

Parental Knowledge and Attitude Regarding E-Cigarette Use in Saudi Arabia and the Effect of Parental Smoking: A Cross-Sectional Study

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Introduction: E-cigarette use has been on the rise among children and adolescents. This study aimed to assess the knowledge and attitudes of the health hazards and laws regarding e-cigarette use among parents in Saudi Arabia. In addition, we evaluated the effect of parental smoking on parent's knowledge.

Methods: This study was conducted with parents of children below 18 years of age in Jeddah, Saudi Arabia. Jeddah was divided into four areas (north, south, east, and west) and in each area, the largest shopping mall was selected. Data were gathered using a self-administered questionnaire.

Results: Out of 1386 parents, 61.7% were smokers, 13.3% reported that their children used e-cigarettes, and 73.6% did not discuss e-cigarette use with their children. In total, 77.3% of parents thought it was important to be educated about e-cigarette use. However, their ability to discuss e-cigarette use with their children was 13.9% lower than their ability to discuss regular cigarette smoking with their children. Parents who were smokers were more accepting of their children using e-cigarettes ($P < 0.0001$). Mothers who smoked were more accepting than fathers of their children using e-cigarettes ($P < 0.0001$).

Conclusion: Parents reported a lack of knowledge and attitudes regarding e-cigarette use. Parental smoking, especially among mothers, was statistically significantly related to their e-cigarette use knowledge and attitudes. Parents agreed that it was important to educate parents regarding e-cigarette use.

Keywords: electronic-cigarette, smoking, Saudi Arabia, parental smoking

Introduction

The use of e-cigarettes has been on the rise among children and adolescents.^{1–3} E-cigarettes, also called nicotine delivery systems, use battery power and heating elements to vaporize a nicotine-containing solution to be inhaled by the user. Hence, e-cigarettes are called vapors due to the inhalation and exhalation of vapors.^{2,4} The nicotine-containing solutions come in various flavors and nicotine content. E-cigarettes are marketed as a safer alternative for smokers to inhale nicotine and as an aid in smoking cessation, although the scientific literature regarding the latter is mixed.^{5,6} Nicotine has several side effects, including a highly addictive quality and a negative effect on brain development from the prenatal period into adolescence.⁷ Additionally, nicotine can be associated with an increased risk of cardiovascular, respiratory, and gastrointestinal disorders.⁸ Furthermore, nicotine decreases the immune response and negatively impacts oral and

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reproductive health. By various mechanisms, nicotine can lead to cancers by affecting cell proliferation, oxidative stress, apoptosis, and DNA maturation.⁹ Moreover, the direct contact of nicotine with oral and pharyngeal tissues can cause irritation, burning, increased salivation, nausea, abdominal pain, vomiting, and diarrhea.¹⁰ The Centers for Disease Control and Prevention (CDC) reported an outbreak of lung injury in 2019, associated with e-cigarette use.¹¹ They recommended refraining from the use of e-cigarettes and vaping products, as they found that over 1.78 million students in middle and high schools in the USA reported trying e-cigarettes.¹²

Recent studies have shown that e-cigarette use among teens has surpassed tobacco cigarette use.^{13,14} A UK study reported a higher prevalence of e-cigarette use (37.3%) compared to traditional cigarettes (26.5%) among students aged 15–16 years.² Significant factors associated with children beginning to smoke included exposure to parental smoking, sibling or peer smoking; peer pressure; easy access to smoking and nonsmoking forms of tobacco.^{15–17}

Parental knowledge, attitudes, and behavior can be conveyed to children.^{18–20} An example of such a phenomenon includes gambling and drinking. It was found that heavy parental drinking resulted in earlier and heavier drinking among adolescents.²¹ Moreover, higher levels of gambling were found among adolescents whose parents were involved or approved of gambling.²²

In Saudi Arabia, smoking is a major public health issue. It is widespread, mostly among males with 20–23.5% and females with 0.31–1.5%.^{23,24} Smoking is more acceptable for males than for females.²⁵ In addition, Algorinees et al (2016)²⁶ who assessed adolescent smoking habits among students in Northern Saudi Arabia reported that 65.7% of smokers started smoking when they were 18 years old with a mean daily usage of 7.98 cigarettes.

Many types of nicotine delivery devices exist in Saudi Arabia, including cigarettes, e-cigarettes, hookas, and shisha. Although the general attitude toward smoking is negative, with frequent anti-smoking education and strict laws, smoking in adolescence was reported to be 20.2% in girls and 31.8% in boys with an increasing appeal.²⁷ Anti-smoking rules include prohibiting the sale of tobacco products to minors, a ban on indoor public smoking, and prohibiting the manufacturing and agriculture of tobacco and tobacco-related products.²⁸ No evidence was found on the prevalence of electronic-cigarette vaping in Saudi Arabia. However, one study investigated the prevalence of electronic-cigarette use among health science students

and showed higher percentages of electronic cigarette (27.7%) vaping compared to conventional smoking (14.1%).²⁹ Thus, the importance of assessing parental knowledge of the dangers of e-cigarettes and providing the proper environment and education for their children is implied. There is a need to study these factors to prevent the use of e-cigarettes among children. Hence, the aim of this study was to assess parental knowledge and attitudes regarding e-cigarette health hazards and the related laws among parents in Saudi Arabia. In addition, we evaluated the relationship between parental knowledge of e-cigarettes' health hazards, related laws and the parents' own proclivity to be smokers.

Materials and Methods

Subjects

This cross-sectional study was conducted with parents of children younger than 18 years living in Jeddah City, Saudi Arabia. The data collection began in June 2018 and ended in April 2019. The city of Jeddah was divided into four sections: North, South, East, and West. The largest shopping mall in each area was selected (four shopping centers), and self-administered written questionnaires were distributed at the site. In these malls, data collectors were positioned in one area and were enquiring all adults if they were parents to participate in the research. They tried to include all parents willing to participate in a one-week schedule for each mall, including an afternoon (from 5 pm to 8 pm) and a morning (10 am to 12pm) rotations.

Inclusion criteria included parents that had unaffected medically free children, less than 18 years old, and spoke Arabic. Parents of children that are medically compromised or affected with congenital anomalies such as cleft lip and palate were excluded from the study. The sample size was estimated using OpenEpi, an online program. The prevalence of smoking in Saudi Arabia was 22.6%,^{30,31} the design effect was selected as 3 for the cluster sample, and the confidence level was selected as 95%. Accordingly, the sample size was 807, and the absolute precision was 5%. From a cluster sample of four shopping malls distributed around Jeddah, 1386 parents agreed to participate in this research.

Methods

Ethical approval was obtained from the ethics committee of KAUFU (132–11-18) for this study. An informative written consent was signed by participating parents.

Parents were provided with a self-administered questionnaire constructed after a thorough literature review.^{15,32-34} The questionnaire was sent to two experts in the field for content validity, and they interviewed 20 mothers for face validity. The questionnaire was modified accordingly. In order to avoid bias in designing the questionnaire, we followed Barnard and Anita's catalog to avoid potential biases prior to the questionnaire's administration.³² The questionnaire contained the following: (i) questions on socio-demographic data, including parental age; child's gender, with family income divided to three levels (lower class with a monthly income of less than 7000 SAR (1863.33 USD), middle class with a monthly income of 7000 SAR (1863.33 USD), to 20,000 SAR (5323.79 USD), and higher class with a monthly income higher than 20,000 SAR (5323.79 USD)), place of residence, parental education and parental job description. If the parents had more than one child, the youngest was selected.

(ii) Questions to assess parental smoking prevalence and a history of regular smoking and e-cigarette use, including the status of the parent's smoking/vaping behavior; (1) if they were current smokers/vapor users, (2) ever smoker/vaper users, or (3) ever smoker/vapor users even if tried it once in their life (seven questions).

(iii) Questions to assess parental e-cigarette knowledge such as the knowledge of its risk to health, knowledge of the related laws and policies, and knowledge of the addicting properties of e-cigarettes using a yes/no/I do not know choice to answer the questions (seven questions).

(iv) Questions to assess parental attitudes towards children's e-cigarettes usage using a 5-point Likert scale (with "5" being strongly-agree and "1" being strongly disagree), such as if they thought e-cigarette use could cause addiction or if they thought the usage of e-cigarettes was better than regular cigarettes, if they accepted their children's use of e-cigarettes and if their attitude differed toward e-cigarette use according to their child's gender (eight questions).

(v) Questions on the parental ability to discuss e-cigarettes with their children and if they thought they needed to be educated using yes/no answers (two questions).

Parental smoking/vaping activity was categorized into: father only (father was the only smoker and/or vapor user), mother only (mother was the only smoker and/or vapor user), both (both parents were smoker and/or vapor users) and neither (non-users' parents) for comparisons. Parents were enquired to sign a written consent form.

Patient and Public Involvement

During the initial formation of the research idea, questions were asked, and literature reviews were initiated, as well as multiple community and public members were contacted. The raw data were made available for involved parents and were sent to any of the parents who gave the data collectors their contact information.

Statistical Analysis

The results included descriptive information displayed as frequency and percentages for categorical variables and a mean with a standard deviation (SD) for continuous variables. To assess the effect of parental smoking on their knowledge and attitudes, a chi-square and *t*-test were used, respectively, with a 0.05 significance level.

Results

Of the 1386 parents who participated in this research, 780 (56.3%) of the mothers and 571 (41.2%) of the fathers were in the age range of 25–44 years. Regarding socio-economic status (SES), 200 (14.5%) mothers were working as teachers, university instructors, or lecturers. On the other hand, 509 (36.7%) fathers were working in the private sector and 440 (31.7%) were working in the governmental sector. The monthly income for 803 (57.9%) of the included families was middle class ranging from 7000 to 20,000 SR (see Table 1).

As for parental smoking history, 621 fathers (44.8%), 35 mothers (2.5%), and 217 both parents (15.7%) reported being a smoker or having ever smoked or used e-cigarettes (of any type) including even once in their lifetime as opposed to nonsmokers who had never tried smoking or used e-cigarettes at any time. In addition, the prevalence of paternal smoking was 616 (44.4%), prevalence of parental cigarette smokers was 430 (31%), and prevalence of parental e-cigarette users was 109 (7.9%). Both parents were smokers in 210 (15.2%) cases, smoked regular cigarettes in 93 (6.7%) cases and engaged in vaping in 13 (0.9%) cases. However, mothers were the sole smokers in the family in 46 (3.3%) of cases with regular cigarette smoking and 14 (1%) for e-cigarette use. When parents were asked if they had a son or a daughter who were e-cigarette users, 184 (13.3%) of parents answered "Yes" (Table 2).

As for parental knowledge regarding use of e-cigarettes, 770 parents (55.6%) reported that e-cigarettes were not an effective way to quit smoking, 992 parents (71.6%) knew that e-cigarettes were related to health problems, 659

Table 1 Distribution of the Sample According to Their Demographic and Socioeconomic Factors. (N=1386)

Variables		N (%)
Maternal age (years)	<25	94 (6.8)
	25–44	780 (56.3)
	45+	512 (37)
Paternal age (years)	<25	11 (0.8)
	25–44	571 (41.2)
	45–64	649 (46.8)
	65+	145 (11.2)
Number of children	1–2	397 (28.6)
	3–4	472 (34.1)
	3–4	375 (27.1)
	more than 6	142 (10.2)
Age of oldest child (years)	Below 18	689 (49.8)
	18 or Above	697 (50.3)
Maternal educational	Illiterate	25 (1.8)
	Elementary School	52 (3.8)
	Secondary School	303 (21.9)
	High education	1006 (72.6)
Paternal educational	Illiterate	19 (1.4)
	Elementary School	58 (4.2)
	Secondary School	328 (23.7)
	High education	981 (70.8)
Maternal occupation	Housewife	790 (57)
	Teacher	200 (14.5)
	Medical field	94 (6.7)
	Government sector	137 (9.9)
	Private sector	148 (10.7)
	Student	17 (1.2)
Paternal occupation	Not working/retired	250 (18)
	Private sector	507 (36.6)
	Medical field	96 (6.9)
	Government sector	440 (31.8)
	Teacher	92 (6.4)
	Student	1 (0.08)
Family income/month	lower class	214 (15.4)
	Middle class	803 (57.9)
	higher class	369 (26.6)

Table 2 Distribution of the Sample According to Parental Smoking/Vaping. (N= 1386)

Smoking	Neither	Father Only	Mother Only	Both
Is one of the parents ever smoked or vaped even if tried it once in their life?	513 (37)	621 (44.8)	35 (2.5)	217 (15.7)
Is one of the parents currently smoking or vaping?	531 (38.3)	616 (44.4)	29 (2.1)	210 (15.2)
Is one of the parents ever smoked or even if tried it once in their life?	542 (39.1)	623 (44.9)	28 (2.0)	193 (13.9)
Is one of the parent's currently smoker?	817 (58.9)	430 (31.0)	46 (3.3)	93 (6.7)
Is one of the parents ever used e-cigarettes even if tried it once in their life?	1109 (80.0)	155 (11.2)	51 (3.7)	71 (5.1)
Is one of the parents ever been a user for e-cigarettes in their life?	1221 (88.1)	109 (7.9)	23 (1.7)	33 (2.4)
Is one of the parents currently using e-cigarettes?	1298 (93.7)	61 (4.4)	14 (1.0)	13 (0.9)

Note: Values are in number (%).

(47.5%) reported that e-cigarettes did not have the lowest incidence of cancer, 485 (35%) knew that e-cigarettes were not declared by the Food and Drug Association (FDA) as a means of smoking cessation.³⁵ Of the parents, 590 (49.8%) reported that indoor e-cigarette vaping was not permitted, and 580 (41.8%) reported that minors were not allowed to buy e-cigarettes in Saudi Arabia. Both these are facts declared by the Saudi Arabian Ministry of Health.³⁰ However, the prevalence of parents answering “I do not know” in the knowledge questions ranged from 38.2% to 62.6%. In addition, 532 (38.4%) and 532 (73.2%) of parents did not discuss regular cigarettes or e-cigarettes with their children, respectively; 114 (8.2%) and 156 (11.3%) of parents disagreed that they were confident in their ability to discuss regular cigarettes and e-cigarettes with their children respectively; and 1072

parents (77.3%) strongly agreed to the need to be educated regarding e-cigarettes. For attitude questions, parents strongly agreed that e-cigarettes caused addiction (608 [43.9%]), that e-cigarettes are better than regular smoking for their children (66 [4.80%]), that their children could smoke regular cigarettes (34 [2.5%]), that their children could use e-cigarettes (20 [1.4%]), and that their sons could smoke/use e-cigarettes more than their daughters (23 [2.7%]). See [Supplementary Table 1](#).

A statistically significant difference was found between non-smoking/vaping parents and smoking/vaping parents, especially for mothers when asked if e-cigarettes were; an effective way to quit smoking; could cause health problems; were related to cancer compared to regular cigarette smoking, were declared by the FDA as a means of smoking cessation; if indoor

Table 3 Distribution of the Sample According to Current Parental Vaping Users and Both Their Knowledge and Behavior Answers

E-Cigarette Use by the Parents		Neither (n= 1298) N (%)	Father Only (n=61) N (%)	Mother Only (n =14) N (%)	Both (n= 13) N (%)	Total N (%)	p
KQ1: Is one of your children e-cigarettes user?	yes	175 (13.5%)	4 (6.6%)	2 (14.3%)	3 (23.1%)	184 (13.3%)	0.316
	No	1123 (86.5%)	57 (93.4%)	12 (85.7%)	10 (76.9%)	1202 (86.7%)	
KQ2: Do you think e-cigarette is an effective way to quit smoking?	Yes	61 (4.7%)	18 (29.5%)	3 (21.4%)	5 (38.5%)	87 (6.3%)	<0.001*
	No	730 (56.2%)	28 (45.9%)	7 (50.0%)	5 (38.5%)	770 (55.6%)	
	I do not know	507 (39.1%)	15 (24.6%)	4 (28.6%)	3 (23.1%)	529 (38.2%)	
KQ3: Do you think e-cigarette have lower incidence of cancer compared to a regular cigarette user?	Yes	134 (10.3%)	23 (37.7%)	6 (42.9%)	5 (38.5%)	168 (12.1%)	<0.001*
	No	631 (48.6%)	19 (31.1%)	5 (35.7%)	4 (30.8%)	659 (47.5%)	
	I do not know	533 (41.1%)	19 (31.1%)	3 (21.4%)	4 (30.8%)	559 (40.3%)	
KQ4: Are the e-cigarette declared by the Food and Drug Association as a means of stopping smoking?	Yes	28 (2.2%)	2 (3.3%)	0 (0.0%)	3 (23.1%)	33 (2.4%)	<0.001*
	No	450 (34.7%)	24 (39.3%)	5 (35.7%)	6 (46.2%)	485 (35.0%)	
	I do not know	820 (63.2%)	35 (57.4%)	9 (64.3%)	4 (30.8%)	868 (62.6%)	
KQ5: Is indoor e-cigarette permitted in Saudi Arabia?	Yes	94(7.2%)	6 (9.8%)	3 (21.4%)	3 (23.1%)	106 (7.6%)	0.008*
	No	543(41.8%)	32 (52.5%)	7 (50.0%)	8 (61.5%)	590 (42.6%)	
	I do not know	661 (50.9%)	23 (37.7%)	4 (28.6%)	2(15.4%)	690 (49.8%)	
KQ6: Can e-cigarette cause health problems	yes	924 (71.2%)	48 (78.7%)	9 (64.3%)	11 (84.6%)	992 (71.6%)	0.382
	No	374 (28.8%)	13 (21.3%)	5 (35.7%)	2 (15.4%)	394 (28.4%)	
KQ7: Are minors allowed to buy e-cigarette in Saudi Arabia?	Yes	132 (10.2%)	3 (4.9%)	2 (14.3%)	2 (15.4%)	139 (10.0%)	0.348
	No	534 (41.1%)	32 (52.5%)	8 (57.1%)	6 (46.2%)	580 (41.8%)	
	I do not know	632 (48.7%)	26 (42.6%)	4 (28.6%)	5 (38.5%)	667 (48.1%)	
BQ1: I have discussed with my children the regular smoking.	yes	805 (62.0%)	36 (59.0%)	8 (57.1%)	5 (38.5%)	854 (61.6%)	0.344
	No	493 (38.0%)	25 (41.0%)	6 (42.9%)	8 (61.5%)	532 (38.4%)	
BQ2: I have discussed with my children e-cigarette.	yes	343 (26.4%)	19 (31.1%)	5 (35.7%)	4 (30.8%)	371 (26.8%)	0.717
	No	955 (73.6%)	42 (68.9%)	9 (64.3%)	9 (69.2%)	1015 (73.2%)	

Notes: *Significant at $P \leq 0.05$. P value based on chi-square test.

Abbreviations: e-cigarette, electronic cigarettes; KQ, knowledge question; BQ, behavior question.

Table 4 Distribution of the Sample According to Current Parental Smoking and Both Their Knowledge and Behavior Answers

Cigarette Smoking by the Parents		Neither (n= 817) N (%)	Father Only (n= 430) N (%)	Mother Only (n= 46) N (%)	Both (n= 93) N (%)	Total N (%)	p
KQ1: Is one of your children e-cigarettes?	yes	114 (14.0%)	51 (11.9%)	10 (21.7%)	9 (9.7%)	184 (13.3%)	0.173
	No	703 (86.0%)	379 (88.1%)	36 (78.3%)	84 (90.3%)	1202 (86.7%)	
KQ2: Do you think e-cigarette is an effective way to quit smoking?	Yes	41 (5.0%)	31 (7.2%)	3 (6.5%)	12 (12.9%)	87 (6.3%)	0.008*
	No	440 (53.9%)	244 (56.7%)	30 (65.2%)	56 (60.2%)	770 (55.6%)	
	I do not know	336 (41.1%)	155 (36.0%)	13 (28.3%)	25 (26.9%)	529 (38.2%)	
KQ3: Do you think e-cigarette have lower incidence of cancer compared to a regular cigarette user?	Yes	93 (11.4%)	55 (12.8%)	4 (8.7%)	16 (17.2%)	168 (12.1%)	0.212
	No	375 (45.9%)	211 (49.1%)	27 (58.7%)	46 (49.5%)	659 (47.5%)	
	I do not know	349 (42.7%)	164 (38.1%)	15 (32.6%)	31 (33.3%)	559 (40.3%)	
KQ4: Are the e-cigarette declared by the Food and Drug Association as a means of stopping smoking?	Yes	14 (1.7%)	15 (3.5%)	0 (0.0%)	4 (4.3%)	33 (2.4%)	0.108
	No	273 (33.4%)	155 (36.0%)	19 (41.3%)	38 (40.9%)	485 (35.0%)	
	I do not know	530 (64.9%)	260 (60.5%)	27 (58.7%)	51 (54.8%)	868 (62.6%)	
KQ5: Is indoor e-cigarette permitted in Saudi Arabia?	Yes	49 (6.0%)	36 (8.4%)	9 (19.6%)	12 (12.9%)	106 (7.6%)	<0.001*
	No	334 (40.9%)	180 (41.9%)	26 (56.5%)	50 (53.8%)	590 (42.6%)	
	I do not know	434 (53.1%)	214 (49.8%)	11 (23.9%)	31 (33.3%)	690 (49.8%)	
KQ6: Can e-cigarette cause health problems	yes	570 (69.8%)	303 (70.5%)	39 (84.8%)	80 (86%)	992 (71.6%)	0.002*
	No	247 (30.2%)	127 (29.5%)	7 (15.2%)	13 (14%)	394 (28.4%)	
KQ7: Are minors allowed to buy e-cigarette in Saudi Arabia?	Yes	74 (9.1%)	45 (10.5%)	9 (19.6%)	11 (11.8%)	139 (10.0%)	0.124
	No	340 (41.6%)	174 (40.5%)	21 (45.7%)	45 (48.4%)	580 (41.8%)	
	I do not know	403 (49.3%)	211 (49.1%)	16 (34.8%)	37 (39.8%)	667 (48.1%)	
BQ1: I have discussed with my children the regular smoking.	yes	522 (63.9%)	255 (59.3%)	27 (58.7%)	50 (53.8%)	854 (61.6%)	0.148
	No	295 (36.1%)	175 (40.7%)	19 (41.3%)	43 (46.2%)	532 (38.4%)	
BQ2: I have discussed with my children e-cigarette.	yes	221 (27.1%)	104 (24.2%)	16 (34.8%)	30 (32.3%)	371 (26.8%)	0.218
	No	596 (72.9%)	326 (75.8%)	30 (65.2%)	63 (67.7%)	1015 (73.2%)	

Notes: *Significant at $P \leq 0.05$. P value based on chi-square test.

Abbreviations: e-cigarette, electronic cigarettes; KQ, knowledge question; BQ, behavior question.

e-cigarette vaping was permitted in Saudi Arabia; if minors were allowed to buy e-cigarettes in Saudi Arabia; if they discussed regular cigarette smoking with their children; their acceptance of their children smoking/vaping and their ability to discuss smoking/vaping with their children ($P < 0.05$). Non-smoking/vaping mothers statistically significantly educated their children more on smoking/vaping effects and recognized the health impact of e-cigarettes compared to smoking/vaping mothers. However, they were statistically significantly less aware of the FDA and Saudi rules regarding indoor smoking/vaping. Although not significant, there was a greater tendency for smoking/vaping mothers to accept their sons' e-cigarette vaping (mean 1.33 ± 0.89) compared to non-smoking/vaping mothers (mean 1.24 ± 0.808) with $P = 0.053$. See Table 3–7. The

α reliability for knowledge questions was 0.68, for attitude questions was 0.51, and for behavior questions was 0.61.

Discussion

This study aimed to evaluate parental attitudes and knowledge regarding e-cigarette use and the effect of parental smoking/vaping. Patel et al (2019), who evaluated parental e-cigarette awareness and attitude in the USA, reported that one-third of adolescents' parents and more than half of children's parents showed no concern about their own child's e-cigarettes use.³⁶ This is crucially important as parental perceptions of smoking/vaping can be taught passively to their children. This was supported by Topa et al in a systematic review and meta-analysis that suggested that personal background factors including family patterns

Table 5 Distribution of the Sample According to Current Parental Smoking/Vaping Users and Both Their Knowledge and Behavior Answers

Parents Smoking/Vaping		Neither (n= 531) N (%)	Father Only (n= 616) N (%)	Mother Only (n= 29) N (%)	Both (n= 210) N (%)	Total N (%)	p
KQ1: Is one of your children e-cigarettes?	yes	67 (12.6%)	81 (13.1%)	5 (17.2%)	31 (14.8%)	184 (13.3%)	0.799
	No	464 (87.4%)	535 (86.9%)	24 (82.8%)	179 (85.2%)	1202 (86.7%)	
KQ2: Do you think e-cigarette is an effective way to quit smoking?	Yes	24 (4.5%)	31 (5.0%)	2 (6.9%)	30 (14.3%)	87 (6.3%)	<0.001*
	No	267 (50.3%)	365 (59.3%)	21 (72.4%)	117 (55.7%)	770 (55.6%)	
	I do not know	240 (45.2%)	220 (35.7%)	6 (20.7%)	63 (30.0%)	529 (38.2%)	
KQ3: Do you think e-cigarette have lower incidence of cancer compared to a regular cigarette user?	Yes	59 (11.1%)	62 (10.1%)	2 (6.9%)	45 (21.4%)	168 (12.1%)	<0.001*
	No	230 (43.3%)	311 (50.5%)	18 (62.1%)	100 (47.6%)	659 (47.5%)	
	I do not know	242 (45.6%)	243 (39.4%)	9 (31.0%)	65 (31.0%)	559 (40.3%)	
KQ4: Are the e-cigarette declared by the Food and Drug Association as a means of stopping smoking?	Yes	7 (1.3%)	19 (3.1%)	0 (0.0%)	7 (3.3%)	33 (2.4%)	0.013*
	No	163 (30.7%)	228 (37.0%)	15 (51.7%)	79 (37.6%)	485 (35.0%)	
	I do not know	361 (68.0%)	369 (59.9%)	14 (48.3%)	124 (59.0%)	868 (62.6%)	
KQ5: Is indoor e-cigarette permitted in Saudi Arabia?	Yes	30 (5.6%)	43 (7.0%)	4 (13.8%)	29 (13.8%)	106 (7.6%)	<0.001*
	No	213 (40.1%)	258 (41.9%)	16 (55.2%)	103 (49.0%)	590 (42.6%)	
	I do not know	288 (54.2%)	315 (51.1%)	9 (31.0%)	78 (37.1%)	690 (49.8%)	
KQ6: Can e-cigarette cause health problems	yes	369 (69.5%)	436 (70.8%)	24 (82.8%)	163 (16.4%)	992 (71.6%)	0.076
	No	162 (30.5%)	180 (29.2%)	5 (17.2%)	163 (16.4%)	394 (28.4%)	
KQ7: Are minors allowed to buy e-cigarette in Saudi Arabia?	Yes	39 (7.3%)	68 (11.0%)	5 (17.2%)	27 (12.9%)	139 (10.0%)	0.038*
	No	236 (44.4%)	245 (39.8%)	16 (55.2%)	83 (39.5%)	580 (41.8%)	
	I do not know	256 (48.2%)	303 (49.2%)	8 (27.6%)	100 (47.6%)	667 (48.1%)	
BQ1: I have discussed with my children the regular smoking.	yes	348 (65.5%)	382 (62.0%)	14 (48.3%)	110 (52.4%)	854 (61.6%)	0.004*
	No	183 (34.5%)	234 (38.0%)	15 (51.7%)	100 (47.6%)	532 (38.4%)	
BQ2: I have discussed with my children e-cigarette.	yes	133 (25.0%)	168 (27.3%)	10 (34.5%)	60 (28.6%)	371 (26.8%)	0.550
	No	398 (75.0%)	448 (72.7%)	19 (65.5%)	150 (71.4%)	1015 (73.2%)	

Notes: *Significant at $P \leq 0.05$. P value based on chi-square test.

Abbreviations: e-cigarette, electronic cigarettes; KQ, knowledge question; BQ, behavior question.

and parental attitudes toward smoking were key factors influencing their children's beliefs regarding smoking and the susceptibility to become smokers.³⁷ This was based on the most recent version of the theory of reasoned action and theory of planned behavior which links personal attitudes, subjective norms, and perceived behavioral control, to an individual's behavior and behavioral intentions.³⁸

The prevalence of parental cigarette smoking and e-cigarettes reported in this study was 41% and 6.3%, respectively. This percentage was higher than that reported for the general Saudi population for smoking regular cigarettes (21.4%) and e-cigarette use reported in the USA 1.21%.^{31,34} However, maternal smoking prevalence (3.3%) was similar to that reported in the Saudi population study (3.9%).³⁹ This could indicate that parenting

motivates honesty in declaring information compared to the total population which includes adults aged 18 years and above.⁴⁰ In addition, this study found a significant difference between the prevalence of maternal and paternal smoking which is supported by several studies that investigated the prevalence of smoking. Males smoking behavior was always greater than females.^{29,41-43}

Children's e-cigarette prevalence in this cross-sectional study (13.3%) was expected to be underestimated, as smoking children tend to hide smoking from their parents.⁴⁴ However, it was slightly lower than the prevalence of regular tobacco smoking reported in Medina (15.17%) and the northern region of Saudi Arabia (19.5%).^{26,32}

This study assessed parental e-cigarette knowledge and attitudes. It reports a gap of knowledge regarding

Table 6 Distribution of the Sample According to Ever Parental Smoking/Vaping Users Even if Tried It Once in Their Life and Both Their Knowledge and Behavior Answers

Parents Ever Used Smoking/Vaping		Neither (n=513) N (%)	Father Only (n=621) N (%)	Mother Only (n= 35) N (%)	Both (n= 217) N (%)	Total N (%)	P
KQ1: Is one of your children e-cigarettes?	Yes	65 (12.7%)	81 (13.0%)	5 (14.3%)	33 (15.2%)	184 (13.3%)	0.819
	No	448 (87.3%)	540 (87.0%)	30 (85.7%)	184 (84.8%)	1202 (86.7%)	
KQ2: Do you think e-cigarette is an effective way to quit smoking?	Yes	21 (4.1%)	32 (5.2%)	3 (8.6%)	31 (14.3%)	87 (6.3%)	<0.001*
	No	261 (50.9%)	366 (58.9%)	23 (65.7%)	120 (55.3%)	770 (55.6%)	
	I do not know	231 (45.0%)	223 (35.9%)	9 (25.7%)	66 (30.4%)	529 (38.2%)	
KQ3: Do you think e-cigarette have lower incidence of cancer compared to a regular cigarette user?	Yes	50 (9.7%)	64 (10.3%)	7 (20.0%)	47 (21.7%)	168 (12.1%)	<0.001*
	No	226 (44.1%)	311 (50.1%)	18 (51.4%)	104 (47.9%)	659 (47.5%)	
	I do not know	237 (46.2%)	246 (39.6%)	10 (28.6%)	66 (30.4%)	559 (40.3%)	
KQ4: Are the e-cigarette declared by the Food and Drug Association as a means of stopping smoking?	Yes	6 (1.2%)	19 (3.1%)	0 (0.0%)	8 (3.7%)	33 (2.4%)	0.003*
	No	157 (30.6%)	227 (36.6%)	19 (54.3%)	82 (37.8%)	485 (35.0%)	
	I do not know	350 (68.2%)	375 (60.4%)	16/35 (45.7%)	127 (58.5%)	868 (62.6%)	
KQ5: Is indoor e-cigarette permitted in Saudi Arabia?	Yes	27 (5.3%)	43 (6.9%)	5 (14.3%)	31 (14.3%)	106 (7.6%)	<0.001*
	No	203 (39.6%)	260 (41.9%)	20 (57.1%)	107 (49.3%)	590 (42.6%)	
	I do not know	283 (55.2%)	318 (51.2%)	10 (28.6%)	79 (36.4%)	690 (49.8%)	
KQ6: Can e-cigarette cause health problems	Yes	354 (69%)	442 (71.2%)	28/35 (80%)	168 (77.4%)	992 (71.6%)	0.087
	No	159 (31%)	179 (28.8%)	7 (20%)	49 (22.6%)	394 (28.4%)	
KQ7: Are minors allowed to buy e-cigarette in Saudi Arabia?	Yes	37 (7.2%)	68 (11.0%)	5 (14.3%)	29 (13.4%)	139 (10.0%)	0.046*
	No	228 (44.4%)	249 (40.1%)	19 (54.3%)	84 (38.7%)	580 (41.8%)	
	I do not know	248 (48.3%)	304 (49.0%)	11 (31.4%)	104 (47.9%)	667 (48.1%)	
BQ1: I have discussed with my children the regular smoking.	Yes	340 (66.3%)	384 (61.8%)	15 (42.9%)	115 (53.0%)	854 (61.6%)	<0.001*
	No	173 (33.7%)	237 (38.2%)	20 (57.1%)	102 (47.0%)	532 (38.4%)	
BQ2: I have discussed with my children e-cigarette.	Yes	131 (25.5%)	169 (27.2%)	10 (28.6%)	61 (28.1%)	371 (26.8%)	0.869
	No	382 (74.5%)	452 (72.8%)	25 (71.4%)	156 (71.9%)	1015 (73.2%)	

Notes: *Significant at $P \leq 0.05$. P value based on chi-square test.

Abbreviations: e-cigarette, electronic cigarettes; KQ, knowledge question; BQ, behavior question.

Table 7 Distribution of the Sample According to Parental Attitude Questions in Relation to Their Nicotine Use (N=1386)

Attitude Questions	Ever Smoked/Vaped or Tried it Once		
	Yes (n=873) (Mean±SD)	No (n=513) (Mean±SD)	P value
I am confident of my ability to discuss e-cigarettes with my children.	3.76 ±1.369	3.85 ± 1.388	0.222
I am confident of my ability to discuss regular smoking with my children.	4.10±1.276	4.24±1.233	0.041*
I accept that my children smoke regular cigarettes.	1.26±.798	1.16±0.705	0.017*
I accept that my children use e-cigarettes.	1.25±.742	1.12±0.563	<0.001*
I accept for my sons to smoke/vape more than my daughters.	1.33±.881	1.24±0.808	0.053
It is important to educate parents about e-cigarettes	4.46±1.113	4.54±1.062	0.184
E-cigarettes use causes addiction	3.67±1.330	3.93±1.226	<0.001*
E-cigarette is better than regular smoking for my children.	1.73±1.177	1.52±1.059	0.001*

Notes: *Significant at $P \leq 0.05$. P value based on t-test. E-cigarettes equals electronic-cigarette vapors. The Likert scale category boundaries were: 1 (strongly disagree) to 5 (strongly agree).

e-cigarette use among parents as parents reported “I do not know” in 38.2% to 62.6% of the knowledge questions.

Many parents (38.2%) were unaware of the FDA stance on e-cigarette use as a smoking cessation device and even a certain percentage believed it to be effective 87 (6.3%), although the FDA has not approved e-cigarettes as a smoking cessation device.³⁵ However, it was found by this study that when mothers were smokers/vapers, they statistically significantly tended to accept their children’s smoking/vaping more than non-smoking/vaping mothers. This could support Anand et al (2015) whose study reported a positive relationship between both adolescence and maternal e-cigarette use.⁴⁵ In addition, smoking/vaping mothers significantly discussed smoking/vaping with their children less compared to those who were non-smokers/vapers ($P < 0.001$). This could be supported with the planned behavior theory which relates maternal attitudes to their actions.³⁸ Furthermore, it was suggested that maternal education was a focal point when planning an educational program that will eventually affect the prevalence of smoking in a positive manner. This supports the findings of Patel et al (2019) who reported the necessity of establishing a school-parent communication effort to control children’s e-smoking use.³⁶ Moreover, 77.3% of parents in this study strongly agreed that it is important to be educated on the use of e-cigarettes.

The lack of parental knowledge regarding e-cigarette use could be because it is a recent trend in the market compared to well-established and popular regular smoking. This study calls for an immediate action for parental education to control the increase in the prevalence of e-cigarette use and that it should be seriously taken into consideration.

In addition, parents have a greater tendency to accept their son’s e-cigarette use more than their daughter’s. This finding was also reported by Wali (2011) in his study on smoking habits in Saudi Arabia.⁴⁶ He related this gender acceptance variation to cultural restriction.

One limitation of this study was that we were not able to select parents randomly in shopping malls. In addition, by conducting the study in shopping malls, we expected to recruit mainly families with middle to high SES. However, this could be considered an advantage as e-cigarette use was reported to be predominant in high SES families.⁴⁷ In addition, there were more mothers than fathers which could have resulted in an unbalanced sample that was not distributed among the general population. However, this could also be related to the site of the sample recruitment (shopping malls) which are comprised of more

females than males. This was supported by Sohail et al (2015) who reported a higher frequency of shopping women compared to men in Saudi Arabia.⁴⁸ Future studies that include various regions, schools, and the effect of various smoking/vaping prevention programs along with educational and community services are suggested.

Conclusion

Parents reported a lack of knowledge and attitudes regarding e-cigarette use. Parental smoking/vaping, especially among mothers was statistically significantly related to their e-cigarette knowledge and attitudes. Most parents agreed to the importance of educating parents on e-cigarettes.

Data Sharing Statement

Extra data are available by emailing the corresponding author “HJS”.

Ethical Statement

Ethical approval was obtained from the ethics committee of KAUFU (132-11-18).

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Author Contributions

Heba Sabbagh: Designing the study, acquisition, performing the analysis, and interpretation of data. Contributed in writing and editing the manuscript. Mona Hassan: edited the manuscript. Layla Khogeer: Contributed in designing the work, collecting the data and writing the paper. Hanaa Allaf: Contributed in, collecting the data and writing the paper.

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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