Original Article

Prevalence of Tobacco Smoking and Accuracy of Self-Reporting in Pregnant Women at a Public Hospital for Women and Children

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Abstract

Introduction: Denial of smoking status by pregnant women presents a missed opportunity for referral to smoking cessation programmes that are shown to be effective in helping them quit smoking. Materials and Methods: A cross-sectional epidemiological survey was conducted to detect the true prevalence of active smoking pregnant patients and the accuracy of self-reporting, investigate the sociodemographic risk factors and test the knowledge of pregnant patients on adverse effects of smoking. This involved 972 antenatal patients of a maternity hospital where participants completed a sociodemographic data survey and answered a knowledge questionnaire. Urine cotinine testing was carried out after informed consent. Results: The prevalence of active smokers was 5.2% (n = 50) with 3% (n = 29) being light smokers and 2.2% (n = 21) being heavy smokers. This was significantly higher than self-reported active smoking status of 3.7% (n = 36; P = 0.02). The Malay race, being aged less than 20 years and not having tertiary level qualifications independently increased the likelihood of being an active smoker. Knowledge of the adverse effects of smoking was generally good with a mean total score of 8.18 out of 10 but there were differences amongst the non-smokers, passive smokers, light smokers and active smokers (P = 0.012). Conclusion: While the prevalence of active smoking among pregnant women is low in Singapore compared to other countries, this study substantiated the unreliability of self-reporting of smoking status in the pregnant population which could complicate referral to smoking cessation programmes. The lower awareness of the harms of smoking during pregnancy among smokers highlights a potential area for improvement.

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Introduction

The adverse effects of smoking in pregnancy have been well documented.[1] Apart from general health risks, expectant women who smoke are also at an increased risk of spontaneous miscarriage, preterm delivery and intrauterine growth retardation with resultant higher incidences of perinatal morbidity and mortality. Pregnancy presents a particularly important time to initiate smoking cessation intervention for women because of a mother's enhanced motivation to protect her foetus. Data has suggested that women who stopped smoking before 15 week's gestation had similar spontaneous preterm birth rates and small for gestational age infants as non-smokers, indicating that these severe adverse effects of smoking may be reversible if smoking is stopped early in pregnancy.[2] Furthermore, smoking cessation interventions have been shown to be effective in reducing continued smoking into late pregnancy, reducing the proportion of babies with low birth weight and preterm births as well as at increasing birth weight.[3] These findings have supported the need for smoking cessation programmes directed specifically at pregnant women.

In clinical practice, smoking cessation interventions are made available to pregnant women who verbalise their smoking status during the maternity booking visit. With

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increasing education about the hazards of smoking during pregnancy, patient denial of smoking may represent a socially desired response rather than true non-smoker status and these susceptible individuals will not be referred to smoking cessation services and receive the appropriate support to stop during pregnancy. Previous research has demonstrated varying degrees of concordance between self-reporting and various biochemical markers of nicotine intake, with studies suggesting up to a quarter of pregnant smokers are missed with purely self-reporting.[4-9]

While the prevalence of daily smoking in local female Singapore residents aged 18 to 65 years was low at 3.4%, the smoking rate was highest among young adults aged 18 to 29 years, and had increased in females aged 18 to 29 years from 6.6% in 2004 to 9.1% in 2007.[10] This is a particularly worrying trend as that female population also coincides with the reproductively active age group. Lower socioeconomic status and educational levels are significantly associated with smoking and nicotine dependence.[11] Distinct ethnic differences in nicotine dependence have also been previously studied, revealing that Malays had a higher prevalence compared to Indians and Chinese.[12]

There has been no study in multiracial Singapore which has assessed the antenatal prevalence of smoking and the robustness of self-reporting to identify pregnant smokers, hence this study was performed to fill this crucial gap in knowledge that would help shape future healthcare strategies.

Materials and Methods

A cross-sectional epidemiological survey of randomly sampled patients attending antenatal clinics at KK Women's and Children's Hospital was performed between July and August 2010. As the largest maternity facility in Singapore, the hospital provides care for over 12,000 women and their babies every year. This amounts to about one-third of the total number of babies born in Singapore. The patients have a wide ranging array of sociodemographic profiles that is reflective of the Singaporean population. This study was approved by the hospital's independent ethics committee (Centralised Institutional Review Board). Women were asked for their smoking status when they stepped into the clinic and were recorded as current active, former, passive (non-smoker with a spouse who smokes or living in an environment with frequent exposure to smoke) or non-smokers. After handing in their sample of urine for a dipstick test for albumin and glucose (done routinely at each clinic visit), a participant information sheet outlining the details of the study was given to each pregnant woman and the women had the option to opt out of the study if they desired. As the patient had reported smoking status prior to handing in their urine sample and reading the participant information sheet, they would not be able to change their self-declared smoking status.

Participants filled up a survey form of sociodemographic data including race, age, marital status, highest level of education, job and religion, as well as a short questionnaire on their awareness of the adverse effects of smoking. The questionnaire comprised of 10 questions with 5 relating to the general adverse effects of smoking on health, 3 questions on the effects of smoking on pregnancy and 2 questions on the effects of passive smoking (Appendix 1).

All women who opted to be included in the study had their urine sample results and forms tagged with a code number to allow analysis of the data to be carried out anonymously. As cotinine is derived only from nicotine metabolism, its measurement in urine is a good indicator of recent nicotine exposure. Cotinine testing was carried out using commercially available kits (Accutest® NicAlert™) and those performing the test were blind to the women's reported smoking status. The urine cotinine dipsticks were able to quantify the amount of exposure in the last 72 hours into 4 categories: non-smoker (level 0 corresponding to 0 to 10 ng/mL of cotinine equivalents), passive smoker (level 1-2 corresponding to 10 to 100 ng/mL of cotinine equivalents), light smoker (level 3-4 corresponding to 100 to 500 ng/mL of cotinine equivalents) and heavy smoker (level 5-6 corresponding to more than 500 ng/mL of cotinine equivalents). The sensitivity and specificity at a 100 ng/mL level were described by the NicAlert™ producer as 87% and 100% respectively. Self-declared active smokers were referred to a smoking cessation counsellor for intensive counselling involving an initial one-on-one therapy session outlining a plan for cessation and subsequent follow-up consults and phone sessions.

The prevalence of cotinine validated current smoking and self-reported current smoking were determined and compared (one-sample test of equality of proportions) using SPSS. Statistical significance of differences between categorical variables was determined using Pearson's x^2 test. T-tests and ANOVA (analysis of variance) were used to compare continuous patient characteristics by smoking status and cotinine concentration including comparison of questionnaire results. Stepwise logistic regression analyses were used to assess associations between subject characteristics with reported smoking status, urinary cotinine concentrations and questionnaire results. Characteristics included in the analysis were age, ethnicity, religion, marital status, highest level of education achieved and vocation.

Results

In total, 972 participants took part in the 1-month study period. None of the pregnant women approached to participate in the study declined. Excluding 2 participants with missing urine cotinine data, the prevalence of active smokers was 5.2% (n = 50), with 3% (n = 29) being light smokers and 2.2% (n = 21) being heavy smokers (Table 1). This is in comparison to the self-reported active smoking status of 3.7% (n = 36). Proportion of self-reported status was significantly lower than cotinine validated smoking status (P = 0.02).

One of the 36 self-reported smokers had a negative urine cotinine test which might have reflected that the last smoking episode was more than 72 hours ago. There was also a significantly larger population of patients whose levels of urine cotinine were equivalent to passive smokers (n = 566) than self-declared passive smokers (n = 217); 101 (72.1%) out of 140 self-reported ex or former smokers had levels of urine cotinine equivalent to that of a passive smoker while 5 (3.6%) were classified as light smokers and 6 (4.3%) were heavy smokers according to the urine cotinine test (Table 2).

Analysis of the demographics of the study population (Table 3) revealed that the Malay race had the highest proportion of passive smokers (70%), light smokers (4.9 %) and heavy smokers (4.3%) according to the urine cotinine tests. This trend was similarly reflected for the Muslims in this study. While most of the active smokers fell into the 20 to 29 age group (n = 24) followed by the 30 to 39 age group (n = 15), those aged less than 20 years old had the highest proportion (22.7%) of smokers. A higher proportion of singles were smokers (11.7%) compared to the married women (4.8%); 33 (8.8%) out of 375 of those with education of up to secondary school were active smokers as compared to 3 (1.1%) of the 267 who had attended university. When categorised according to employment status, the unemployed had the highest proportion of active smokers (9.4%), followed by the housewives (6.3%) and then the students (5%).

Stepwise logistic regression showed that Malays were more likely to be active smokers than Chinese (odds ratio [OR]: 3.45; CI , 1.56 to 7.64; P value 0.002); smokers were more likely to be less than 20 years old (OR: 5.88; CI, 2.44 to 14.1; P value 0.00) and having a highest education level of junior college (high school equivalent) or a vocational college like polytechnic or Institute of Technical Education (ITE) compared to being a university graduate was associated with a higher likelihood of smoking (OR: 2.99; CI, 1.42 to 6.22; P value 0.003).

Table 1. Categorisation of Pregnant Women into Smoker Status Based on Urine Cotinine Results and Self-Reported Smoking Status in Pregnancy (n = 972)

Urine Cotinine Results	**Frequency n (%)**		**Self-Reported Smoking Status***	**Frequency n (%)**
Non-smoker	354 (36.4)		Non-smoker	579 (59.6)
Passive smoker	566 (58.2)		Passive smoker	217 (22.3)
Light smoker	29 (3.0)	50 (5.2)	Active smoker	36 (3.7)
Heavy smoker	21 (2.2)			
-	-		Ex-smoker	140 (14.4)
Missing data	2 (0.2)		-	-
Total	972 (100)		Total	972 (100)

*Inaccurate self-reporting rate: P value 0.02.

Knowledge of the adverse effects of smoking was generally good with a mean total score of 8.18 out of 10 (Table 4). Stratifying the patients by the urine cotinine levels, there was a difference in knowledge between the non-smokers, passive smokers, light smokers and active smokers (P = 0.012), with the non-smokers scoring the highest for awareness.

Discussion

The prevalence of active smoking pregnant patients in Singapore as validated with urine cotinine measurements was low at 5.2%. In comparison to other countries, where cotinine validated figures of current smokers reached 28% to 30%[8] and inaccurate self-reporting rates approached the highest rate of 38%,[13] the figures in the study were slightly

Table 2. Cross Tabulation of Declared Smoking Status with Classification by Urine Cotinine

Declared Smoking Status	**Urine Cotinine by 4 Categories***				
	Non-Smoker n (%)	**Passive Smoker n (%)**	**Light Smoker n (%)**	**Heavy Smoker n (%)**	**Total n (%)**
Non-smoker	266 (46.0)	302 (52.2)	6 (1.0)	4 (0.7)	578 (100)
Passive smoker	59 (27.3)	149 (69.0)	5 (2.3)	3 (1.4)	216 (100)
Ex-smoker	28 (20.0)	101(72.1)	5 (3.6)	6 (4.3)	140 (100)
Active smoker	1 (2.8)	14 (38.9)	13 (36.1)	8 (22.2)	36 (100)
Total	354 (36.5)	566 (58.3)	29 (3.0)	21 (2.2)	970 (100)

*Excluding 1 non-smoker and 1 passive smoker with missing cotinine data.

Table 3. Maternal Age, Ethnic Group, Religion, Marital Status, Highest Level of Education Reached and Employment Status in Relation to Smoking Status Using Urine Cotinine Levels*

Characteristics	Non-Smoker	Passive Smoker	Light Smoker	Heavy Smoker	Total
Age					
<20 (4.7)	8 (18.2)	26 (59.1)	6 (13.6)	4 (9.1)	44 (100)
20 – 29 (52.1)	165 (33.5)	303 (61.6)	15 (3.0)	9 (1.8)	492 (100)
30 – 39 (42.5)	168 (41.8)	219 (54.5)	7 (1.7)	8 (2.0)	402 (100)
>40 (0.7)	5 (71.4)	2 (28.6)	0 (0.0)	0 (0.0)	7 (100)
Missing data	8	16	1	0	25
Total (100)	346 (36.6)	550 (58.2)	28 (3.0)	21 (2.2)	945 (100)
Race					
Chinese (36.1)	155 (44.3)	184 (52.6)	7 (2.0)	4 (1.1)	350 (100)
Malay (35.8)	72 (20.7)	243 (70.0)	17 (4.9)	15 (4.3)	347 (100)
Indian (16.8)	72 (44.2)	86 (52.8)	4 (2.5)	1 (0.6)	163 (100)
Others (11.3)	55 (50.0)	53 (48.2)	1 (0.9)	1 (0.9)	110 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Religion					
None (12.0)	50 (43.1)	62 (53.4)	3 (2.6)	1 (0.9)	116 (100)
Christian/Catholic (12.1)	61 (52.1)	54 (46.2)	1 (0.9)	1 (0.9)	117 (100)
Muslim (43.3)	94 (22.4)	289 (68.8)	21 (5.0)	16 (3.8)	420 (100)
Buddhist (21.5)	87 (41.6)	116 (55.5)	3 (1.4)	3 (1.4)	209 (100)
Hindu/Sikh (11.1)	62 (57.4)	45 (41.7)	1 (0.9)	0 (0.0)	108 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Marital status					
Single (7.9)	13 (16.9)	55 (71.4)	9 (11.7)	0 (0.0)	77 (100)
Married (84.2)	316 (38.7)	461 (56.4)	20 (2.4)	20 (2.4)	817 (100)
Separated/divorced (7.8)	25 (32.9)	50 (65.8)	0 (0.0)	1 (1.3)	76 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Highest level of education					
Secondary or less (38.7)	113 (30.1)	229 (61.1)	16 (4.3)	17 (4.5)	375 (100)
Junior college (9.2)	27 (30.3)	58 (65.1)	2 (2.2)	2 (2.2)	89 (100)
Polytechnic/ ITE (24.6)	73 (30.5)	156 (65.3)	8 (3.3)	2 (0.8)	239 (100)
University (27.6)	141 (52.8)	123 (46.1)	3 (1.1)	0 (0.0)	267 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)
Occupation					
Employed (51.2)	184 (37.0)	296 (59.6)	10 (2.0)	7 (1.4)	497 (100)
Unemployed (13.2)	41 (32.0)	75 (58.6)	8 (6.3)	4 (3.1)	128 (100)
Student (2.1)	3 (15.0)	16 (80.0)	0 (0.0)	1 (5.0)	20 (100)
Retired (0.5)	4 (80.0)	1 (20.0)	0 (0.0)	0 (0.0)	5 (100)
Housewife (33.0)	122 (38.1)	178 (55.6)	11 (3.4)	9 (2.8)	320 (100)
Total (100)	354 (36.5)	566 (58.4)	29 (3.0)	21 (2.2)	970 (100)

ITE: Institute of Technical Education
*n = 970, with percentages in brackets.

more reassuring as the pregnant population had a much lower prevalence and only a 1.5% point difference between self-reported and cotinine validated smoking status. However, even with a low prevalence of smokers in the pregnant population, there appeared to be a significant discordance between self-reports of smoking status and urinary cotinine assays at antenatal visits (*P* value 0.02). From results of the study, self-reporting did not appear to be a valid and reliable indicator of smoking status in comparison to the urine nicotine test.

Table 4. Questionnaire Scores According to Urine Cotinine Classification*

Smoking Status	Mean Total Correct Scores Max = 10	Mean Score for General Effects Max = 5	Mean Score for Pregnancy Effects Max = 3	Mean Score for Effects of Passive Smoking Max = 2
Non-smoker (n = 354)	8.39 (2.28)	4.39 (1.16)	2.48 (0.83)	1.52 (0.74)
Passive smoker (n = 566)	8.14 (2.39)	4.38 (1.14)	2.37 (0.93)	1.39 (0.80)
Light smoker (n = 29)	7.28 (2.25)	4.00 (1.23)	2.14 (0.83)	1.14 (0.88)
Heavy smoker (n = 21)	7.19 (2.09)	3.95 (1.24)	2.19 (0.75)	1.05 (0.92)
Total (n = 970)	8.18 (2.35)	4.36 (1.15)	2.40 (0.89)	1.42 (0.79)

*Standard deviation in brackets.

Interestingly, one (2.8%) out of 36 self-reported active smokers had a negative urine cotinine test and 14 (38.9%) had a urine cotinine level that was indicative of passive smoking. This may indicate that the last smoking episode was more than 72 hours ago or could be a reflection of the higher clearance of nicotine and cotinine in pregnant women as suggested by previous research[14] where the half life of cotinine was 8.8 hours compared to 16.6 hours in the non-pregnant state. Thus, this biochemical method may also underestimate the true prevalence of pregnant smokers.

There was a significantly larger population of patients who tested positive for passive smoking levels of urine cotinine than self-declared passive smokers. This may be accounted for by a high proportion of former smokers who had declared themselves to be ex-smokers and not passive smokers but are still living in a home environment with spouses or relatives who smoke as 72.1% of ex-smokers had levels of cotinine in their urine equivalent to passive smokers. Second, this may also have reflected environmental exposure and the widespread prevalence of cigarette smoke in public areas that may have endangered maternal health without their knowledge. The Smoking (Prohibition In Certain Areas) Act was most recently updated on 15 January 2013 and involved an extension of the ban on smoking in indoor public areas, common residential areas and outdoor playgrounds, fitness corners and sports facilities. A long-term policy goal to prohibit smoking in all public areas except designated smoking points may help curb the adverse effects of passive smoke and it would be of interest to know if the proportion of passive smokers detected by urine continine after extension of the ban would be significantly decreased compared to the study results.

Despite strict implementation of policies and legislation in Singapore to reduce the prevalence of smoking, there has been an increasing rate of smokers among females. A previous study on smoking and nicotine dependence in Singapore[15] had indicated that the Malay ethnic community and the lower educated group of Singaporeans aged 18 to 34 years were more likely to smoke. Our findings are consistent with this study. However, while in that study, the odds of smoking were lower in the economically inactive groups of students and homemakers compared to those employed, this study found a higher proportion of smokers among housewives and the unemployed. Also, current smokers were more likely to be divorced or separated in that previous study while in this study, single pregnant patients formed the highest proportion of active smokers.

Knowledge of the adverse effects of smoking was high, reflecting good public health message dissemination. However, there were still differences in levels of knowledge between smokers and non-smokers. A confounding factor could be that smokers in general had a lower education level than non-smokers and hence might fare poorer in knowledge questionnaires. Furthermore, knowledge does not necessarily translate to behavioural modification and active smokers still require support from tailored smoking cessation programmes to provide significant health benefits to both mother and child.

This study substantiated the unreliability of self-reporting of smoking status in the pregnant population. It showed that a significant proportion of smokers could be missed and not referred to prenatal smoking cessation programmes. Further research is needed to elucidate how smoking patients can be ethically identified in a way that makes economical sense for maximal interventional efficacy. Suggestions to improve detection of smokers include extension of the single question assessment approach at first visit to a more comprehensive assessment at each trimester with an appropriately developed line of prompts aimed at encouraging the smokers to self-report. A biochemical validation of smoking status such as the urine cotinine dipstick or a carbon monoxide breath test could also be employed as part of the standard array of tests at first visit to screen all women. It had been suggested that a carbon monoxide breath test at maternity booking could increase the identification of pregnant smokers to 95%.[16] However, a cost-benefit analysis of such a strategy would have to be performed before the introduction of this measure. Apart from using biochemical means to screen for smokers, point-of-care testing with urine cotinine and feedback in subsequent antenatal visits used in intervention programmes has been shown to significantly reduce smoking during pregnancy and increase birthweight[17] and could be incorporated in a smoking cessation programme.

Future studies are needed to evaluate the characteristics of smokers including multiparity and number of smokers in the household. Previous literature had shown that a woman who was multigravida was more likely to continue smoking during pregnancy and also if she had a partner who smoked.[18] It is probably necessary to expand smoking cessation strategies to address other smokers in the household to collectively encourage pregnant smokers to quit prenatally and continue to stay smoke-free even after delivery.

Conclusion

This study revealed the true prevalence of actively smoking pregnant patients seen in antenatal clinics by comparing self-reported smoking status of pregnant patients with their smoking status validated by means of a urine cotinine measurement. Although prevalence was low at 5.2%, there was a statistically significant rate of inaccurate self-reporting (current smokers who deny smoking status) highlighting the need to address pregnant smokers who had no access to smoking cessation programmes. The antenatal population is no different from the general female population in having lower socioeconomic status and educational level as significant risk factors for smoking. Pregnant women were generally well informed about the adverse effects of smoking and the effects of secondhand smoke on pregnancy; however there were still statistically significant differences in knowledge of non-smokers and smokers, hence these information gaps represent an avenue for further enhancement of smoking cessation strategies.

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Appendix 1
Questionnaire

Circle the Number That Corresponds to Your Answer	1-True	2-False	3-Unsure
1) Smoking leads to a 2 to 4 times increased risk of heart disease.	1	2	3
2) Chronic smokers are likely to suffer from permanent lung damage resulting in lung and heart failure, and cancer.	1	2	3
3) Smoking causes a higher risk of stroke by more than 4 times.	1	2	3
4) Smokers have an increased risk of kidney, stomach, cervical, mouth, throat and tongue cancer.	1	2	3
5) Smoking can cause bad breath, discoloured teeth and premature wrinkling and ageing.	1	2	3
6) Smoking affects fertility for both males and females.	1	2	3
7) Cigarette smoking during pregnancy increases the risk of miscarriage, prematurity and low birth weight in the foetus.	1	2	3
8) Nicotine from cigarette smoke crosses the placenta and can also pass into the breast milk affecting the baby.	1	2	3
9) Smoker's children are more likely to get bronchitis, pneumonia, and other chest infections, especially in the first year of life.	1	2	3
10) Non-smokers living with smokers have a 35% increased risk of getting lung cancer.	1	2	3