

Factors influencing smoking cessation: Insights from Singapore's nationwide health and lifestyle survey

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ABSTRACT

Introduction: Singapore has implemented an evidence-based smoking cessation framework to support smokers in quitting. Our study investigated the prevalence and correlates of (1) quit attempts (QA) and quit intentions (QI) among current smokers, and (2) smoking cessation (SC) among ever-smokers in Singapore.

Method: Data was collected from a nationwide survey conducted between 2020 and 2022. QA was defined as attempting to stop smoking at least once in the past 12 months, while QI was defined as planning to quit smoking within the next 30 days or the next 6 months. SC referred to individuals who quit smoking over 6 months ago. Sociodemographic factors, doctor's advice to quit and perceived harm from smoking were assessed using logistic regression among current smokers (n=1024) and ever-smokers (n=1457).

Results: Among current smokers, 31.3% and 41.2% reported QI and QA, respectively. Smokers with secondary or pre-tertiary education were less likely to report QI compared to those with a degree or higher. Doctor's advice to quit was associated with a higher likelihood of QA. Among ever-smokers, 25.3% reported SC, and this was more likely when they perceived smoking 1 or more packs of cigarettes daily as posing a moderate or high health risk.

Conclusion: Educational campaigns should focus on simplifying messages for individuals with lower literacy levels. Smoking cessation training can be incorporated into medical education, and graphic health warnings on cigarette packs can help effectively communicate the dangers of smoking.

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Keywords: epidemiology, public health, quit attempt, quit intention, smoking cessation

CLINICAL IMPACT

What is New

- This study adds to global knowledge on of smoking cessation by identifying key factors within a diverse, multi-ethnic population.
- Higher educational attainment and perceived harm from smoking increased the likelihood of quitting.

Clinical Implications

- Smoking cessation campaigns should be designed to be easily understood, especially by those with lower literacy levels.
- Singapore's current approach, including graphic health warning on cigarette packs, can serve as a model for other countries looking to boost smoking cessation rates.

INTRODUCTION

The global prevalence of smoking has declined over the years. According to authors utilising data from the Global Burden of Disease, Injuries, and Risk Factors Study, from 1990 to 2020, the number of male smokers fell by 27.2%, whereas female smokers fell by 37.9%.¹ Moreover, the decline in smoking prevalence was higher in countries with a higher sociodemographic index than those with a lower sociodemographic index.¹ Despite the fall in smoking prevalence worldwide, challenges in smoking cessation remain. One prominent challenge is the emergence of the e-cigarette, the novelty

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of which has enticed younger individuals to start smoking.² Developing countries face additional challenges such as limited awareness and poor access to smoking cessation services.³

Similar to other countries, Singapore faces several challenges in improving its smoking cessation rates. A Singapore-based study on patients with substance use disorders identified several hurdles to cessation, including withdrawal symptoms, high cost of smoking cessation treatments, and lack of motivation.⁴ Nonetheless, smoking prevalence in Singapore has declined from 13.9% to 10.1% between 2010 to 2020.⁵ This decline can be attributed to Singapore's multiprolonged approach to reducing smoking rates, which involves the enforcement of 2 primary legislative acts: the Tobacco (Control of Advertisement and Sale) Act and the Smoking (Prohibition in Certain Places) Act.⁶ The former act encompasses measures such as prohibiting the sale of tobacco products to individuals below 21 years old and banning advertisements of tobacco products. The latter act restricts smoking in specific public places, including public transport and hospitals. Additionally, there is the "I Quit" smoking cessation programme that tailors cessation plans for smokers according to their characteristics.⁷ These successful strategies to reduce smoking prevalence can be a blueprint for other countries with high smoking prevalence.

International studies, brought together through systematic reviews, have identified factors that influence smoking quit attempts and cessation.^{8,9} They found that individuals were more likely to attempt quitting if they had made previous attempts to quit, had longer duration of abstinence and had motivation to quit.⁸ Moreover, individuals were more likely to cease smoking if they smoked more cigarettes per day and had a negative perception of smoking.⁹ However, a common limitation of these systematic reviews is methodological heterogeneity, whereby the study methods are so diverse that it is difficult to compare findings for several correlates.^{8,9} With Singapore's multicultural context and multiprolonged approach to smoking cessation, understanding the factors behind its success can provide a complementary perspective for other countries struggling with low cessation rates.

Hence, our study aimed to examine the prevalence and correlates of different stages of smoking cessation in Singapore, which include intentions and attempts to quit and smoking cessation.

METHOD

This cross-sectional study is part of a larger study that aimed to examine drug consumption in Singapore (i.e. Health and Lifestyle Survey). In addition to drug

consumption, the study captured comprehensive information on participants' sociodemographic and lifestyle habits. The methodology is explained in a previous publication.¹⁰ Briefly, the study obtained its sample (n=6509) from an administrative database and adopted a disproportionate stratified sampling design. The analysis was weighted to account for disproportionate stratified sampling, non-response and post-stratification by age, sex and ethnicity. These processes are similar to those used in other population-based studies,^{11,12} ensuring that the analysis is representative of Singapore's population.

Individuals were included if they were (1) Singapore citizens or permanent residents living in Singapore, (2) aged 15–65 years old, and (3) literate in English, Mandarin, Malay or Tamil. The exclusion criteria were (1) inability to do the interview and (2) hospitalised or institutionalised during the study period.

The study team employed a survey company to carry out the study between April 2021 and July 2022. The study team also trained lay interviewers to conduct the interviews. Due to COVID-19 restrictions, after obtaining consent from the participant face-to-face, a QR code or link was given to the participants, followed by a unique number for them to complete the online survey.

As the study involved asking sensitive questions such as illicit drug use, steps were taken to protect the participants' identity. No identifiers were collected. The questionnaire was self-administered using tablets, and only verbal consent was taken to avoid documentation. Consent was not documented to minimise the risk of identifying the participants and to protect them from potential legal issues due to their responses. Moreover, parental consent was waived for participants who were minors. All questions had choices such as "I prefer not to answer" and "I don't know" so that participants could skip questions they found personal. Three months after the survey's completion, the survey company destroyed all contact information. The study protocol adhered to the ethical standards of the responsible committee on human experimentation (institutional and national) and with the principles of the Declaration of Helsinki. The study was approved by the Domain Specific Review Board from the National Healthcare Group.¹

Smoking-related outcomes

The outcome variables were intentions to quit, attempts at quitting, and smoking cessation. Participants were asked to indicate their smoking status using one of the following options: smoker (daily or sometimes a week), former smoker, and

non-smoker. Among current smokers (i.e. participants who smoked daily or a few times a week), intentions to quit were assessed by asking them if they had planned to quit in the next 30 days, next 6 months or not at all in the next 6 months. Those who had planned to quit in the next 30 days or next 6 months were considered to have intentions to quit. Attempts at quitting were evaluated among the current smokers using the question: "How many times have you tried to stop smoking in the past 12 months?" Those who had tried to stop smoking at least once in the past 12 months were classified as having attempted to quit. In examining smoking cessation, the study used the term "ever-smoker" to denote participants who answered either "smoker (daily or sometimes a week)" or "former smoker". Smoking cessation was assessed by asking former smokers whether they "quit more than 6 months ago" or "quit within the last 6 months". Those who had quit more than 6 months ago were considered to have successfully achieved smoking cessation.

Independent variables

Our study examined the association between the outcome variables with the following variables: age, sex, ethnicity, education, marital status, having children, employment, personal income, number of chronic conditions, age of initiation of smoking, perceived risk of harm for occasional smoking and smoking 1 or more packs daily. The perceived risks of harm associated with smoking were self-reported using a 4-point Likert scale (i.e. no risk, little risk, moderate risk and great risk of harm). In this analysis, perceived risk of harm was dichotomised into no/little risk of harm and moderate/great risk of harm. For intentions and attempts to quit, additional variables were examined. These variables were doctor's advice to quit smoking and nicotine dependence.

Chronic conditions were self-reported by individuals using a modified checklist of 18 chronic conditions. These conditions were asthma, arthritis, back problems, cancer, chronic inflammatory bowel disease, chronic lung diseases, congestive heart failure, diabetes, heart disease, hyperlipidaemia, hypertension, kidney failure, migraine, neurological conditions including Parkinson's disease, stomach ulcer, stroke and thyroid disease. Our study classified the responses into 3 groups: no chronic condition, 1 chronic condition, and 2 or more chronic conditions.

Nicotine dependence was assessed using the Fagerstrom test for nicotine dependence.¹³ Individuals were classified as having very low nicotine dependence if the score was 0–2, low nicotine dependence if the score was 3–4, and moderate-to-high nicotine dependence if the score was 5 and above.¹³

Statistical analysis

Weighted percentages and unweighted counts were presented for all categorical variables. Multiple logistic regression was conducted to determine the correlates of each smoking-related outcome. For each outcome, the following steps were performed: (1) a univariate logistic regression model was generated to identify potential correlates, and (2) variables with P value <0.05 were included in the initial multivariable logistic regression using the enter method. Subsequently, variables with P value >0.05 were removed and another multivariable logistic regression analysis was performed to determine the final model.

The results of the models were presented in odds ratio (OR) and 95% confidence interval (CI). Standard error was estimated using Taylor linearisation. The analysis was generated using IBM SPSS version 23 (IBM Corp, Armonk, US) and Stata/MP 18.0 (StataCorp, College Station, US), with 2-tailed tests at a 5% significance level.

RESULTS

The analysis included 1457 ever-smokers, of which 1024 were current smokers. Among the 1024 current smokers, 1021 answered the question on intention to quit and 881 answered the question on attempts to quit.

Most participants in both groups were male (current smokers: 82.99%, ever-smoker: 80.54%), of Chinese ethnicity (current smoker: 63.48%, ever-smoker: 63.15%), married (current smoker: 59.24%, ever-smoker: 59.71%), had no children (current smoker: 65.94%, ever-smoker: 64.97%), and were either employed or self-employed (current smoker: 86.82%, ever-smoker: 86.26%) (Table 1). Regarding smoking-related variables, most participants in both groups started smoking at 18 years of age or later (current smoker: 51.55%, ever-smoker: 52.53%), and received advice from a doctor to quit smoking (current smoker: 84.55%, ever-smoker: 87.66%) (Table 1). Additionally, most participants in both groups believed that smoking occasionally or smoking at least 1 pack per day presented a moderate to great risk of harm (Table 1).

Among current smokers, the prevalence of intentions and attempts to quit were 31.27% ($n=385$) and 41.21% ($n=427$), respectively (Fig. 1). Among ever-smokers, the prevalence of smoking cessation was 25.25% ($n=345$).

Table 2 presents the logistic regression models for intentions to quit. In the multivariable model, current smokers were more likely to contemplate quitting if they were of Malay (versus [vs] Chinese, OR 1.62, 95% CI 1.004–2.61) or Indian ethnicity (vs

Table 1. Characteristics of current smokers and ever-smokers.

	Current smokers (n=1024)		Ever-smokers (n=1457)	
	Weighted %	Unweighted n	Weighted %	Unweighted n
Age groups, years				
15–34	33.97	369	35.10	554
35–49	32.16	368	33.73	524
50–65	33.87	287	31.17	379
Sex				
Female	17.01	183	19.46	308
Male	82.99	841	80.54	1149
Ethnicity				
Chinese	63.48	233	63.15	335
Malay	23.92	493	24.05	700
Indian	9.65	262	9.45	366
Others	2.95	36	3.36	56
Education				
Degree/professional qualification and postgraduate and above	15.82	117	20.44	222
No formal education/primary	12.96	128	10.31	165
Secondary school	34.17	320	31.49	426
Pre-tertiary education ^a	37.06	447	37.75	630
Marital status				
Married	59.24	602	59.71	856
Single	32.71	324	32.88	469
Separated/widowed/divorced	8.05	94	7.41	125
Have children				
No	65.94	632	64.97	902
Yes	34.06	392	35.03	555
Employment				
Employed/self-employed	86.82	874	86.26	1217
Economically inactive/students	9.05	89	9.84	153
Unemployed/temporarily laid off	4.13	44	3.90	64
Personal income, SGD				
No income/below 2000	39.51	355	37.04	484
2000 to 3999	35.72	341	35.27	483
4000 to 6999	13.31	97	14.63	147
7000 and above	11.47	68	13.07	113

Table 1. Characteristics of current smokers and ever-smokers. (Cont'd)

	Current smokers (n=1024)		Ever-smokers (n=1457)	
	Weighted %	Unweighted n	Weighted %	Unweighted n
Number of chronic conditions				
0	51.94	521	48.74	711
1	29.61	269	30.03	391
2 or more	18.44	222	21.23	339
Age of onset for smoking				
<18 years old	48.45	406	47.47	569
≥18 years old	51.55	418	52.53	608
Received advice from doctor to stop smoking				
Yes	15.45	182	12.34	
No	84.55	839	87.66	
Nicotine dependence				
Very low	52.63	533		
Low	28.57	285		
Moderate to high	18.79	203		
Perceived risk of harm (smoke occasionally)				
No/little risk of harm (reference)	46.96	379	42.35	494
Moderate/great risk of harm	53.04	476	57.65	741
Perceived risk of harm (smoke 1 or more packs per day)				
No/little risk of harm (reference)	13.86	127	10.91	142
Moderate/great risk of harm	86.14	733	89.09	1104

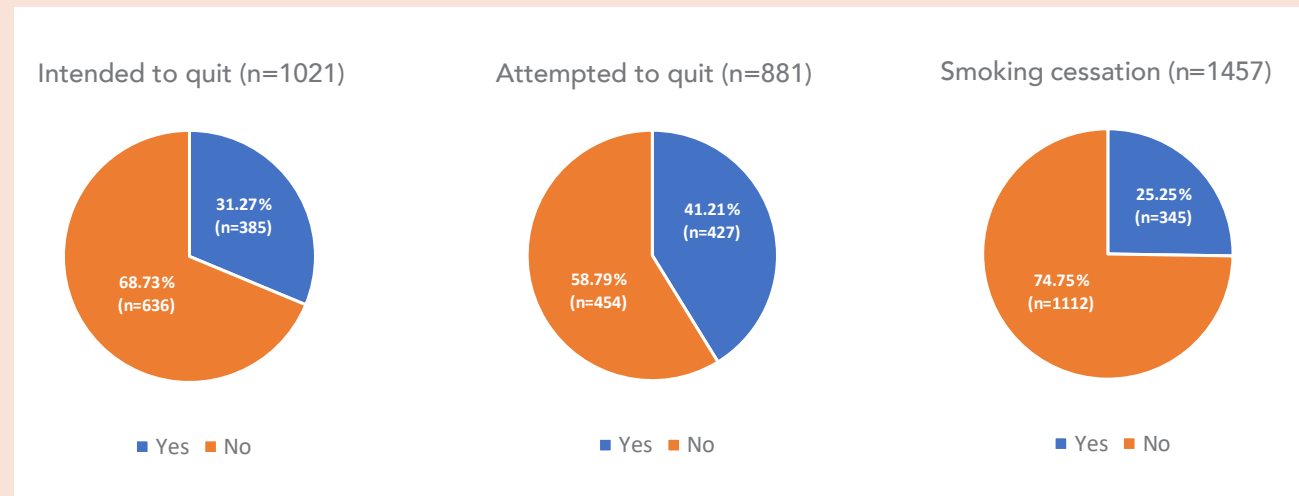
Missing data: education (current smoker [n=12], ever-smoker [n=14]); marital status (current smoker [n=4], ever-smoker [n=7]); employment (current smoker [n=17], ever-smoker [n=23]); personal income (current smoker [n=163], ever-smoker [n=230]); number of chronic conditions (current smoker [n=12], ever-smoker [n=16]); age of initiation to smoking (current smoker [n=200], ever-smoker [n=280]); received advice from doctor to stop smoking (current smoker [n=3]); nicotine dependence (current smoker [n=3]); perceived risk of harm (smoke occasionally) (current smoker [n=169], ever-smoker [n=222]); perceived risk of harm (smoke 1 or more packs per day) (current smoker [n=164], ever-smoker [n=211])

^a Pre-tertiary education includes vocational institute/institute of technical education/pre-university/junior college/diploma/International Baccalaureate

Chinese, OR 2.59, 95% CI 1.61–4.18), and had attempted to quit previously (OR 8.15, 95% CI 5.02–13.22). Current smokers were less likely to have intentions to quit if they had secondary school education (vs degree and above, OR 0.32, 95% CI 0.14–0.69) or pre-tertiary education (vs degree and above, OR 0.37, 95% CI 0.17–0.80), separated/widowed/divorced (vs married, OR 0.34, 95% CI 0.17–0.69), and had low (vs very low, OR 0.53, 95% CI 0.31–0.89) or moderate-to-high nicotine dependence (vs very low, OR 0.53, 95% CI 0.29–0.97).

For correlates for attempts to quit, current smokers were more likely to attempt quitting if they were of Malay (vs Chinese, OR 2.21, 95% CI 1.49–3.29) or Indian ethnicity (vs Chinese, OR 2.18, 95% CI 1.40–3.39), had received doctor's advice to quit smoking (OR 2.36, 95% CI 1.29–4.32), and perceived occasional smoking to have moderate or great risk of harm (vs no/little harm, OR 1.91, 95% CI 1.24–2.94) (Table 3). They were less likely to attempt quitting if they had moderate-to-high nicotine dependence (vs very low dependence, OR 0.49, 95% CI 0.28–0.85).

Fig. 1. Proportion of current smokers that had intentions or attempts to quit, and proportion of ever-smokers that achieved smoking cessation.



In Table 4, ever-smokers were more likely to cease smoking if they had 2 or more chronic conditions (vs no chronic condition, OR 2.14, 95% CI 1.35–3.38), and perceived smoking 1 or more packs daily to have moderate or great risk of harm (vs no/little harm, OR 4.52, 95% CI 1.89–10.80). They were less likely to quit smoking if they were male (vs female, OR 0.64, 95% CI 0.43–0.94), and had primary school education and below (vs degree and above, OR 0.19, 95% CI 0.10–0.38), secondary school (vs degree and above, OR 0.39, 95% CI 0.23–0.65) or pre-tertiary education (vs degree and above, OR 0.54, 95% CI 0.34–0.84).

DISCUSSION

Our study examined the prevalence of intentions to quit, attempts at quitting and smoking cessation in Singapore. Our study has a higher proportion of current smokers who intended to quit (31.27%) and attempted to quit (41.21%), and the proportion of those who ceased smoking successfully lagged behind (25.25%). Consistent with this finding, a study from the US reported a higher proportion of intention to quit (77.1%) than smoking cessation (7.5%).¹⁴ A similar trend was also found in a Malaysian study, which found that while 49.1% of smokers attempted quitting, the success rate for smoking cessation was lower at 31.4%.¹⁵ These studies imply that globally, smokers face challenges in translating intention and attempts to quit into successful cessation.

A prominent finding in our study was that current smokers who were advised by a doctor to quit

smoking were more likely to attempt quitting. Similarly, in a systematic review that examined 42 trials worldwide, brief advice from a physician increased the chance of smoking cessation.¹⁶ These findings suggest that integrating cessation advice into primary healthcare settings can be an important intervention for smoking cessation worldwide. Currently, in Singapore, a framework for addressing tobacco dependence exists within the primary healthcare setting.¹⁷ Moreover, smoking cessation clinics are available in polyclinics and restructured hospitals.¹⁷ Other countries can modify these measures by providing appropriate training to clinicians on offering advice and support based on their cultural context.

Our study also found that individuals with a higher perceived risk of harm from 1 or more packs of cigarettes were more likely to quit smoking successfully. Moreover, those with a higher perceived risk of harm from occasional smoking were more likely to attempt quitting. These findings align with studies in other countries, demonstrating that awareness of the harmful effects of smoking is associated with smoking cessation.^{18,19} In a study among Korean adolescents, graphic health warnings increased the odds of attempts to quit by 1.72 times for boys and by 1.74 times for girls.¹⁸ An Australian market research reported that among ever-smokers, 61% of those who quit successfully said that graphic health warnings made them more concerned about their smoking habits, leading them to quit.¹⁹

Our study found that those with nicotine dependence were less likely to have the intention

Table 2. Logistic regression with intentions to quit as outcome.

	Intentions to quit			
	Univariate regression		Multivariable regression (n=874)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Age groups, years				
15–34 (reference)				
35–49	0.55 (0.37–0.82)	0.003		
50–65	0.45 (0.28–0.72)	0.001		
Sex				
Female (reference)				
Male	0.84 (0.53–1.33)	0.459		
Ethnicity				
Chinese (reference)				
Malay	1.73 (1.21–2.45)	0.002	1.62 (1.004–2.61)	0.048
Indian	2.48 (1.69–3.64)	<0.001	2.59 (1.61–4.18)	<0.001
Others	2.50 (1.20–5.23)	0.014	2.01 (0.84–4.82)	0.117
Education				
Degree/professional qualification and postgraduate and above (reference)				
No formal education/primary	0.35 (0.17–0.73)	0.005	0.33 (0.11–1.02)	0.054
Secondary school	0.43 (0.24–0.76)	0.004	0.32 (0.14–0.69)	0.004
Pre–tertiary education ^b	0.68 (0.39–1.16)	0.156	0.37 (0.17–0.80)	0.011
Marital status				
Married (reference)				
Single	1.58 (1.08–2.32)	0.019	0.92 (0.56–1.52)	0.743
Separated/ widowed/divorced	0.56 (0.28–1.15)	0.113	0.34 (0.17–0.69)	0.003
Have children				
Yes (reference)				
No	1.44 (0.98–2.10)	0.060		
Employment				
Employed/self–employed (reference)				
Economically inactive/students	0.73 (0.38–1.40)	0.349		
Unemployed/temporarily laid off	1.37 (0.55–3.39)	0.495		
Personal income, SGD				
No income/below 2000 (reference)				
2000 to 3999	0.85 (0.55–1.31)	0.452		
4000 to 6999	0.60 (0.30–1.18)	0.137		
7000 and above	1.04 (0.51–2.12)	0.917		

Table 2. Logistic regression with intentions to quit as outcome. (Cont'd)

	Intentions to quit			
	Univariate regression		Multivariable regression (n=874)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Number of chronic conditions				
0 (reference)				
1	0.79 (0.51–1.21)	0.275		
2 or more	1.27 (0.79–2.05)	0.327		
Age of initiation to smoking				
<18 years old (reference)				
≥18 years old	1.18 (0.79–1.77)	0.430		
Received advice from doctor to stop smoking				
No (reference)				
Yes	1.56 (0.97–2.49)	0.066		
Nicotine dependence				
Very low (reference)				
Low	0.42 (0.27–0.65)	<0.001	0.53 (0.31–0.89)	0.017
Moderate to high	0.42 (0.25–0.69)	0.001	0.53 (0.29–0.97)	0.039
Perceived risk of harm (smoke occasionally)				
No/little risk of harm (reference)				
Moderate/great risk of harm	1.88 (1.26–2.81)	0.002		
Perceived risk of harm (smoke 1 or more packs per day)				
No/little risk of harm (reference)				
Moderate/great risk of harm	1.60 (0.88–2.90)	0.125		
Previous attempt to quit				
No (reference)				
Yes	7.87 (4.95–12.52)	<0.001	8.15 (5.02–13.22)	<0.001

CI: confidence interval; OR: odds ratio

^a P values in bold indicate statistical significance (*P* < 0.05).^b Pre-tertiary education includes vocational institute/institute of technical education/pre-university/junior college/diploma/ International Baccalaureate

to quit or to attempt to quit smoking. This finding is not surprising, as they likely experienced stronger addiction or more severe withdrawal symptoms. This finding highlights the need for increased support, such as nicotine replacement therapy and counselling, for these individuals. Additionally, future research could explore interventions and communication strategies that might encourage them to develop the intention to quit or take steps towards quitting smoking.

For sociodemographic correlates, a noteworthy finding is that lower educational qualification is significantly associated with a lower likelihood of intention to quit and smoking cessation. These findings corroborate with findings from other population-based studies. A longitudinal Finland-based study found that higher educational levels were associated with higher odds of smoking cessation.²⁰ Similarly, a study that utilised data from Australia, Canada, the UK and US reported that

Table 3. Logistic regression with attempts to quit as outcome.

	Attempts to quit			
	Univariate regression		Multivariable regression (n=756)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Age groups, years				
15–34 (reference)				
35–49	0.57 (0.38–0.87)	0.009		
50–65	0.74 (0.46–1.20)	0.224		
Sex				
Female (reference)				
Male	1.29 (0.79–2.12)	0.310		
Ethnicity				
Chinese (reference)				
Malay	2.17 (1.51–3.11)	<0.001	2.21 (1.49–3.29)	<0.001
Indian	2.18 (1.46–3.27)	<0.001	2.18 (1.40–3.39)	0.001
Others	2.46 (1.11–5.45)	0.027	2.15 (0.84–5.47)	0.110
Education				
Degree/professional qualification and postgraduate and above (reference)				
No formal education/primary	1.07 (0.49–2.34)	0.865		
Secondary school	1.00 (0.53–1.87)	0.996		
Pre-tertiary education ^b	1.64 (0.91–2.95)	0.099		
Marital status				
Married (reference)				
Single	1.77 (1.18–2.64)	0.006		
Separated/widowed/divorced	0.68 (0.32–1.41)	0.297		
Have children				
Yes (reference)				
No	1.11 (0.75–1.63)	0.613		
Employment				
Employed/self-employed (reference)				
Economically inactive/students	1.21 (0.61–2.41)	0.583		
Unemployed/temporarily laid off	1.59 (0.58–4.40)	0.369		
Personal income, SGD				
No income/below 2000 (reference)				
2000 to 3999	1.11 (0.70–1.76)	0.653		
4000 to 6999	0.81 (0.42–1.59)	0.547		
7000 and above	1.17 (0.57–2.43)	0.666		

Table 3. Logistic regression with attempts to quit as outcome. (Cont'd)

	Attempts to quit			
	Univariate regression		Multivariable regression (n=756)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Number of chronic conditions				
0 (reference)				
1	0.81 (0.52–1.27)	0.358		
2 or more	1.18 (0.71–1.94)	0.524		
Age of initiation to smoking				
<18 years old (reference)				
≥18 years old	1.12 (0.74–1.69)	0.580		
Received advice from doctor to stop smoking				
No (reference)				
Yes	2.38 (1.42–3.98)	0.001	2.36 (1.29–4.32)	0.005
Nicotine dependence				
Very low (reference)				
Low	0.54 (0.35–0.84)	0.007	0.62 (0.38–1.03)	0.066
Moderate to high	0.56 (0.34–0.92)	0.021	0.49 (0.28–0.85)	0.011
Perceived risk of harm (smoke occasionally)				
No/little risk of harm (reference)				
Moderate/great risk of harm	2.12 (1.41–3.20)	<0.001	1.91 (1.24–2.94)	0.003
Perceived risk of harm (smoke 1 or more packs per day)				
No/little risk of harm (reference)				
Moderate/great risk of harm	1.61 (0.90–2.88)	0.107		

CI: confidence interval; OR: odds ratio

^a P values in bold indicate statistical significance ($P < 0.05$).^b Pre-tertiary education includes vocational institute/institute of technical education/pre-university/junior college/diploma/ International Baccalaureate

smokers with lower education had 1.4 times higher odds of not intending to quit than those with higher education.²¹

The aforementioned findings can have broader significance to the development of global public health strategies. In Singapore, the perceived risk of harm from cigarette smoking is heightened by putting graphic health warnings on cigarette packs.²² Moreover, educational programmes were implemented to target students from a young age, raising awareness of the harmful effects of smoking.²³ These approaches can be valuable for other countries seeking to increase smoking cessation prevalence. However, successful adaption

may require tailoring their approaches based on their population's education level and awareness level.

One strength of our study is that the use of a structured questionnaire ensured that the methodology could be replicated in other countries. Although the specific questions related to smoking should be tailored according to the cultural context of the country, the overall structure of the questionnaire can be universally applied. By having a standardised questionnaire, the results from different countries can be compared. Another strength is that because the data is from a population-based study, the results can be generalised to the

Table 4. Logistic regression with smoking cessation as outcome.

	Smoking cessation			
	Univariate regression		Multivariable regression (n=1230)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Age groups, years				
15–34 (reference)				
35–49	1.29 (0.90–1.85)	0.169		
50–65	0.8 (0.51–1.25)	0.326		
Sex				
Female (reference)				
Male	0.63 (0.43–0.92)	0.017	0.64 (0.43–0.94)	0.023
Ethnicity				
Chinese (reference)				
Malay	0.89 (0.65–1.20)	0.444		
Indian	0.70 (0.49–1.00)	0.052		
Others	1.55 (0.83–2.88)	0.170		
Education				
Degree/professional qualification and postgraduate and above (reference)				
No formal education/primary	0.14 (0.08–0.26)	<0.001	0.19 (0.10–0.38)	<0.001
Secondary school	0.30 (0.18–0.49)	<0.001	0.39 (0.23–0.65)	<0.001
Pre–tertiary education ^b	0.46 (0.30–0.71)	<0.001	0.54 (0.34–0.84)	0.007
Marital status				
Married (reference)				
Single	0.93 (0.65–1.33)	0.679		
Separated/widowed/divorced	0.62 (0.30–1.27)	0.190		
Have children				
Yes (reference)				
No	0.76 (0.54–1.07)	0.116		
Employment				
Employed/self–employed (reference)				
Economically inactive/students	1.46 (0.88–2.41)	0.145		
Unemployed/temporarily laid off	0.77 (0.34–1.72)	0.517		
Personal income, SGD				
No income/below 2000 (reference)				
2000 to 3999	1.26 (0.81–1.96)	0.296		
4000 to 6999	2.13 (1.20–3.79)	0.010		
7000 and above	2.13 (1.17–3.87)	0.013		

Table 4. Logistic regression with smoking cessation as outcome. (Cont'd)

	Smoking cessation			
	Univariate regression		Multivariable regression (n=1230)	
	OR (95% CI)	P value ^a	OR (95% CI)	P value ^a
Number of chronic conditions				
0 (reference)				
1	1.35 (0.90–2.00)	0.144	1.35 (0.88–2.07)	0.168
2 or more	2.08 (1.36–3.17)	0.001	2.14 (1.35–3.38)	0.001
Age of onset for smoking				
<18 years old (reference)				
≥18 years old	1.08 (0.74–1.56)	0.699		
Perceived risk of harm (smoke occasionally)				
No/little risk of harm (reference)				
Moderate/great risk of harm	1.79 (1.23–2.60)	0.002		
Perceived risk of harm (smoke 1 or more packs per day)				
No/little risk of harm (reference)				
Moderate/great risk of harm	5.37 (2.32–12.42)	<0.001	4.52 (1.89–10.80)	0.001

CI: confidence interval; OR: odds ratio

^a P values in bold indicate statistical significance ($P < 0.05$).

^b Pre-tertiary education includes vocational institute/institute of technical education/pre-university/junior college/diploma/International Baccalaureate

Singapore population. However, caution should be exercised when generalising to other countries. Although our results aligned with some studies from other countries, policies should be tailored according to the needs of the population.

A limitation of our study is that the study was done during the COVID-19 period. Studies have shown that COVID-19 can act as a hindrance and a catalyst for smoking cessation, due to reasons such as boredom and fear.^{24,25} It is unclear whether the effect of COVID-19 on smoking cessation will be sustained over time. Another limitation of our quantitative study is that we are unable to examine the impact of smoking cessation interventions, as well as the reasons that people continue or quit smoking. Future studies can build on this study by examining the efficacy of different smoking cessation messages across countries, as well as the effect of clinician training on smoking cessation behaviours. Moreover, qualitative studies can explore the barriers and facilitators of smoking cessation.

CONCLUSION

In conclusion, our study contributes to the global knowledge of smoking cessation by identifying sociodemographics, perceived risk of harm from cigarette smoking, nicotine dependence, and clinicians' advice associated with smoking cessation behaviour in a multi-ethnic population. As lower education is associated with poorer quit intention and smoking cessation, educational campaigns should be tailored for easy understanding by individuals with lower literacy levels. Moreover, smoking cessation training can be integrated into medical education. Singapore's approach to smoking cessation behaviours, such as graphic health warnings on cigarette packs and smoking cessation clinics, can serve as a model for other countries aiming to improve smoking cessation behaviours.

Ethics statement

The study adhered to the ethical standards of the responsible committee on human experimentation

(institutional and national) and with the Declaration of Helsinki. The study was approved by the Domain Specific Review Board from the National Healthcare Group (NHG-DSRB Ref 2019/0077).

Declaration

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