




Changes in Tobacco Use in the Early Phase of Coronavirus Disease 2019 Pandemic in Hong Kong: A Qualitative Study

Xiaoyu Zhang MSc^{1, #}, Yuying Sun PhD^{1, #, }, Derek Yee Tak Cheung PhD², Man Ping Wang PhD², Yongda Wu PhD^{2, }, Kin Yeung Chak MSc¹, Jianjiu Chen PhD^{1, 3}, Lok Tung Leung PhD¹, William Ho Cheung Li PhD², Tai Hing Lam MD¹, Sai Yin Ho PhD^{1, }

¹School of Public Health, University of Hong Kong, Hong Kong SAR, China

²School of Nursing, University of Hong Kong, Hong Kong SAR, China

³Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, USA

Corresponding Author: Sai Yin Ho, PhD, School of Public Health, The University of Hong Kong, Patrick Manson Building (North Wing), 7 Sassoon Road, Pokfulam, 999077 Hong Kong SAR, China. Telephone: 852-3917-9883; Fax: 852-2855-9528; E-mail: syho@hku.hk

[#]Shared co-first authorship.

Abstract

Introduction: Changes in tobacco use and related personal and environmental factors amid the coronavirus disease 2019 (COVID-19) pandemic can be captured by qualitative studies, but they are few in non-Western populations.

Aims and Methods: We assessed the perceived links between tobacco use and COVID-19, and changes in the use of cigarettes, electronic cigarettes (ECs), and heated tobacco products (HTPs) in the early phase of the pandemic in Hong Kong, where lockdown was not implemented. Semi-structured telephone interviews were conducted from January to June 2021 in 95 participants (36 EC users, 28 HTP users, and 32 exclusive cigarette users). Transcriptions were coded using deductive and inductive approaches, and factors for changes were nested in the social-ecological model.

Results: Two-thirds of participants perceived their infection susceptibility was the same as never tobacco users, and 44.2% perceived more severe COVID-19 disease if infected. Amid the pandemic, tobacco use decreased overall but increased indoors for all three products. Increased tobacco use was mostly attributed to increased emotional distress, while decreases were attributed to various personal (health concerns) and environmental factors (e.g., COVID-19 regulations). Perceived convenience and lower costs were reasons for increased EC use. Limited access to HTPs was compensated by cigarette use.

Conclusions: Many participants were unaware of the potential harm of tobacco use on COVID-19. Overall tobacco use decreased due to COVID-19 regulations, which may not be sustainable post-pandemic. Indoor consumption increased, supporting a comprehensive smoke-free policy that covers private indoor areas. Better cessation services targeting EC, HTP, and cigarette use are needed.

Implications: Smokers need better awareness of the risk of tobacco use on COVID-19. Smoking cessation services can be improved by offering brief advice, strengthening advocacy against secondhand smoke, and covering EC and HTP use, highlighting their potential harms to users and others, and their risk of addiction and relapse to cigarette use.

Introduction

Tobacco use is an established cause of respiratory diseases.¹ Recently, the World Health Organization (WHO) has also associated smoking with a higher risk of serious consequences and death from coronavirus disease 2019 (COVID-19).² Moreover, a recent UK Biobank cohort combining observational analyses and Mendelian randomization approaches provided strong evidence on the causal effect of smoking on risks of COVID-19-related outcomes, including infection, hospitalization, and mortality.³

The pandemic has disrupted daily life routines followed by changes in tobacco use behaviors. Some cross-sectional studies showed more smokers increased rather than decreased consumption amid COVID-19,^{4–6} while others showed net decreases in smoking.^{7,8} A UK study showed increased quit attempts and cessation following COVID-19 lockdown.⁹ A US study also found most cigar smokers (70.8%) had an

intention to quit in the next 6 months, and about 46.5% reported a quit attempt since the onset of COVID-19.¹⁰ A study of four countries showed 37.6% (Australia) to 50.9% (England) of smokers had an intention to quit.¹¹ It seems that heterogeneous responses in tobacco use may differ by factors, such as country, COVID-19 policies, and the type of tobacco products used, which may not be clear from specific quantitative surveys.

Several qualitative studies explored the underlying mechanisms for the changes in tobacco use amid the pandemic. On the one hand, tobacco users increased their consumption to cope with pandemic-induced stress, anxiety, and boredom.^{12–15} On the other hand, COVID-19 concerns, reduced social activities, and lower income led to reduced consumption.^{12,14,15} Almost all reports from qualitative studies were from Western countries, especially the United States and the United Kingdom, and were mostly focused on the impact

of COVID-19 lockdown. However, such changes may not fully represent changes throughout the pandemic in places without lockdown or when social distancing is relaxed after mass vaccination against COVID-19. To the best of our knowledge, only two qualitative studies explored smokers' behavioral responses to COVID-19 in regions outside the United States and the United Kingdom.^{16,17} One qualitative study in Pakistan focused on factors related to quitting or continuous use of cigarettes or e-cigarettes amid the pandemic, with 262 non-users and only 14 tobacco users.¹⁶ Another qualitative study in South Korea of 11 non-users and 25 tobacco users showed most tobacco users reported no change in use pattern while an increase in tobacco use was mostly attributed to limited social interaction and working or studying from home.¹⁷

Despite being an ultra-high-density international city, Hong Kong has brought four waves of COVID-19 outbreaks under control, with 12 338 confirmed cases and 213 deaths by October 28, 2021.¹⁸ Instead of lockdown, the Hong Kong SAR Government implemented several public health regulations at the early stage, such as restricting social gatherings on March 28, 2020 and mandatory mask-wearing requirement on July 23, 2020.¹⁸ Work from home practices were also adopted by the government and many organizations during the peak of the outbreak.¹⁹

Changes in tobacco use amid COVID-19 differ by the type of tobacco products, especially alternative tobacco products that claim to have lower health risks, such as electronic cigarettes (ECs) and heated tobacco products (HTPs). For example, a limited supply of ECs in physical stores has led to more online purchases or more compensatory cigarette use.¹⁴ Spending more time indoors, on the other hand, has led dual users to increase EC or HTP use but decrease cigarette use in an attempt to reduce exposure to family members.^{14,17} Given the diversified changes in response to COVID-19 across users of different tobacco products, the present study aims to explore the reasons for changes in tobacco use in three subgroups of users (exclusive cigarette, EC, and HTP users) amid the COVID-19 outbreak in Hong Kong, so as to inform tobacco control strategies for specific products.

Methods

Participants were from our ongoing smoking surveys in Hong Kong who agreed to be contacted for further in-depth interviews and were approached by telephone. The sampling frame was drawn from 133 telephone numbers from a population-based household survey conducted from October 2019 to November 2020 and 513 from a smoking hotspot survey conducted from July 2019 to December 2020 in three districts.²⁰

Participants were selected using a purposive sampling strategy. Participants reported the tobacco products that they were using from December 2019 to January 2020, just before the COVID-19 pandemic, with three options of "cigarettes," "ECs," and "HTPs." Users of one or more of the products were included and further stratified into three groups: exclusive cigarette use (used cigarettes but not ECs and HTPs), EC use, and HTP use. Cigarettes are the main tobacco product used in Hong Kong, but EC and HTP use is emerging.^{21,22} Given their relatively small numbers, exclusive use of ECs and HTPs was not required as an inclusion criterion. When one group had reached the target number of data saturation (when no new information can be collected),²³ we

stopped recruiting that group. Out of the sampling frame of 646 persons, 161 were contacted, and 95 completed a telephone interview, with refusals mainly due to limited time and lack of interest. These 95 participants included 19 from the household survey and 76 from the smoking hotspot survey. There were 32 exclusive cigarette users, 36 EC users, and 28 HTP users of whom one was concurrently using ECs and HTPs.

Semi-structured, in-depth interviews were conducted by our trained research assistants from January to June 2021. Verbal consent was obtained over the telephone first. An interview guide was developed with two topics ([Supplementary Appendix 1](#)), including (1) the perceived relation of tobacco use with contracting COVID-19 and the severity of COVID-19 after infection; and (2) participants' experiences in tobacco use since the COVID-19 pandemic, especially in the early phase of the outbreak (February-March 2020). In the second topic, we focused on changes in quantity, types of tobacco products and smoking places, and reasons for those changes. After the interview, participants received a HK\$100 (US\$12.8) cash transfer or supermarket coupon as an incentive. Ethics approval was obtained from the Institutional Review Board of the University of Hong Kong or Hospital Authority Hong Kong West Cluster (No. UW21-011).

All audio records were transcribed by trained transcribers who are native Cantonese speakers. The transcripts were then imported into NVivo 12 (QSR International; qualitative data management software) for qualitative analyses. During the initial coding process, XZ conducted line-by-line coding to generate initial codes for the data, and YS checked all initial codes. After summarizing the initial codes, XZ generated deductive codes for the 2 topics, assigned the initial codes to the deductive codes, and inductively came up with new codes while sifting through the data. YS checked the code classifications and discussed any discrepancy between the codes with XZ to reach a consensus. For the second topic, XZ and YS identified reasons for changes and further organized them into different levels of the socio-ecological model. The socio-ecological model posits that health is influenced by the interplay between individual, relationship, community, and societal factors.²⁴ It had been applied in a US qualitative study exploring driving factors of tobacco use during COVID-19.¹⁴ The final codes were confirmed by the research team.

Results

A total of 95 participants (aged 33.1 ± 8.8 years, 69.5% males) completed the interviews. About 90% of participants perceived no difference among the three products (cigarettes, ECs, HTPs) in the risk of contracting COVID-19 (90.5%) and in the severity of COVID-19 after infection (88.4%). Most participants (64.2%) perceived tobacco use was not associated with contracting COVID-19 and 44.1% perceived tobacco use was not associated with the severity of COVID-19. One in five participants believed tobacco users were at a higher risk of COVID-19 infection, and 44.2% believed tobacco users would have more serious consequences of COVID-19 once get infected. A few participants perceived lower risk of getting infected (6.3%) or having less severe symptoms (2.1%) than never users. One-third of participants (34.7%) reported that they acquired such information from official news and research. Participants most commonly (43.2%) made judgments

based on their own experiences or opinions from people around, and 10.5% relied on information from social media. Further details of participants' perceptions regarding the first topic are shown in [Supplementary Appendix 2](#).

Table 1 shows lower consumption of each tobacco product amid the pandemic overall, but indoor consumption (e.g. at home or in a car) increased. Net changes in percentage points for cigarettes, ECs, and HTPs were, respectively, -28.2, -13.9, and -25.0 overall, but 25.0, 22.2, and 21.5 indoors. Further details of changes in tobacco use of participants are shown in [Supplementary Appendix 3](#). Factors that influenced tobacco use behaviors since the COVID-19 pandemic were nested in four levels of the socio-ecological model ([Figure 1](#)).

The Societal Level

Mandatory Mask-Wearing Requirement

The mandatory mask-wearing requirement was one of the most common factors that influenced tobacco use behaviors. Over one-third of participants reported a decrease in tobacco use due to fear of being fined for taking off the mask in public places.

Both (cigarettes and ECs) consumptions decreased, because you cannot smoke on the street after all... I am afraid to be fined.... (Male, 34, cigarettes and ECs)

Nevertheless, the degree to which the regulation had affected tobacco use varied, potentially depending on the

Table 1. Changes in the Use of Each Tobacco Product in the Early Phase of the COVID-19 Pandemic

	Total consumption		Indoor consumption	
	Changes, <i>n</i> (%)	Net change (percentage points)	Changes, <i>n</i> (%) ^a	Net change (percentage points)
Use of CCs, exclusively (<i>n</i> = 32)		-28.2		25.0
Increased	5 (15.6)		12 (37.5)	
Decreased	14 (43.8)		4 (12.5)	
No change	13 (40.6)		10 (31.3)	
Did not use indoors	—		4 (12.5)	
Use of ECs, exclusively or concurrently (<i>n</i> = 36) ^{b,c}		-13.9		22.2
Increased	8 (22.2)		14 (38.9)	
Decreased	13 (36.1)		6 (16.7)	
No change	15 (41.7)		13 (36.1)	
Did not use indoors	—		1 (2.8)	
Use of HTPs, exclusively or concurrently (<i>n</i> = 28) ^{b,d}		-25.0		21.5
Increased	5 (17.9)		12 (42.9)	
Decreased	12 (42.9)		6 (21.4)	
No change	11 (39.3)		8 (28.6)	
Did not use indoors	—		0 (0.0)	

CC = conventional cigarette; EC = e-cigarette; HTP = heated tobacco product.

^aPercentage may not add up to 100% due to missing information in some participants.

^bOne was a dual user of ECs and HTPs who decreased HTP use but increased EC use.

^cUse EC exclusively: *n* = 6; dual use of cigarettes and ECs: *n* = 29; dual use of ECs and HTPs: *n* = 1.

^dUse EC exclusively: *n* = 12; dual use of cigarettes and HTPs: *n* = 15, dual use of ECs and HTPs: *n* = 1.

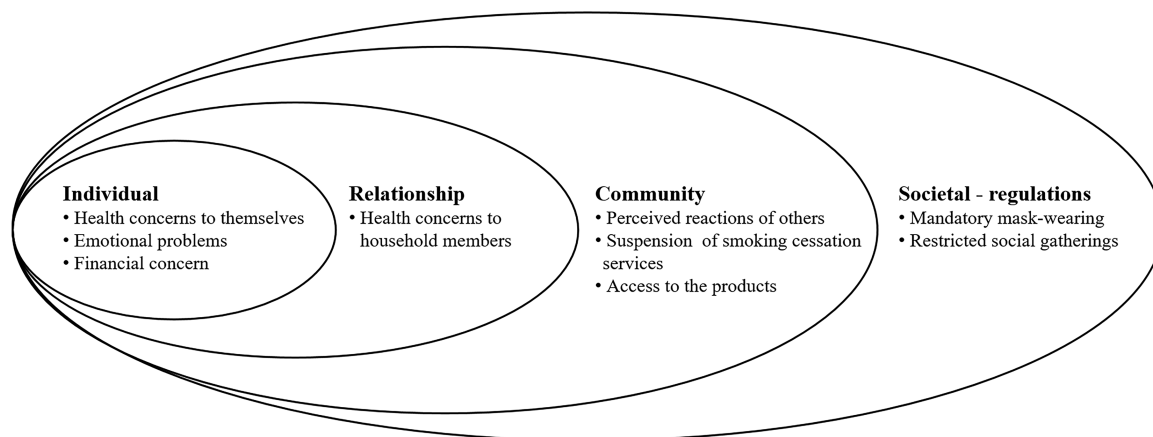


Figure 1. Summary of factors that impacted tobacco use behaviors since the COVID-19 pandemic using the socio-ecological model.

different levels of nicotine dependence. One individual who smoked about 10 cigarettes per day described a modest change in cigarette consumption due to the regulation.

The change ... the change was not too big. I smoked relatively less, just because smoking outside would be fined. You know, if you wear a mask, you are not able to smoke, so you have to remove the mask. But if you do so, it is possible for you to get a ticket for violation of the regulation. So I smoked a little bit less, but I cannot say that I reduced smoking a lot. Maybe... I reduced by about 2-3 cigarette sticks per day, because I have an addiction (to nicotine). (Male, 28, cigarettes exclusively)

One light smoker quit smoking abruptly and completely:

I smoked about 3-4 cigarette sticks per day before... I quit (smoking) in March last year (2020), I did not want to remove the mask, so I quit... Yeah, I quit it suddenly. (Male, 29, cigarettes exclusively)

Some participants reported no change in the amount of tobacco consumed, but they chose to smoke in more secluded places, such as back alleys or stairwells.

The (smoking) location would be a little more secluded, but the amount smoked would not change. I usually took a few more turns in the back alley before I smoked, otherwise, a cop may come by and catch me. (Male, 28, cigarettes and HTPs)

Restricted Social Gatherings

Several participants described that restrictions on social gatherings reduced group smoking in tobacco users.

Since COVID-19, I spent less time smoking with friends because of the regulation on restricted social gatherings. (Male, 29, cigarettes exclusively)

Restrictions on social gatherings resulted in reduced social activities. Some participants mentioned that they usually smoked when they drank alcohol with friends in bars. But the closure of bars due to the outbreak limited their "social smoking." Notably, such phenomenon was only reported by alternative tobacco product users.

I could not have drinks or dinner with my friends at night, so I smoked less. (Male, 45, HTPs exclusively)

As regards tobacco use behaviors in the future, those who had reduced social smoking reported that they would increase consumption as they socialize more with friends after the pandemic.

I think I will increase smoking later. Because the bars will re-open, and I will increase social smoking. Also, I can smoke on the street freely (later). (Female, 18, cigarettes and ECs)

However, some participants reported that such changes were only temporary, and their tobacco use behavior returned to normal later because enforcement of COVID-19-related regulations was low.

It (reduction of smoking) happened at the very beginning. I reduced HTP consumption from one pack to half a pack at the beginning (of the pandemic)... I was a little bit afraid (to be caught), because I would be punished when smoking without wearing a mask. But later I felt relaxed, because I found the enforcement was weak and they did not have enough manpower to implement it (the regulation). (Male, 45, cigarettes and HTPs)

In the societal level, no difference in changes of use pattern was observed across the three types of tobacco products.

The Community Level

Perceived Reactions of Others

Some tobacco users perceived stigma of their tobacco use behavior outside, especially during outbreaks, from others. They felt being discriminated when taking off the mask for smoking while others were conforming to the regulation of mask-wearing. To avoid such discrimination, they chose to decrease smoking outside or changed the smoking place.

I decreased smoking outside ... the major consideration was the perception of passers-by. Because others must wear masks on the street due to the mask regulation, but you are smoking on the street. This was the main reason rather than the fear of infection. (Male, 24, cigarettes and ECs)

Suspension of Smoking Cessation Services

As the government and many organizations started special work arrangements, healthcare providers, including primary care and smoking cessation services, reduced opening hours.¹⁹ As a result, a few cigarette smokers (but not alternative tobacco product users) who used the smoking cessation service before the pandemic reported reduced service use amid the pandemic.

The last time you saw me, I had just been to the smoking cessation centre. The services are worse now than in the past. Maybe (workers) could not return to work because of the pandemic, and so they served less... The consultation was shorter. That's just the way it is, because each consultation was in-person and lasted for about one hour... (Female, 45, cigarettes exclusively)

I checked the smoking cessation services a few months ago. It seemed that the centres did not open because of the pandemic, and so I did not go to the centre eventually... I think that maybe the government or non-profit organizations can provide some special smoking cessation service programmes, e.g. regularly posting nicotine patches to smokers. It could reduce the burden of traveling to the (smoking cessation) centres. (Male, 28, cigarettes exclusively)

Access to the Products

Cigarettes were well stocked in the retail stores. Because of no lockdown, cigarette smokers described no changes in accessibility. In contrast, most EC users who used to buy ECs at physical EC stores had turned to online stores. This was because the number of such stores was much less than retail stores selling cigarettes, and it was more difficult to buy ECs than cigarettes.

I will have a new job soon ... but I have not worked for a few months. I went to buy ECs (at an EC store) in Kwun Tong when I was working there. Sometimes, I bought ECs online using teleshopping... But now, I rarely buy it at the EC store. (Female, 24, ECs exclusively)

One participant attributed such change to being unable to smoke outside.

I bought ECs at the EC store before, but now, I do not go out to buy (EC), because I am too lazy. Because I cannot smoke outside, I'd rather shop online. (Female, 22, cigarettes and ECs)

Conversely, since HTPs have not formally entered the local market, it is more difficult to buy them amid the pandemic. Hence, HTP users either switched to cigarettes or reduced their HTP consumption without increasing cigarette use. A participant who had used HTPs for 2 years described:

I switched to conventional cigarettes again, because there was no supply (of HTPs) at the later period of COVID-19. It is difficult to buy HTPs. It happened late last year (December 2020)... I used HTPs if they were available and smoked cigarettes if HTPs were not available. (Male, 38, HTPs exclusively)

In the community level, "perceived reactions of others" was a common factor of changes in the three groups, while reduced smoking cessation services resulting from "suspension of services" was only mentioned by exclusive cigarette users. Due to the difficulty in obtaining ECs and HTPs amid the pandemic, most EC users turned to online purchases, and HTP users either switched to cigarettes or reduced HTP use.

The Relationship Level

Health Concern to Household Members

Amid the pandemic, some workers were advised to work from home and children had to study from home due to in-school class suspension. Therefore, some participants spent more time with their family members at home amid the pandemic, and they reduced tobacco use indoors to limit secondhand smoke exposure to their family members.

I decreased smoking because my family members were at home. It was inconvenient (to smoke). (Male, 27, cigarettes and HTPs)

Actually, I used ECs less because my kid studied at home for a long time... I did decrease the frequency of going outside and spent more time at home. To avoid secondhand smoke to my kid, I did decrease consumption. (Female, 39, ECs exclusively)

However, a few participants perceived ECs and HTPs as inodorous alternatives to cigarettes, and therefore, switched to using ECs or HTPs indoors. They equated less odor with less secondhand exposure to others. Their family members accepted their use of ECs and HTPs at home.

I used ECs because I live together with others. It is not good to make a strong smell when you are smoking (cigarettes)

but others are not... My family members felt good (about ECs), because they do not have an odour. (Male, 30, cigarettes and ECs)

I used HTPs at home and rarely used them on the street... Because they do not have an odour, and the secondhand smoke does not affect others as cigarettes do. The most important reason is actually ... there should not be too much secondhand smoke at home. (Male, 28, cigarettes and HTPs)

In the relationship level, some tobacco users reduced their consumption regardless of the tobacco product used, because of "health concern to household members." However, some dual users used more ECs or HTPs indoors as they perceived such products would produce less secondhand smoke.

The Individual Level

Health Concern to Themselves

In participants who decreased tobacco use amid the pandemic, most did it due to health concern. They were worried about contracting COVID-19 once they removed their masks to smoke.

I decreased smoking, because I am not bold enough to smoke outside. I am afraid of infection, including getting infected or infecting others. (Male, 20, cigarettes and ECs)

One participant who smoked 10 cigarettes per day had successfully quit smoking after being misdiagnosed with COVID-19.

Because I almost got the virus, so ... uhm ... I was hospitalized and even in the isolation ward to check if I had the virus. It was lucky that I did not get infected eventually... Then, a doctor told me that smokers were more likely to contract COVID-19, so I quit. (Male, 41, cigarettes exclusively)

However, due to their favorable perceptions of ECs, such as cleanness, odorlessness, and convenience, some dual users of cigarettes and ECs increased EC use amid the pandemic.

I smoked less now because it is inconvenient to smoke outside. You have to wash hands and do many things before smoking one cigarette, but you can use ECs anytime.... Because of the mask regulation, you have to remove the mask every time you smoke and put it in an appropriate place. And you have to wash hands before smoking because you will touch the cigarette tips. You know, your hands have bacteria (which will contaminate the tips). (Female, 31, cigarettes and ECs)

I used ECs instead because they are more convenient. I do not have to smoke outside, which decreases the risk of going outside. It is convenient and safe. For example, there are a lot of people smoking near the company. If I use ECs, I could use them in the office bathroom secretly.... Cigarettes will leave an odour on your body, but ECs will not. No one knows that I have used an EC in the bathroom. (Male, 19, cigarettes and ECs)

One EC user reported no change in EC consumption because of the convenience of EC use.

I had no change in EC use. I use ECs as normal because ECs do not need to be ignited. I can wear my mask immediately after I take a puff. (Male, 30, ECs exclusively)

Emotional Problems

In those who increased tobacco use amid the pandemic, most attributed such increase to the boredom associated with working from home, unpaid leave, and unemployment, and described tobacco use as a “time-filler.”

I used ECs more because I had nothing to do. The pandemic resulted in no business, so I used ECs more. The more ECs I used, the faster time seemed to pass. (Female, 28, ECs exclusively)

I was unemployed between November 2020 and February 2021, so I went outside less frequently and stayed at home at that time. I used to smoke 4-5 cigarettes per day, then I increased to half a pack, and later fell back, all related to work. I want to smoke if I have nothing to do. I always light a cigarette, for example, when I watch TV. (Female, 22, cigarettes and ECs)

Increased stress was primarily resulted from unemployment, job uncertainty, and domestic chores. A woman described home as a cage that trapped her:

I know I smoke more now... I feel that I was stuck at home and I did not have any breaks. Before, I went to work alone and there was nothing to distract me. But now, a lot of things can distract you at home, so you cannot do what you want to do. I need to get away from such a small space! You know how small Hong Kong homes are. (Female, 35, cigarettes exclusively)

A dual user mentioned that she used more cigarettes but not ECs, because ECs could not satisfy her stress-related addiction.

Before, I had unpaid leave and did not know when we had work and when we did not. In addition to the economic slump, I smoked more cigarettes to relieve stress.... Yes, I just increased cigarette-smoking (but not ECs), because ECs could not satisfy my addiction adequately. (Female, 18, cigarettes and ECs)

Financial Concern

Some participants mentioned serious financial issues due to COVID-19 and reduced cigarette use, as most of them had low (<HK\$20 000 [US\$2560]) and moderate (HK\$20 000-39 000 [US\$2560-4992]) household income monthly. However, three dual users reported using ECs more to compensate for the reduced cigarette consumption, because ECs were much cheaper.

Yes (I smoked less cigarettes for financial reasons). I use more ECs, because ECs are cheaper... (Male, 19, cigarettes and ECs)

Because of unpaid leave, I bought fewer cigarettes and bought more Relx (a brand of ECs). Yeah, because cigarettes are more expensive. (Male, 22, cigarettes and ECs)

In the individual level, “health concern to themselves” was the most common factor of decreased consumption

while “emotional problems” was the most common factor of increased consumption in cigarette, EC and HTP users alike. “Financial concern” was reported by some participants who reduced cigarette smoking. However, some EC users increased consumption due to favorable perceptions of ECs, such as cleanness, convenience, and cheapness.

Discussion

This qualitative paper offers comprehensive insights into how tobacco users perceived the threat of COVID-19 in relation to tobacco use and how they had changed their tobacco use behaviors amid the pandemic, and explores the differences across cigarette, EC, and HTP use.

About half of the participants thought tobacco use was not associated with the progression of COVID-19 despite evidence to the contrary is clear.² Public health education is needed to disseminate the evidence-based knowledge of the greater severity of COVID-19 associated with smoking. On the other hand, two-thirds of participants perceived no difference in infection risk between tobacco users and never users, possibly because of inconsistent results from early studies on the association between smoking and COVID-19 infection. Some studies found a lower proportion of smokers in COVID-19 patients than expected based on the estimated proportion in the general population, hence the claim that smoking protected against COVID-19 in the early stage of the pandemic.²⁵ Later, researchers argued that such apparent protective effect was subject to potential biases,²⁶ but it gained less attention. In addition, our study found that most participants obtained information based on their own experiences or opinions from people around and the social media. The social media was found a major source of rumors about COVID-19.²⁷ A lack of authoritative source, such as official news, would easily led to misperception. A study using Twitter data found the sentiment of tweets on smoking and COVID-19 became more hopeful just after the spread of results from studies in smoking’s favor.²⁸ The authors ascribed it to psychological processes that individuals tend to justify their own behaviors and reject opposite viewpoints to avoid cognitive dissonance.^{29,30} Any unverified and misleading information favoring smoking on social media should be monitored and clarified appropriately.

Individuals who increased tobacco consumption most frequently described it as a result of emotional distress. The finding was consistent with previous studies which showed increased tobacco use as a coping strategy to deal with stress and boredom amid the pandemic.^{12,13} The general public had experienced increased psychological distress during the COVID-19 outbreak,³¹ Smoking has long been documented as a coping strategy; perceived stress and negative affect were associated with increased smoking.³² Mitigating mental health issues related to COVID-19 may help control tobacco use amid the pandemic.

Decrease in tobacco use amid the pandemic was attributed to various personal and environmental factors. Pandemic-induced environmental factors, such as mandatory mask-wearing requirement, restricted group gatherings and thus reduced social activities had forced tobacco users to decrease tobacco consumption. Such desirable results, however, would be unsustainable when the pandemic is over. Indeed, the Hong Kong SAR Government specifically highlighted that taking off the mask for smoking is a violation but that for

eating or drinking is allowed when mandatory mask-wearing requirement was first implemented on July 23, 2020³³; however, some participants resumed usual smoking once they found the mandatory mask-wearing requirement was not seriously enforced. Notably, some participants mentioned that they did not reduce consumption but chose to smoke at more secluded places. The mandatory mask-wearing requirement might have affected some tobacco users' choice of smoking places, but not necessarily their consumption. In Hong Kong, smoke-free areas have been extended to all indoor areas of workplaces and public places, certain outdoor areas, and over 200 public transport facilities.³⁴ However, tobacco users can always find a place to smoke if they want to. The findings provide new insights for governments to examine their enforcement of tobacco control policies.

Health concern was the most commonly cited reason for decreasing tobacco use amid the pandemic. Interestingly, a cigarette smoker in our study quit smoking because of doctors' advice after he was suspected to have COVID-19. We had shown that the physician's brief advice was effective in tobacco abstinence in a randomized controlled trial with a 12-month follow-up.³⁵ Offering brief smoking cessation advice has good potential to be more widely practiced by health care professionals, taking advantage of the risk of smoking on COVID-19.

The study also found that health concerns to household members aided smoking reduction. However, tobacco health warnings more often focus on the harms on smokers themselves than on the harms of secondhand smoke on family members. For example, only 1 of 12 pictorial warning labels used in Hong Kong describes the harm to children.³⁶ Strengthening public health advocacy against secondhand smoke and to promote smoke-free household should help smoking reduction and cessation.

Previous studies showed increased quit intention and quit attempts due to the COVID-19 pandemic.^{5,9} However, our findings showed that some smoking cessation services were closed or reduced. Some participants reported that in-person services were too long and tedious and expressed a preference for remote forms of cessation support. In Hong Kong, smoking cessation services have adapted to introduce remote services, such as smoking cessation mobile clinic with outreach services in different locations, artificial intelligence chatbot which offers information related to smoking cessation and instant consultation, and mail-to-quit service which provides postal delivery of nicotine replacement therapy.³⁷ The Hong Kong Tobacco and Alcohol Control Office also launched the "Quit in June" campaign in June 2021 in response to the World No Tobacco Day.³⁸ Remote interventions by adapting web and mobile technologies would be promising alternatives to traditional in-person service,^{39,40} especially amid pandemics or in special situations where in-person services are unavailable.

Importantly, our study showed while overall consumption of each tobacco product decreased amid the pandemic, indoor consumption increased. Health risk of secondhand cigarette smoke has been well studied.⁴¹ Smoking indoors is particularly of concern in Hong Kong given the small living space. Our previous studies have shown harms of secondhand and thirdhand smoke exposure at home or from neighbors.⁴² Notably, Hong Kong implemented mandatory mask-wearing regulations that prohibit removing the mask for smoking amid the pandemic. Such regulations effectively prohibited individuals from using inhaled tobacco products in all public

places, indoors and outdoors. Our results suggest that this has displaced tobacco use to private indoor settings such as the family home. Policymakers should consider a comprehensive smoke-free policy both outside and inside home to protect nonsmokers.

In addition, although our study was unable to confirm whether exclusive cigarette users increased smoking in the presence of family members, we did observe that EC or HTP users highly rated ECs and HTPs as odor-free and expressed a preference for using ECs and HTPs indoors when living with others. However, we have reported respiratory-related health problems associated with HTP and EC use in Hong Kong.^{43,44} The WHO reiterated that less exposure to some harmful chemicals does not equal to less harmful to health since other toxicant levels are higher in HTPs than in conventional cigarettes.⁴⁵ Indeed, the popularity of using ECs and HTPs indoors or at home due to the misbelief of no or less harm would increase family members' and workmates' exposure to harmful chemicals from both increased EC and HTP use and reduced avoidance of others in the same room. Moreover, we found some HTP users compensated by smoking cigarettes when HTPs were unavailable. Exclusive HTP users have been found to have similar levels of nicotine dependence as exclusive, non-daily cigarette smokers, suggesting potential relapse to cigarettes in exclusive HTP users.⁴⁶ Our prospective study in Hong Kong has shown that baseline HTP use did not predict cigarette smoking abstinence at 6 months.⁴⁷ In addition, a Cochrane Review did not find any randomized controlled trials evaluating the effect of HTPs on cigarette smoking cessation, casting doubt on HTPs ability for this purpose.⁴⁸ Although the Hong Kong SAR Government has banned the import, manufacture, sale, distribution, and advertisement of alternative smoking products (ECs, HTPs, herbal cigarettes) on April 30, 2022, use of these products remain legal.⁴⁹ Smokers need better awareness of the risk of EC and HTP use to themselves and others, and their risk of addiction and relapse to cigarette use. Smoking cessation services should cover EC and HTP use as well as cigarette use.

As a qualitative study, we have a large sample size of 95 participants, which allowed us to describe the changes of tobacco use in subgroups using different products amid the pandemic. However, our results may not be generalizable to other regions or countries where tobacco control policies, the outbreaks, and COVID-19-related regulations were different. The percentages presented in this qualitative study could not be precise estimates of frequency or prevalence, and should only be suggestive. Finally, all interviews were conducted amid the pandemic. Whether the changes in tobacco use amid the pandemic would persist beyond the COVID-19 era is uncertain. Further qualitative and quantitative research to monitor changes in tobacco use behaviors and related factors is warranted.

Conclusions

Many participants did not perceive the association between tobacco use and COVID-19, which suggests the necessity of public health education to increase awareness of tobacco use impacts on COVID-19. Participants decreased overall consumption of each tobacco product but increased indoor consumption amid the pandemic, supporting a comprehensive

smoke-free policy both outside and inside home. Importantly, our study explored changes in tobacco use amid the pandemic in Hong Kong, where no lockdown was implemented but COVID-19-related regulations were enforced. We found a unique phenomenon in Hong Kong that COVID-19-related regulations forced tobacco users to decrease consumption, while such desirable results would be unsustainable when the enforcement is relaxed, which suggested that the enforcement of tobacco control policies should be monitored closely. In addition, health concerns to themselves and household members were commonly cited reasons for reduced tobacco use. Smoking cessation services can be improved by offering brief advice, strengthening advocacy against second-hand smoke, and covering EC and HTP use. The study also added new insights on how HTP and EC users changed their behaviors amid the pandemic. Notably, the specific characteristics of odourlessness of HTPs and ECs brought about increased consumption of HTPs and ECs indoors when living with family members, exposing others in the same room to harmful chemicals. Some HTP users compensated by smoking cigarettes when HTPs were unavailable. The finding cautions smokers who are using or have an intention to use HTPs for smoking cessation due to the risk of addiction and relapse to cigarette use.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

Acknowledgments

We would like to thank all participants for sharing thoughts and experiences with us, and also thank our research assistants, including Cheyenne Chan and Sin Lok Hang for conducting the interviews.

Funding

The study was self-initiated without external funding.

Declaration of Interest

None declared.

Data Availability

Data are available upon request to the corresponding author at syho@hku.hk.

References

- National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Chapter 7: Respiratory Diseases*. Atlanta, GA: Centers for Disease Control and Prevention (US); 2014. <https://www.ncbi.nlm.nih.gov/books/NBK294322/>. Accessed October 28, 2021.
- World Health Organization. *Smoking and COVID-19: Scientific Brief*. 2020. https://apps.who.int/iris/bitstream/handle/10665/332895/WHO-2019-nCoV-Sci_Brief-Smoking-2020.2-eng.pdf?sequence=1&isAllowed=y. Accessed October 28, 2021.
- Clift AK, von Ende A, San Tan P, et al. Smoking and COVID-19 outcomes: an observational and Mendelian randomisation study using the UK Biobank cohort. *Thorax*. 2022;77(1):65–73. doi:10.1136/thoraxjnl-2021-217080.
- Bommele J, Hopman P, Walters BH, et al. The double-edged relationship between COVID-19 stress and smoking: implications for smoking cessation. *Tob Induc Dis*. 2020;18:63. doi:10.18332/tid/125580.
- Klemperer EM, West JC, Peasley-Miklus C, Villanti AC. Change in tobacco and electronic cigarette use and motivation to quit in response to COVID-19. *Nicotine Tob Res*. 2020;22(9):1662–1663.
- Gendall P, Hoek J, Stanley J, Jenkins M, Every-Palmer S. Changes in tobacco use during the 2020 COVID-19 lockdown in New Zealand. *Nicotine Tob Res*. 2021;23(5):866–871.
- Rigotti NA, Chang Y, Regan S, et al. Cigarette smoking and risk perceptions during the COVID-19 pandemic reported by recently hospitalized participants in a smoking cessation trial. *J Gen Intern Med*. 2021;36(12):3786–3793. doi:10.1007/s11606-021-06913-3.
- Di Renzo L, Gualtieri P, Pivari F, et al. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J Transl Med*. 2020;18(1):229.
- Jackson SE, Garnett C, Shahab L, Oldham M, Brown J. Association of the COVID-19 lockdown with smoking, drinking and attempts to quit in England: an analysis of 2019–20 data. *Addiction*. 2021;116(5):1233–1244.
- Kowitz SD, Cornacchione Ross J, Jarman KL, et al. Tobacco quit intentions and behaviors among cigar smokers in the United States in response to COVID-19. *Int J Environ Res Public Health*. 2020;17(15):5368.
- Gravelly S, Craig LV, Cummings KM, et al. Smokers' cognitive and behavioural reactions during the early phase of the COVID-19 pandemic: findings from the 2020 ITC four country smoking and vaping survey. *PLoS One*. 2021;16(6):e0252427.
- Grogan S, Walker L, McChesney G, et al. How has COVID-19 lockdown impacted smoking? A thematic analysis of written accounts from UK smokers. *Psychol Health*. 2020;37(1):17–33. doi:10.1080/08870446.2020.1862110.
- Schnitzer K, Jones S, Kelley JH, et al. A qualitative study of the impact of COVID-19 on smoking behavior for participants in a post-hospitalization smoking cessation trial. *Int J Environ Res Public Health*. 2021;18(10):5404.
- Giovenco DP, Spillane TE, Maggi RM, Lee EY, Philbin MM. Multi-level drivers of tobacco use and purchasing behaviors during COVID-19 "lockdown": a qualitative study in the United States. *Int J Drug Policy*. 2021;94:103175. doi:10.1016/j.drugpo.2021.103175.
- Klein EG, Koopman Gonzalez S, Pike Moore S, et al. Pulling your mask down to smoke: qualitative themes from young adults on nicotine use during a pandemic. *Subst Use Misuse*. 2020;56(4):437–441.
- Amin M, Syed J, Salman HM, et al. Smoking and vaping during the covid-19 pandemic: a qualitative study among healthcare workers in a low and middle-income country. *Preprints*. 2021, 2021050200. doi:10.20944/preprints202105.0200.v1.
- Hwang J, Chun H-R, Cheon E. A Qualitative study on the impact of COVID-19 on the behavior and attitudes of smokers and non-smokers in South Korea. *BMC Public Health*. 2021;21(1):1–8.
- The Government of the Hong Kong Special Administrative. *Together We Fight the Virus*. 2021. <https://www.coronavirus.gov.hk/eng/index.html>. Accessed October 11, 2021.
- The Government of the Hong Kong Special Administrative. *Special Work Arrangement for Government Employees*. 2020. <https://www.info.gov.hk/gia/general/202001/28/P2020012800310.htm>. Accessed October 28, 2021.
- Sun Y, Lam TH, Cheung YTD, et al. First report on smoking and infection control behaviours at outdoor hotspots during the COVID-19 pandemic: an unobtrusive observational study. *Int J Environ Res Public Health*. 2021;18(3):1031.
- Cheung YT, Wang MP, Ho SY, Lee P. *Report on Tobacco Control Policy-related Survey 2017*. Hong Kong SAR: Hong Kong Council on Smoking and Health; 2018.

22. Wu Y, Cheung YT, Ho SY, Tong SC, Lai WY, Lam TH, Wang MP. *Report on Tobacco Control Policy-related Survey 2020*. Hong Kong SAR: Hong Kong Council on Smoking and Health; 2021.
23. Grady MP. *Qualitative and Action Research: A Practitioner Handbook*. Bloomington, IN: Phi Delta Kappa International; 1998.
24. US Centers for Disease Control and Prevention. *The Social-Ecological Model: A Framework for Prevention*. 2021. <https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html>. Accessed October 28, 2021.
25. van Westen-Lagerweij NA, Meijer E, Meeuwse EG, *et al*. Are smokers protected against SARS-CoV-2 infection (COVID-19)? The origins of the myth. *NPJ Prim Care Respir Med*. 2021;31(1):1–3.
26. Usman MS, Siddiqi TJ, Khan MS, *et al*. Is there a smoker's paradox in COVID-19? *BMJ Evid Based Med*. 2020;26(6):279–284. doi:10.1136/bmjebm-2020-111492.
27. Zhou J, Ghose B, Wang R, *et al*. Health perceptions and misconceptions regarding COVID-19 in China: online survey study. *J Med Internet Res*. 2020;22(11):e21099.
28. Kamiński M, Muth A, Bogdański P. Smoking, vaping, and tobacco industry during COVID-19 pandemic: Twitter data analysis. *Cyberpsychol Behav Soc Netw*. 2020;23(12):811–817.
29. Klayman J, Ha Y-W. Confirmation, disconfirmation, and information in hypothesis testing. *Psychol Rev*. 1987;94(2):211–228. doi:10.1037/0033-295X.94.2.211.
30. Festinger L. *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press; 1957.
31. Zhao SZ, Wong JYH, Luk TT, *et al*. Mental health crisis under COVID-19 pandemic in Hong Kong, China. *Int J Infect Dis*. 2020;100:431–433. doi:10.1016/j.ijid.2020.09.030.
32. Stubbs B, Veronese N, Vancampfort D, *et al*. Perceived stress and smoking across 41 countries: a global perspective across Europe, Africa, Asia and the Americas. *Sci Rep*. 2017;7(1):1–8.
33. The Government of the Hong Kong Special Administrative Region. *Cap. 599I Prevention and Control of Disease (Wearing of Mask) Regulation*. 2020. <https://www.elegislation.gov.hk/hk/cap599I/en>. Accessed October 28, 2021.
34. The Government of the Hong Kong Special Administrative Region. *Cap. 371 Smoking (Public Health) Ordinance*. 2021. https://www.elegislation.gov.hk/hk/cap371?xpid=ID_1438403108469_001. Accessed October 28, 2021.
35. Cheung YT, Jiang N, Jiang CQ, *et al*. Physicians' very brief (30-sec) intervention for smoking cessation on 13 671 smokers in China: a pragmatic randomized controlled trial. *Addiction*. 2021;116(5):1172–1185.
36. The Government of the Hong Kong Special Administrative Region. *Cap. 371B Smoking (Public Health) (Prescribed Information) Order*. 2017. <https://www.elegislation.gov.hk/hk/cap371B>. Accessed October 28, 2021.
37. Tung Wah Group of Hospitals. *Integrated Centre on Smoking Cessation*. 2021. <https://icsc.tungwahcsd.org/>. Accessed October 28, 2021.
38. The Government of the Hong Kong Special Administrative Region. *DH Launches Quit in June Campaign in Support of World No Tobacco Day [Press release]*. 2021. <https://www.info.gov.hk/gia/general/202105/31/P2021053100794.htm>. Accessed October 28, 2021.
39. Nomura A, Tanigawa T, Muto T, *et al*. Clinical efficacy of telemedicine compared to face-to-face clinic visits for smoking cessation: multicenter open-label randomized controlled noninferiority trial. *J Med Internet Res*. 2019;21(4):e13520.
40. Wang MP, Luk TT, Wu Y, *et al*. Chat-based instant messaging support integrated with brief interventions for smoking cessation: a community-based, pragmatic, cluster-randomised controlled trial. *Lancet Digit Health*. 2019;1(4):e183–e192.
41. US. Centers for Disease Control and Prevention. *Secondhand Smoke (SHS) Facts*. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/general_facts/index.htm. Accessed March 30, 2022.
42. Leung LT, Ho SY, Wang MP, Lam TH. Secondhand smoke from multiple sources, thirdhand smoke and respiratory symptoms in Hong Kong adolescents. *Nicotine Tob Res*. 2018;20(2):192–198.
43. Wang MP, Ho SY, Leung LT, Lam TH. Electronic cigarette use and respiratory symptoms in Chinese adolescents in Hong Kong. *JAMA Pediatr*. 2016;170(1):89–91.
44. Wang L, Chen J, Leung LT, *et al*. Characterization of respiratory symptoms among youth using heated tobacco products in Hong Kong. *JAMA Netw Open*. 2021;4(7):e2117055.
45. World Health Organization. *WHO Statement on Heated Tobacco Products and the US FDA Decision Regarding IQOS*. 2020. <https://www.who.int/news/item/27-07-2020-who-statement-on-heated-tobacco-products-and-the-us-fda-decision-regarding-iqos>. Accessed August 26, 2021.
46. Lau YK, Okawa S, Meza R, Katanoda K, Tabuchi T. Nicotine dependence of cigarette and heated tobacco users in Japan, 2019: a cross-sectional analysis of the JASTIS study. *Tob Control*. 2021;tobaccocontrol-2020-056237. doi:10.1136/tobaccocontrol-2020-056237.
47. Luk TT, Weng X, Wu YS, *et al*. Association of heated tobacco product use with smoking cessation in Chinese cigarette smokers in Hong Kong: a prospective study. *Tob Control*. 2020;30(6):653–659.
48. Tattan-Birch H, Hartmann-Boyce J, Kock L, *et al*. Heated tobacco products for smoking cessation and reducing smoking prevalence. *Cochrane Database Syst Rev*. 2022;1(1):CD013790. doi:10.1002/14651858.CD013790.pub2.
49. The Government of the Hong Kong Special Administrative Region. *Hospital Authority Welcomes Passage of Smoking (Public Health) (Amendment) Bill 2019 [Press release]*. 2021. <https://www.info.gov.hk/gia/general/202110/21/P2021102100523.htm?fontSize=1>. Accessed October 28, 2021.