

Smoking and Nicotine Dependence in Singapore: Findings from a Cross-Sectional Epidemiological Study

Louisa Picco,¹*MPH*, Mythily Subramaniam,¹*MBBS, MHS*, Edimansyah Abdin,¹*PhD*, Janhavi A Vaingankar,¹*MSc*, Siow Ann Chong,¹*MMed, MD, FAMS*

Abstract

Introduction: Smoking is one of the leading preventable causes of death throughout the world and can lead to nicotine dependence, particularly when initiated at a young age. This paper describes the prevalence of smoking and nicotine dependence in the adult Singapore resident population, whilst also exploring rates among the major ethnic groups (Chinese, Malay and Indian), different education levels and those with chronic psychiatric and physical comorbidities. **Material and Methods:** The Singapore Mental Health Study (SMHS) is a cross-sectional epidemiological study that was conducted between December 2009 and December 2010. Information on smoking status was assessed using the Composite International Diagnostic Interview version 3.0 (CIDI 3.0) and the Fagerstrom Test for Nicotine Dependence measured nicotine dependence. Socio-demographic information was also collected. **Results:** In total, 6616 respondents participated in the SMHS giving a response rate of 75.9%. We found that 16% of the population were current smokers and 4.5% had nicotine dependence. Current smokers were more likely to be younger (18 to 34 years old), males, Malay and have lower education, whilst males had a 4.6 times higher risk of nicotine dependence to that of females. The prevalence of nicotine dependence was also higher in those with alcohol abuse and those experiencing chronic pain. **Conclusion:** The results from this study highlight the important differences in the prevalence of smoking and nicotine dependence among different age groups, gender and ethnicity in Singapore and are important for developing future health policies and targeted preventive strategies.

Ann Acad Med Singapore 2012;41:325-34

Key words: Ethnicity, Gender, Population, Prevalence

Introduction

Tobacco is the leading cause of preventable death and is the fourth most common risk factor for disease. Nearly 6 million deaths occur worldwide every year, which equates to one death every 6 seconds or one in 10 adult deaths.¹ Cigarette smoke contains over 7000 chemicals and compounds, of which hundreds are toxic and at least 69 are carcinogenic.² Nicotine is the key chemical compound that causes and sustains cigarette addiction and the design and contents of tobacco products today have made them more addictive than ever before.² Tobacco causes over 20 different diseases, many of which are fatal or disabling. More specifically, it is responsible for over 70% of all lung cancer deaths globally, 42% of respiratory disease deaths and nearly 10% of all cardiovascular disease related deaths.³

It has been well established in the literature that cigarette smoking is a risk factor for numerous physical illnesses and

more recently, studies have explored the association between cigarette smoking and psychiatric illness.^{4,5} Furthermore, among adult psychiatric patients, cigarette smoking has been associated with psychotic disorders,⁶ depressive disorders,⁷⁻¹¹ anxiety disorders,¹²⁻¹⁵ suicidal behaviours¹⁶⁻¹⁸ and substance use disorders.¹⁹ Findings in the literature have also shown that smokers with psychiatric disorders not only have higher cigarette consumption²⁰ but also higher levels of nicotine dependence.²¹

Lower socio-economic status (SES) and educational levels have shown a significant association with higher prevalence of smoking²² and nicotine dependence,²³ and the number of cigarettes consumed,²⁴ respectively. This is consistent with an earlier study in Singapore which examined nicotine dependence and psychiatric disorders among young males²⁵ and found that those with nicotine dependence had attained lower Primary School Leaving Examination (PSLE) scores

¹Research Division, Institute of Mental Health

Address for Correspondence: Ms Louisa Picco, Research Division, Institute of Mental Health, Buangkok Green Medical Park, 10 Buangkok View, Singapore 539747.

Email: louisa_picco@imh.com.sg

and attended fewer years of schooling, compared to those without a diagnosis of nicotine dependence.

There has been an increased interest in the ethnic differences in the prevalence of smoking and nicotine dependence, particularly in multi-ethnic countries such as Singapore. A literature review on tobacco use and dependence among Asian Americans found that smoking prevalence varied between Asian ethnic subgroups, similar to other racial or ethnic groups in the United States (US).²⁶ In previous research in Singapore^{25,27} distinct ethnic differences associated with nicotine dependence were found, where Malays had a higher prevalence of nicotine dependence compared to Indians and Chinese.

Smoking rates in Singapore have increased slightly over the past 10 years, despite various policy and legislative changes aimed at reducing smoking and a raft of intervention and smoking cessation programmes. Results from the 2010 National Health Surveillance Survey found that the prevalence of daily smoking among adult Singapore residents (aged 18 to 69 years) was 14.3%²⁸ which had increased slightly since a previous survey in 2007, when it was 13.6%.²⁹ On average, this equates to approximately 406 cigarettes being consumed per person (aged 15 years and above) annually, in Singapore. Findings from the 2007 Survey²⁹ also found that the daily smoking was 6 fold greater in males; approximately one in 4 (23.7%) males aged 18 to 69 years were daily smokers compared with one in 27 (3.7%) females, and daily smoking was most prevalent in young adults aged 18 to 29 years (17.2%). Less is known, however, about the prevalence of nicotine dependence in the adult population in Asian countries and specifically in Singapore.

Singapore is a small island city-state, situated just south of the Malaysian peninsular with a population of 3.7 million residents (including Singapore citizens and Permanent Residents), the majority of whom are Chinese (74.1%), Malays (13.4%) and Indians (9.2%).³⁰ The Singapore Mental Health Study (SMHS) was conducted with Singapore residents, aged 18 years and above, using the Composite International Diagnostic Interview version 3.0 (CIDI 3.0)³¹ and a series of additional measures to gather information relating to psychiatric disorders, nicotine dependence, gambling and chronic physical conditions. This paper reports the findings from the SMHS, specifically in relation to the prevalence of smoking and nicotine dependence in this adult population. In particular, rates of smoking and nicotine dependence among respondents from the 3 major ethnic groups (Chinese, Malay and Indian), different education levels and those with other comorbidities are also discussed.

This paper aims to:

1. Establish the prevalence of smoking and nicotine

dependence in the adult Singapore resident population.

2. Investigate socio-demographic risk factors for smoking and nicotine dependence in this population.
3. Investigate the association of nicotine dependence with life-time psychiatric and physical disorders.

Materials and Methods

Participants and Procedure

The SMHS was carried out between December 2009 and December 2010 after receiving ethics approval from the relevant Institutional Review Boards. The SMHS is a representative, nationwide survey of Singapore residents aged 18 and above, who were randomly selected via an administrative database.³² Those who were selected were sent an invitation letter, explaining the purpose and procedures of the study. Following this, contact was made by an external, professionally trained interviewer and upon agreeing to participate, a convenient time was arranged to conduct the face-to-face interview, in English, Mandarin or Bahasa Melayu. Written consent was obtained from respondents and for those under the age of 21, consent was also obtained from a legally acceptable representative. A total of 6616 face-to-face interviews were successfully conducted and the overall response rate was 75.9%.

The survey excluded residents who were incapable of completing an interview due to severe medical conditions affecting their physical or mental health, language barriers, living outside the country, being institutionalised or hospitalised at the time of the survey and those who were not contactable via the information provided from the database.

Measures

Composite International Diagnostic Interview version 3.0 (CIDI 3.0): This instrument aims to obtain valid information about the prevalence of mental disorders in the general population, unmet need for treatment of mental disorders, treatment adequacy among patients receiving treatment for mental disorders and the societal burden of mental disorders.³¹ A modified version of the CIDI was used for the SMHS and included a screening module as well as modules on Depression, Mania, Generalised Anxiety Disorder, Obsessive Compulsive Disorder, Psychosis, Services, Pharmaco-epidemiology, alcohol use, 30-day functioning, social networks and family burden. The screening module included a question relating to smoking, where respondents were asked whether they are current smokers, ex-smokers or non-smokers who had never smoke before. Diagnosis of DSM-IV life-time mental disorders was generated using established algorithms with organic exclusions and

diagnostic hierarchy rules.

Fagerstrom Test for Nicotine Dependence: The 6-item Fagerstrom Test for Nicotine Dependence (FTND)³³ was used to assess physical dependence on tobacco smoking. The number of response options varies for each item and response options are given a score of 0, 1, 2 or 3, which are then summed to calculate a total score ranging from 0 to 10. Scores of 4 or less are classified as ‘low dependence’ whilst scores of 8 to 10 equate to ‘very high dependence’. The higher the overall score, the more likely the respondent is to have withdrawal symptoms if they give up smoking and these symptoms are more likely to be more prominent. The FTND has been shown to have adequate validity and reliability,^{33,34} and has been widely used in various settings. The coefficient of construct reliability in the present study was 0.73.

Chronic Medical Condition Checklist: A Chronic Medical Condition Checklist was used to measure chronic physical conditions of the respondents. The respondents were asked to report any of the disorders listed in the checklist. Respondents were read the following statement: ‘I’m going to read to you a list of health problems some people have. Has a doctor ever told you that you have any of the following...’ This was followed by a list of 15 chronic conditions which were considered prevalent in Singapore’s population. These disorders were then reclassified into 8 types of physical disorders: (1) respiratory conditions (asthma, chronic lung disease such as chronic bronchitis or emphysema), (2) diabetes, (3) hypertension and high blood pressure, (4) chronic pain (arthritis or rheumatism, back problems including disk or spine, migraine headaches), (5) cancer, (6) neurological conditions (epilepsy, convulsion, Parkinson’s disease), (7) cardiovascular disorders (stroke or major paralysis, heart attack, coronary heart disease, angina, congestive heart failure or other heart disease), and, (8) ulcer and chronic inflamed bowel (stomach ulcer, chronic inflamed bowel, enteritis, or colitis).

South Oaks Gambling Screen: The South Oaks Gambling Screen (SOGS) consists of 16 questions, comprising 37 items, which asked the respondents about their gambling activity and associated behaviour throughout their lifetime.³⁵ There are 20 scoring items, all equally weighted, requiring a ‘yes’ or ‘no’ answer. To score, each ‘yes’ answer attains one point, with a score of 5 or more indicating ‘probable’ pathological gambling. The non-scoring items identify the type of gambling, the amount of money gambled in a day, and relatives and friends with a gambling problem. Respondents scoring 5 or more were categorised as ‘pathological

gamblers’, those scoring 3 and 4 were classified as ‘problem gamblers’ and those scoring 1 or 2 as ‘non-gamblers’ and ‘non problem gamblers’.

In addition, socio-demographic information relating to age, gender, ethnicity, education, marital status, income, employment history, etc was also collected. For those instruments and measures that were not available in Mandarin and Bahasa Melayu, they were translated into these languages using internationally accepted translation procedures.

Statistical Analysis

All estimates were weighted to adjust for oversampling and post-stratification sampling for age and ethnic distributions between the survey sample and the Singapore resident population in 2007. Mean and standard deviations were calculated for continuous variables, and frequencies and percentages were calculated for categorical variables. Cross-tabulations were used to calculate the prevalence of nicotine dependence across the socio-demographic characteristics. Multiple logistic regression models adjusted for age and gender were used to generate odd ratios (ORs) and 95% confidence intervals to study associations between nicotine dependence and other mental disorders and chronic physical conditions. Standard errors (SE) and significance tests were estimated using the Taylor series linearisation method. Multivariate significance was evaluated using Wald χ^2 tests based on design corrected coefficient variance-covariance matrices. Statistical significance was evaluated at the <0.05 level using two-sided tests. All statistical analyses were carried out using Statistical Analysis Software (SAS) System version 9.2.³⁶

Results

Socio-demographic Characteristics

Table 1 shows the socio-demographic characteristics of the study sample. Among the population, 16% were current smokers and 10.8% were ex-smokers, while 4.5% had nicotine dependence. Table 2 shows the socio-demographic correlates among current smokers and ex-smokers from the study population. As compared to non-smokers, those who were current smokers were more likely to be Malay, male, divorced or separated, and had lower education (pre-primary, primary, secondary and vocational education). Odds of current smoking were higher among 18 to 34 years old as compared to those aged 35 years and above and lower among the economically inactive group i.e., students and homemakers (compared to those being employed). Ex-smokers were more likely to be older (aged 65 years

Table 1. Socio-demographic Characteristics of the Study Sample

	Unweighted n	Weighted %
Age Group (years)		
18 to 34	2293	31.7
35 to 49	2369	34.1
50 to 64	1542	23.1
65 and above	412	11.1
Ethnicity		
Chinese	2006	76.9
Malay	2373	12.3
Indian	1969	8.3
Others	268	2.4
Gender		
Male	3299	48.5
Female	3317	51.5
Marital Status		
Never Married	1825	28.9
Currently Married	4290	62.4
Divorced/ Separated	262	4.2
Widowed	237	4.4
Education		
Pre-primary	307	5.5
Primary	929	14.7
Secondary	1975	27.6
Vocational	721	7.9
Pre-u/ Junior College/ Diploma	1342	22.4
University	1342	21.9
Employment		
Employed	4594	71.0
Economically inactive*	1522	24.5
Unemployed	313	4.5
Personal income (annually)		
Below S\$ 20,000	3392	51.3
S\$20,000 to 49,999	1924	31.2
S\$50,000 above	962	17.5

* includes retirees, students and housewives

and above), male, unemployed, belonging to Malay or 'Others' ethnicity and had primary, secondary or vocational education.

Multiple logistic regressions showed that males had a 4.6 times higher risk of nicotine dependence compared to females. Furthermore, nicotine dependence was significantly higher among those with lower education (pre-primary, primary, secondary and vocational education) (Table 3).

Relationship between Nicotine Dependence and Other Psychiatric Disorders

As compared to those without nicotine dependence, the prevalence rate of Alcohol Abuse (11.3% vs 2.8%, $\chi^2 = 35.5$, $P < 0.001$) and Probable Pathological Gambling (5.4% vs 2.6%, $\chi^2 = 3.9$, $P = 0.047$) were significantly higher among those with nicotine dependence (Table 4). After adjusting for age and gender in multivariate logistic regression analyses, the association of alcohol abuse with nicotine dependence remained significant (OR = 3.1).

Relationship between Nicotine Dependence and Chronic Physical Conditions

After adjusting for age and gender in multivariate logistic regression analyses, the odds of having chronic pain (OR = 1.6) was significantly higher among those with nicotine dependence, whilst the odds of having neurological conditions (OR = 0.1) was lower among this group (Table 5).

Discussion

Sixteen percent of the population were current smokers. Previous Ministry of Health (MOH) studies have collected data relating to smoking prevalence whereby the smoking status of respondents has been classified as daily smokers, occasional smokers, ex-smokers and non-smokers and findings from these studies are similar to ours, despite using slightly different classification criteria and having a large sample size. The 2010 National Health Survey²⁸, 2007 National Health Surveillance Survey²⁹ and the 2004 National Health Survey³⁷ found daily smoking rates to be 14.3%, 13.6% and 12.6%, respectively. Whilst our findings are slightly higher than those found in the MOH studies, in comparison to other countries, these rates are relatively low. A multinational study conducted as part of the World Mental Health Consortium found that among 17 participating countries, the prevalence of current smokers was between 20% and 35%.³⁸ It is important to note however that over the past decade, the prevalence of smoking has increased slightly in Singapore, despite both legislative and policy changes to reduce smoking and the introduction of various cessation programmes.³⁹

Consistent with the large majority of other studies, our study found that the prevalence of smoking was significantly higher among males (27%) compared to females (5.6%). A systematic review of prospective studies in Asia relating to an association between smoking, quitting and cause-specific illness was conducted by Nakamura et al.⁴⁰ In total, 77 studies were included of which 42 were from Japan, 16 from China, 5 from Singapore, 5 from Taiwan, 4 from Korea, 3 from

Table 2. Socio-demographic Correlates of Current Smokers and Ex-Smokers

		Current smoker vs non-smoker				Ex-smoker vs non-smoker			
		95% Confidence Limit (CL)				95% Confidence Limit (CL)			
		OR [†]	Lower CL	Upper CL	P value	OR [†]	Lower CL	Upper CL	P value
Age group (years)	18 to 34	‡Ref				Ref			
	35 to 49	0.5	0.4	0.7	<0.001	0.9	0.6	1.4	0.536
	50 to 64	0.3	0.2	0.5	<0.001	0.9	0.5	1.4	0.544
	65 and above	0.4	0.2	0.9	0.018	2.1	1.1	4.0	0.031
Ethnicity	Chinese	Ref				Ref			
	Malay	2.2	1.8	2.6	<0.001	1.9	1.5	2.5	<0.001
	Indian	1.1	0.9	1.4	0.234	1.0	0.8	1.3	0.927
	Others	2.0	1.2	3.3	0.009	2.7	1.7	4.4	<0.001
Sex	Male	8.6	6.5	11.4	<0.001	7.4	5.3	10.5	<0.001
	Female	Ref				Ref			
Marital	Single	Ref				Ref			
	Married	0.9	0.7	1.3	0.633	1.3	0.8	2.0	0.237
	Divorced/ Separated	1.8	1.1	3.1	0.023	1.3	0.6	3.2	0.509
	Widowed	1.1	0.5	2.7	0.774	1.2	0.5	3.2	0.701
Education	Pre primary	9.5	4.4	20.4	<0.00001	1.8	0.8	4.3	0.179
	Primary	9.1	5.4	15.6	<0.001	3.7	2.1	6.5	<0.001
	Secondary	5.9	3.8	9.2	<0.001	3.1	1.9	5.0	<0.001
	Pre-u/ Junior-college/ Diploma	1.7	1.1	2.6	0.021	1.2	0.8	2.0	0.341
	Vocational	5.5	3.4	8.7	<0.001	2.0	1.1	3.4	0.015
Employment	University	Ref				Ref			
	Employed	Ref				Ref			
	Economically inactive*	0.4	0.2	0.6	<0.001	0.8	0.5	1.3	0.420
Income	Unemployed	1.3	0.8	2.0	0.335	2.1	1.2	3.6	0.010
	Below S\$20,000	Ref				Ref			
	S\$20,000 to 49,999	1.0	0.8	1.3	0.994	1.0	0.7	1.5	0.802
	S\$50,000 and above	0.8	0.5	1.3	0.473	1.2	0.8	2.0	0.381

* include retirees, students and housewives

[†]Odds Ratios derived from multivariate logistic regression model

[‡]Ref: Reference

Hong Kong, and 1 each from India and Thailand, whereby most of the studies found the prevalence of smoking among men in Asia to be over 50% whereas for women, it is more often below 10%. Three of the studies above, which were conducted in Singapore, found that approximately 20% of participants were current smokers, however we are unable to distinguish from Nakamura's study, the percentage of current smokers by gender. Consistent with our findings, surveys conducted over the past 10 years by the MOH have also shown a higher prevalence of male smokers in Singapore. For example, the most recent National Health Surveillance Survey conducted in 2007²⁹ reported that 23.7% of males were daily smokers compared with 3.7% of females.

While several safeguards and campaigns are in place to control tobacco use and smoking in Singapore, more focus is needed to understand important social influences

on health behaviours, particularly with the use of cigarette and tobacco among young males.⁴¹ Given the significantly higher prevalence of male smokers, cessation should focus more on males whereas preventative strategies should target women and by adopting a gender explicit focus, it is more likely that an epidemic among women will be prevented in countries such as Singapore, where the rates of smoking in women are low.⁴¹

Smoking was higher among Malays, when compared to the Chinese (Table 2), findings which were similar to previous MOH surveys. The 2007 National Health Surveillance Survey found that adult Malays, aged 18 to 69, had the highest daily smoking prevalence (23.2%) compared to Chinese (12.3%) and Indians (11.4%)²⁹ and the prevalence of Malay smokers actually increased by over 4.5% from a previous study conducted in 2004.³⁷ More specifically,

Table 3. Socio-demographic Correlates of Nicotine Dependence

		Univariate Analysis					Multivariate analysis			
		Yes		No			OR [†]	Lower CL	Upper CL	P value
		%	SE	%	SE	P value				
Age group (years)	18 to 34	35.5	3.6	31.5	0.2	0.745	1.0			
	35 to 49	32.7	3.6	34.2	0.2		0.7	0.4	1.1	0.163
	50 to 64	22.8	3.4	23.1	0.2		0.6	0.3	1.1	0.076
	65 and above	9.0	3.1	11.2	0.1		0.4	0.1	1.4	0.163
Ethnicity	Chinese	69.1	2.7	77.3	0.1	<0.01	1.0			
	Malay	19.3	1.9	12.0	0.1		1.4	0.99	1.8	0.057
	Indian	8.0	1.0	8.3	0.0		1.0	0.7	1.4	0.970
	Others	3.6	0.9	2.4	0.0		2.2	1.1	4.4	0.023
Sex	Male	80.5	3.2	47.0	0.9	<0.01	4.6	2.9	7.2	<0.0001
	Female	19.5	3.2	53.0	0.9		1.0			
Marital	Single	34.3	3.7	28.7	0.7	0.486	1.0			
	Married	56.4	4.0	62.7	0.8		0.8	0.5	1.3	0.377
	Divorced/ Separated	5.0	1.7	4.2	0.4		1.1	0.5	2.5	0.882
	Widowed	4.4	2.0	4.4	0.4		1.6	0.4	7.6	0.521
Education	Pre-primary	5.2	2.1	5.6	0.4	<0.01	4.7	1.3	16.3	0.015
	Primary	19.3	3.4	14.4	0.6		4.7	2.0	11.1	<0.001
	Secondary	34.8	3.8	27.3	0.8		3.4	1.7	6.8	<0.001
	Pre-u/ Junior-college/ Diploma	13.7	2.6	22.8	0.7		1.1	0.5	2.1	0.852
	Vocational	15.6	2.7	7.5	0.4		2.8	1.4	5.8	0.005
	University	11.5	2.5	22.4	0.7		1.0			
Employment	employed	82.0	3.3	70.4	0.8	0.001	1.0			
	Economically inactive*	11.7	2.7	25.1	0.7		0.6	0.3	1.2	0.142
	Unemployed	6.3	2.2	4.4	0.4		1.3	0.6	2.9	0.491
Income	Below \$SD 20,000	46.1	4.1	51.6	0.9	0.002				
	\$SD 20,000 to 49,999	43.2	4.0	30.6	0.8		1.5	1.0	2.3	0.064
	\$SD 50,000 and above	10.6	2.5	17.8	0.7		1.0	0.5	2.1	0.963

*include retirees, students and housewives

[†]Odds Ratios derived from multivariate logistic regression model

Malays who smoked were more likely to be younger, less educated and 12 times more likely to be male.

In Asian countries, tobacco has an important cultural role, and in particular among men, the exchange of cigarettes is often used in social interactions.⁴² Furthermore, according to anecdotal evidence, it remains acceptable for men to smoke, while smoking by women is not socially sanctioned in countries such as Malaysia. This may also explain the significantly higher number of Malay male smokers in our study. Customised intervention programmes have been designed to target specific population subgroups and the Health Promotion Board (HPB) in Singapore has partnered with Community Development Councils (CDCs), schools and non-governmental organisations to promote a smoke-free lifestyle among the subgroups with a higher tendency to smoke, as well as encouraging current smokers to try

and quit.³⁹

Results from our study also showed that smoking prevalence was highest among participants aged 18 to 34 years (20.2%, $P \leq 0.0006$) and these findings are also consistent with previous surveys in Singapore.^{29,43} The study conducted by Storr et al³⁸ found that current smoking prevalence among 18 to 24 years old varied from above 45% in Germany and Ukraine compared to 1.2% in Nigeria and 11.9% in Colombia and that the prevalence of smoking among 18 to 24 year old living in most of the high income countries was higher than that of 24 to 44 years old.

The prevalence of nicotine dependence in the population was 4.5%. Significant differences were identified by gender and ethnicity; 7.5% of males and 1.7% of females had nicotine dependence, whilst Malays had a higher prevalence of nicotine dependence compared with the 2 other major

Table 4. Prevalence and Odds Ratio of Other Lifetime Psychiatric Disorders in People with Nicotine Dependence

Lifetime psychiatric disorders	%	SE	OR	95% CI	OR*	95% CI
Major Depressive Disorder	7.4	1.9	1.3	(0.7, 2.3)	1.5	(0.9, 2.8)
Dysthymia	0.1	0.1	0.4	(0.1, 3.1)	0.8	(0.1, 6.1)
Bipolar disorder	1.1	0.4	0.9	(0.4, 2)	0.9	(0.4, 2)
Generalised Anxiety Disorder	1.3	0.8	1.6	(0.5, 5.3)	1.9	(0.5, 6.9)
Obsessive Compulsive Disorder	5.0	1.6	1.8	(0.9, 3.6)	1.8	(0.9, 3.7)
Alcohol Abuse	11.3	2.5	4.5	(2.6, 7.6) [†]	3.1	(1.8, 5.4) [†]
Alcohol Dependence	0.7	0.3	1.5	(0.6, 3.5)	1.1	(0.4, 2.7)
Pathological Gambling	5.4	1.9	2.2	(1, 4.7) [‡]	1.4	(0.7, 3.1)

*Odds Ratios derived from a single multivariate logistic regression model adjusted for age and gender

[†] $P < 0.01$; [‡] $P < 0.05$

Table 5. Prevalence and Odds Ratio of Chronic Physical Conditions in People with Nicotine Dependence

Chronic physical conditions	%	SE	OR	95% CI	OR*	95% CI
Respiratory conditions	10.2	2.1	1.1	(0.7, 1.8)	1.0	(0.6, 1.5)
Diabetes	10.0	2.8	1.1	(0.6, 2.1)	1.2	(0.6, 2.4)
High Blood Pressure	14.5	3.0	0.7	(0.4, 1.1)	0.6	(0.3, 1.2)
Chronic pain	18.4	3.0	1.3	(0.8, 1.9)	1.6	(1.0, 2.4) [‡]
Cancer	0.1	0.1	0.1	(0.02, 1.1)	0.2	(0.02, 1.3)
Neurological conditions	0.3	0.2	0.1	(0.03, 0.3) [†]	0.1	(0.03, 0.3) [†]
Cardiovascular diseases	3.6	1.8	1.0	(0.3, 2.9)	1.0	(0.3, 2.8)
Ulcers	2.6	1.2	1.3	(0.5, 3.4)	1.0	(0.4, 2.9)

*Odds Ratios derived from a single multivariate logistic regression model adjusted for age and gender

[†] $P < 0.01$; [‡] $P < 0.05$

ethnic groups in Singapore, Chinese (4.1%) and Indians (4.4%). Very few studies in Singapore have looked at nicotine dependence in this population. A recent study conducted by Subramanian et al²⁵ reported the lifetime prevalence of nicotine dependence among young males in Singapore to be 12.3%. There were also significant ethnic differences associated with nicotine dependence, $\chi^2(3, N = 9702) = 189.9, P < 0.005$. A higher proportion of Malays and Indians were found to be in the nicotine dependent group as compared with those who were not dependent (39.8% vs 24.1% and 10.0% vs 7.2%, respectively).

We also examined the relationship between nicotine dependence and other psychiatric disorders and found the prevalence of alcohol abuse was significantly higher among those with nicotine dependence. In the study conducted by Subramanian et al,²⁵ alcohol use disorders were significantly different between those with and without nicotine dependence, $\chi^2(1, N = 9702) = 470.1, P < 0.005$ and $\chi^2(1, N = 9702) = 238.7, P < 0.005$, respectively. Such findings are also consistent with findings in Western studies in both adolescents and adults.⁴⁴⁻⁴⁸ In addition to Alcohol Abuse, results from our study also showed a significantly higher prevalence of Probable Pathological Gambling among those with nicotine dependence, however when we adjusted for age and gender in multivariate analysis,

this was no longer significant. A national survey in the US investigated the relationship between pathological gambling and psychiatric conditions found that the lifetime prevalence of pathological gambling was 0.42% and 60.4% of pathological gamblers were nicotine dependent.⁴⁹

Of those with nicotine dependence, 18.4% also experienced chronic pain (OR = 1.6) after adjusting for age and gender. It is well established in the literature that those suffering from chronic pain problems are at increased risk of certain types of substance abuse and more recently there has been increased interest in the association between chronic pain and cigarette smoking although extant work on this association is somewhat limited. Zvolensky et al⁵⁰ examined the relationship between lifetime and current (in the past year) chronic pain and cigarette smoking and nicotine dependence. Similar to our findings, after they adjusted for certain socio-demographic variables and the presence of lifetime substance use disorders, individuals with a lifetime history of chronic back or neck pain were significantly more likely to be current smokers and have nicotine dependence.⁵⁰ More specifically, this study found that those with a lifetime history of chronic neck or back pain were 1.31 times more likely to smoke cigarettes and 1.77 times more likely to be diagnosed with lifetime nicotine dependence. Whilst in our study and other previous research,⁵⁰⁻⁵² it is evident that

chronic pain is related to smoking and nicotine dependence, it is unclear why this association exists. It has been theorised that smoking may contribute to the onset of chronic pain, while alternatively, it may be chronic pain that plays a role in the onset of smoking. Smokers with chronic pain may rely or use smoking to manage their pain and controlled experimental pain induction studies have found evidence for a pain inhibitory effect of smoking.⁵³ However, the direction of causality is uncertain and therefore the relationship between chronic pain and smoking may reflect smokers' use of tobacco to cope with pain, smoking's aggravation of painful condition or both.⁵³

The significant public health burden that results from smoking will eventually have a detrimental impact on the economy of individual countries. In Singapore, the economic costs attributable to tobacco use, excluding intangible costs such as pain, suffering and the value of human life was estimated to be over USD 426 million.⁵⁴ More than 2 million deaths resulted from smoking-related diseases occur each year in Asia, however tobacco control programmes in Asian countries have not been very effective, based on their smoking rates.⁵⁵ The emphasis of these programmes has mainly been focussed on smoking prevention or preventing new smokers in the population, rather than smoking cessation and therefore, such programmes 'have been the weakest link in tobacco control among Asian countries'.⁵⁵

In Singapore, the National Tobacco Control Programme (NTCP) was formed to develop and implement smoking control programmes to reduce the smoking rates in Singapore. Strategies employed include taxation, tobacco control legislation, public education, collaborative partnerships, and the provision of smoking cessation services, to combat smoking as well as reduce the supply and demand of tobacco.³⁹ Smoking cessation services have also been integrated into the primary healthcare settings and non-governmental organisations whilst partnerships and engagement by the Health Promotional Board (HPB) with educational institutions, private workplaces, uniformed groups, healthcare professionals, youth organisations, community and religious groups and parents are key to promoting a smoke-free lifestyle.⁵⁶ In order to address certain subgroups within the population, however, more tailored approaches need to be adopted to ensure the messages are reaching to those most in need.

There are some limitations of this study. Firstly, the sample was restricted to those residing in households and therefore excluded residents who are institutionalised and whilst these people comprise a minimal proportion of the total population in Singapore, we are unsure of the rates of nicotine dependence within this population. For example, research has shown that the prevalence of smoking is considerably higher in prison detainees where results from

a systematic literature review undertaken by Ritter et al⁵⁷ found that the smoking prevalence in this population varied between 64% and 91.8% and can be more than 3 times higher than the general population. Secondly, respondents were aged 18 years and above and therefore we were unable to capture smoking and nicotine prevalence in the adolescent population and it is well documented in the literature that smoking rates are often higher among this population subgroup.^{58,59} Furthermore for those respondents aged 18 to 21 years, parental consent was required and consequently, this group may be under-represented. Finally, an additional limitation is that due to the cross-sectional nature of this study, we were unable to establish the temporal relation of smoking and comorbid conditions.

Conclusion

In summary, our study reports important findings relating to both the prevalence of smoking and nicotine dependence in Singapore and in doing so, identifies rates are higher in males compared to females, those aged 18 to 34 years and among Malays. The prevalence of nicotine dependence was also higher in those with alcohol abuse and those experiencing chronic pain. It is important that similar cross-sectional epidemiological studies are conducted in the future, in order to track the prevalence of smoking and nicotine dependence and to ensure that appropriate and targeted intervention and cessation programmes are best designed to reach those population subgroups with the highest rates of smoking and nicotine dependence.

Acknowledgements

This study was funded by the Singapore Millennium Foundation and the Ministry of Health, Singapore.

REFERENCES

1. World Health Organization. Tobacco. Available at: <http://www.who.int/mediacentre/factsheets/fs339/en/index.html> Accessed 15 August 2011.
2. Rockville, US Department of Health and Human Services. A Report of the Surgeon General: How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-attributable Disease, 2010. Available at: http://www.surgeongeneral.gov/library/tobaccosmoke/report/full_report.pdf Accessed 15 December 2011.
3. World Health Organization. World No Tobacco Day 2011. Available at: http://www.wpro.who.int/media_centre/fact_sheets/fs_20110526.htm Accessed 15 August 2011.
4. Dierker LC, Ramirez RR, Chavez LM, Canino G. Association between psychiatric disorders and smoking stages among Latino adolescents. *Drug Alcohol Depend* 2005;80:361-8.
5. Wilens TE, Biederman J, Adamson JJ, Henin A, Sgambati S, Gignac M, et al. Further evidence of an association between adolescent bipolar disorder with smoking and substance use disorders: a controlled study. *Drug Alcohol Depend* 2008;95:188-98.

6. Üçok A, Polat A, Bozkurt O, Meteris H. Cigarette smoking among patients with schizophrenia and bipolar disorders. *Psychiatry Clin Neurosci* 2004;58:434-7.
7. Acton GS, Prochaska JJ, Kaplan AS, Small T, Hall SM. Depression and stages of change for smoking in psychiatric outpatients. *Addict Behav* 2001;26:621-31.
8. Tanskanen A, Viinamäki H, Koivumaa-Honkanen H, Hintikka J, Jääskeläinen J, Lehtonen J. Smoking and depression among psychiatric patients. *Nordic J Psychiatry* 1999;53:45-8.
9. Breslau N, Kilbey M, Andreski P. Nicotine dependence, major depression, and anxiety in young adults. *Arch Gen Psychiatry* 1991;48:1069-74.
10. Glassman A, Helzer J, Covey L, Cottler LB, Stetner F, Tipp JE, et al. Smoking, smoking cessation, and major depression. *JAMA* 1990;264:1649-59.
11. Kendler K, Neale M, MacLean C. Smoking and major depression. *Arch Gen Psychiatry* 1993;50:36-43.
12. Breslau N, Klein M. Smoking and panic attacks: an epidemiologic investigation. *Arch Gen Psychiatry* 1999;56:1141-7.
13. Baker-Morissette S, Gulliver SB, Wiegel M, Barlow D. Prevalence of smoking in anxiety disorders uncomplicated by comorbid alcohol or substance abuse. *J Psychopathol Behav Assess* 2004;26:107-12.
14. Cuijpers P, Smit F, Have M, Graaf R. Smoking is associated with first-ever incidence of mental disorders: a prospective population-based study. *Addiction* 2007;102:1303-9.
15. Mykletun A, Overland S, Aarø LE, Liabø H-M, Stewart R. Smoking in relation to anxiety and depression: evidence from a large population survey: the HUNT study. *Eur Psychiatry* 2008;23:77-84.
16. Boden J, Fergusson D, Horwood J. Cigarette smoking and suicidal behaviour: results from a 25-year longitudinal study. *Psychol Med* 2008;38:433-9.
17. Breslau N, Novak P, Kessler RC. Daily smoking and the subsequent onset of psychiatric disorder. *Psychol Med* 2004;34:323-33.
18. Hemenway D, Solnick S, Colditz G. Smoking and suicide among nurses. *AM J Public Health* 1993;83:249-51.
19. Vanable PA, Carey MP, Carey KB, Maisto SA. Smoking among psychiatric outpatients: Relationship to substance use, diagnosis, and illness severity. *Psychol Addict Behav* 2003;17:259-65.
20. Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: a population-based prevalence study. *JAMA* 2000;284:2606-10.
21. John U, Meyer C, Rumpf HJ, Hapke U. Smoking nicotine dependence and psychiatric comorbidity – a population-based study including smoking cessation after three years. *Drug Alc Dep* 2004;76:287-95.
22. Thomas M, Walker A, Wilmot A, Bennett N. Living in Britain: results from the 1996 general household survey. London: The Stationery Office, 1998.
23. Siahpush M, McNeill A, Hammond D, Fong GT. Socioeconomic and country variations in knowledge of health risks or tobacco smoking and toxic constituents of smoke: results from the 2002 International Tobacco Control (ITC) four country survey. *Tob Control* 2006;15Suppl3:65-70.
24. Bobak M, Jarvis MJ, Skodova Z, Marmot M. Smoke intake among smokers is higher in lower socioeconomic groups. *Tob Control* 2000;9:310-2.
25. Subramaniam M, Cheok C, Lee I-M, Pek E, Verma S, Wong J, et al. Nicotine dependence and psychiatric disorders among young males in Singapore. *Nicotine Tob Res* 2009;11:1107-13.
26. Kim SS, Ziedonis D, Chen KW. Tobacco use and dependence in Asian Americans: a review of the literature. *Nicotine Tob Res* 2007;9:169-84.
27. Bhalla V, Fong CW, Chew SK, Satku K. Changes in the levels of major cardiovascular risk factors in the multi-ethnic population in Singapore after 12 years of a national non-communicable disease intervention programme. *Singapore Med J* 2006;47:841-50.
28. Research and Strategic Planning, Health Promotion Board, Singapore. World No Tobacco Day Information Paper, 2011. Available at: http://www.nrdo.gov.sg/uploadedFiles/NRDO/Info_Paper_WNTD_2011_3_June_Final.pdf Accessed 15 August 2011.
29. Ministry of Health, Singapore. National Health Surveillance Survey 2007. Available at: <http://www.moh.gov.sg/mohcorp/uploadedFiles/Publications/Reports/2009/nhss2007.pdf> Accessed 15 August 2011.
30. Census of Population 2010 Statistical Release 1: Demographic Characteristics, Education, Language and Religion. Singapore: Singapore Department of Statistics; c2007-2011. Available at: <http://www.singstat.gov.sg/pubn/popn/C2010sr1/cop2010sr1.pdf> Accessed 15 August 2011.
31. Kessler RC, Ustun TB. The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res* 2004;13:93-121.
32. Subramaniam M, Vaingankar J, Heng D, Kwok KW, Lim YW, Yap M, et al. The Singapore Mental Health Study: an overview of the methodology. *Int J Methods Psychiatr Res* 2012;21:149-57.
33. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom test for nicotine dependence: a revision of the “Fagerstrom Tolerance Questionnaire”. *Br J Addict* 1991;86:1119-27.
34. Weinberger AH, Reutenauer EL, Allen TM, Termine A, Vessicchio JC, Sacco KA, et al. Reliability of the Fagerstrom Test for nicotine dependence, Minnesota Nicotine Withdrawal Scale and Tiffany Questionnaire for smoking urges in smokers with and without schizophrenia. *Drug Alcohol Depend* 2007;12;86:278-82.
35. Lesieur HR, Blume SB. The South Oaks Gambling Screen (SOGS): a new instrument for the identification of pathological gamblers. *Am J Psychiatry* 1987; 144:1184-8.
36. Statistical Analysis Software (SAS) Institute Inc. 2011. SAS/STAT 9.2 User's Guide. Cary, North Carolina.
37. Ministry of Health, Singapore. National Health Survey 2004. Available at: [http://www.moh.gov.sg/mohcorp/uploadedfiles/Publications/Reports/2005/NHS_2004\(Part4\).pdf](http://www.moh.gov.sg/mohcorp/uploadedfiles/Publications/Reports/2005/NHS_2004(Part4).pdf) Accessed 15 August 2011.
38. Storr CL, Karam EG, Girolamo G, Cheng H, Wells JE, Anthony JC, et al. Smoking estimates from around the world: data from the first 17 participating countries in the World Mental Health Survey Consortium. *Tob Control* 2010;19:65-74
39. Health Promotion Board, Singapore. Smoking control programmes for adults. Available at: <http://www.hpb.gov.sg/programmes/article.aspx?id=2490> Accessed 15 August 2011.
40. Nakamura K, Huxley R, Ansary-Moghaddam A, Woodward M. The hazards and benefits associated with smoking and smoking cessation in Asia: a meta-analysis of prospective studies. *Tob Control* 2009;18:345-53.
41. Morrow M, Barraclough S. Tobacco control and gender in Southeast Asia. Part II: Singapore and Vietnam. *Health Promot Int* 2003a;18:373-380.
42. Morrow M, Barraclough S. Tobacco control and gender in Southeast Asia. Part I: Malaysia and the Philippines. *Health Promot Int* 2003(b);18:255-64.
43. Ministry of Health, Singapore. National Health Surveillance Survey 2001. Available at: http://www.moh.gov.sg/mohcorp/uploadedfiles/Publications/Reports/2002/nhss_2001.pdf Accessed 15 August 2011.
44. Dierker LC, Rose JS, Donny E and Tiffany S. Alcohol use as a signal for sensitivity to nicotine dependence among recent onset smokers. *Addict Behav* 2011;36:421-6.
45. Dierker LC, Canino G and Merikangas KR. Association between parental and individual psychiatric/substance use disorders and smoking stages among Puerto Rican adolescents. *Drug Alcohol Dep* 2006;84:144-53.

46. Grant BF, Hasin DS, Chou SP, Stinson FS, Dawson DA. Nicotine dependence and psychiatric disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Arch Gen Psychiatry* 2004;61:1107-15.
 47. John U, Meyer C, Rumpf H, Hapke U. Probabilities of alcohol high-risk drinking, abuse or dependence estimated on grounds of tobacco smoking and nicotine dependence. *Addiction* 2003;98:805-14.
 48. Breslau N. Psychiatric comorbidity of smoking and nicotine dependence. *Behav Genet* 1995;25:95-101.
 49. Petry NM, Stinson FS, Grant BF. Comorbidity of DSM-IV pathological gambling and other psychiatric disorders: Results from a national epidemiological survey on alcohol and related conditions. *J Clin Psychiatry* 2005;66:564-74.
 50. Zvolensky MJ, McMillan K, Gonzalez A, Asmundson GJG. Chronic pain and cigarette smoking and nicotine dependence among a representative sample of adults. *Nicotine Tob Res* 2009;11:1407-14.
 51. Breslau N, Johnson E, Hiripi E, Kessler R. Nicotine dependence in the United States. *Arch Gen Psychiatry* 2001;58:810-6.
 52. Girdler SS, Maixner W, Naffel HA, Stewart PW, Moretz RL, Light KC. Cigarette smoking, stress induced analgesia and pain perception in men and women. *Pain* 2005;114:372-85.
 53. Ditte JW, Brandon TH. Pain as a motivator of smoking: Effects of pain induction on smoking urge and behavior. *J Abnorm Psychol* 2008;117:467-72.
 54. Shafey O, Eriksen M, Ross H, Mackay J. Tobacco Atlas. Compare countries. <http://www.tobaccoatlas.org/comparecountries.html?countries=singapore#> Accessed 15 August 2011.
 55. Wen CP, Tsai MK, Shigekawa EL. The framework convention on tobacco control—article 14 “demand reduction” (smoking cessation)—the weakest link of FCTC in Asia. *Asian Journal of WTO & International Health Law and Policy (AJWH)* 2010;5:381-404.
 56. World Health Organization. Second (five-year) implementation report under the WHO Framework Convention on Tobacco Control. Available at: http://www.who.int/fctc/reporting/singapore_5y_report_final.pdf Accessed 11 August 2011.
 57. Ritter C, Stöver H, Levy M, Etter J-F, Elger B. Smoking in prisons: the need for effective and acceptable interventions. *J Public Health Policy* 2011;32:32-45.
 58. The Global Youth Tobacco Survey Collaborative Group. Tobacco use among youth: A cross country comparison. *Tob Control* 2002;11:252-70.
 59. Sirichotiratana N, Sovann S, Aditama TY, Krishnan M, Kyaing NN, Miguel-Baquilod M, et al. Linking data to tobacco control program action among students aged 13-15 in Association of Southeast Asian Nations (ASEAN) member states, 2000-2006. *Tob Control* 2008;17:372-8.
-