

Chapter

Design Insights to Support the Development of Effective Virtual Reality Nicotine and Vaping Dependency Therapy Scenarios for Future Telehealth

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Abstract

Vaping, or the use of electronic nicotine delivery systems (ENDS), has grown rapidly worldwide and is becoming an epidemic among youth in many countries. Invented as a method to help to quit smoking, ENDS are very popular, reaching increasing numbers of users and becoming a health concern. Virtual reality technology (VRT) represents an important tool for conducting addiction-associated interventions, including telemedicine. The design and quality of virtual reality scenarios (VRS) used for VR interventions are fundamental. How well VRS can replicate real-world scenarios has an impact on how realistic the VR immersion experiences are. Thus, VRS development influences therapeutic outcomes. VRT is used for interventions and treatments for smoking-related nicotine addiction but has yet to be validated for vaping-related disorders. Since vaping represents a technological step forward in nicotine consumption, the accurate contextualization of environments surrounding vapers is fundamental for developing advanced VR tools for the prevention and treatment of vaping disorders. Here, we present the results of focus group discussion with young vapers in New Zealand. The knowledge gained from this study will be used to design VRS for cue exposure and reactivity as a first step toward developing effective solutions for vaping disorders using VR interventions and telemedicine.

Keywords: virtual reality (VR), electronic nicotine delivery systems (ENDS), vaping, nicotine dependence, interventions, VR in telemedicine

1. Introduction

Vaping, which refers to the use of electronic nicotine delivery systems (ENDS, e-cigarettes, vapes, or nicotine vaping devices), has grown rapidly worldwide [1, 2], and is currently considered to be an epidemic among teens and young adults in

countries, such as the United States [3]. From an initial cig-a-like device, developed to help to quit smoking, ENDS evolved rapidly into a wide spectrum of gadgets that are used either as tobacco cigarette replacements or for recreational purposes, transforming vaping into a paradigm of its own. Despite being relatively new, ENDS have been subjected to extensive study, with research topics ranging from vaping demographics to their latest technological developments. Nonetheless, as the number of vapers grows, many gaps exist in what is known about vaping, especially in fundamental issues such as those related to long-term health effects [4] and addiction. However, vaping has been shown to be a multifactorial practice that not only relates to a physiological need for nicotine but also responds to different cultural, socio-economic, and psychological aspects that are yet to be fully understood. In order to characterize vaping contexts, some consumers' features, such as ENDS or smoking habit (tobacco cigarettes, hookah, or waterpipe tobacco), use history and status may be of help by providing some evidence in the effort to achieve a better understanding of this trend. Thus, vaper status, such as if they are ex-smokers, dual users, or vape only, has been identified [5]. According to the user status, the context surrounding vaping, preferences, habits, and behavior may change. Therefore, the approach to study vaping-related problems should be adjusted accordingly.

Aside from conventional methods used in interventions and treatment of behavioral and health disorders, virtual reality technology (VRT) represents a reliable and more personalized technique that can be used under well-developed and lifelike controllable settings [6]. VRT has already been used satisfactorily for craving assessments, cue exposure, and cue reactivity therapy for smoking-associated interventions and treatments [7]. As vaping is associated with smoking and mainly with nicotine use, VRT may be suitable for the study of vaping-related disorders. Nevertheless, a key factor in the implementation of VRT for the study of behavioral and substance use disorders depends on how well real-life situations, locations, and features associated with the targeted condition are identified and characterized. Realistic representations are fundamental to inform the development of virtual reality scenarios (VRS) in which the VR studies take place. These technical systems provide a 3D vision, 360-degree range, and head tracking where the recreated real-life situations are presented [8]. The design and technical development of the VRS will determine how inclusive, extensive, and vivid the resemblances that the system generates are. Thus, it determines how good the VR immersion experience can be and influences the perceptions and reactions experienced by each patient. Recently VR and telehealth have effectively been used to provide different types of interventions, which not only can help improve health conditions but also enable social connectedness and psychological support. For many, in-person consultations may be difficult and costly. VR in telehealth allows the interactive use of online scenarios that represent a cost-effective solution for those who need treatment but for some reason are unable to visit their therapist or doctor's office [9].

As vaping is relatively new but growing at a rapid rate, the situations, locations, and reasons why people vape may be dynamic and changing according to time and geographical location. In New Zealand (NZ), nicotine e-liquids started being sold legally in 2018 [10]. Since then, the country's policies have been changing, and more recently, additional regulations toward vaping products have been put in place [11]. In recent years, NZ has experienced a sharp increase in ENDS use, mostly in teens [12]. In parallel, tobacco cigarette taxes were increased under a plan to achieve a smoke-free country by 2025. This plan included campaigns to switch to vaping as a way to stop smoking tobacco cigarettes [13]. As ENDS evolved rapidly, vaping represents a technological step forward into a new way of nicotine use and dependence [14], which although presented as a less harmful

and disruptive way to use nicotine, may signify an underlying cause of long-term health issues. Understanding and accurately characterizing the environments and contexts in which people vape, and the reasons why is fundamental for developing strategies and advanced aid tools in the current and future health issues associated with vaping.

This qualitative study was part of a wider project that aimed to develop and test VRS associated with vaping. The aim of this study was to perform focus group discussions to inform our research about real environments where young people vape in NZ. Thus, we interviewed a diverse sample of university students who had experimented with ENDS, to learn about their vaping experiences. The final VRS will be used for the study of vaping cue exposure and reactivity in VR and telehealth interventions and treatments.

2. Methods

Focus group discussions were conducted to gain knowledge directly from young adults about their motivations, habits, behavior, contexts, and views associated with vaping. Grounded theory was used as the conceptual research approach [15] since at the time of the study, vaping characteristics and contexts in NZ were not fully identified and a better understanding of the concepts surrounding this practice was necessary to inform the development of realistic vaping VRS. Four focus group sessions were conducted from September to November 2019 at the University of Canterbury (UC - Christchurch, NZ). Recruitment of participants was conducted via an advertisement on UC's social media, TV media, and an event management website. The theoretical sampling method [15], a qualitative method for data collection based on obtaining concepts from data, was used to gain insights into NZ's vaping contexts. We recruited university students that have previously used ENDS.

2.1 Recruitment

Inclusion criteria: being 18+ years having vaped in the past or at the study's time.

Exclusion criteria: having addictions different from smoking or vaping, suffering from mental illness, being associated with a vaping company, and using other nicotine replacement products (nicotine patches, chewing gum, or lozenges). At first contact, all prospective candidates were informed about the project and the focus group aims and checked for inclusion and exclusion criteria.

2.2 Participants

Nine students were selected to participate in the focus group discussions, from whom 7 were males (M) and 2 females (F). The groups composition was: group 1: n = 3 (M); group 2: n = 3 (1F, 2 M); group 3: n = 1 (M); group 4: n = 2 (1F, 1 M). The groups were not arranged by any specific participant characteristics related to vaping habits or views.

2.3 Focus groups procedure

All sessions were scheduled to last up to 2 hours. Before each session, consent forms and questionnaires regarding demographics were distributed and completed by all participants. At the beginning of each session, the moderator gave an introduction,

informing each group about the project aim and explaining the focus group objectives, procedures, and ground rules. Verbal consent was requested for video and audio recording. Additionally, participants were assured of anonymity and data confidentiality. Everyone chooses a nickname to be addressed during the discussions. All participants were informed that nicknames will be replaced by codes during the transcription process. The raw recorded data can only be used as material for publications related to the research project.

While any assumptions about users' views, experiences, and behavior associated with vaping were not pre-established, semi-structured interviews [16] were conducted throughout the focus group sessions. Thus, with the aim to cover the study's objectives, an interview guide was developed. Four main topics were considered: background, current context, triggers, and reactions. For each topic, questions were elaborated, aiming to prompt each participant to provide open, free, and in-depth answers. The semi-structured interview scheme helped to steer the discussions while allowing for flexibility [16]. Questions were not necessarily asked in the same order and the moderator was free to follow digressions or asked for clarification if required. Probes were used in some questions to facilitate the process. All participants were free to give any personal opinions. At the end of each session, a small financial token was given to the participants to compensate them for their time. The UC Human Ethics Committee approved this study.

2.4 Transcriptions and coding

All focus group interviews were transcribed into text documents and coded using NVIVO software. At first, using the interview guide, all participants' answers were grouped by related questions. Next, codes were created by finding and grouping similar responses, as well as individual/uniquely relevant answers. Once the data search was exhausted and all possible codes were defined, codes were grouped by theme/topic.

3. Results

3.1 Demographics

The total number of participants was nine (2F and 7 M). The mean age was 24 years; hence, most participants were considered as young adults, from which four were New Zealanders, four Indians, and one German. All participants were students at UC (3 undergraduate and 6 postgraduate) (**Table 1**).

3.2 Participants' vaping profile

In this study, for data analysis, all participants were classified according to their vaping profile:

- *Smoking and vaping habits*: tobacco and e-cigarettes, hookah, and ENDS.
- *Status*: dual user, ENDS (only), and hookah.
- *Current use*: active and inactive; and

Participants code*	Gender	Age group	Country of birth	Educational level	Current occupation	Time in NZ (years)
FG1M1	M	40–44	NZ	Undergraduate	Postgraduate student	>10
FG1M2	M	21–24	Germany	Postgraduate	Postgraduate student	<1
FG1M3	M	18–20	NZ	Secondary	Undergraduate student	>10
FG2M1	M	18–20	NZ	Secondary	Undergraduate student	>10
FG3F1	F	25–29	India	Undergraduate	Postgraduate student	<1
FG3M1	M	21–25	India	Undergraduate	Postgraduate student	<1
FG3M2	M	21–24	India	Undergraduate	Postgraduate student	<1
FG4F1	F	21–24	India	Undergraduate	Postgraduate student	<1
FG4M1	M	18–20	NZ	Secondary	Undergraduate student	>10

*The participants' nicknames were replaced by codes.

Table 1.
 Demographics of ENDS users who participate in vaping focus group discussions (UC, Christchurch NZ, 2019).

- *Current frequency of use:* frequent (few times per week/daily), occasional (sometimes per month), and rare. Thus, according to the habit type, there were five dual users (tobacco and e-cigarettes), two ENDS users only and two hookah users. One of the dual users (FG1M1) presented himself as a predominantly tobacco cigarette smoker (occasional e-cigarette user), and one hookah user (FG3M1) stated that he rarely used tobacco cigarettes, therefore, he was classified as a hookah user (Table 2).

3.3 Background: length of use, vaping factors associated with start and continuing vaping

The earliest and latest first use of ENDS by participants were reported around 2009 (FG1M1) and 2018 (FG2M1). Reasons to start vaping were not necessarily associated with one aspect only. Instead, they were a combination of different factors, for six participants the financial aspect was the main reason to start vaping. All five dual users associated high prices of tobacco cigarettes and how ENDS prices help them save money. Other main reasons were: ENDS are more socially acceptable (4 participants), peer pressure (3 participants), and out of curiosity (2 participants). Moreover, only two dual users mentioned quitting smoking as an additional reason to start vaping and one dual user mentioned the need to reduce the intake of tobacco cigarettes. In particular, one participant mentioned a personal relationship: “I wanted to switch because my girlfriend was like really piss off at me smoking and then so it didn’t

Code	Habits	User status	Current use	Frequency of use
FG1M1	Tobacco cigarettes	Dual	Active	Frequent
	ENDS		Active	Occasional
FG1M2	Tobacco cigarettes	Dual	Active	Occasional
	ENDS		Active	Frequent
FG1M3	Tobacco cigarettes	Dual	Inactive	Frequent (in the past)
	ENDS		Active	Frequent
FG2M1	ENDS	ENDS	Active	Occasional
FG3F1	Tobacco cigarettes	Dual	Inactive	Occasional
	ENDS		Inactive	Occasional
FG3M1	Hookah*	Hookah	Inactive	Occasional
	Tobacco Cigarettes		Active	Occasional
FG3M2	Hookah	Hookah	Inactive	Frequent (in the past)
FG4F1	ENDS	ENDS	Inactive	Rare (in the past)
FG4M1	ENDS	Dual	Active	Frequent
	Tobacco cigarettes		Active	Frequent

*Hookah classification was based on the mechanism to heat and deliver the tobacco smoke used by the hookah, in which the tobacco is heated with charcoal and the smoke is cooled by passing it through water.

Table 2.

Code and classification of ENDS users who participated in vaping focus group discussions (UC, Christchurch NZ, 2019).

really come from me” (FG1M2). Another mentioned the technological convenience of it, and smell: “The fact that you don’t have to carry a lighter where you go, it seems like a technology advance which was interesting [...] smells good” (FG3F1). Only one participant mentioned health as an important reason to start vaping. Among dual users, three participants experienced an intermittent pattern of ENDS use, for example, “Yeah, so I probably have been vaping for about 263 days but, before that, I had probably vaped half a year before and then stopped after a party sort of went out of track. [I] started smoking cigarettes with friends and then sort of went back to rolling cigarettes for about 3–4 months and just went back to vaping because I’ve had a bit of breakdown about it. I don’t want to be wasting money and the fact that I had a lot at stake...” (FG1M3). In relation to factors associated with continuing vaping, after the initial onset, these included: nicotine (3 dual users), flavor (2 hookah users and 1 dual user), hanging out with friends or socializing (2), convenience and enjoyment (1 dual user): “It’s more convenient than sitting down to have a cigarette because you can vape in the car [...] without like, stinking like tobacco smoke, so that’s probably the main reason why I’m still using [...]. Like it’s fun so I mean I use it for enjoyment” (FG4M1). In addition, two participants had already stopped vaping.

3.4 Vaping context: frequency of vaping (currently or at the time of ENDS use), e-liquids preferences, nicotine awareness and relevance, devices used, and common places where participants vape

In general, the participants did not manifest having clear patterns of vaping, their use seemed to be irregular and related to their personal needs or convenience. Keeping this in mind, at the time of the discussions, four participants considered their ENDS use as frequent (3 active and 1 stopped), three occasional, two rare, and two had stopped vaping (Table 2). In relation to e-liquid preferences, fruit flavors were the most popular (4 participants). Strawberry, apple, grape, watermelon, and guava were the most commonly used. Three persons indicated menthol and mint as their favorites. For hookah users, bay leaves, and “chilly ice” flavors were preferred. Tobacco flavor was not chosen by anyone, for example, *“I have tried it, like I don’t like the tobacco flavor, I like the taste of tobacco I don’t like the taste of tobacco vape”* (FG4M1). *“I tried tobacco [vape] [I] absolutely hated it [...], smells like tobacco but it doesn’t taste like tobacco, not sure at all”* (FG1M2). In addition, for one dual user fruit flavors have helped him to reduce smoking tobacco cigarettes: *“... I changed to grape flavor and it was quite different to the actual cigarette flavor, because the tobacco vape doesn’t taste like a cigarette at all [...] when I started using the grape flavor [...] my mind can separate the two, vaping/smoking, so it’s sort of why I think it helped me move away from that”* (FG1M3).

Concerning awareness of nicotine presence in e-liquids and related relevance, five participants were aware of it (4 dual users and 1 ENDS user) and four were not (2 hookah users, 1 ENDS user, and 1 dual user). Notably, one hookah user was not aware of nicotine presence in tobacco used in hookahs: *“Because, when I used to smoke, that was like free of nicotine, just the flavor thing so [...] that was like ok, not much harm that I’m doing.”* Moreover, when asked about the importance of nicotine presence in e-liquids, most of the participants (7) found nicotine critical, for example, *“I mean for the most part doesn’t matter the flavor, there is no vape purpose if there is not nicotine, [...]. There’s not really much point doing it, without the nicotine”* (FG1M3). Nevertheless, for some participants nicotine was a matter of concern, for example, *“I usually try to get non-nicotine. I’m just trying to not get addicted to nicotine”* (FG2M1). In addition, for the second hookah, user nicotine content was not as important as it was flavor.

The levels of nicotine more frequently used by participants varied between low (0–3 mg/ml) to very high (salts) >18 mg/ml. One dual user compared his nicotine addiction to caffeine addiction: *“I would most often buy the lowest, which is 3 mg/ml, and that’s down to like I am addicted to nicotine but in the same way that someone is addicted to caffeine. Like you would not go in the morning without a cup of coffee just because you do not want to and so I choose the nicotine option”* (FG4M1). Another dual user associated levels of nicotine used to circumstance: *“I usually use 6 mg/ml, I also use 50 mg or 30 mg [...], because [I] jump onto the top occasionally if I’m just stressed out, but because I do that I don’t know the exact amount when I do that”* (FG1M3). In addition, two dual users were taken by surprise when they learned about different levels of nicotine in e-liquids: *“I never considered that, because I never thought that there would be different levels of nicotine, or that you can get it free of nicotine. I picked fruity flavors because I like them, but if I knew, I’d prefer the ones with lower nicotine”* (FG3F1); *“Even the mint ones will have nicotine on it? oh”* (FG1M1). In addition, two participants

indicated not having a vaping device, adducing that when needed they could just use their friend's, for example, *"If I wanted to use, I could use somebody else's"* (FG2M1).

When asked about places for vaping, more than actual locations, answers related to a situation: hanging out with friends (7 participants), for example, *"If you are doing it alone, that's sad"* (FG3M2). Associated locations were at home (2), in a bar (2) outside (2), shisha bar (2), anywhere (2), and in the car (1). Some relevant statements included: *"In the car mostly. Because then you don't have to take time out of your day. [...]. It's quite fun to take to parties and stuff, stops you from smoking cigarettes at a party. If I'm like out drinking and smoking cigarettes I can [go] through like 5 or 6 [cigarettes] and it's quite expensive"* (FG4M1). *"If I'm just walking down the street then I would have had a smoke or if I'm waiting somewhere, vaping is [...] quick, you just sort of do it, wherever. If you got a cigarette, it's a time constraint as well because you're like burn it, it takes a couple of minutes, the vape is two seconds"* (FG1M3). Additionally, some frustrations about current bar smoking/vaping rules and settings were stated: *"Lots of bars I don't quite like because if somebody is trying to vape exclusively and [don't want] to come back to the cigarette, you are sort of forced into the cigarette area [...]"* (FG1M2). Interestingly, some participants (5) found sharing devices, a commonly accepted practice, for example, *"I mean sometimes, if I'm at a party, somehow it gets around [...] I really don't have a problem with that as long as it returns to me, no one breaks it"* (FG1M3).

3.5 Triggers: situations or feelings that triggered cravings for vaping

Regarding visual stimuli acting as a vaping trigger (e.g., seeing others vaping), four dual users answered that it does not. Conversely, seeing others smoking tobacco cigarettes can be a trigger for smoking, for example, *"Vaping does not really trigger me, smoking does trigger me for smoking"* (FG1M2). Two participants found some association, for example, *"... If I see other people vape, I feel more inclined to do it"* (FG2M1); *"I think that depends on the situation and where I am. The other day [in] a bar there were people vaping, I felt the temptation of vaping, but when I'm walking to the university and I see other people vaping I do not feel the need, because I'm coming here to study so my focus is on the studies I don't feel tempted then"* (FG3F1). Moreover, one dual user indicated that the ENDS "artificial" look causes him to have a mental block *"... For me, it's so robotic, the vape, it doesn't have the organic, I mean the cigarettes are still a plant, still lights, but vape, just feel like you are taking a machine into your body, like in a hospital kind of thing, you're check in for the machine. Maybe for me, that's part of the mental block: sure, you got the nicotine hit, but it looks too artificial. I feel, no men no"* (FG1M1). Concerning the smell of e-liquids acting as cravings triggers, only three participants (1 dual user, 1 hookah user, and 1 ENDS user) were positive, for example, *"I prefer the smell of fruit, so, when I smell cigarettes, I don't feel tempted, but with fruity vapes, I do feel the temptation to try again"* (FG3F1). In addition, vaping advertising or vaping shops did not trigger vaping cravings.

To the question of stressful situations acting as vaping triggers, three participants found some association to unspecified stressful situations, for example, *"If things are not great, I probably will be vaping a lot more. It's a coping response. Again, and then it becomes this point there's bigger things to worry about yeah, right?"* (FG1M2). Moreover, two participants may use either, under highly stressful situations, for example, *"It kind of depends on how I feel like at the time, but also like the severity of it. So, if I just had like a really traumatic event I probably just go straight and have a cigarette but like I mean, the same effect from vaping, but cigarettes are just quicker and stronger"* (FG4M1). Two participants also found studying a stress-related vaping trigger. The remaining participants did not find any relation.

When exploring deeper, views regarding the role of social contexts as vaping triggers, four participants' (3 dual users and 1 ENDS user) answers were affirmative, for example, *"It's like the worst, being the [odd] one out [...] everyone is smoking and you are not smoking. For sure if anyone is passing around a machine, I want a piece of the machine"* (FG1M1). On the other hand, one dual user who previously lived overseas noted that, since he moved to NZ, smoking and vaping has changed from a very socially driven practice to a very lonely experience: *"now it has become like the completely solitary thing it used to be a very special thing, very social thing ... but that doesn't happen that often [now]"* (FG1M2). The fact that vaping can be seen as a solitary practice was also shared by another dual user. In addition, one dual user found that social situations might not necessarily represent a trigger factor or a reason to vape: *"Probably [socializing] doesn't really make a difference. So, I just got a vape when I feel like it and sometimes, I might be around a crowd of friends, that none of them vape or smoke, so to that event I wouldn't bring my vape, but other times yeah, [I will] be going out maybe [with] people that I'm going with vape or smokes, and so I bring my vape along"* (FG4M1). For the hookah users, rather being than a trigger, socializing was a situation in which, in order to hang out, vaping was compulsory: *"being in a party, I used to do it. If I didn't do it, it would be like turned down from the group [...] So we have to participate, even if you have only one drag, you have to, it's the kind of thing"* (FG3M2).

3.6 Reactions and views associated with vaping: Moods, benefits, harms to health, smoking vs. vaping, quitting smoking, participants' plans to quit vaping

Seven participants indicated feeling relaxed, as the mood most associated with vaping, followed by: happy (4 participants), focused (2), and stimulated (1). Some participants indicated more than one mood associated with vaping, for example, *"All of the time it's relaxing. Some of the time it can cheer you up, if you are just a bit moody that day or whatever, go for really nice vape [and] you're happier because of it"* (FG4M1). The same participant voiced some concern: *"In terms of vaping you don't seem to have that finish point [as] with a cigarette [...], with vaping it's not. [Instead it's] 'give me another hit, give me another hit', kind of thing. That is a big negative of vaping for me because I can see myself just sitting [vaping]"* (FG1M1). Nevertheless, in relation to the benefits found with vaping, several reasons stand out: making friends, a feeling of belonging, peace, fun, it helps work better, psychological control, and it does not interfere with daily activities, such as working out as much as cigarettes can do.

The perceptions associated with harm to health from vaping vs. harm caused by smoking tobacco cigarettes were as follows: six participants found vaping less harmful than smoking cigarettes, and for two others more data/research is needed to determine vaping's long-term health risk. One believed that vaping is as harmful as smoking tobacco cigarettes and for other, vaping represented a risk due to the e-liquid intake: *"For me, that would be a big risk of vaping, you seem to be a seat in a trap, you seat there a lot more, take a lot more on"* (FG1M1). In addition, when asked about their opinion on whether using both (ENDS and tobacco cigarettes) was healthier than only smoking tobacco cigarettes, four dual users answer yes, and one (dual user) said that using both, although it may help regulating and cutting down smoking and use of tobacco cigarettes, may have a nicotine addictive effect. One hookah user indicated that using both is less healthy than smoking only, and two more participants considered the opposite.

Dual users were asked about how ENDS helped them to quit smoking tobacco cigarettes. For this, two participants re-stated their relapses. In one case, the participant

had recently managed to quit smoking for 3 months before relapsing. Another had managed to exclusively vape for several months, after earlier relapses. A third one acknowledged a failure in this regard: *“Nah, failed [I] started 10 years ago, it didn’t work. Now I thought about trying again, [but] it hasn’t work[ed].”* For some others, quitting smoking by using ENDS can only happen with discipline: *“It alleviates the cravings pretty quick. Like, you only need to do like one puff really, to stop smoking a cigarette, so it’s quite effective in that regard. It feels like, if you were trying to cut out the smoking, then you need to be quite disciplined with the vaping because it’s pretty easy to pick up the vape and vape more than you should.”* Moreover, when asked about how satisfying vaping was, six participants felt satisfied, from which two (dual users) commented: *“To save a lot of money, exactly. Yeah, like I said before, I love it. I feel a little bit less tired. Like the stomach upset wise, my throat feels a little bit better than when I was smoking [only] and again comes down to right now I just don’t care enough, I think you really need to care about your health at some point if you want to quit smoking”* (FG1M2). *“For me, it’s been a financial benefit [...] I guess it has brought a social benefit in the sense that I don’t feel the need to [smoke]. So, [it’s] mainly financially better for me, and obviously, some health benefit, because there was a period when I was heavily smoking for a while but I just can’t taste anything...”* (FG1M3). Despite being positive, another dual user voiced concerns: *“I think that it’s a good alternative, and especially as there’s more research into it. I think that the ban on the nice flavors is probably a good idea because I don’t like the idea, myself included, that people just vape for fun, because it’s just a good way to get really addicted to nicotine [...], so if you are using it to cut out the cigarettes, I think it’s a good alternative.”* On the contrary, one person did not find it satisfactory: *“I don’t know, it just feels like, a waste of money you don’t get much for it [...]. I don’t enjoy it as much ...”* (FG2M1).

In regards to recommending vaping as a way to quit smoking tobacco cigarettes, mixed opinions were given: for three participants it was an option, for example, *“I think it’s a good alternative because it gets you a lot more control over exactly how much nicotine you get.”* Three other participants had doubts, for example, *“I do n’t know about it because I’ve got so many mates, including myself, who tried to quit that way they bought it and they haven’t. So, for me to recommend that to someone seems a bit disingenuous.”* Moreover, one participant would recommend it as a way to help reduce the tobacco cigarettes intake. Another one recommended it with warnings: *“I feel like if somebody is at the point where they start really caring, then I’ll tell you to use a vape to try to quit. For me it [has been] such a rollercoaster [...] you need to know a lot of things before you start this and if you pick wrong on the nicotine level, you might hit your tolerance like crazy it’s very tempting to always do it [...] like I’ve gone to hell and back with my tolerance based on vaping”* (FG1M2).

The final question asked, was related to plans to quit vaping, to which only one participant considered quitting a possibility: *“Yeah, probably. I don’t do it much at the moment [...]. Well, likely to do it [...] my friends are stopping doing it [...] I’ll see”* (FG2M1). Four participants were not considering quitting in the foreseeable future, for different reasons, such as occasional use (1 hookah user) and intermittent use (1 dual user), do not consider nicotine addiction as a bad thing (1 dual user): *“I mean, probably not [quitting], just because I don’t really see having a nicotine addiction as a bad thing [...]. I enjoy it, and I think probably right now it brings me more benefits to my life than the negatives [...], the whole reason for vaping in the first place is for the nicotine”* (FG1M3). The final related statement was: *“Now, like I said that’s one of the things I would really need to [quit], and I know that, but that doesn’t mean that [it] can change for the foreseeable future I don’t think so. When I get off the nicotine, I’m not functional at all, and that’s the big issue right now”* (FG1M2).

After finishing covering all focus groups' topics, the recording systems were turned off and all participants were thanked for their participation and were asked any further questions about the project and the focus groups discussions.

4. Discussion

Analyzing the participants' demographics, the cultural and ethnic diversity of the group was evident. Their diverse backgrounds allowed us to have a glimpse into different geographical and cultural contexts surrounding ENDS use. Cultural and geographical contexts should be considered when working toward the development of more targeted and personalized VRT and telehealth services, since they may influence the subject's level of immersion and sense of presence during a VR intervention and, therefore, their physiological and psychological responses [17]. While the resulting information from the number of participants interviewed does not provide a comprehensive representation of the vaping community in NZ, it shows some of the varied factors influencing vaping in our universities. A limited number of participants has not been an impediment to carry out similar qualitative studies in the past [18]. In our study, despite a comprehensive recruitment campaign, only a small turnout of candidates was obtained. Nevertheless, the information acquired not only has provided valuable insights from the participants' perspectives but also has contributed toward gaining a better understanding of how students from diverse backgrounds adapt their vaping habits for NZ university contexts. Statements gathered in these focus group discussions will contribute toward VRS development that resembles more accurately situations and environments related to vaping among young people.

The financial benefit when compared to smoking tobacco cigarettes was the main reason why the participants started vaping. It is remarkable how the lower prices of vaping products influenced the participants' transition toward a more affordable source of nicotine. While higher taxes on tobacco products may be associated with a decline in tobacco smoking, conversely, it may have also influenced the increase in ENDS use [19]. In this regard, before making any assumptions, it is important to consider that, although ENDS have been promoted as a less harmful option than conventional tobacco, there are increasing concerns regarding their long-term health risks, which are already a matter of public health debate [20]. Advance long-term studies are needed to come to definitive conclusions [21]. Furthermore, our findings about the reasons why the participants continued using ENDS were associated mainly with two factors: nicotine and flavor. Together with the perception that ENDS are less harmful to health, these have been identified previously as some of the main reasons why vaping are so popular among teens and young adults [22, 23].

While vaping has become a viable nicotine alternative to many, for some of our dual users, ENDS did not satisfy completely their needs, and stopping smoking tobacco cigarettes was not seen as an option in the foreseeable future. Compared to tobacco cigarettes, ENDS deliver lower levels of plasma nicotine, which can produce an unsatisfied feeling in dual users, inducing them to increase their nicotine intake, either by smoking, vaping, or using more of both [24]. Thus, some dual users may face not only nicotine dependency issues but also potential health problems, such as respiratory and heart conditions [24]. Noticeably, quitting smoking was not found to be one of the main reasons to start vaping, similar to other studies [25, 26], where health, curiosity, or financial reasons had a more relevant role in making the decision. In addition, some dual users in our study indicated having a recurrent pattern of

intermittent phases between tobacco cigarettes and vaping and/or using both during the same period. In a recent study [23], similar transitions from single to dual or from dual to single-use were described in one out of three study participants, who were all adolescents (13–18 years old). In our study, the majority of participants were young adults and the pattern described here was spontaneously stated by them rather than being a pre-established assessment.

In regards to e-liquids of choice, as previously established among youth, young adults, and adult vapers [5, 27], flavored products were the most popular ones, among our study's participants. Moreover, in relation to flavors, fruit e-liquids were preferred, followed by menthol, as has been reported previously [28]. Similar to the findings of a recent survey carried out in North America [29], tobacco flavor was not popular, but rather was considered unpleasant. As indicated, flavored e-liquids have become topics of research and discussion since they are determinant factors for vaping initiation and may act as a gateway to smoking cigarettes and nicotine dependency [30–32]. Regardless of the source, nicotine dependency has been associated with disturbances of cognitive development in teens and young adults [33]. In addition, recent studies have reported the presence of toxic substances in vape aerosols [34] and the findings of traces of some chemicals in menthol mint and fruit-flavored e-liquids that increase the risk of cancer [22]. Nevertheless, in some cases, flavored e-liquids have been reported to help some users to cut down on tobacco smoking [35], as was reported by one of our participants. In this regard, the use of flavored e-liquids has been suggested for use in self-help for smoking cessation, alongside other intervention types, such as educational videogames [36, 37], which may be further developed toward targeted VR and telehealth.

In this study, nicotine (the presence and level of) was a determining factor for vaping among some participants (mainly dual users). Notably, other participants manifested a lack of awareness about nicotine information in the e-liquid that they have used. Moreover, in some cases, the participants stated a lack of knowledge on whether or not the products they tried contained nicotine. Neither did they know about the nicotine levels of their preferred products, similar to previous findings [38]. Although consumer awareness is required in many countries, limitations in users' knowledge about vaping products may be associated with the lack of proper warning labels for e-liquids and even mislabeling in some cases [38]. This should be a matter of concern, particularly since the population at higher risk to start using ENDS are teens and young adults. Not only should correct labeling be mandatory but also educational tools for information and guidance should be available for all current and potential users. In this regard, the NZ government is making an effort to regulate all vaping and smokeless tobacco through the Smokefree Environments and Regulated Products Act, 1990 [11]. VRT and telehealth can be used as platforms for prevention and education for all potential health risks associated with vaping.

Hanging out with friends was a situation highly linked to vaping for our focus group participants. Notably for the hookah users interviewed, when hanging out with friends back in their country of origin, at times when vaping took place, this was considered a must-do activity among them. Thus, similar to the findings of previous studies [14, 39], it appears that among our participants, vaping is predominantly a social practice and is increasingly more socially accepted. Moreover, for some participants, it may be part of their socio-cultural practices. In some cases, as a social practice, sharing ENDS devices among friends was considered acceptable, and because of this, some participants did not consider it necessary to acquire their own devices, as long as sharing was an option. Conversely, in a study developed with students of the

University of Edinburgh, sharing ENDS was considered socially unacceptable [40], depending on temporal and geographical contexts. In addition, it was notable how vaping, unlike smoking cigarettes, was perceived as a more flexible practice that conveniently can be integrated into different situations or places, such as being in a bar, at home, studying, walking, or driving, either within social or individual contexts. Similar findings were reported by Keane et al. [14]. Nevertheless, the culture shock experienced by some of our international students seemed to have influenced their vaping behavior and attitudes toward it, since either the social context or the physical settings experienced in NZ do not match what they were familiar with, in their country of origin. This reinforces the idea that ENDS contexts and characteristics vary according to culture and geographical location.

In relation to vaping triggers, unlike previous reports [41], in our study, neither passive exposure to vaping nor vaping advertisement appeared to trigger a desire for vaping or smoking. This applies mainly to dual users, who also indicated that, when seeing others smoking tobacco cigarettes, this may trigger their desire for smoking, which sometimes, maybe mitigated with vaping [42]. In terms of olfactory triggers, only fruit e-liquids were found to have some effect. With respect to the role of stressful situations as vaping craving triggers, it seems that regardless of the nature of it, for some of our participants, vaping may be used as a coping mechanism for stress. Similar findings were observed by tobacco cigarette users, which may be associated with nicotine [43]. Moreover, some of our participants related vaping to feeling relaxed, happier, focused, stimulated, and responses that have been linked previously to the effect of nicotine [44]. In addition, a highlighted concern raised by some participants was related to a perception of losing control over vape intake and “endless” vaping. Similar remarks have been observed in for dual users and young adults [40]. This may be associated to previous user’s sense of having control over their own smoking, given by the knowledge of time taken to smoke a conventional tobacco cigarette. Nevertheless, uninhibited vaping may induce to higher consumption of nicotine, which given the ever-growing popularity of vaping, may contribute to an overall increase in nicotine dependency, therefore, higher health risks.

In general, our participants perceived vaping as a less harmful practice than smoking conventional cigarettes. Even though the long-term health effects of vaping are under investigation, the same impression seems to be shared by many [36, 45, 46]. The majority of participants considered the use of both ENDS and smoking conventional cigarettes healthier than to smoke tobacco cigarettes only. Although there is insufficient scientific evidence to support this statement, the perception may be associated with the idea that cigarette consumption may be reduced, despite its continued use of it [46, 47]. It is important to remember that vaping and its potential harmful effects depend on many factors, such as frequency of use, the quantity of nicotine consumed, flavors of preference, and type of devices used, together with socioeconomic and associated demographic factors. In particular vaping practice has been associated with youth in socioeconomic disadvantage, who have never smoked [46], which may serve as a gateway to nicotine dependency and consequently, associated health issues. An integrated analysis of contexts and factors influencing vaping is needed to advance effective future interventions and treatments for vaping disorders. As for the lack of success in trying to quit smoking by vaping, it appears to be a common situation among college students and adults [36, 48], who either fail, relapse, or become dual users. It appears that for some participants of our study, relapsing may be a common situation and for others, quitting smoking seems to be a challenge only achievable by being extremely disciplined. As the effectiveness of using vaping

to quit smoking appears to be debatable [46], vaping may be of better use as a tool to help reduce smoking. Some attributes associated with vaping, such as being more socially accepted, the variety of e-liquids flavors as well as different levels of nicotine concentration, may be of help in the effort to reduce smoking [39], nevertheless, the potential effect caused by these attributes should be carefully considered.

In general, our participants seemed to be satisfied with vaping. This feeling was primarily linked to its financial benefit compared to smoking, followed by health and social acceptance. As mentioned by some of our participants, due to high taxation on cigarettes it is possible that, in NZ, conventional cigarette smokers are switching to vaping, a situation that may have been further enhanced by health marketing campaigns [13]. How this may have affected the use of vaping by non-smokers and possibly influenced the increase in nicotine dependency is yet to be understood and is critical to be quantified. The questions about recommending vaping as a way to quit smoking conventional cigarettes, varied opinions were obtained in our focus groups. Our participants' views agree with other studies' report, in which vapers did not recommend it due to their own or their friends' failed attempts [40], or even their own difficulties and struggles with self-controlling nicotine intake. In addition, regarding plans to quit vaping, there was not a clear position about it. Whether it is because of the benefits seen by using it (when compared to smoking conventional cigarettes), nicotine dependency, or their occasional use, quitting vaping does not appear to be considered a priority in the foreseeable future for most of our participants.

As observed in this study, vaping is a dynamic practice. The discussions that took place throughout our focus group sessions, provided important information that has helped us to identify some key social, cultural, and economic components in the vaping contexts of a diverse group of young adults. This material will contribute to the development of a more realistic and immersive VRS. The current technological advances achieved in the development of online VRS can enable better integration with telehealth for the future delivery of interventions and treatments as well as prevention and education campaigns for vaping-related disorders. This would build on recent developments using VRT in telemental health services, in areas, such as social anxiety, obsessive-compulsive and substance use disorders [49], and smoking interventions [50]. As yet, the knowledge of vaping-related disorders is limited and still a work in progress. Nevertheless, the use of VRT for cue exposure treatments could represent an alternative to help patients suffering from nicotine dependence caused by vaping. Moreover, in order to help achieve better results, previous studies developed in smoking cue exposure therapy using VRT have recommended, including mechanisms that help patients to improve their coping skills [7, 51]. In addition, studies indicate a potential need to modulate negative effects and stress during cue exposure [7]. These recommendations are worth being considered and testing in future vaping treatments using VRT.

5. Limitations

The limitations of the study were primarily related to the number of vapers interviewed in the focus groups and how representative the sample could be in relation to different types of vapers, given demographic factors and geographic location. Thus, we acknowledge that our findings are limited to the views, background, behavior, and environments surrounding a sample of local and international university students in

NZ. Nevertheless, despite how dynamic and rapidly growing vaping is, in our study, we found similarities with some perceptions and behaviors described in previous studies carried out worldwide [5, 14, 22, 23, 27, 38, 39], which help to support our findings and will contribute toward vaping-related VRS development.

6. Conclusion

In this study, the accessible price of vaping products was a key reason for starting and continuing vaping. In most cases, vaping was associated with nicotine dependency by the participants, particularly for dual users. In our sample, flavored e-liquids were popular, especially fruit and menthol, but not tobacco flavor. Flavored e-liquids may be seen to help with the transition from smoking conventional tobacco into vaping, but they are also a concern for potential nicotine dependency. Furthermore, in this group, vaping appears to be mostly seen as a social practice, linked to hanging out with friends, regardless of the location (party, bar, house, car, etc.). On the other hand, for some international students, their current settings for vaping are dissimilar to what they were used to in their countries of origin, which, in some cases, has led to a change in vaping behaviors from a social context into a solitary practice.

In our study, passive exposure to vaping or vaping advertisements appears not to be a trigger for vaping or smoking but for dual users, seeing others smoking conventional cigarettes does trigger their desire for smoking conventional cigarettes, which may not always be mitigated by vaping. When compared to smoking, vaping is perceived as more socially accepted, healthier, more beneficial, and in general satisfying. Moreover, while vaping was not perceived as a way to quit smoking, it may be of help to reduce smoking conventional cigarettes, but concerns remained regarding a tendency toward loss of control of nicotine intake that can occur when vaping, which may induce nicotine dependence. Nevertheless, quitting vaping does not seem to be a concern or priority among our participants, and this may lead to continued or even increased nicotine dependency as well as increasing the risk of health disorders associated with vaping. Further studies are needed to clarify and test these matters.

Vaping is an ever-changing global practice with rapid technological and social growth, which may be taking nicotine dependency to a new level, reaching all socio-cultural contexts and age groups. The socio-cultural and economic background of the target population should become a key component to be considered when developing new technological tools toward enabling more inclusive and personalized online VRT and telehealth services for prevention, intervention, and treatment of vaping and its potential associated disorders. The dynamic and multifactorial character of vaping together with its potential associated health risks makes it a key challenge for future VRT and telehealth developments. Furthermore, as adolescents and young adults are at higher risk, the use of online VRT for telehealth represents an attractive and accessible technological platform that can be used to engage this age group to be better informed about vaping. Further technological advancements should facilitate interactive access to online environments developed under more realistic and contextualized settings, in which prevention, control, and treatment focused telehealth programs can tackle commonly associated issues, such as nicotine dependence, ENDS misuse, health harms linked to e-liquids flavors and chemical components. Thus, further developments in online VRS are needed to enhance and facilitate telehealth services in the growing field of vaping-related disorders.

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Conflict of interest

The authors declare no conflict of interest.

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