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Sébastien Quélou & Jean-François Etter

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A survey of users of the IQOS tobacco vaporizer: perceived dependence and perceived effects on cigarette withdrawal symptoms

Sébastien Queloz, PhD and Jean-François Etter, PhD

Institute of Global Health, Faculty of Medicine, University of Geneva, Geneva, Switzerland

ABSTRACT

Background: Tobacco vaporizers are devices that heat tobacco without burning it. There is currently a scarcity of studies about the addictiveness of tobacco vaporizers or their effects on cigarette withdrawal symptoms.

Goals: To assess the perceived dependence of users of tobacco vaporizers and the perceived effects of these products on cigarette withdrawal symptoms.

Methods: Enrollment of participants through the internet from 2016 to 2018. Participants were self-selected visitors to an anti-addiction website, current and past users of tobacco vaporizers aged ≥ 18 .

Results: We included 139 users of IQOS tobacco vaporizers. All participants were current (49.6%) or former cigarette smokers at the time when they began to use the tobacco vaporizer. Among the 135 current users, the median dependence on vaporizers was 80 on a scale from 0–100 (25th and 75th percentiles: 50 and 90), and 63.6% reported being somewhat to totally afraid of becoming dependent on the vaporizer. Half (51%) reported that they were less dependent on vaporizers than on combustible cigarettes, 43.8% were equally dependent on both products and 5.2% were more dependent on vaporizers than on cigarettes. Only one cigarette withdrawal symptom was reported by participants, “craving” for combustible cigarettes, and among respondents who experienced craving, 83.9% found that the IQOS vaporizer relieved it “a lot” to “totally”.

Conclusions: In this self-selected online sample of IQOS users, the perceived dependence on this tobacco vaporizer was relatively high and almost two thirds of respondents were afraid of becoming dependent on IQOS. Most participants perceived that IQOS relieved the craving to smoke combustible cigarettes.

KEYWORDS

Tobacco vaporizer; IQOS; smoking dependence; nicotine addiction; cigarette withdrawal symptoms

Introduction

Tobacco vaporizers are devices that heat tobacco without burning it. They are therefore also called “heat-not-burn” tobacco products.^{1–3} Philip Morris International (PMI) launched the IQOS tobacco vaporizer in 2014 in Japan, and IQOS is now available in 61 countries.^{1–4} In 2017, British American Tobacco (BAT) launched the “Glo” tobacco vaporizer and Japan Tobacco International (JTI) acquired the “Ploom Tech” tobacco vaporizer, a new hybrid version of the “Ploom” vaporizer that was launched in 2011.^{5,6} PMI has invested around \$6 billion since 2008 in research and development for what they call “smoke-free products”.¹ PMI recently estimated that 7.3 million smokers had switched to IQOS worldwide.¹ A study from the American Cancer

Society⁷ concluded that the accelerating decline of cigarettes sales in Japan (from 1.8% average annual decline in 2011–2015 to 9.5% average annual decline in 2015–2018) was most likely due to the introduction of IQOS in Japan. On 30 April 2019, the U.S. FDA authorized the commercialization of IQOS in the U.S.¹ Thus, the major tobacco companies have launched heat-not-burn tobacco products at great cost, but some observers consider that these products are another strategy of the tobacco industry to slow progress in tobacco control.⁸

Studies show that IQOS delivers some toxicants in lesser amounts compared to combustible cigarettes, but that the aerosol it produces is not free of toxicologically active substances.^{9–16} Some toxicants are present at higher amounts in IQOS

than in combustible cigarettes⁴ and some are not present in combustible cigarettes.³ Also, emissions of potentially harmful substances could be higher for tobacco vaporizers than for electronic cigarettes (i.e. products that vaporize a nicotine-containing liquid but do not contain tobacco).¹⁷

The nicotine supplied by some tobacco vaporizers reaches the bloodstream at a speed approaching the delivery speed achieved by inhaling cigarette smoke,¹⁸ and some tobacco vaporizers produce lower^{18,19} or similar²⁰ nicotine concentrations in the blood. One study conducted by PMI²¹ showed a mean nicotine quantity of 1.32 mg per IQOS stick and a mean nicotine quantity of 1.89 mg per reference combustible cigarette. One independent study²² found around the same value of mean nicotine quantity per IQOS stick (1.4 mg). Since the addictiveness of a nicotine-delivery system depends on both the speed and amount of nicotine delivery,²³ these results suggest that some users could become dependent on tobacco vaporizers.

Tobacco vaporizers are still relatively new. Some independent studies focused on the toxicological effects of these products,^{3,4,9,12,13,15,16} but independent studies on these products are scarce, particularly studies on their addictiveness and on their effects on cigarette withdrawal symptoms. PMI developed an instrument to assess dependence on tobacco and nicotine products,^{24,25} but to our knowledge, PMI did not publish any study using this instrument to assess the dependence on IQOS. To our knowledge, except for one Japanese study that assessed the time to first tobacco vaporizer use,²⁶ there are no published studies assessing the addictiveness of tobacco vaporizers or their potential effects on cigarette withdrawal symptoms.

Thus, the goals of this survey of tobacco vaporizer users were to describe their perceived dependence on these products and the perceived effects of vaporizers on cigarette withdrawal symptoms.

Methods

We posted a questionnaire in French and English on www.stop-dependance.ch, an anti-addiction website that is run by the second author at the University of Geneva, Switzerland. This website

received about 200'000 visits per month during the data collection phase. We also asked other discussion forums, websites and anti-tobacco groups to post links to the questionnaire (http://www.stop-dependance.ch/tabac/IQOS/IQOS1_en.html). We also posted this link on a dedicated Facebook page.

Data were collected between October 2016 and October 2018.

Participants were aged 18 or older and reported that they were using, or had used, a tobacco vaporizer (any brand). The questionnaire heading specified that "tobacco vaporizer" or "vaporizer" referred to a product that heats tobacco to produce an aerosol that can be inhaled, and that this excludes e-cigarettes that vaporize a liquid but do not contain tobacco.

We recorded IP addresses to identify and delete duplicate records.

The questionnaire covered:

- Current or past utilization of a tobacco vaporizer, brand and model (open-ended text fields).
- Current or past utilization of tobacco (cigarettes, cigars or pipes), number of cigarettes per day, minutes to first cigarette of the day, perceived dependence on combustible cigarettes (on a scale from 0 to 100) using an item from the Cigarette Dependence Scale (CDS).²⁷
- Age, gender, country of residence.
- Perceived dependence on tobacco vaporizers, using a version of the Fagerström Test²⁸ modified by ourselves (v-FTND; we replaced the term "cigarette" with "tobacco vaporizer" and "smoking" with "using a tobacco vaporizer"), and using a scale from 0 to 100 adapted from the CDS item above.²⁷
- Subjective comparison of the addictiveness of tobacco vaporizers and combustible cigarettes.
- Tobacco withdrawal symptoms assessed with the Minnesota Withdrawal Form,²⁹ plus mood swings, cough, sore throat, and need to hold a cigarette, and whether the vaporizer relieved each of these symptoms.
- The following elements from the same survey were reported previously: who are the users of tobacco vaporizers, reasons and modes of utilization of the vaporizer, perceived effects of the vaporizer, satisfaction and perceived advantages and risks, and current or past utilization of combustible cigarettes.³⁰

Statistical analysis

The initially intended sample size was 200, which would have allowed us to obtain a 95% confidence interval of $\pm 7\%$ for variables whose frequency is 50%, and of $\pm 6\%$ for variables with a frequency of 25%. We estimated that this level of precision was sufficient for this exploratory study.

We indicate 95% confidence intervals for proportions in the Tables.

Ethics and informed consent

The study protocol was submitted to the ethics committee of the canton of Geneva which did not examine it because the committee considered that this type of study (an online survey) did not require approval, according to the Swiss laws that regulate medical research (Decision 2016-00275).

We informed participants that their answers would be anonymously stored on a computer file for statistical analyses and that answers would not be transmitted to third parties. We did not request a formal consent for participation, consent was implicit.

Results

Participation

We enrolled 242 participants, including 144 consumers of tobacco vaporizers who indicated their products brand (PMI's IQOS, $n = 139$; Storz and Bickel Crafty, $n = 2$; Ploom Pax 2, $n = 2$; BAT's Glo, $n = 1$), and deleted 98 records: 62 incomplete results (respondents who did not mention which product they used), answers from 34 e-cigarette users, from one user of nicotine inhaler and one duplicate record.

For homogeneity, and as there were only five users of other brands, we only included the 139 IQOS users in our analysis. All included participants were currently using (97.1%, $n = 135$) or had used IQOS in the recent past (2.9%, $n = 4$). Among the 135 current IQOS users, 92.5% were daily users and 7.5% were occasional (non-daily) users.

Half of these 139 respondents (50.4%) were former cigarette smokers and 49.6% were current cigarette smokers (i.e. dual users). There were no never smokers and so all our participants were

either current or former cigarette smokers at the time when they first began to use a tobacco vaporizer. Half were females (51.8%) and the median age of participants was 42 years (25th and 75th percentiles: 32 and 51 years; range: 19–70 years). Two thirds (66%) were living in Switzerland. Among current smokers (dual users), 31.7% were currently trying to quit smoking and 83.1% were currently trying to reduce the number of cigarettes they smoked.

About half the participants (58.1%) had the intention to use the tobacco vaporizer for another year or more.

Perceived dependence on the vaporizer

On a scale of 0–100, the median score of dependence on tobacco vaporizers was 80 (25th and 75th percentiles: 50 and 90, mean = 68.8, SD = 25.6), and the median score of dependence on combustible cigarettes was 85 (25th and 75th percentiles: 50 and 95, mean 71.7, SD 30.9).

The median time to first puff of the day on the vaporizer was 30 minutes (25th and 75th percentiles: 15 and 60, mean = 61 minutes, SD = 85.5). In dual users, the median time between waking up and smoking the first combustible cigarette was also 30 minutes (Table 1). One in seven vaporizer users (14.3%) inhaled their first puff of the day within five minutes of waking up and 57.1% within 30 minutes of waking up.

The median score on the v-FTND (i.e. the modified version of FTND adapted for vaporizers) was 3.0 and the mean score was 3.1 (SD: 1.8). The median number of refills (sticks) consumed per day was 8.5 (25th and 75th percentiles: 5 and 15).

Around two thirds (63.6%) of respondents were “somewhat” to “totally” afraid of becoming dependent on their vaporizer. The majority of respondents (81.2%) found that it was unlikely they would have stopped using the vaporizer one month later, and 43.6% found that if they tried to stop using the vaporizer, the probability of success would be low. Around a third (29.6%) said it would be “very difficult” to “impossible” to definitively stop using the vaporizer.

When the investigators asked the participants to compare their dependence on the tobacco vaporizer to their dependence on combustible

Table 1. Perceived dependence on IQOS tobacco vaporizers: Internet survey, 2016–2018.

	All current IQOS users
Number of respondents	135
Degree of dependence on tobacco vaporizers* (scale of 0–100)	80 (50, 90)
Degree of dependence on combustible cigarettes* (scale of 0 – 100), among the 62 current smokers (dual users) (among the 62 current smokers)	85 (50, 95)
Time to first puff of the day on the vaporizers	14.3 (±5.9)
- Within 5 minutes (%):	57.1 (±8.3)
- Within 30 minutes (%):	
Minutes to first puff of the day on the vaporizer	30 (15, 60)
- Median*:	61 (85.5)
- Mean (SD):	
Minutes to first cigarette of the day, among the 62 current smokers (dual users)	30 (10, 60)
- Median*:	56 (89.9)
- Mean (SD):	
Number of puffs on the vaporizer per day	120 (40, 210)
- Median*:	131 (100.7)
- Mean (SD):	
Number of IQOS refills (Heatsticks) per day	8.5 (5, 15)
- Median*:	10.1 (7.7)
- Mean (SD):	
Number of combustible cigarettes per day, among the 62 current smokers (dual users)	8 (3, 15)
- Median*:	9.8 (7.8)
- Mean (SD):	
Dependence on the vaporizer, modified Fagerström test scores:	
- 0 (%):	6.5 (±5.0)
- 1–2 (%):	32.2 (±9.5)
- 3–4 (%):	43.0 (±10.1)
- 5–7 (%):	17.2 (±7.7)
- 8–10 (%):	1.1 (±2.1)
- Median*:	3 (2, 4)
- Mean (SD):	3.1 (1.8)
I'm afraid to become dependent on my vaporizer (somewhat agree to totally agree), %	63.6 (±8.1)
Is it probable that in one month you will have stopped using your vaporizer? (unlikely to really unlikely), %	81.2 (±6.6)
For how long do you still have the intention to use your vaporizer? (for more than one year), %	58.1 (±8.3)
If you decided to stop using your vaporizer, is it probable that you would succeed in stopping? (Not really sure to succeed to no chance to succeed), %	43.6 (±8.4)
If you decided to stop smoking (combustible cigarettes), is it probable that you would succeed in stopping? (Not really sure to succeed to no chance to succeed) (% among the 62 current smokers)	76.3 (±10.6)
During the last 12 months, did you make a serious attempt to stop using your tobacco vaporizer? (No), %	96.2 (±3.2)
For you, to stop using your vaporizer would be "very difficult to impossible", %	29.6 (±7.7)
Today, how often did you feel an urgent need to use your vaporizer? (rather often to always), %	35.2 (±8.1)
Today, how was the urge of this need to use your vaporizer? (strong to extremely strong), %	25.8 (±7.4)
Please evaluate your dependence on your vaporizer, compared to your dependence on combustible cigarettes, %	
- Much stronger:	0.0
- Somewhat stronger:	5.2 (±3.7)
- The same:	43.8 (±8.4)
- Somewhat less to much less:	51.0 (±8.4)
During a typical day, how much time do you spend using your vaporizer, compared to the time you spent smoking when you were a smoker? %	
- Much more time:	0.0
- A little bit more time:	8.3 (±4.7)
- The same time:	44.8 (±8.4)
- A little bit less to much less time:	46.9 (±8.4)
After a few hours without using my vaporizer, I feel an irresistible need to use my vaporizer (somewhat agree to totally agree), %	53.5 (±8.4)
I'm afraid of starting to smoke again if I stopped using my vaporizer (somewhat agree to totally agree), %	65.6 (±8.0)

Median (25th and 75th centiles).

cigarettes, half the participants (51%) rated their dependence on vaporizers as lower than their dependence on cigarettes, 43.8% said it was about the same, and a minority (5.2%) rated their dependence on vaporizers as somewhat stronger than their dependence on cigarettes. Around a tenth (8.3%) said they were spending more time using the vaporizer compared to the time they spent smoking when they were smokers, 44.8% said they were spending the same time and

46.9% said they were spending less time using the vaporizer compared to the time they spent smoking when they were smokers.

Perceived effects of the vaporizer on cigarette withdrawal symptoms

One cigarette withdrawal symptom was predominating: "craving" for combustible cigarettes, with around a quarter (23.9%) of respondents who

Table 2. Perceived effects of IQOS tobacco vaporizers on cigarette withdrawal symptoms: Internet survey, 2016–2018.

	All IQOS users, %	Does the vaporizer relieve this symptom? (among respondents who felt rather strongly to very strongly the symptom) Yes, %
N = 139		
Please describe your state today (rather strong to very strong):		
Urgent need to smoke	23.9 (±7.1)	83.9 (±12.9)
Need to hold a cigarette between your fingers	17.6 (±6.4)	78.3 (±16.8)
Anxious or worried	5.8 (±3.9)	37.5 (±33.5)
Mood swings	2.9 (±2.8)	33.3 (±53.3)
Sad or in bad mood	5.1 (±3.7)	28.6 (±33.5)
Angry or irritable	5.1 (±3.7)	20.0 (±35.1)
Cough	4.5 (±3.5)	20.0 (±35.1)
Impatient, nervous or agitated	3.7 (±3.2)	20.0 (±35.1)
Insomnia, disturbed sleep or nocturnal wake up	11.8 (±5.7)	6.3 (±11.9)
Sore throat	3.7 (±3.2)	0
Difficulty to concentrate	3.6 (±3.1)	0
Stronger appetite or weight gain	8.1 (±4.6)	0

said that, today, they were feeling a “rather strong” to “very strong” urgent need to smoke combustible cigarettes, and around one in six respondents (17.6%) said that, today, they were feeling a “rather strong” to “very strong” need to hold a combustible cigarette between their fingers. Among the respondents who reported feeling these symptoms, 83.9% found that the vaporizer helped them “a lot” to “totally” to relieve the urgent need to smoke and 73.8% found that the vaporizer helped them “a lot” to “totally” to relieve the need to hold a cigarette.

The frequency of the other cigarette withdrawal symptoms was lower (between 4 and 12% of participants experienced them) and the perceived effect of the tobacco vaporizer on these symptoms was modest (between 0 and 37.5% of the participants who reported these symptoms said that the vaporizer relieved them) (Table 2).

Discussion

In this self-selected online sample of IQOS consumers, half the participants were current cigarette smokers (dual users) and half were former smokers. None of our participants was a never smoker when they first began to use a tobacco vaporizer. These results differ from those of an Italian study independent from the manufacturers³¹ in which, among people who had tried IQOS, the number of never smokers was comparable to the number of current smokers. The authors of this Italian study concluded that their findings suggested that IQOS may create a generation of new individuals misusing nicotine.³¹

In our sample, IQOS was by far the most frequent brand of tobacco vaporizers, probably because it was launched around three years before its two largest competitors (BAT’s “Glo” and JTI’s “Ploom Tech”) and because Switzerland was one of the first three countries where IQOS was launched.^{1,5,6}

Almost two thirds of respondents were afraid of becoming dependent on tobacco vaporizers, and our results showed medium to high scores of perceived dependence, even though these scores were lower for tobacco vaporizers than for combustible cigarettes. More than half of the current vaporizer users inhaled their first puff of the day on the vaporizer within 30 minutes of waking up, which is an indicator of strong dependence.³² In contrast, v-FTND scores indicated low to moderate dependence, with a relatively low number of refills (sticks) used per day. IQOS consumers seemed therefore to be moderately to highly dependent on the vaporizer despite a low daily consumption. These results should be confirmed by research in more representative samples, but they suggest that switching from combustible cigarettes to tobacco vaporizer would not mean to break free from tobacco misuse. To our knowledge, there is no independent study on the addictiveness of tobacco vaporizers, and our study makes a first contribution to this major subject.

Most respondents perceived that IQOS helped relieve the urgent need to smoke (“craving”) and the need to hold a cigarette in one’s hand. Few consumers experienced the other cigarette withdrawal symptoms, and therefore we could not draw conclusions about the effects of the vaporizer on these symptoms. The low frequency of cigarette

withdrawal symptoms reflects the fact that half of our sample continued to smoke (dual users). An independent study¹⁹ showed that tobacco vaporizers were less efficient than combustible cigarettes in relieving withdrawal symptoms, whereas manufacturers-funded studies^{18,20} showed that vaporizers and cigarettes had the same ability to relieve tobacco withdrawal symptoms.

Study strengths and limitations

We used an online survey in self-selected volunteers and therefore we had no way of ensuring that the respondents were effectively using the brand of tobacco vaporizer that they mentioned. Participants were among the first consumers of this product, soon after it was launched, and were innovators and early adopters that may differ from the late majority.³³

The number of participants was lower than intended, probably owing to the novelty of tobacco vaporizers. Given the very low prevalence of heated tobacco product use at the time of data collection, obtaining a representative sample of 200 users would have required a prohibitively large survey, which was not feasible with our resources. For these reasons, our study only included a small sample of innovators and early adopters and may not be representative of all tobacco vaporizers users. Moreover, participants were recruited via an anti-addiction website and may have been more motivated to reduce or stop smoking than other users of tobacco vaporizers. Users of tobacco vaporizers who take part in online survey research may also differ from other users, in that they may be more educated. Thus, participants in our study may differ from average tobacco vaporizers consumers, and our results may have limited generalizability.

Despite these limitations, this exploratory study contributes valuable information about the perceived addictiveness of tobacco vaporizers and their potential effects on cigarette withdrawal symptoms. Further research should be conducted in representative samples of tobacco vaporizer consumers, should include other brands of tobacco vaporizers, and should use experimental methods.

Conclusions

In this self-selected online sample of IQOS users, the perceived dependence on this tobacco vaporizer was relatively high, although somewhat lower than for combustible cigarettes, and almost two thirds of respondents were afraid of becoming dependent on tobacco vaporizers. Most participants perceived that IQOS relieved the craving to smoke combustible cigarettes and to hold a combustible cigarette in the hand.

Abbreviations

PMI	Philip Morris International
BAT	British American Tobacco
JTI	Japan Tobacco International

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