of experiencing negative health effects from vaping, the current study findings highlighted some important points. Firstly, vapers residing in Iraq demonstrated a higher likelihood of experiencing negative health effects from vaping in comparison to vapers living in Qatar, which is in line with the other findings in the study which suggest that vapers in Iraq vape more frequently than those in Qatar. Additionally, quit attempts were associated with negative health effects from vaping. This is logical given that experiencing negative health effects drives vapers to stop vaping. An important implication of this result is to increase the awareness of current vapers about the need to improve their health (or reduce negative health effects) through quitting vaping. This is congruent with past studies that found the desire for health improvements a commonly cited reason to quit vaping by vapers seeking cessation [35], and dual users with past quit attempts [36]. Particularly, vapers often report respiratory effects from vaping such as wheezing and dry coughs [37], and rate respiratory harms highly in terms of discouraging them from vaping [38-40] Assisted support through Varenciline and counselling may be necessary for daily vapers, as they increase the likelihood of quitting among this subset of vapers [41]. Vapers who quit vaping will benefit by reducing their likelihood of smoking relapse which is higher among ex-smokers that quit smoking through vaping relative to ex-smokers who quit through other methods [6]. If vapers with a past history of smoking quit vaping restart smoking, they can receive cessation support through evidence-based methods such as Varenciline, which is effective for smoking cessation [42], and not associated with respiratory or cardiovascular risks.

Lastly, male vapers were less likely to experience negative health effects in comparison to female vapers. This finding aligns with past research suggesting that there are different health effects from exposure to vaping contents based on sex differences [43]. An important implication of this finding is the necessity to account for sex differences when investigating vaping toxicity and other health-related consequences in future research.

4.1. Strengths

While past studies have looked at vaping frequency differences by country in western countries, for example: 12 % of current vapers among smokers and recent ex-smokers were in Canada, while 11.8 % of USA residents were current vapers among smokers and recent ex-smokers [44], the same has not been done in the Middle East. Therefore, this is the first study to attempt studying vaping frequency differences among a sample of countries in the Middle East. Secondly, this is the first study to reveal important differences in vaping frequency for different Middle Eastern countries that differ in their legislation, by showing that the stronger the legislation the lower the vaping frequency. Along the same lines, the higher the cost, the less vaping frequency, as it was shown earlier in our findings for Qatar sample. Thirdly, this is the first study in the Middle East that examines vapers who use vaping products regularly, defined as using a vaping device at least once weekly for the past three months. It also examined differences in vaping frequency, considering the number of days vaped per week, vaping episodes per day, and the number of puffs per episode. This approach enhances the study's robustness, offering insights into regular vaping rather than mere experimentation. Insights from such samples provide true reflections of the issue of vaping.

4.2. Limitations

First, our study used one of the most common data collection methods that is an online sampling of regular vapers, which can be a considered a limitation to gather data from large proportions of participants thus the study sample may not represent the general population of vapers. Secondly, despite an attempt to gather data from a number of Middle Eastern countries, the study gathered analyzable samples mostly from three Middle Eastern countries, Egypt, Iraq, and Qatar. Input from participants in other countries was lumped into an "other" category but excluded from the analysis due to the fact that it cannot be meaningfully interpreted. Arab Middle Eastern countries differ considerably in their legislations and may have different vaping frequencies, thereby limiting the implications of the current study findings to the studied countries. Future studies may need to recruit sufficient samples from other countries in the Middle East to capture further differences in the region. Nevertheless, this study presents a good first step towards learning more about vaping in Middle Eastern countries. Third, although we assumed that the differences in vaping frequency among countries are related to different legislations, other factors such as cultural norms may explain these differences. Therefore, future studies that test mediators that explain the relationship between country of residence and vaping frequency are needed. Finally, the cross-sectional design of this study limits the ability to establish directionality. Future studies with longitudinal designs are needed in order to establish the directionality of the effects.

5. Conclusion

This study examined the differences in vaping frequency, in terms of the number of days vaped per week, vaping episodes per day, and number of puffs per episode in addition to experienced negative health effects, by the effect of country of residence and different sociodemographic variables in a sample of Middle Eastern countries: Qatar, Egypt, and Iraq. Overall, Qatar had lower vaping frequency relative to Iraq and Egypt and vapers with less likelihood of experiencing negative health effects from vaping relative Iraq, and this could be related to its stringent policies against vaping relative to the two counterparts, and calls for policy and cessation interventions in Egypt and Iraq. Differences in vaping frequency and experiencing negative health effects by other sociodemographic variables indicate the potential need for intervention specificity. Examples of such specificity include targeting vapers who are current tobacco users and ex-tobacco users through specialized vaping cessation interventions such as behavioral counselling and nicotine replacement therapy, as they may support them in quitting vaping. Furthermore, implementing nicotine restriction policies and price interventions can have an impact to reduce vaping frequency. Moreover, it is important to consider sex differences when exploring vaping toxicity and other health-related consequences in future vaping cessation studies as females seem to be disproportionately impacted by negative health effects from vaping relative to males.

CRediT authorship contribution statement

Rana Abouzoor: Writing – review & editing, Writing – original draft. **Mohammed Al-Hamdani:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Ethical declaration statement

This study was reviewed and approved by the Institutional Review Board at Qatar University (QU-IRB), on January 19, 2023, with the approval number: [#QU-IRB 1806-E/23].

Consent declaration statement

The participants reviewed an electronic informed consent that included detailed information about the purpose, benefits, and risks, confidentiality, and data storage procedures. Only individuals that agreed to participate, after reviewing the electronic informed consent, were able to proceed and participate in the survey. Agreement was indicated by clicking on "By clicking next, you agree to participate in the survey".

Data availability statement

Due to the sensitive nature of the data, the data will only be retained for 5 years from the end date of data collection as this was a condition stated in the informed consent. Requests to access the datasets should be directed to malhamdani@qu.edu.qa.

Funding

Open Access funding provided by QU Health, Qatar University.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Open Access funding provided by QU Health, Qatar University.

Appendix A. Supplementary file

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2025.e42657.

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