



# The identification of maternal smokers postnatally in an Irish maternity hospital

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## Abstract

**Background and aims** While many women quit smoking spontaneously before or during early pregnancy, information is limited about maternal smoking as pregnancy advances. This study examined the smoking behaviour of women throughout pregnancy and immediately after delivery.

**Methods** Women on the postnatal ward were consented for BCO testing and after completing this under supervision, they were asked to complete an accompanying questionnaire on smoking behaviour (unsupervised).

**Results** In this small pilot study, we found BCO testing in an inpatient environment, not surprisingly, was ineffective in identifying current smokers. As reported in other studies, we found that few women quit smoking after the time of the first antenatal visit.

**Conclusions** This suggests that postnatal smoking cessation interventions should receive greater attention. We recommend that all women who identify themselves as current smokers at the first antenatal visit should complete a short questionnaire postnatally and should be offered support to quit smoking or maintain cessation after they bring their baby home.

**Keywords** Breath carbon monoxide testing · Pregnancy · Smoking · Smoking cessation

## Introduction

Cigarette smoking during pregnancy is an important, preventable cause of adverse pregnancy and neonatal outcomes including intrauterine growth restriction, preterm birth, low birth weight, stillbirth and sudden infant death syndrome [1]. However, some women continue to smoke throughout pregnancy. An observational study conducted in a tertiary maternity hospital between 2011 and 2015 studying the self-reported smoking status of 42,509 women in pregnancy found that the prevalence of smoking decreased from 14.3–10.9% ( $p < 0.001$ ) over the 5-year period [2]. While this is an improvement, it still represents a significant clinical problem.

Smoking status is often underreported, particularly in pregnancy, and therefore it may be difficult to determine the true smoking behaviours in pregnancy. The National Institute for

Health and Care Excellence advises breath carbon monoxide (BCO) measurement to identify pregnant women who fail to disclose their current smoking [3]. It is a rapid, non-invasive measure of recent smoking (the half-life of CO in expired breath is approximately 4 h) which allows direct feedback to the woman. As there is a dearth of information on smoking behaviour throughout pregnancy and immediately postpartum, we used a detailed questionnaire with BCO testing as an adjunct for biochemical verification of smoking status in the immediate postnatal period.

## Methods

Women who delivered a live healthy baby were enrolled at their convenience on the postnatal ward. The Hospital is a large, tertiary maternity hospital with a no smoking policy. Women were consented for BCO testing and after completing this under supervision, they were asked to complete an accompanying questionnaire on smoking behaviour (unsupervised).

Women who were < 18 years old or who could not understand English were excluded. Clinical details and sociodemographic information, including self-reported

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smoking behaviour, were computerised at the first antenatal visit. Women who identify as smokers receive verbal advice and a leaflet on smoking cessation at this visit. Based on a previous study in the same hospital population during pregnancy, we used a BCO cut-off of  $>2$  ppm to identify probable current smokers. (Reynolds CM, personal communication, May 2018) Ethical approval was granted from the Hospital Research Ethics Committee. Statistical analysis was performed using SPSS version 24.

## Results

Of the 134 questionnaires distributed, 119 were returned. Of the 114 women who completed the questionnaire adequately, the mean age was 30.4 (standard deviation (SD) 5.7) years, 29.8% ( $n = 34$ ) were obese, 78.1% ( $n = 89$ ) were of Irish nativity and 50.9% ( $n = 58$ ) were first-time mothers.

Table 1 shows the smoking behaviour that women reported at their first antenatal visit and postnatally and the BCO levels recorded postnatally. Based on the self-reported smoking status recorded at the first prenatal visit; 5.3% ( $n = 6$ ) were current smokers, 34.2% ( $n = 39$ ) were ex-smokers and 60.5% ( $n = 69$ ) were never smokers.

In the postnatal questionnaire, 7.9% ( $n = 9$ ) self-reported as current smokers with 66.7% of them ( $n = 6$ ) reporting cutting down during pregnancy with 50.0% ( $n = 3$ ) using electronic cigarettes to assist this. A further 7.9% ( $n = 9$ ) reported quitting since planning pregnancy or on becoming pregnant. There were 23.7% ( $n = 27$ ) who identified as ex-smokers with 25.9% ( $n = 7$ ) reporting quitting in the year before becoming pregnant and 60.5% were never smokers. Of the nine women who quit while planning pregnancy or upon finding out they were pregnant, all were spontaneous quitters with none of them reporting use of nicotine replacement therapy, medication or alternative methods. All but one of them reported no relapses and all intended not to recommence smoking.

None of the women surveyed reported quitting smoking after their first antenatal visit. Of the nine reported current smokers on the postnatal survey, one was beginning to think about quitting, three described themselves as being “determined to quit but have not got around to doing it yet” and four identified as previously quitting smoking but since starting again. Of these four women, two identified as ex-smokers on the antenatal questionnaire.

The ROC curve showed the BCO levels measured in parts per million (ppm) were predictors of maternal cigarette smoking (area under the curve = 0.744). A BCO cut-off point of  $>2$  ppm resulted in a sensitivity of 55.6% and a specificity of 84.8%. This gives a possible non-disclosure rate (women declaring themselves non-smokers with BCO  $>2$  ppm) of 15.2% and a rate of possible smokers missed (women declaring themselves smokers with BCO  $\leq 2$  ppm) of 44.4%.

## Discussion

This postpartum study found that there were differences in self-reported smoking status at the first antenatal visit compared to the postnatal period, with identification of a higher number of current smokers as well as recent “pregnancy inspired quitters” who were classified as “ex-smokers” at the time of their first visit. There were also possible non-disclosures of smoking based on a positive BCO reading in those who self-reported as a non-smoker.

A UK study of 10,768 women identified their smoking patterns during the pre-conception, pregnancy and postnatal period [4]. A total of 26.5% ( $n = 2499$ ) stated they were smokers 1 year before pregnancy with 12.3% ( $n = 1050$ ) identifying as smokers after confirmation of the pregnancy and this dropped to 11.3% ( $n = 955$ ) later in pregnancy, showing few women (1%,  $n = 95$ ) quit after initial confirmation of pregnancy. There was a gradual increase in smoking postpartum from 12.8% ( $n = 1130$ ) at 4–10 weeks to 14.7% ( $n = 1333$ ) at 8–10 months postpartum.

**Table 1** Comparison of smoking behaviour gathered at the first antenatal visit compared to smoking behaviour and the BCO measurements gathered in the postnatal period

	First antenatal visit ( $n = 114$ )	Postnatal BCO $> 2$ PPM ( $n = 21$ )	Postnatal survey ( $n = 114$ )	Postnatal BCO $> 2$ PPM ( $n = 21$ )
Current smoker	6 (5.3%)	2 (9.5%)	9 (7.9%)	5 (23.8%)
Recently quit (in planning or on finding out about the pregnancy)	Not available	–	9 (7.9%)	2 (9.5%)
Quit after the first antenatal visit	Not available	–	0 (0.0%)	–
Ex-smokers	39 (34.2%)	9 (42.9%)	27 (23.7%)	4 (19.1%)
Of the ex-smokers, quit in the year before becoming pregnant	Not available	–	7 (25.9%)	0
Never smokers	69 (60.5%)	10 (47.6%)	69 (60.5%)	10 (47.6%)

A strength of this study is that it was conducted in a large university hospital which accepts women without differentiation across all socioeconomic groups and across the urban-rural divide including women who are privately insured. Conducting the study in the immediate postnatal period minimises the risk of recall bias regarding smoking behaviour in pregnancy.

Considering the limitations of the study, with the use of a BCO cut-off of > 2 ppm, 44.4% of self-reported smokers were not verified by BCO measurement. However, the use of BCO measurement in an inpatient setting may not be as reliable due to constraints on usual smoking behaviour. The hospital is set on a non-smoking campus and other factors such as pain may influence women leaving their ward to smoke. Furthermore, measurements were typically taken mid-morning which may have been before their first cigarette.

Cotinine, a by-product of nicotine metabolism, is widely used as biomarker of smoking. Salivary, serum and urinary cotinine have been studied to investigate non-disclosure of smoking in pregnancy [5–7].

Cotinine samples take longer and are more expensive to analyse and can be affected by nicotine replacement therapy but the major advantage over BCO measurement is the longer half-life of cotinine. This can be up to 15 h in urine samples and 30 h in serum samples [8]. In the inpatient setting in our study, BCO had limited sensitivity in identifying self-reported smokers due to its short half-life. A future study of inpatients ideally should measure cotinine as well as BCO.

An American survey of 1426 women who smoked in their last pregnancy assessed changes in smoking status and a smaller survey of 60 women assessed fluctuations in the amount smoked in pregnancy [9]. In the larger cohort, 71% of quitters were in first trimester with only 8% “attempting” to quit in the third trimester. Considering the smaller cohort, more than half (54%) of the smokers changed their smoking intensity multiple times. The authors concluded that women needed repeated interventions during pregnancy not only to assist cessation but also for harm reduction, for example, reducing heavy smoking in the third trimester.

Cigarette smoking in pregnancy is often under-reported. As smoking is a modifiable risk factor for many adverse outcomes in pregnancy, it is important to identify these women and promote smoking cessation. Based on this study and the literature, few women quit after the first antenatal

visit. This suggests that postnatal smoking cessation interventions should receive greater attention. BCO may have a role in identifying women who do not disclose their smoking status in pregnancy; however, the limitations of BCO testing in an inpatient setting have been highlighted in this study. BCO measurement with the detailed postnatal questionnaire resulted in a better disclosure rate compared to interview at the first antenatal visit but it complements self-reporting and should not replace it.

## Compliance with ethical standards

**Ethical approval** Ethical approval was granted from the hospital Research Ethics Committee.

**Conflicts of interest** The authors declare that have no conflicts of interest.

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