



# Knowledge and Beliefs of Jordanian Community Toward E-cigarettes: A National Survey

Derar H. Abdel-Qader<sup>1</sup> · Ahmad Z. Al Meslamani<sup>1</sup>

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## Abstract

Electronic nicotine delivery systems were promoted publically as a healthier replacement for conventional cigarettes. Knowledge and beliefs of the public can drive their behaviours to adapt or reject the new habit. No previous research was conducted in Jordan to assess electronic cigarettes (e-cigarettes) prevalence, and limited data are available on public opinions and orientation toward this new habit. To assess prevalence of, knowledge, attitude and beliefs about e-cigarettes, and examine factors associated with plans of quitting or initiating e-cigarettes among adults in Jordan. A large cross-sectional face-to-face survey on a random sample of adult population aged  $\geq 18$  years was conducted over two months to include 1820 adults in Jordan. A representative sample was collected using proportionate random sampling technique, which enabled us to geographically categorise the study population. Reliability and validity measures were taken to ensure a comprehensive and appropriate study tool. The Statistical Package for Social Science (SPSS®) version 24 was used to conduct descriptive analysis, logistic regression, and Rao–Scott chi-square. Findings were considered statistically significant at  $p$  value  $< 0.05$  (with a confidence limit at 95%). Of 2164 adults approached, 1820 completed the questionnaire (84.1% response rate). The prevalence of current e-cigarette smokers and dual smokers were 11.7% and 4.0%, respectively. Quitting conventional smoking (38.8%) and enjoying the flavour (32.5%) were the most common reasons to start vaping. Friends were the major source of information about e-cigarettes. There was evidence that adults aged 45–59 years were less likely to be dual smokers (OR 0.51; 95%CI 0.29–0.66;  $p=0.03$ ). Poor knowledge about the content (23.7%) and types of e-cigarettes (14.5%) was reported. Plans to reduce or quit e-cigarettes were significantly associated with three factors: smokers' knowledge about its content, social impression, smokers' satisfaction with e-cigarettes. Social impression was also associated with plans of initiating e-cigarettes. Most participants thought vaping cannot be harmful to children and pregnant women (73.1%) and cannot be addictive (58.2%). Electronic cigarettes were considered helpful in smoking cessation by 69.1% of participants. The proportions of adults who were currently electronic cigarette and dual smokers were 11.7% and 4.0%, respectively. Our research may provide insight to product and individual factors that were associated with plans to sustain, quit or initiate electronic smoking.

**Keywords** Tobacco · E-cigarettes · Community health · Jordan

## Introduction

Electronic nicotine delivery systems (e-cigarettes) are devices that use battery powered heating part to deliver inhaled aerosol usually containing nicotine [1]. More than 6 million people die due to cigarettes smoking worldwide annually [2]. Although e-cigarettes are claimed to have less toxic nicotine dosage than regular cigarettes smoking,

clinicians declared that e-cigarettes have unknown safety and their benefits in quitting smoking are uncertain [3, 4]. Many other studies went further and recoded many potential harmful effects of e-cigarettes including inflammatory changes in airways' muscles [5], development of lipoid pneumonitis [6], and eosinophilic pneumonitis [7].

Given the serious nature of these potential harms, it is crucial to understand and fully comprehend what users and potential users of these devices think and what they truly know about the effects of e-cigarettes. Accurate and comprehensive understanding of people's perspectives about e-cigarettes is important, because of its powerful influence on their behaviour. Therefore, if there is any hope of attaining certain

✉ Ahmad Z. Al Meslamani  
Amaslamanie1095@gmail.com

<sup>1</sup> Faculty of Pharmacy & Medical Sciences, University of Petra, Amman, Jordan

level of awareness among the public, better understanding of their beliefs will be required. However, only few studies were carried out to assess people's knowledge and attitude toward e-cigarettes; most of them were conducted in the US and the UK.

American dual users (regular and electronic smokers) rated e-cigarettes as more physically irritating and addictive, as well as less satisfying [8]. Another US study aimed to assess cigarettes smokers' attitude and beliefs showed that around one-fifth (20.4%) of cigarettes smokers use e-cigarettes concurrently. Also, quit attempts were found more frequently among e-cigarette users (82.8%) than nonusers (74.0%) [9]. In addition, an overall acceptance of e-cigarettes among the public was reported in the US [10]. Young adults and non-Hispanic whites were predictors for e-cigarettes use in a study that used random sampling approach to include current and former cigarette smokers [11]. American adolescents preferred candy-flavoured, fruit-flavoured and menthol-flavoured e-cigarettes more than tobacco-flavoured or alcohol-flavoured e-cigarettes [12]. Prevalence of e-cigarette ever use was 22.4% and more than half (54.7%) of included adults in the US rated e-cigarettes as moderately harmful [13].

In the UK, use of e-cigarettes has grown and negligible evidence of e-cigarette use was found among those who had never smoked [14, 15]. Many factors that influenced e-cigarette initiation amongst UK smokers were reported: misconception of harm reduction, accessibility, social networks influence, and the ability to use it in public places [16]. Electronic cigarettes were mostly viewed as healthier among the UK public [17].

Other studies were conducted in Spain [18], Singapore [19], Poland [20], Pakistan [21], Egypt [22], and 27 European Union member states [23] to assess the knowledge, prevalence and attitude the public toward e-cigarettes. Most of the recent studies showed high rate of e-cigarette use with relative lack of knowledge about harmfulness of vaping.

In Jordan, e-cigarettes use is expected to be popular especially in Amman, the capital of Jordan, where vaping shops and clubs are outspread. The Jordanian public's perspective of conventional cigarettes smoking was rarely addressed [24]. Although the overall prevalence of cigarette smoking is high [24] compared to other countries, no studies were carried out to assess the public's knowledge and attitude toward e-cigarettes.

## Aim of the Study

The study aimed to: (1) evaluate the knowledge and beliefs about e-cigarettes among adult community in Jordan, (2) document the prevalence of e-cigarette smokers, (3) study the utilisation of e-cigarette among its users (4) assess

factors associated with reducing or initiating e-cigarettes, and (5) investigate factors associated with dual smokers and never smokers.

## Method

### Study Design

A cross-sectional national survey was conducted over 2 months (November to December 2019) in 12 governorates in Jordan: Amman, Irbid, Ajloun, Jerash, Mafraq, Balqa, Zarqa, Madaba, Karak, Tafilah, Ma'an, and Aqaba. The questionnaire was carried out as face-to-face interviews on a random sample of the adult population aged  $\geq 18$  years.

### Sampling Technique and Size

The population of the study was divided using proportionate random sampling into four geographical regions: Northern Region (Irbid, Ajloun, Jerash, Mafraq), Southern Region (Karak, Tafilah, Ma'an, Aqaba), Capital Region (West Amman, East Amman) and Central Region (Balqa, Zarqa, Madaba). Each governorate was stratified geographically into rural and urban areas. Two urban areas and two rural areas were selected randomly from each governorate. A random sample was selected from each area.

A Previous study used a sample size of 530 males and 350 females to assess the prevalence of smoking in Jordan [24]. Also, the Jordan National Behavioural survey, conducted in 2004 and published in 2008, showed that nearly 40% of all adults in Jordan aged 25 years or older reported having smoked at least 100 cigarettes during their lifetime [25]. To include a representative sample which can be generalised, the authors decided to include, 1200 males and 620 females at 95% significance level and 5% error margin, distributed as in Table 1.

### Study Instrument

Our study instrument was a self-administered questionnaire, which was developed to serve the purpose of our research. Our tool was developed in Jordan after analysing previous studies that investigated the public's knowledge, beliefs and attitude toward e-cigarettes [9, 10, 12, 21, 23, 26]. The Arabic translated version of the questionnaire was used and validated to be suitable for researching the Jordanian population. The translation was validated by two bilingual linguistic experts from the University of Petra who applied cultural and linguistic validation.

The questionnaire was constructed to include the following topics:

**Table 1** Calculation of sample proportionate distribution in Jordan (n = 1820)

Region	Areas	Population	% of total	Sample size
Capital	West Amman, East Amman	4,430,700	42.0	764
North	Irbid, Ajloun, Jerash, Mafraq	3,021,800	28.6	521
Central	Balqa, Zarqa, Madaba	2,261,800	21.4	389
South	Karak, Tafilah, Ma'an, Aqaba	839,700	8.0	146
Total	–	10,554,000	100.0	1820

### Socio-demographic Characteristics

The following information was collected: age, gender, education, income and region.

### Smoking History

Respondents answered a series of questions about their current and past use of conventional cigarettes and e-cigarettes. The aim of this section was to categorise the respondents into six groups (Table 2): current e-cigarette smokers, former e-cigarette smoker, dual smokers, non-smokers, current conventional cigarette smokers, and former conventional cigarette smokers. Similar terminology has been used in recent studies and reports on e-cigarettes released by the Centres for Disease Control and Prevention (US), the World Health Organisation (WHO), and the previous literature [8, 11, 15, 19, 27]. The terms e-cigarettes, vaping, and electronic nicotine delivery systems were used interchangeably in our paper.

### Knowledge and Beliefs

All participants were asked to answer Yes/No questions about their knowledge on e-cigarettes' content, regulations and types. Beliefs of participants about the social impression, cost, and the satisfaction achieved with e-cigarettes were also addressed.

### Awareness and Attitude Toward E-cigarettes

All participants answered questions about potential benefits and harms of e-cigarettes. Attitude of participants toward banning and regulating e-cigarettes were also addressed. These questions were designed with a rating scale with four choices ranging from strongly agree to strongly disagree.

### E-cigarettes Utilisation

We targeted adults who were currently e-cigarette smokers with many specific questions. We aimed to collect information about: (1) reasons of initiation of e-cigarette use; (2) characteristics of e-cigarettes they were currently using; (3) their source of information about e-cigarettes; (4) amount of money they spent monthly on e-cigarettes.

### Plans to Quit or Initiate E-cigarettes

Current e-cigarette smokers were asked if they had any intention or plan to reduce or quit e-cigarettes. Similarly, participants who were not currently e-cigarettes smokers were asked if they planned to start vaping. We aimed in this section to try to understand the potential behaviours of participants and address the factors associated with these behaviours.

### Reliability and Validity of Study Instrument

Reliability was established using a pilot test by collecting data from 30 subjects in each governorate. Data collected

**Table 2** Operational definitions of the sample groups

Category	Definition
Current e-cigarette smoker	An adult who has smoked e-cigarettes daily for the last month
Former e-cigarette smoker	An adult who has smoked e-cigarettes daily for at least one month in his or her lifetime, but who had quit smoking at the time of interview
Current cigarette smoker	An adult who has smoked at least 100 conventional cigarettes in his or her lifetime, and who now smokes every day
Former cigarette smoker	An adult who has smoked at least 100 cigarettes in his or her lifetime, but who had quit smoking at the time of interview
Dual smoker	An adult who is currently e-cigarette and cigarette smoker
Never-smoker	Those who have smoked fewer than 100 cigarettes (conventional or electronic) during their lifetime

were analysed by SPSS Version 24 (Statistical Package for Social Sciences, by IBM incorporated). Given the fact that Cronbach's alpha ( $\alpha$ ) is the most commonly used measure of internal consistency reliability [28, 29], we used it in order to test our instrument reliability. A reliability coefficient (alpha) of  $< 0.5$  was considered as bad reliability, above 0.5 and below 0.7 moderate reliability, above 0.7 good, and above 0.8 great reliability [30]. Our results showed good reliability ( $K = 0.74$ ), and it was a significant result ( $p < 0.05$ ). Data of pilot testing were not included in our study results.

Content validity was assessed by a panel of seven experts with public health, family medicine, clinical pharmacy and respiratory medicine. The main investigator arranged face-to-face meeting with the professionals in Amman (27, Oct, 2019). The draft questionnaire with the score sheet was distributed to the group. Respondents were asked to rate the question out of 10 in relation to appropriateness, importance and phrasing. Also, raters' additional comments were collected. Overall means for appropriateness, importance and phrasing were; 8.2 s.d.  $\pm$  1.23, 8.45 s.d.  $\pm$  1.47 and 8.81 s.d.  $\pm$  1.74, respectively. Amendments to the survey included adding extra information to knowledge questions and attitude questions.

### Eligibility Criteria

Those who aged  $\geq 18$  years, Arabic speakers, and permanently lived in Jordan were included. Those who lived in Jordan occasionally (less than 6 months a year), people with mental illness and those who were not willing to participate were excluded.

### Data Collection

The final survey was delivered through face-to-face interviews with participants who were willing to participate, and met the inclusion criteria. Interviews were conducted by eight pharmacy students from the fifth-year of their academic study at the University of Petra. These students (data collectors) received one lecture (2 h) on the topic, and five training sessions on completing the study questionnaire; the main investigator (DAQ) provided all training. Eligible participants were approached randomly in nine public places: streets, supermarkets, cafes, restaurants, gyms, bus stations, pharmacies, and gardens. 2 h for each place. Students briefed the participants about aims of the study, time needed to complete the survey, and included people were given the choice to complete the questionnaire by themselves or by the data collector. Verbal consent was obtained from eligible respondents. Participants could withdraw from the interview at any time and had the right to refuse to answer any question without providing a reason. If a participant refused to

complete the survey or was ineligible to participate, the data collector approached randomly the closest eligible participant. The authors ensured that the survey was anonymous and confidential.

### Data Analysis

Data were coded and entered into the Statistical Package for Social Science (SPSS®) version 24 (IBM, Chicago, IL, US) by the investigator. Descriptive results are presented as proportions (%) with 95% CIs, while logistic regression results are presented as adjusted ORs with 95% CI. Statistical significance was considered at  $p$  value  $< 0.05$  (with a confidence limit at 95%). Logistic regression was used to determine odds of dual smokers and never smokers among all participants, and odds of plans to quit/reduce e-cigarette use among current e-cigarette smokers, or initiate e-cigarette use among none e-cigarette smokers. Rao-Scott chi-square test which is a design-adjusted version of the Pearson chi-square [31], was used to assess differences between categorical variables.

## Results

### Participants

To achieve the targeted sample size, we approached 2164 adults, 1820 completed the questionnaire (84.1% response rate). As shown in Table 3, around half of respondents were current e-smokers (213/1820, 11.7%), dual smokers (73/1820, 4.0%), and current conventional smokers (651/1820, 35.8%). Former e-cigarette smokers accounted for 2.3% (42/1820) of participants, and 40.4% (735/1820) of respondents were never smokers. No gender differences were related significantly to current e-cigarette smokers proportion [Females; 13.9% (86/620) Vs. Males; 10.6% (127/1200),  $p > 0.05$ ]. Adults aged 45–59 years were less likely to be dual smokers (OR 0.51; 95%CI 0.29–0.66;  $p = 0.03$ ). Adults who had  $> 1000$  USD income were more likely to be dual smokers (OR 1.3; 95%CI 0.89–2.17;  $p = 0.004$ ). Adults who aged above 29 years were more likely to be never smokers. Females were more likely to be never smokers than males (OR 4.13; 95%CI 1.64–6.07;  $p = 0.007$ ). Adults who lived in the southern region of Jordan were less likely to be never smokers (OR 0.25; 95%CI 0.19–2.97;  $p = 0.0001$ ). No demographic differences were related significantly to plans to quit use or initiate use of e-cigarettes.

### Knowledge and Beliefs

Participants' knowledge and beliefs and factors associated with it were summarised in Table 4. Less than

**Table 3** Demographics and categorisation of participants (N = 1820)

Demographics	Total [N = 1820, (n, %)]		Ever E-cigarette smokers [N = 328, (n, %)]		None E-cigarette smokers [N = 1492, (n, %)]			
	Dual smokers	Former e-smokers	Current e-smoker (N = 213) 11.7%	Predicting current HM users, OR (95% CI)	Cigarettes smokers N = 651 35.8%	Former cigarettes smokers N = 106 5.8%	Never-smokers N = 735 40.4%	Predicting never smokers, OR (95% CI)
Age (years)								
18–29 (Ref)	(731, 40.2%)	(23, 3.1%)	(158, 21.6%)	1.00	(302, 41.3%)	(53, 7.3%)	(144, 19.7%)	1.00
30–44	(674, 37.0%)	(8, 1.9%)	(31, 4.6%)	1.57 (0.91–4.74)	(194, 28.8%)	(28, 4.2%)	(396, 58.8%)	4.45 (1.47–6.31)*
45–59	(366, 20.1%)	(5, 1.4%)	(23, 6.3%)	0.51 (0.29–0.66)*	(137, 37.4%)	(18, 4.9%)	(172, 49.7%)	2.75 (1.60–4.51)*
≥ 60	(49, 2.7%)	(0, 0.0%)	(1, 2.0%)	<sup>a</sup>	(18, 36.7%)	(7, 14.3%)	(23, 46.9%)	2.3 (0.76–1.47)*
Gender								
Male (Ref)	(1200, 65.9%)	(56, 4.7%)	(127, 10.6%)	1.00	(542, 45.2%)	(74, 6.2%)	(372, 31.0%)	1.00
Female	(620, 34.1%)	(17, 2.7%)	(86, 13.9%)	0.48 (0.21–1.27)	(109, 17.6%)	(32, 5.2%)	(363, 58.5%)	4.13 (1.64–6.07)**
Educational level								
Bachelor degree (Ref)	(1094, 60.1%)	(32, 2.9%)	(71, 6.5%)	1.00	(341, 31.2%)	(70, 6.4%)	(562, 51.4%)	1.00
MS.c or PhD	(98, 5.4%)	(5, 5.1%)	(8, 5.2%)	1.29 (0.91–3.12)	(23, 23.5%)	(13, 13.3%)	(46, 46.9%)	0.93(0.49–3.09)
Diploma degree or less	(628, 34.5%)	(36, 5.7%)	(134, 21.3%)	0.65 (0.23–1.47)	(287, 45.7%)	(23, 3.7%)	(127, 20.2%)	0.29 (0.36–4.14)
Monthly income								
≤ 500 JOD (Ref)	(961, 52.8%)	(27, 2.8%)	(89, 9.3%)	1.00	(314, 32.7%)	(64, 6.7%)	(456, 47.4%)	1.00
501–1000 JOD	(706, 38.8%)	(28, 4.0%)	(83, 11.7%)	0.96 (0.81–1.76)	(301, 42.6%)	(26, 3.7%)	(247, 35.0%)	0.62 (0.47–4.64)
≥ 1000 JOD	(153, 8.4%)	(18, 11.8%)	(41, 26.8%)	1.30 (0.89–2.17)**	(36, 23.5%)	(16, 10.5%)	(32, 20.9%)	0.51 (0.39–7.09)
Location								
Capital region	(764, 42.0%)	(51, 6.7%)	(95, 12.4%)	1.00	(178, 23.3%)	(46, 6.0%)	(380, 49.7%)	1.00
North region	(521, 28.6%)	(3, 0.6%)	(54, 10.4%)	0.01 (0.02–0.42)**	(235, 45.1%)	(39, 7.5%)	(173, 33.2%)	0.38 (0.29–1.67)
Central region	(389, 21.4%)	(13, 3.3%)	(41, 10.5%)	0.56 (0.41–1.11)	(164, 42.1%)	(14, 3.6%)	(149, 38.3%)	0.50 (0.24–1.77)
South region	(146, 8.0%)	(6, 4.1%)	(23, 15.7%)	0.50 (0.19–0.68)	(74, 50.7%)	(7, 4.8%)	(33, 22.6%)	0.25 (0.19–2.97)***

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

<sup>a</sup>Item were excluded due to zero responses

**Table 4** Knowledge and beliefs of adults and factors associated with it (N = 1820)

	Total [N = 1820, (n, %)]	Dual smokers + Current e-smokers [N = 286, (n, %)]		None current e-cigarette smokers [N = 1534 (n, %)]			
		Plan to quit/ reduce e-cigarettes	No plan to quit/reduce e-cigarettes	Predicting plan to quit/ reduce e-cigarettes, OR (95% CI)	Plan to initiate e-cigarettes	No Plan to initiate e-cigarettes	Predicting plan to initiate e-cigarettes, OR (95% CI)
<b>Knowledge and beliefs</b>							
I have knowledge about e-cigarettes <sup>a</sup>							
Yes	(432, 23.7%)	(46, 10.6%)	(40, 9.3%)	1.00	(127, 29.4%)	(219, 50.7%)	1.00
No	(1388, 76.3%)	(36, 2.6%)	(164, 11.8%)	0.19 (0.04–7.54)*	(291, 21.0%)	(897, 64.6%)	0.56 (0.34–0.91)
I know about vaping regulations in Jordan							
Yes	(674, 37.0%)	(36, 5.3%)	(67, 9.9%)	1.00	(105, 15.6%)	(466, 69.1%)	1.00
No	(1146, 63.0%)	(46, 4.0%)	(137, 12.0%)	0.64 (0.26–3.2)	(313, 27.3%)	(650, 56.7%)	2.18 (1.47–6.01)
I know the differences between types of e-cigarettes devices							
Yes	(264, 14.5%)	(14, 5.3%)	(34, 12.8%)	1.00	(77, 29.2%)	(139, 52.7%)	1.00
No	(1556, 85.5%)	(68, 4.4%)	(170, 10.9%)	0.97 (0.71–2.41)	(341, 21.9%)	(977, 62.8%)	0.61 (0.41–0.85)
I want to know more about vaping							
Yes	(706, 38.8%)	(61, 8.7%)	(56, 7.9%)	1.00	(361, 51.1%)	(228, 32.3%)	1.00
No	(1114, 61.2%)	(21, 1.9%)	(148, 13.3%)	0.12 (0.05–7.64)	(57, 5.1%)	(888, 79.7%)	0.004 (0.0003–0.026)***
I think vaping has negative social impression							
Yes	(819, 45.5%)	(72, 8.8%)	(34, 4.1%)	1.00	(41, 5.0%)	(672, 82.1%)	1.00
No	(1001, 55.0%)	(10, 1.0)	(170, 17.0%)	0.02 (0.001–9.26)**	(377, 37.6%)	(444, 44.4%)	13.77 (5.64–19.21)**
I think vaping is as satisfied as conventional smoking							
Yes	(697, 38.3%)	(14, 2.0%)	(148, 21.2%)	1.00	(287, 41.2%)	(248, 35.6%)	1.00
No	(1123, 61.7%)	(68, 6.0%)	(56, 5.0%)	12.87 (9.54–17.64)***	(131, 11.7%)	(868, 77.3%)	0.13 (0.021–0.91)
I think the cost of e-cigarettes is high							
Yes	(1334, 73.3%)	(73, 5.5%)	(159, 11.9%)	1.00	(291, 21.8%)	(811, 60.8%)	1.00
No	(486, 26.7%)	(9, 1.8%)	(45, 9.3%)	0.44 (0.34–0.79)	(127, 26.1%)	(305, 62.8%)	1.17 (0.67–3.14)

\**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001

quarter (432/1820, 23.7%) of participants had knowledge about e-cigarettes’ content. The majority of respondents (1556/1820, 85.5%) had lack of knowledge about types of e-cigarettes. Around two-thirds (1123, 61.7%) of participants believed that vaping was not as satisfying as conventional smoking. Around three-quarters (1334/1820, 73.3%) of participants thought the cost of e-cigarettes was high.

E-cigarette smokers and dual smokers who declared their lack of knowledge on e-cigarette content were less likely to plan quitting or reducing e-cigarettes (OR 0.19; 95%CI 0.04–7.54;  $p=0.03$ ). E-cigarette smokers and dual smokers who did not believe vaping had negative social impression were less likely to plan quitting or reducing vaping (OR 0.02; 95%CI 0.001–9.26;  $p=0.004$ ). Those e-cigarette smokers and dual smokers who believed e-cigarettes was not as satisfying as conventional smoking were more likely to plan quitting or reducing e-cigarettes (OR 12.87; 95%CI 9.54–17.64;  $p=0.001$ ). None e-cigarette smokers who believed e-cigarettes did not have negative social impression were more likely to plan initiating e-cigarettes (OR 13.77; 95%CI 5.64–19.21;  $p=0.001$ ). Differences in beliefs about the cost of e-cigarettes were not significantly related to plans to quit or initiate use of e-cigarettes. No knowledge and beliefs differences were related significantly to the participants’ category.

### Attitude and General Awareness

As shown in Fig. 1, the majority of participants agreed (641/1820, 35.2%) and strongly agreed (914/1820, 50.2%) that e-cigarettes should be regulated by law. Around three-quarters (1341/1820, 73.7%) of respondents were not in agreement with banning e-cigarettes in public places. The majority of adults (1331/1820, 73.1%) thought e-cigarettes could not be dangerous to children and pregnant women.

Responses seemed divided about the harmfulness of e-cigarettes; more than half of participants considered e-cigarettes were less harmful than conventional smoking (1107/1820, 60.8%), were helpful in smoking cessation (1257/1820, 69.1%), and cannot be addictive (1062/1820, 58.2%). No demographic differences were related significantly to attitude and awareness statements ( $p > 0.05$ ).

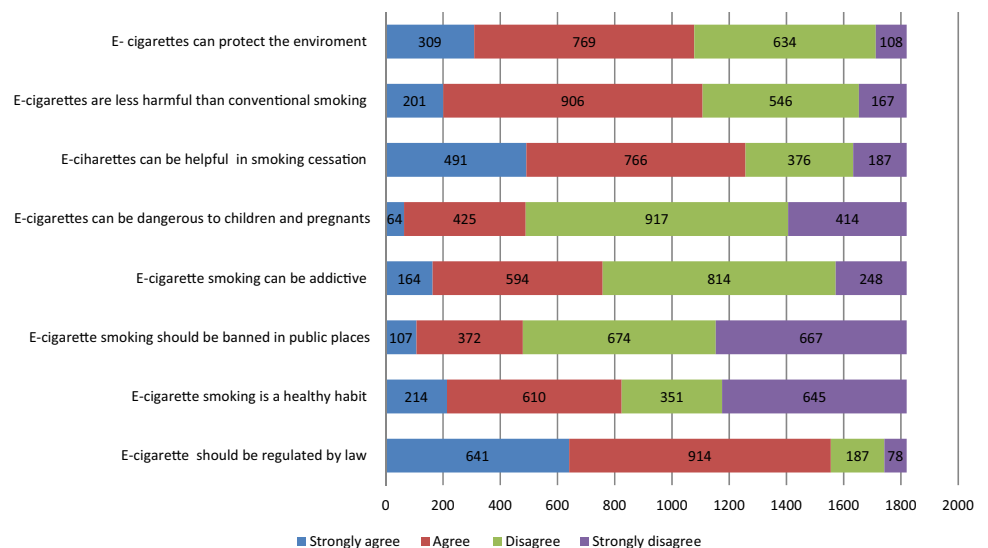
### E-cigarettes Utilisation

Differences in e-cigarettes’ utilisation and habits among dual smokers and current e-cigarettes smokers were summarised in Table 5. Among all e-cigarette smokers, around two-thirds of them started e-cigarettes in the first place to either quit conventional smoking (111/286, 38.8%) or enjoy the flavour (93/286, 32.5%). Around one-third of e-cigarette smoker (83/286, 29.0%) usually use > 20 mg/mL nicotine strength. The majority of (234/1820, 81.8%) e-cigarette smokers reported < 50 USD budget monthly for e-cigarettes. The major information sources for e-cigarette smokers were friends (167/286, 58.4%), social media (51/286, 17.8%), and vaping shops/clubs (39/286, 13.6%). Health care providers were the least source of information for e-cigarette smokers (3/286, 1.0%). Among all e-cigarette smokers, dual smokers had a tendency to prepare e-cigarette juice by themselves compared to current e-smokers [Dual smokers; (51/73, 69.9%) Vs. Current e-cigarette smokers; (38/213, 17.8%),  $p=0.021$ ].

### Discussion

Our study granted us an indication of the popularity of e-cigarettes in Jordan. To our knowledge, this was the first national study of e-cigarette use, knowledge, and beliefs

**Fig. 1** Attitude and awareness of e-cigarette among all participants (n = 1820)





**Table 5** E-cigarettes utilisation among current e-cigarette smokers and dual smokers (N=286)

Items	Total, (n, %)	Dual users N=73	Current e-smoker (N=213)	P value <sup>a</sup>
Why did you start using e-cigarettes?				0.061
Quit smoking	(111, 38.8%)	(41, 56.2%)	(70, 32.9%)	
Enjoy the flavour	(93, 32.5%)	(19, 26.0%)	(74, 34.7%)	
Try something new	(43, 15.0%)	(11, 15.1%)	(32, 15.0%)	
Healthier option to enjoy nicotine	(39, 16.6%)	(2, 2.7%)	(37, 17.4%)	
Which nicotine strength you are usually using in your liquid?				0.417
< 5 mg/mL	(13, 4.5%)	(3, 4.1%)	(10, 4.7%)	
6:10 mg/mL	(54, 18.9%)	(14, 19.2%)	(40, 18.8%)	
11:20 mg/mL	(136, 47.6%)	(17, 23.3%)	(119, 55.9%)	
> 20 mg/mL	(83, 29.0%)	(39, 53.4%)	(44, 20.6%)	
Approximately, how much do you spend on Vaping devices monthly?				0.915
< 50 JOD	(234, 81.8%)	(62, 84.9%)	(172, 80.8%)	
50 to 100 JOD	(49, 17.1%)	(10, 13.7%)	(39, 18.3%)	
> 100 JOD	(3, 1.0%)	(1, 1.4%)	(2, 0.9%)	
How do you get your e-liquid or juice?				.021
I purchase it	(197, 68.9%)	(22, 30.1%)	(175, 82.2%)	
I prepare it myself	(89, 31.1%)	(51, 69.9%)	(38, 17.8%)	
What is your source of information about vaping?				0.463
Friends/relatives	(167, 58.4%)	(43, 58.9%)	(124, 58.2%)	
Social media	(51, 17.8%)	(16, 21.9%)	(35, 16.4%)	
Commercials	(17, 5.9%)	(5, 6.8%)	(12, 5.6%)	
Vaping shops/clubs	(39, 13.6%)	(8, 11.0%)	(31, 14.6%)	
Health care providers	(3, 1.0%)	(0, 0.0%)	(3, 1.4%)	
Others	(9, 3.1%)	(1, 1.4%)	(8, 3.8%)	

<sup>a</sup>p values from Rao–Scott chi-square test

among Jordanian adults. Given the size and geographic distribution of our survey, we could generalise our outcome. However, we think more rigorous surveillance is still necessary due to many limitations our study had; our data were self-reported, which may inaugurate some bias in the behavioural pattern of the respondents especially females who due to cultural and traditional reasons in Arabic region were less likely to admit habits like smoking, and we also think few aspects of our study may lack punctilious data collection. However, we were tied by the study aims and due to pragmatic and practical reasons; some aspects of the study were not meticulously addressed as others.

The prevalence of current e-cigarette smokers and dual smokers in our study were 11.7% and 4.0%, respectively. More than one-third of adults were currently conventional cigarette smokers. Prevalence of e-cigarette smoking was not addressed in Jordan previously. Nevertheless, a growing rate of conventional smoking was reported in Jordan in the last two decades [24, 25, 32]. We suspect high smoking rate in Jordan is a major risk factor for the high incidence of chronic diseases that have been reported previously in Jordan [33]. Our study found patterns of e-cigarette smoking

similar to those reported in the US 16.1% [11], and the UK 16.0% [15]. However, inconsistent rate of e-cigarette smoking was reported in Egypt [22]. Given the relatively high rate of e-cigarette smoking in Jordan and absence of proven research on vaping harmfulness, we raise the alarms of health officials to shed light on this new habit.

More than two-thirds of e-cigarette smokers in Jordan started vaping to either quit or enjoy the flavour. Friends and social media were the major sources of information about vaping for e-cigarette smokers. Vaping devices have been aggressively promoted on social media, search engines and networks including Facebook, YouTube, Google, Yahoo and MSN [34]. Adults particularly those with younger ages have been online with an increasing number on these websites [35].

Our results suggest males and females had insignificant difference to current e-cigarette smokers' proportion. Adults with younger ages were more likely to be dual smokers and less likely to be never smokers. Similar pattern was found in a study conducted in the US [11]. Also, Egyptians young people were more aware of e-cigarettes [22]. The facts that young adults are more active in social network, which is



one of the most common places where e-cigarettes are promoted, and desire of experimentation might have contributed to these findings.

A relatively poor knowledge about the content, regulations and types of e-cigarettes was reported among all participants in our study. Different levels of adults' knowledge about e-cigarettes were reported in the US [36], Egypt [22], Saudi Arabia [37], Spain [38], Singapore [19], Pakistan [21], and physicians of Poland [26]. Nearly most participants among all studies heard about e-cigarettes, but little knew about its content, types and regulations.

We used a unique approach to predict potential behaviours of adults based on their demographics, knowledge and beliefs. We found that differences in demographics were not statistically related to plans of reducing/quitting or initiating e-cigarettes. On the other hand, plans to reduce or quit e-cigarettes were significantly associated with level of knowledge on e-cigarette content, beliefs about negative social impression, and about satisfaction. More perceived satisfaction was found to be associated with more frequent use of vaping product [39]. In addition, our study indicated that intentions to initiate e-cigarette smoking were associated with adults who wanted to know more about vaping and those who believed it did not have negative social impression. We think our findings provide keys to health officials and policymakers to act in an early stage of spreading this habit. Health officials are invited to deliver the recent proven information about electronic vaping devices to the public and especially to those who want to know more about these devices and have plans to initiate it.

Around three-quarters of adults in our study thought e-cigarettes could not be dangerous to children and pregnant women. Although e-cigarettes may have fewer harmful substances than conventional smoking cigarette, they contain nicotine which is dangerous for pregnant women and developing babies and can cause serious damage to their brains and lungs. Moreover, some flavours used in e-cigarettes may cause harm to developing babies [40]. The majority of our participants thought e-cigarettes was helpful in smoking cessation and cannot be addictive. Evidence to use e-cigarettes in smoking cessation has not been sufficient, regardless of some efficacy showed in clinical trials [41]. However, many studies suggested e-cigarette smoke may contribute to lung and bladder cancer, as well as heart disease in humans [42, 43] While the debate about harmfulness of e-cigarettes is ongoing, we recommend bringing the attention of the public that e-cigarettes may be harmful and precautionary measures are needed.

## Conclusion

More than one-fifth of adults were e-cigarette smokers. Many factors were significantly associated with plans of reducing/quitting or initiating e-cigarettes. Policymakers and health officials should utilise our data to implement proper measures and campaigns to raise the awareness of the public about e-cigarettes.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethics Approval** The study was approved by the Institutional Review Board (IRB) at the University of Petra (No. 13H-11-2019).

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