Electronic cigarette use among Italian smokers

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Electronic cigarette use among Italian smokers: patterns, settings, and adverse events

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Abstract

Objective: Information is scanty on the patterns and settings of electronic cigarette use and on its possible adverse events. To fill the knowledge gap on these issues, we conducted a survey among ever-smokers attending smoking cessation services (SCS) in Italy.

Methods: In 2016–2018, we enrolled 395 ever-smokers aged ⩾18 years who were current or former electronic cigarette users in 12 SCS from northern, central, and southern Italy.

Results: In all, 12.4% of ever smokers were regular, 9.4% occasional, and 78.2% past users of electronic cigarettes. Of all users, 93.8% consumed electronic cigarettes with nicotine, 95.9% used refillable devices, and 76.6% purchased electronic cigarette devices or liquids in vape shops. The mean duration of use was 3.7 months and the mean number of puffs per day was 86. Among users, 71.5% used electronic cigarettes in at least 1 smoke-free indoor environment, 53.7% in workplaces, 49.5% in restaurants and bars, 33.5% in train/metro stations or airports, and 18.4% in public transports. The use of electronic cigarettes in smoke-free environments significantly decreased with age and increased with duration of use and nicotine dependence. In our sample, 47.1% reported at least 1 adverse event attributable to electronic cigarette use: 19.5% dry cough, 12.0% dry mouth, 7.6% throat or mouth irritation, and 6.8% sore throat.

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Conclusion: In Italy, most conventional cigarette smokers use electronic cigarettes where smoking conventional cigarettes is prohibited. About half of users reported 1 or more symptoms attributable to electronic cigarettes, despite the relatively short duration of use.

Keywords
E-cigarettes, adverse events, patterns of use, survey, Italy

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Introduction

Electronic cigarettes are electronic devices containing a liquid heated to generate an inhalable vapor, which may contain nicotine.[1,2] In most high-income countries, electronic cigarettes were introduced into the market around 2010, and since then they have gained popularity worldwide.[1,3,4] In Europe, after an initial rapid spread of electronic cigarette use,[5] its use increased only slightly, with the proportion of adult regular users rising from 1.5% in 2014 to 1.8% in 2017.[6] In Italy, the prevalence of adults who had ever tried electronic cigarettes remained stable around 5% in 2013–2018,[1,4] and the number of current regular users is limited (1.3% in 2018).[1]

In line with several scientific societies,[7,8] the World Health Organization (WHO) recently warned against the use of electronic cigarette use not only for nonsmokers, but also as a smoking cessation strategy at a population level, stating that it is "undoubtedly harmful," there is insufficient evidence to support effectiveness in assisting smokers attempting to quit, and the majority of electronic cigarette users are dual users (i.e. concurrently using electronic cigarettes and conventional cigarettes).[9]

In 2013, the WHO recommended regulating electronic cigarette use and banning electronic cigarettes in indoor places where smoking conventional cigarettes is prohibited.[10] Despite this, and despite the fact that the general population strongly supports the recommendation,[11,12] as of 2018, only 14 of the 28 European Union Member States had partially regulated use in smoke-free environments and only 4 European Union Member States had banned their use in all places where smoking is not allowed.[13]

Few studies have examined the patterns of use of electronic cigarette use in smoke-free environments. These studies concluded that the use of electronic cigarettes, particularly by young people, is common in places where smoking is banned.[14,15] Thus dual users do not simply replace some conventional cigarettes with less harmful products, but they presumably add the nicotine intake from electronic cigarettes to that from conventional cigarettes. No studies are available so far from Italy, where electronic cigarette use is prohibited only in schools,[13] and no national legislation covers their use in indoor workplaces and other public places such as restaurants and bars, where bans can be set by the owner.

As recently noted by the WHO,[9] current scientific evidence suggests that electronic cigarette use is not risk-free, and its harm should not be underestimated.[16–18] Given that the majority of electronic cigarette users are dual users,[19–22] also in Italy,[1] the combined use of these products may increase the dose of nicotine[23] and other harmful and potentially harmful substances, and consequently, their related symptoms.[24] Some studies, although mostly based on small or convenience samples,[16] have reported adverse events attributable to electronic cigarette use, including cough, wheeze, dry or irritated oral cavity, and increased heart rate.[25–27] Recently, the US Centers for Disease Control and Prevention investigated whether 200 cases of severe lung illness, including some deaths, are related to electronic cigarette use.[28–30] Explosions and burns caused by electronic cigarette use have been reported recently.[31,32]

We conducted an observational study to obtain new data about patterns of use and adverse events in ever-smokers and electronic cigarette users.

Methods

Study population

Data come from a cross-sectional study conducted from June 2016 to July 2018 on Italian adults (⩾18 years) attending smoking cessation services (SCS). The survey was coordinated by the Italian Association of Hospital Pulmonologists (AIPO) in collaboration with Mario Negri Institute for Pharmacological Research (IRFMN). Participants were enrolled in 12 SCS from northern, central, and southern Italy: AORNA Cardarelli Hospital (Naples), Hospital of Sassari (Sassari), S. Camillo-Forlanini Hospital (Rome), Ospedali Riuniti of Livorno (Livorno), San Camillo de Lellis Hospital (Rieti), IRCCS-INRCA Hospital (Ancona), Regina Elena Institute IRCCS (Rome), Santa Maria della Misericordia Hospital (Rovigo), ASST Vimercate (Vimercate, Monza Brianza), SS. Antonio and Biagio Hospital (Alessandria), ASL Na 3 (Sanitary District 59; Meta di Sorrento, Naples), and University Hospital of Pisa (Pisa).

We obtained approval for the study protocol from the ethics committee of the coordinating center (Fondazione IRCCS Istituto Neurologico "Carlo Besta") and from the ethics committees of each of the 12 SCS. Details of the survey were provided to all participants by SCS professionals

through a structured information sheet, and all participants signed a consent form.

The present study is based on 2 different samples of participants (Supplementary Table 1): (1) a sample of 481 current smokers, consecutively attending the SCS for the first time to obtain support for smoking cessation. This sample included 282 electronic cigarette ever users, 2 heated tobacco products (HTP) users, and 197 electronic cigarette never users; and (2) a convenience sample of 152 ever-smokers (i.e. current or former) attending the SCS for other reasons, mostly for a control visit. This sample included 113 electronic cigarette ever users, 10 HTP users, and 29 electronic cigarette never users.

Overall, 633 participants were enrolled in the study. For the present analysis, we excluded HTP users and electronic cigarette never users. We therefore considered 395 current and ex-smokers who had ever used electronic cigarettes.

All participants answered the same ad hoc questionnaire administered by an SCS professional. A first draft of the survey questionnaire in Italian was developed by researchers from the Mario Negri Institute, mostly based on previous electronic cigarette use questionnaires.[4,33,34] A specific commission of 5 Italian experts among study partners (S.G., A.L., S.H., P.M., and A.S.) was set up to review the questionnaire and produce a second version. This version was used for a pilot study based on 5 electronic cigarette users to evaluate its comprehensiveness. This pilot study resulted in the final version of the questionnaire. Each SCS could choose among 3 different survey modes: paper questionnaire, electronic online (through SurveyMonkey), or electronic offline (in Excel). Four SCS used the paper, 5 the electronic online, and 3 the electronic offline questionnaire.

Measures

Participants provided information on sociodemographic characteristics, including sex, age, level of education, and cigarette smoking habits. Ever smokers were participants who smoked at the time of the survey or had smoked in the past. Current smokers were smokers who smoked at the time of the survey, while former smokers were those who had successfully quit. They were asked to specify their age at starting smoking, the number of cigarettes smoked per day, and smoking duration. Current smokers attending the SCS to obtain support for smoking cessation were asked about the level of nicotine dependence rated by using the Fagerström Test for Nicotine Dependence (FTND).[35,36] We also asked all participants the following question: "Do you use electronic cigarettes, even only occasionally?" The answer options were as follows: "Yes, occasionally (less than 5 days in the last 30 days)" (occasional users); "Yes, usually (5 or more days in the last 30 days)" (regular users); "I used it in the past (not in the last 30 days)" (past users); "No" (never users). Electronic cigarette ever users were defined as participants who used electronic cigarettes at the time of the survey (either occasionally or regularly) or in the past. They were then asked about the duration of use of electronic cigarettes, number of puffs per day, place of purchase, type of electronic cigarette (refillable, box mod, or disposable), type of liquid (with or without nicotine) and number of different liquids used at the same time, and how the electronic cigarette was used, with short sessions described as similar to conventional smoking (i.e. approximately 10 puffs in 5 minutes) and long sessions involving 1 or 2 puffs approximately every 5 minutes for 1 hour. Subjects were divided into 3 groups of nicotine dependence: low to intermediate (FTND <6), high (6–7) and very high dependence ($\geqslant 8$).[35]

To investigate adverse events (i.e. acute or irritative symptoms) related to electronic cigarette use, we asked participants if they had ever had any of the following symptoms during or after the use of the electronic cigarette: dry cough, dry mouth, throat or mouth irritation, sore throat, shortness of breath, nausea or vomiting, headache or migraine, burn or shock to the lips, bad breath, dizziness or lightheadedness, or mouth ulcer. Participants could also report other symptoms that were not included in the list.

We then asked ever users whether they had used electronic cigarettes during the last 6 months in the following indoor places: home, workplace, relatives' or friends' house, private vehicle, restaurants or bars, train/metro stations, airport, public transport (bus, tram, metro, train, airplane), nightclubs, libraries or public offices, cinema/theatre, art/sport/music courses, and hospitals. Answers to these questions were as follows: Yes; No; or I did not attend this place over the last 6 months. Participants who had not visited these places in the last 6 months were excluded from the corresponding analyses.

Statistical analyses

We considered absolute and relative frequencies for categorical variables and used Pearson chi-square test of independence to compare the proportions among groups. We calculated means and standard deviations (SDs) for continuous variables and used the analysis of variance F-test to compare the means. Unconditional multiple logic regression models were used to compute the odds ratios (ORs) and corresponding 95% confidence intervals (CIs) for electronic cigarette users vaping in indoor places and users having at least 1 adverse event related to electronic cigarette use. All the models were adjusted for age, sex, level of education, electronic cigarette use status, and duration of electronic cigarette use. The level of statistical significance was set to a 2-sided p value < 0.05. All the analyses were done using SAS 9.4 software (SAS Institute, Cary, NC).

Results

In our sample of 395 ever electronic cigarette users and ever smokers, 282 (71.4%) were consecutive smokers

Table 1. Distribution of 395 electronic cigarette ever users enrolled in 12 Italian smoking cessation services (SCS) according to selected demographic and socioeconomic characteristics and electronic cigarette and cigarette smoking features, overall and by electronic cigarette use status (Italy, 2016–2018).

	All ever users	Electronic cigarette use status			
		Past users	Occasional users	Regular users	*p* Value[a]
Total	395 (100.0)	309 (100.0)	37 (100.0)	49 (100.0)	
Reason for attending the SCS					
Smoking cessation	282 (71.4)	240 (77.7)	27 (73.0)	15 (30.6)	<0.001[c]
Other	113 (28.6)	69 (22.3)	10 (27.0)	34 (69.4)	
Sociodemographic characteristics					
Age, y	51.3 ± 13.0	51.5 ± 13.2	51.9 ± 13.2	49.4 ± 11.5	0.545
Sex[b]					
Women	183 (46.4)	142 (46.1)	17 (46.0)	24 (49.0)	0.930
Men	211 (53.6)	166 (53.9)	20 (54.0)	25 (51.0)	
Education[b]					
Primary or less	134 (34.1)	105 (34.2)	11 (29.7)	18 (36.7)	0.661
Secondary	193 (49.1)	147 (47.9)	22 (59.5)	24 (49.0)	
University	66 (16.8)	55 (17.9)	4 (10.8)	7 (14.3)	
Electronic cigarette use					
Duration of use, mo[b]					
<1	135 (35.0)	117 (38.7)	13 (37.1)	5 (10.2)	0.001[c]
1–2	122 (31.6)	94 (31.1)	11 (31.4)	17 (34.7)	
⩾3	129 (33.4)	91 (30.1)	11 (31.4)	27 (55.1)	
Number of puffs/day	86.4 ± 203	82.9 ± 222	55.1 ± 67.4	121.6 ± 147	0.357
Place of purchase[b]					
Vape shops	294 (76.6)	234 (78.0)	26 (74.3)	34 (69.4)	0.396
Other	90 (23.4)	66 (22.0)	9 (25.7)	15 (30.6)	
Type of liquid[b]					
With nicotine	333 (93.8)	258 (92.8)	30 (96.8)	45 (97.8)	0.328
Without nicotine	22 (6.2)	20 (7.2)	1 (3.2)	1 (2.2)	
Number of liquids used[b]					
1	231 (77.0)	198 (79.8)	18 (69.2)	15 (57.7)	0.092
2	45 (15.0)	32 (12.9)	6 (23.1)	7 (26.9)	
3 or plus	24 (8.0)	18 (7.3)	2 (7.7)	4 (15.4)	
Type of electronic cigarette[b]					
Refillable	281 (95.9)	236 (97.9)	22 (84.6)	23 (88.5)	<0.001[c]
Others	12 (4.1)	5 (2.1)	4 (15.4)	3 (11.5)	
Type of consumption[b]					
Short sessions	247 (68.8)	187 (67.5)	23 (69.7)	37 (75.5)	0.534
Long sessions	112 (31.2)	90 (32.5)	10 (30.3)	12 (24.5)	
Cigarette smoking habits					
Smoking intensity, cigarettes/day	22.0 ± 10.1	22.4 ± 9.7	22.7 ± 12.5	19.3 ± 9.9	0.149
Smoking duration, y	34.4 ± 13.3	34.7 ± 13.4	34.4 ± 14.1	32.6 ± 11.9	0.623
Fagerström Test for Nicotine Dependence	5.7 ± 1.9	5.7 ± 1.9	6.0 ± 2.0	5.4 ± 2.3	0.353

Values are n (%) or mean ± standard deviation.
[a]χ^2 test for categorical variables and analysis of variance F-test for continuous variables.
[b]The sum does not add up to the total because of some missing values.
[c]Significant.

visiting a SCS for the first time for smoking cessation and 113 (28.6%: 90 current smokers and 22 former smokers) were enrolled among electronic cigarette ever users. Overall, 49 (12.4%) were regular electronic cigarette users, 37 (9.4%) were occasional users, and 309 (78.2%) were past users; 368 (93.4%) were current smokers and 26 (6.6%) were former smokers. The sample included 211 (53.6%) men and 183 (46.4%) women, with a mean age of 51.3 years (SD, 13.0; Table 1). The mean number of traditional cigarettes smoked per day

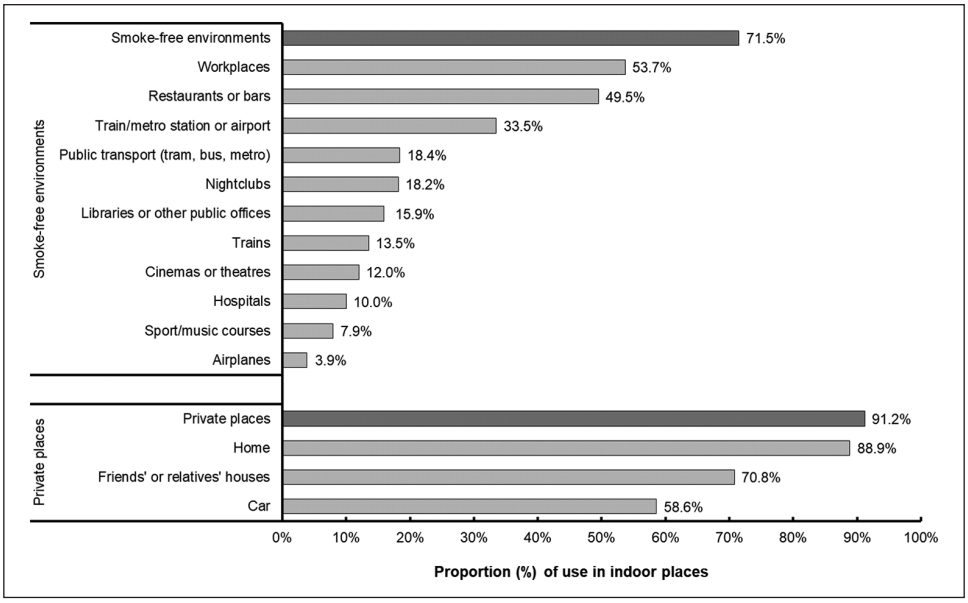

Figure 1. Percent prevalence of ever users using electronic cigarettes in selected public and private indoor places (Italy, 2016–2018).

was 22.0 (SD, 10.1), mean smoking duration was 34.4 years (SD, 13.3) and mean FTND was 5.7 (SD, 1.9). Nicotine dependence was low to intermediate (i.e., FTND $<$ 6) for 41.0% of ever smokers, high (i.e., 6–7) for 41.5%, and very high ($\geq$8) for 18.4%. In all, 95.9% of electronic cigarette ever users used a refillable device and 93.8% consumed liquids with nicotine. Mean duration of electronic cigarette use was 3.7 months (SD, 6.3); 66.6% of ever users and 44.9% of regular users had used electronic cigarettes for less than 3 months. Mean number of puffs per day was 86.4 (SD, 203.4) for ever users and 121.6 (SD, 146.6) for regular electronic cigarette users. The majority of users purchased electronic cigarettes in vape shops (76.6%), consumed 1 single liquid (77.0%), and used electronic cigarettes in short sessions (68.8%).

Figure 1 shows the proportion of electronic cigarette use in smoke-free public places and in private settings. Among electronic cigarette ever users, 71.5% used them in at least 1 smoke-free environment: 53.7% at the workplace, 49.5% in restaurants or bars, and 33.5% in train/metro stations or at airports. Considering private indoor places, 88.9% used electronic cigarettes at home, 70.8% at friends' or relatives' houses, and 58.6% in private cars. Among those who used electronic cigarettes in private vehicles, 5.9% used them in the presence of children.

Use of electronic cigarettes in at least 1 smoke-free indoor environment was significantly less frequent among individuals aged 60 years or more (compared to 18–49 years, OR, 0.32; 95% CI, 0.16–0.64; Table 2). It was more frequent in those having used electronic cigarettes for 1–2 months (OR, 2.82; 95% CI, 1.49–5.34) or 3 months or more (OR, 3.22; 95% CI, 1.69–6.15) compared to $<$1 month, and in users with a high level of nicotine dependence (compared to a FTND $<$6; OR, 3.37; 95% CI, 1.70–6.69 for 6–7, and OR, 3.10; 95% CI, 1.36–7.07 for a score $\geq$8). No significant relationship was observed between use of electronic cigarettes in smoke-free indoor places and sex, education, electronic cigarette use, intensity and means of use, cigarette smoking, intensity, and duration. With reference to the use of electronic cigarettes in at least 1 private indoor place, consumption was higher among individuals with an intermediate (6–7) than low (1–5) FTND (OR, 4.02; 95% CI, 1.19–13.6). None of the other sociodemographic, electronic cigarette, or conventional cigarette characteristics were significantly related to the use of electronic cigarettes in private places.

Almost half (47.1%) of the respondents reported at least 1 symptom attributable to the use of electronic cigarettes (Figure 2). Among these subjects, the most reported adverse events were dry cough (41.4%), dry mouth (25.4%), throat or mouth irritation (16.0%), and sore throat (14.4%).

Table 3 shows the ORs for symptoms related to the use of electronic cigarettes in relation to selected sociodemographic variables and electronic cigarette use and cigarette smoking. Highly nicotine-dependent individuals more frequently reported having dry mouth (OR, 3.67; 95% CI, 1.34–10.0 for FTND $\geq$8 vs $<$6). Using electronic cigarettes for 1–2 months compared with less than 1 month was directly related with higher odds of sore throat (OR, 6.08; 95% CI, 1.62–22.8). Long sessions of electronic cigarette

Table 2. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) for electronic cigarette use in some public and private indoor places according to selected demographic and socioeconomic characteristics and electronic cigarette and tobacco smoking features (Italy, 2016–2018).

	Smoke-free environments, OR[a] (95% CI)					Private places, OR[a] (95% CI)			
	At least 1 smoke-free environment	Workplaces	Restaurants or bars	Public transport or stations or airports	Other smoke-free environments[b]	At least 1 private place	Home	Relatives' or friends' house	Car
Sociodemographic characteristics									
Age, y									
18–49	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
50–59	0.54 (0.28–1.02)	0.71 (0.37–1.34)	0.51 (0.28–0.91)[d]	0.88 (0.44–1.74)	1.05 (0.54–2.05)	0.42 (0.14–1.24)	0.60 (0.23–1.61)	0.50 (0.25–1.00)	0.74 (0.41–1.36)
⩾60	0.32 (0.16–0.64)[d]	0.28 (0.14–0.59)[d]	0.62 (0.33–1.19)	0.71 (0.33–1.54)	0.84 (0.40–1.76)	0.45 (0.14–1.51)	1.25 (0.41–3.85)	0.57 (0.25–1.29)	0.60 (0.31–1.19)
Sex									
Female	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
Male	1.46 (0.87–2.47)	1.96 (1.16–3.31)[d]	0.96 (0.59–1.56)	1.80 (1.01–3.20)[d]	1.22 (0.69–2.16)	0.71 (0.28–1.77)	0.43 (0.19–1.01)	0.97 (0.54–1.74)	1.70 (1.03–2.81)[d]
Education									
Primary or less	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
Secondary	0.72 (0.40–1.30)	0.64 (0.35–1.18)	0.80 (0.47–1.37)	1.32 (0.69–2.51)	0.80 (0.43–1.50)	1.08 (0.38–3.10)	0.87 (0.36–2.09)	0.73 (0.38–1.38)	0.96 (0.54–1.68)
University	1.00 (0.45–2.22)	0.76 (0.34–1.72)	0.84 (0.41–1.72)	1.01 (0.42–2.44)	0.66 (0.28–1.58)	1.08 (0.27–4.28)	1.30 (0.38–4.41)	1.04 (0.42–2.58)	0.65 (0.31–1.38)
Electronic cigarette use									
Status									
Past user	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
Occasional user	1.11 (0.44–2.79)	0.28 (0.11–0.69)[d]	1.44 (0.62–3.34)	0.96 (0.36–2.56)	1.90 (0.74–4.90)	1.34 (0.23–7.66)	0.56 (0.18–1.78)	1.14 (0.38–3.42)	1.28 (0.51–3.18)
Regular user	1.07 (0.43–2.61)	0.57 (0.26–1.27)	1.12 (0.55–2.27)	2.25 (1.00–5.05)[d]	1.72 (0.78–3.82)	—	2.18 (0.45–10.50)	1.46 (0.61–3.50)	1.15 (0.53–2.51)
Duration of use, mo									
<1	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
1–2	2.82 (1.49–5.34)[d]	2.59 (1.34–5.01)[d]	1.64 (0.90–2.98)	2.30 (1.07–4.94)[d]	1.22 (0.59–2.50)	2.28 (0.74–7.01)	1.65 (0.62–4.38)	1.57 (0.78–3.14)[d]	2.47 (1.32–4.62)[d]
⩾3	3.22 (1.69–6.15)[d]	4.32 (2.15–8.68)[d]	1.64 (0.89–3.01)	2.44 (1.14–5.23)[d]	1.68 (0.83–3.42)	1.18 (0.43–3.26)	1.69 (0.65–4.42)	2.61 (1.24–5.49)[d]	2.74 (1.45–5.18)[d]
Number of puffs/day									
1–20	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
21–60	0.58 (0.26–1.31)	0.78 (0.36–1.67)	0.98 (0.46–2.07)	0.70 (0.27–1.79)	0.65 (0.26–1.60)	3.27 (0.49–21.68)	1.06 (0.33–3.44)	0.42 (0.17–1.06)	1.43 (0.64–3.17)
⩾61	1.35 (0.47–3.87)	0.95 (0.37–2.40)	1.41 (0.57–3.48)	1.13 (0.41–3.13)	0.88 (0.30–2.61)	—	4.91 (0.81–29.8)	1.00 (0.34–2.96)	3.93 (1.45–10.6)[d]

(Continued)

Table 2. (Continued)

	Smoke-free environments, OR[a] (95% CI)					Private places, OR[a] (95% CI)			
	At least 1 smoke-free environment	Workplaces	Restaurants or bars	Public transport or stations or airports	Other smoke-free environments[b]	At least 1 private place	Home	Relatives' or friends' house	Car
Use sessions length									
Short	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
Long	0.96 (0.52–1.79)	0.89 (0.46–1.71)	0.72 (0.39–1.30)	0.61 (0.30–1.26)	1.25 (0.64–2.44)	1.01 (0.37–2.76)	1.79 (0.63–5.04)	0.75 (0.37–1.50)	1.15 (0.62–2.11)
Cigarette smoking habits									
Smoking status									
Current	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
Former	0.77 (0.24–2.47)	0.66 (0.23–1.85)	0.69 (0.25–1.95)	0.79 (0.27–2.33)	0.40 (0.10–1.62)	0.25 (0.03–1.84)	0.42 (0.07–2.54)	0.90 (0.28–2.87)	2.94 (0.75–11.49)
Smoking intensity, cigarettes/day[e]									
1–19	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
20–24	1.24 (0.62–2.50)	1.04 (0.51–2.12)	1.11 (0.58–2.13)	1.00 (0.44–2.26)	1.20 (0.57–2.55)	0.95 (0.26–3.47)	1.53 (0.49–4.76)	0.50 (0.22–1.15)	2.04 (1.02–4.05)[d]
⩾25	1.13 (0.56–2.30)	1.02 (0.50–2.10)	0.62 (0.32–1.22)	1.22 (0.54–2.74)	1.01 (0.47–2.19)	0.61 (0.16–2.29)	1.05 (0.35–3.13)	0.60 (0.26–1.41)	1.29 (0.65–2.57)
Smoking duration, y[e]									
1–30	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
31–44	2.88 (0.59–14.10)	1.38 (0.33–5.78)	0.78 (0.25–2.44)	0.38 (0.10–1.47)	0.27 (0.06–1.31)	2.71 (0.24–30.89)	1.50 (0.15–15.2)	1.02 (0.27–3.86)	2.80 (0.68–11.6)
⩾45	2.85 (0.45–18.17)	1.51 (0.26–8.84)	0.90 (0.21–3.87)	0.24 (0.04–1.50)	0.34 (0.05–2.30)	3.98 (0.15–105)	1.08 (0.06–21.0)	2.02 (0.35–11.6)	1.15 (0.20–6.69)
Fagerström Test for Nicotine Dependence[e]									
1–5	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]	1.00[c]
6–7	3.37 (1.70–6.69)[d]	2.19 (1.10–4.34)[d]	1.25 (0.68–2.29)	1.08 (0.49–2.35)	1.61 (0.80–3.24)	4.02 (1.19–13.6)[d]	1.07 (0.42–2.71)	1.52 (0.70–3.28)	1.31 (0.70–2.46)
⩾8	3.10 (1.36–7.07)[d]	2.75 (1.14–6.66)[d]	1.01 (0.47–2.15)	2.12 (0.85–5.28)	1.84 (0.78–4.32)	1.48 (0.40–5.40)	6.29 (1.16–34.2)[d]	0.85 (0.33–2.21)	1.64 (0.75–3.61)

[a]Estimated by multiple unconditional logistic regression models after adjustment for age, sex, education, electronic cigarette status, and electronic cigarette duration.
[b]Other places include nightclubs, libraries, public offices, cinemas, theatres, art/sport/music courses, and hospitals.
[c]Reference category.
[d]Estimates statistically significant at 0.05 level.
[e]Analyses conducted on current smokers only.

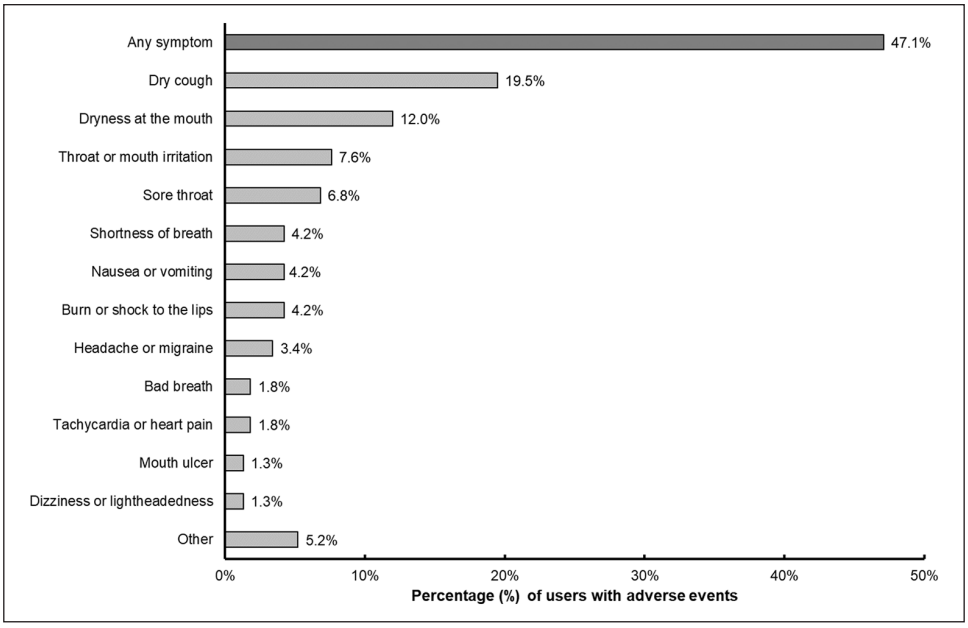

Figure 2. Distribution of main adverse events of electronic cigarette use among 384 electronic cigarette ever users (Italy, 2016–2018).

use gave higher odds of throat or mouth irritation (OR, 2.78; 95% CI, 1.13–6.84; data not shown in Table). No other significant relations were observed for dry mouth, throat or mouth irritation, or sore throat. For any symptom and dry cough we did not find any significant differences among the characteristics considered.

Discussion

Our study shows that among Italian smokers, almost all electronic cigarette ever users consume liquids with nicotine, most of them use the device in smoke-free environments, and about half have experienced at least 1 acute/irritative symptom caused by electronic cigarettes, despite the relatively limited duration of use for the majority of users.

The most used devices were refillable tanks and the most common places of purchase were vape shops. These results are in agreement with findings from other European countries, showing that 85% of e-cigarettes used are rechargeable,[37] and that specialist vape shops are the most popular places of purchase.[38] Almost all ever users consumed liquid with nicotine, supporting findings from previous studies, particularly in Europe.[37,39]

Almost 3 out of 4 electronic cigarette users have used the device in at least 1 smoke-free environment. Most common smoke-free places of use were workplaces, restaurants or bars, and train/metro stations or airports. Among the few previous studies evaluating electronic cigarette use in smoke-free environments, a US study conducted in 2014 showed that 60% of 952 current users vaped in at least 1 smoke-free environment.[14] Another study conducted in 2015 in Japan on 1243 ever users showed that 29% had used electronic cigarettes in smoke-free restaurants and 26% in smoke-free workplaces.[40] A study from Australia in 2016 showed that among 66 current electronic cigarette users, 15% vaped in restaurants and bars and 28% in workplaces.[2] Finally, in a Spanish study based on 600 electronic cigarette users, 33% had used electronic cigarettes in workplaces, 69% in restaurants or bars, 3% on public transport, and 55% in nightclubs.[15] Compared to the above studies, in general, we found higher prevalence rates of use in smoke-free indoor environments, probably because our sample included mainly relatively heavy smokers looking for smoking cessation support. There is evidence that dual users vape more than exclusively electronic cigarette users in smoke-free environments in order to satisfy their nicotine addiction.[14,23] Similarly, the total number of puffs per day and nicotine dependence were directly related to the use of electronic cigarettes in smoke-free environments. The proportion of users in restaurants or bars and nightclubs in Italy was lower than in Spain,[15] possibly because our sample was based on older participants, who spent less time in such venues. Differences in geographic areas may also be related to different climates in various countries.

Among our ever smokers, the duration of electronic cigarette use was short (i.e. less than 3 months) for 2 out of 3 users, and for almost half of the regular users. Notwithstanding, about half reported at least 1 symptom attributable to the use of electronic cigarettes. Most common adverse events were dry cough, dry mouth, throat or mouth irritation, and sore throat.

Table 3. Distribution and odds ratios (ORs) and corresponding 95% confidence intervals (CIs) for any and main symptoms related to electronic cigarette use according to selected demographic and socioeconomic characteristics and electronic cigarette and tobacco smoking features (Italy, 2016–2018).

	Total[a]	Any symptom		Dry cough		Dry mouth		Throat or mouth irritation		Sore throat	
		%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)
Total	384	47.1		19.5		12.0		7.6		6.8	
Sociodemographic characteristics											
Age, y[c]											
18–49	151	45.0	1.00[d]	15.9	1.00[d]	13.9	1.00[d]	6.0	1.00[d]	6.6	1.00[d]
50–59	130	46.9	1.08 (0.64–1.83)	23.9	1.60 (0.84–3.07)	11.5	0.87 (0.39–1.92)	6.9	0.97 (0.35–2.71)	6.2	0.87 (0.30–2.58)
⩾60	99	50.5	1.11 (0.63–1.98)	20.2	1.14 (0.55–2.34)	8.1	0.52 (0.20–1.33)	11.1	1.19 (0.43–3.29)	7.1	1.22 (0.40–3.76)
Sex[c]											
Female	176	49.4	1.00[d]	23.3	1.00[d]	11.4	1.00[d]	9.7	1.00[d]	8.5	1.00[d]
Male	207	44.9	0.87 (0.56–1.35)	16.4	0.69 (0.40–1.19)	12.1	1.04 (0.52–2.08)	5.8	0.59 (0.26–1.33)	4.8	0.61 (0.25–1.49)
Education[c]											
Primary or less	130	42.3	1.00[d]	20.0	1.00[d]	10.8	1.00[d]	6.2	1.00[d]	5.4	1.00[d]
Secondary	187	49.7	1.10 (0.67–1.80)	19.3	0.86 (0.47–1.60)	11.8	0.87 (0.40–1.89)	7.5	1.10 (0.42–2.90)	6.4	1.33 (0.46–3.81)
University	65	50.8	1.29 (0.67–2.48)	20.0	0.98 (0.44–2.20)	15.4	1.45 (0.55–3.82)	10.8	1.68 (0.54–5.19)	10.8	1.95 (0.56–6.75)
Electronic cigarette use											
Status[c]											
Past user	300	47.7	1.00[d]	18.3	1.00[d]	11.0	1.00[d]	7.7	1.00[d]	7.3	1.00[d]
Occasional user	35	40.0	0.89 (0.42–1.91)	25.7	1.94 (0.81–4.66)	8.6	0.93 (0.25–3.48)	8.6	1.02 (0.27–3.87)	2.9	0.44 (0.06–3.55)
Regular user	49	49.0	1.10 (0.56–2.18)	22.5	1.53 (0.67–3.49)	20.4	1.68 (0.68–4.12)	6.1	0.81 (0.21–3.13)	6.1	0.71 (0.15–3.52)
Duration of use, mo[c]											
<1	134	44.8	1.00[d]	18.7	1.00[d]	9.0	1.00[d]	6.7	1.00[d]	3.0	1.00[d]
1–2	122	43.4	0.94 (0.55–1.60)	16.4	0.83 (0.42–1.66)	13.9	1.57 (0.67–3.69)	5.7	1.01 (0.34–2.95)	11.5	6.08 (1.62–22.8)[f]
⩾3	127	52.8	1.48 (0.86–2.53)	23.6	1.40 (0.74–2.68)	13.4	1.67 (0.70–4.00)	10.2	1.96 (0.76–5.06)	6.3	3.00 (0.75–12.0)

(Continued)

Table 3. (Continued)

	Total[a]	Any symptom		Dry cough		Dry mouth		Throat or mouth irritation		Sore throat	
		%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)	%	OR[b] (95% CI)
Number of puffs/day											
1–20	111	42.3	1.00[d]	18.9	1.00[d]	5.4	1.00[d]	6.3	1.00[d]	8.1	1.00[d]
21–60	105	48.6	1.16 (0.58–2.32)	20.0	1.04 (0.43–2.51)	17.1	2.47 (0.75–8.13)	7.6	1.59 (0.41–6.11)	7.6	1.66 (0.45–6.07)
⩾61	86	48.8	1.36 (0.60–3.12)	18.6	0.99 (0.34–2.86)	10.5	1.08 (0.25–4.65)	9.3	2.66 (0.53–13.3)	5.8	0.87 (0.16–4.67)
Cigarette smoking habits											
Smoking status											
Current	358	47.5	1.00[d]	19.8	1.00[d]	12.0	1.00[d]	7.3	1.00[d]	7.0	1.00[d]
Former	25	40.0	0.87 (0.34–2.24)	16.0	0.82 (0.23–2.89)	12.0	0.67 (0.16–2.79)	12.0	4.54 (0.86–23.9)	4.0	0.74 (0.07–7.46)
Smoking intensity, cigarettes/day[c,e]											
1–19	106	46.2	1.00[d]	17.0	1.00[d]	9.4	1.00[d]	9.4	1.00[d]	7.6	1.00[d]
20–24	122	49.2	0.90 (0.50–1.62)	21.3	1.23 (0.59–2.56)	13.9	1.22 (0.47–3.18)	5.7	0.47 (0.16–1.41)	9.8	1.41 (0.48–4.09)
⩾25	122	48.4	0.99 (0.55–1.80)	21.3	1.40 (0.67–2.93)	12.3	1.39 (0.52–3.69)	7.4	0.82 (0.28–2.40)	4.1	0.51 (0.13–1.99)
Smoking duration, y[c,e]											
1–30	123	43.9	1.00[d]	16.3	1.00[d]	13.0	1.00[d]	5.7	1.00[d]	6.5	1.00[d]
31–44	145	50.3	1.25 (0.46–3.42)	24.1	1.52 (0.47–4.99)	12.4	1.54 (0.43–5.53)	6.9	1.00 (0.17–5.94)	6.9	1.69 (0.21–13.3)
⩾45	82	47.6	0.70 (0.19–2.68)	18.3	0.91 (0.20–4.22)	8.5	2.05 (0.26–15.9)	11.0	1.09 (0.12–9.77)	7.3	3.25 (0.22–49.2)
Fagerström Test for Nicotine Dependence[c,e]											
1–5	141	45.4	1.00[d]	17.7	1.00[d]	9.2	1.00[d]	5.0	1.00[d]	7.1	1.00[d]
6–7	144	49.3	1.04 (0.59–1.84)	19.4	1.24 (0.62–2.46)	12.5	1.13 (0.42–3.00)	6.9	1.03 (0.28–3.82)	7.6	1.10 (0.37–3.22)
⩾8	59	50.9	1.44 (0.72–2.90)	25.4	1.45 (0.65–3.25)	20.3	3.67 (1.34–10.0)[f]	11.9	2.98 (0.80–11.2)	6.8	1.10 (0.30–4.07)

[a]Number of electronic cigarette users with information on related symptoms.
[b]Estimated by unconditional multiple logistic regression models after adjustment for age, sex, education, electronic cigarette status, and electronic cigarette duration.
[c]The sum does not add up to the total because of some missing values.
[d]Reference category.
[e]Analyses conducted on current smokers only.
[f]Estimates statistically significant at 0.05 level.

The proportion of electronic cigarette users experiencing an adverse event is lower than in a US study, in which 58% of 1624 electronic cigarette ever users reported at least 1 symptom, 40% cough, and 31% dry or irritated mouth or throat.[27] These differences can be explained by the fact that our sample comprised relatively heavy smokers who may already have symptoms like cough or dry mouth,[41] making it difficult to distinguish adverse events attributable to conventional cigarettes from those attributable to electronic cigarettes. This may lead to underreporting of electronic cigarette adverse events.[27] Indeed, in our population, current smokers reported higher proportions of adverse events compared to former smokers.[42]

Among other symptoms, 7 patients (1.8% of the total sample) reported tachycardia or heart pain, in line with previous evidence that short-term use of electronic cigarettes increases heart rate.[25] One patient (0.3%) reported that the device exploded and burned the face. This is not an isolated case as it has been reported that burn and explosion injuries caused by electronic cigarettes are rare but not negligible.[31,32,38]

This study has some limitations, mainly inherent to the design based on self-reported information, so recall bias cannot be ruled out and conclusions cannot be drawn on causal inference. Moreover, only a few electronic cigarette users were enrolled in northern Italy, thus generalization of findings to the whole country might be debatable. Finally, as we included mainly current smokers seeking support for smoking cessation in SCS, we cannot generalize the results to all cigarette smokers. Among the study strengths, although the sample is not large enough to evaluate frequencies in subgroups, this is one of the largest studies conducted in Europe recording adverse events attributable to electronic cigarettes[16] and providing data on electronic cigarette use in smoke-free environments.[15] Moreover, although we do not have the response rate in each SCS, the number of smokers who refused to enter the study was null or limited.

Conclusions

In Italy, smokers use electronic cigarettes with nicotine where conventional cigarette smoking is banned. Consequently, to avoid dual use of electronic and conventional cigarettes, we support the recent WHO suggestion to ban electronic cigarettes at least in public places and workplaces where smoking is prohibited.[9] Despite the relatively short duration of use in our sample, the risk of adverse events, including dry mouth, irritation in the mouth or throat, and dry cough, was frequent, even for brief duration of consumption. The symptoms attributable to electronic cigarette use should not be underestimated.

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Authors' contributions

S.G. and S.H. had the original idea for the study. S.G. and A.L. coordinated the study in collaboration with S.H., A.S., and P.M. S.G. and A.L. contributed to finalizing the survey questionnaire. L.C., G.D.P., S.E.V., G.I., P.M., M.P., F.P., B.P., M.F.P., R.P., N.P., S.R., and R.S. provided data from the survey. E.B. carried out the statistical analysis under the supervision of A.L. and X.L. S.G. and E.B. wrote the article in collaboration with X.L. and A.L. L.C., G.D.P., S.E.V., S.H., G.I., P.M., M.P., F.P., B.P., M.F.P., R.P., N.P., S.R., R.S., A.S., A.O., and P.v.d.B. made substantial contributions to conception, design, and data interpretation. All the authors approved the final version of the manuscript.

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Supplemental material

Supplemental material for this article is available online.

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