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Accuracy of self-reported smoking cessation during pregnancy

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Abstract

Evidence of bias of self-reported smoking cessation during pregnancy is reported in high-income countries but not elsewhere. We sought to evaluate self-reported smoking cessation during pregnancy using biochemical verification and to compare characteristics of women with and without biochemically confirmed cessation in Argentina and Uruguay. In a cross-sectional study from October 2011 to May 2012, women who attended one of 21 prenatal clinics and delivered at selected hospitals in Buenos Aires, Argentina and Montevideo, Uruguay, were surveyed about their smoking cessation during pregnancy. We tested saliva collected from women <12 h after delivery for cotinine to evaluate self-reported smoking cessation during pregnancy. Overall, 10.0% (44/441) of women who self-reported smoking cessation during pregnancy had biochemical evidence of continued smoking. Women who reported quitting later in pregnancy had a higher percentage of nondisclosure (17.2%) than women who reported quitting when learning of their pregnancy (6.4%).

Keywords

Smoking; reproductive health; pregnancy; cotinine; biochemical verification; Argentina; Uruguay

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Conflict of interest

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

Introduction

Smoking is the leading cause of preventable death among women and a leading preventable cause of poor pregnancy and infant outcomes in high-income countries (1). Self-reported smoking during pregnancy in nine countries in Latin America, Asia, and Africa was highest in two countries, Uruguay (18.3%) and Argentina (10.3%) (2). Studies in high-income countries have found that women's self-reported smoking status during pregnancy can underestimate smoking prevalence by 24– 28%, and intervention studies have documented differences in self-reported and biochemically verified quitting (3,4). To our knowledge, no studies have been conducted to assess the prevalence of nondisclosure during pregnancy in middle-income countries, and prior studies have not assessed nondisclosure by women who spontaneously quit when learning of their pregnancy vs. later in pregnancy.

The objective of this study was to evaluate self-reported smoking cessation during pregnancy using biochemical verification among women attending 21 prenatal clinic clusters in Argentina and Uruguay. We sought to assess what percentage of women who self-reported quitting during pregnancy had evidence of current smoking. We also assessed differences in characteristics of women who were biochemically confirmed quitters from those who were not confirmed as quitters.

Material and methods

Our study used baseline data from a cluster randomized controlled trial prior to randomization and before implementing a brief smoking cessation counseling intervention. Women were eligible for the study if they attended one of 21 prenatal clinic clusters and delivered in one of 10 public hospitals in the Province of Buenos Aires, Argentina, or one of two hospitals in Montevideo, Uruguay, during October 2011–May 2012 (5). Within 12 h after delivery, trained interviewers asked eligible women two questions about their smoking status, and women who self-reported quitting smoking during pregnancy were asked to provide a saliva sample by chewing on the cotton swab insert from a Salivette® (Sarstedt, Newton, NC, USA). A longer survey was administered to women later, but within 48 h after delivery, to collect more detailed information regarding demographics, smoking patterns during pregnancy, and secondhand smoke exposure. Information about parity was also abstracted from medical charts. The study was approved by the ethics committees of all participating hospitals, the Ministry of Health of the Province of Buenos Aires, Argentina, the Center for Medical Education and Clinical Research "Norberto Quirno," Buenos Aires, Argentina, the Faculty of Medicine, University of the Republic, Montevideo, Uruguay, as well as the Center for Diseases Control, Atlanta, and the Tulane University in New Orleans institutional review boards (USA).

The saliva samples were stored in a refrigerator at the hospital for up to 1 month, transferred to a central freezer in each country, and shipped with dry ice to the Centers for Disease Control and Prevention laboratory in Atlanta, for analysis. Salivary cotinine was measured by high-performance liquid chromatography atmospheric-pressure chemical ionization tandem mass spectrometry (LC APCI MS/MS) using a modification of a method that has

been described previously (6,7). Briefly, a 0.5-mL aliquot of the saliva sample was spiked with a deuterium-labeled cotinine-d_3 internal standard and then applied to a basified, supported liquid extraction column and extracted with methylene chloride. All samples were analyzed on an AB Sciex API 4000 tandem mass spectrometer (http://discover.absciex.com/mass-spectrometer), with the heated nebulizer installed, by measuring selected quantitation and confirmation transition ions in the multiple reaction monitoring mode in comparison with a standard curve. The limit of detection was 0.015 ng/mL.

Of 3427 women enrolled in the randomized controlled trial at baseline, 441 (12.9%) were included in the analysis if they self-reported smoking cessation upon learning of the pregnancy (spontaneous quitter) or sometime later during the pregnancy (later quitter) and consented to provide saliva. Women with missing data for demographic, clinical or secondhand smoke exposure were excluded from analyses [range: 0.2% (home smoking ban) to 6.4% (parity)]. We calculated the percentage and 95% confidence intervals of women with biochemically confirmed smoking cessation overall and by selected characteristics. It should be noted that the baseline data were collected prior to the clusters being randomized and before implementing the intervention; thus treatment condition would not have an effect on nondisclosure rates and was not assessed.

Although the precise cut-off point to determine active smoking in pregnant women is unknown, we considered a cut-off point of >10 ng/mL to determine active smoking, as this point was recommended by a scientific committee convened by the Society for Research on Nicotine and Tobacco (8). The recommended 10 ng/mL cut-off point for pregnant women is lower than the one used for the general population (>15 ng/mL), as nicotine is metabolized and cotinine is cleared faster during pregnancy (8). To assess possible misclassification due to varying levels of secondhand exposure, sensitivity analyses were conducted using two additional cut-off points. These points were determined from non-pregnant population-based studies conducted in countries with low secondhand smoke exposure (>3 ng/mL) and with extensive secondhand smoke exposure (>15 ng/mL) (3,9).

We compared biochemically confirmed quitters with those who were not confirmed quitters. Analyses were conducted using SURVEYFREQ and SURVEYREG procedures in SAS version 9.3 to account for the clustered study design. Wald chi-squared test for independence (p-value <0.05) was used to assess differences in characteristics of women who were biochemically confirmed quitters to those who were not confirmed as quitters.

Results

Most of the women in the sample were aged 20–29 years old (72.9%), married or partnered (82.8%), had incomplete secondary education (79.9%), were unemployed (72.7%), and had previous live births (62.0%). On average, women attended eight prenatal care visits and reported smoking a mean of 12 cigarettes/day prior to pregnancy.

Overall, 67.1% (296/441) of postpartum women in the sample said that they quit when they learned of the pregnancy (spontaneous quitter), and 32.9% (145/441) said that they quit sometime later during the pregnancy (later quitter) (Table 1). Based on the cotinine cut-off

point of >10 ng/mL, 10.0% (44/441) of total self-reported quitters had evidence of continued smoking. A significantly higher proportion of later quitters had evidence of continued smoking (17.2%) compared with spontaneous quitters (6.4%) ($p = 0.01$). Using a lower cut-off point of >3 ng/mL, 17.0% of self-reported quitters, 12.2% of spontaneous quitters, and 26.9% of later quitters had evidence of continued smoking. Using a higher cut-off point of >15 ng/mL, 8.4% of self-reported quitters, 5.7% of spontaneous quitters, and 13.8% of later quitters had evidence of continued smoking.

Women with evidence of continued smoking (cotinine >10 ng/mL), compared with women without evidence of continued smoking, were more likely to be a later quitter (56.8% and 30.2%, respectively), had prior live births (77.5% and 60.3%) and allowed smoking in the home (59.1% and 38.9%) (Table 2). There were no differences seen for maternal age, marital status, education, work status, whether the woman's partner or other household member smoked, frequency that the woman was around other smokers, number of cigarettes smoked per day before pregnancy, or receipt of provider advice to quit. However, the sample size had limited power to test differences in proportions of women according to these characteristics.

Discussion

The overall nondisclosure rate (10%) found in pregnant women in our study countries, and one based on a lower cut-off point (17%), was lower than has been reported in high-income countries. For example, in the USA and the UK it was estimated using biochemical verification that a quarter of pregnant women who smoke do not disclose their smoking status (3,4). This difference in nondisclosure rates may be a result of heightened awareness of the dangers of smoking during pregnancy and prevailing societal stigma against prenatal smokers (1). In our study countries, smoking is still very prevalent among the general population (10) and also among health care providers. In Argentina, about a third of physicians smoke (11), and 10% of physicians in Uruguay reported smoking (12). As a result, the lower nondisclosure rate in our study may suggest that pregnant smokers may feel less stigmatized and therefore do not hide their true smoking status. However, as strong tobacco control efforts are implemented in these countries and knowledge of the health effects of prenatal smoking becomes more prevalent, it may be necessary to evaluate whether nondisclosure rates change in pregnant women over time in these countries.

This study also shows that the nondisclosure rate for women who quit later in pregnancy was significantly higher than the nondisclosure rate for spontaneous quitters among women attending prenatal care. In addition, characteristics associated with non-disclosure included higher parity and smoking allowed in the house, consistent with risk factors for continued prenatal smoking (13).

The study had several limitations. First, the precise cut-off point to identify smoking among pregnant women is unknown, and varies by secondhand smoke exposure. Pregnant women metabolize nicotine and clear cotinine faster than non-pregnant women (8). We applied generally accepted cotinine cut-off points, which may underestimate nondisclosure rate. We also utilized a lower and higher cut-off point to account for varying secondhand smoke

exposure in our study countries. Secondly, as cotinine can be cleared within 2 days (8), our study protocol required that the saliva sample be obtained from women as soon as possible after delivery, but no later than 12 h after delivery. However, our estimates of nondisclosure could be underestimated if the duration of labor and delivery exceeded 48 h from a woman's last cigarette. Thirdly, our sample size had limited power and was not planned to test differences in nondisclosure. Finally, these results may not be generalizable to women with characteristics different from those in the 21 prenatal clusters sampled.

In conclusion, one in 10 postpartum women in our study who self-reported smoking cessation during pregnancy had cotinine levels consistent with active smoking. In view of this, prenatal care providers should be trained to conduct effective and non-judgmental assessment of tobacco use to encourage disclosure (14).

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References

1. CDC. The health consequences of smoking: 50 years of progress: a report of the surgeon general. CDC; Atlanta: 2014.
2. Bloch M, Althabe F, Onyamboko M, Kaseba-Sata C, Castilla EE, Freire S, et al. Tobacco use and secondhand smoke exposure during pregnancy: an investigative survey of women in 9 developing nations. Am J Public Health. 2008; 98:1833–40. [PubMed: 18309125]
3. Dietz PM, Homa D, England LJ, Burley K, Tong VT, Dube SR, et al. Estimates of nondisclosure of cigarette smoking among pregnant and nonpregnant women of reproductive age in the United States. Am J Epidemiol. 2011; 173:355–9. [PubMed: 21178103]
4. Shipton D, Tappin DM, Vadiveloo T, Crossley JA, Aitken DA, Chalmers J. Reliability of self reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross sectional study. BMJ. 2009; 339:b4347. [PubMed: 19875845]
5. Althabe F, Aleman A, Mazzoni A, Berrueta M, Morello P, Colomar M, et al. Tobacco cessation intervention for pregnant women in Argentina and Uruguay: study protocol. Reprod Health. 2013; 10:44. [PubMed: 23971512]
6. Bernert JT, Turner WE, Pirkle JL, Sosnoff CS, Akins JR, Waldrep MK, et al. Development and validation of a sensitive method for the determination of serum cotinine in both smokers and non-smokers by using liquid chromatography/atmospheric pressure ionization tandem mass spectrometry. Clin Chem. 1997; 43:2281–91. [PubMed: 9439445]

7. Bernert JT, McGuffey JE, Morrison MA, Pirkle JL. Comparison of serum and salivary cotinine measurements by a sensitive high-performance liquid chromatography-tandem mass spectrometry method as an indicator of exposure to tobacco smoke among smoker and nonsmokers. J Anal Toxicol. 2000; 24:333–9. [PubMed: 10926356]
8. SRNT Subcommittee on Biochemical Verification. Biochemical verification of tobacco use and cessation. Nicotine Tob Res. 2002; 4:149–59. [PubMed: 12028847]
9. Avila-Tang E, Al-Delaimy WK, Ashley DL, Benowitz N, Bernert JT, Kim S, et al. Assessing secondhand smoke using biological markers. Tob Control. 2013; 22:164–71. [PubMed: 22940677]
10. Giovino GA, Mirza SA, Samet JM, Gupta PC, Jarvis MJ, Bhala N, et al. Tobacco use in 3 billion individuals from 16 countries: an analysis of nationally representative cross-sectional household surveys. Lancet. 2012; 380:668–79. [PubMed: 22901888]
11. Mejia R, Martinez VG, Gregorich SE, Pérez-Stable EJ. Physician counseling of pregnant women about active and secondhand smoking in Argentina. Acta Obstet Gynecol Scand. 2010; 89:490–5. [PubMed: 20367427]
12. Boado M, Bianco E. Tabaquismo en los médicos uruguayos (2011). Rev Urug Cardiol. 2011; 26:214–24.
13. Flemming K, Graham H, Heirs M, Fox D, Sowden A. Smoking in pregnancy: a systematic review of qualitative research of women who commence pregnancy as smokers. J Adv Nurs. 2013; 69:1023–36. [PubMed: 23278126]
14. WHO. WHO recommendations for the prevention and management of tobacco use and second-hand smoke exposure in pregnancy. World Health Organization; Geneva: 2013. Available online at: http://www.who.int/tobacco/publications/pregnancy/guidelinestobaccosmokeexposure/en/index.html (accessed October 3, 2014)

Table 1

Comparison of self-reported smoking cessation during pregnancy with saliva cotinine cut-points of 10 ng/mL, including sensitivity analyses with cut-points of 3 and 15 ng/mL.

	Saliva cotinine			
Self-report	≤10 ng/mL	>10 ng/mL	Total	*p*-value*
Spontaneous quitter	93.6, 90.5–96.6 (277)	6.4, 3.4–9.4, (19)	67.1, 59.4–74.8 (296)	0.0106
Later quitter	82.8, 76.5–89.0 (120)	17.2, 11.0–23.5 (25)	32.9, 25.2–40.6 (145)	
Total	90.0, 87.2–92.9 (397)	10.0, 7.1–12.8 (44)	100.0 (441)	
	≤3 ng/mL	>3 ng/mL		
Spontaneous quitter	87.8, 84.2–91.5 (260)	12.2, 8.5–15.8 (36)	67.1, 59.4–74.8 (296)	0.0149
Later quitter	73.1, 63.8–82.4 (106)	26.9, 17.6–36.2 (39)	32.9, 25.2–40.6 (145)	
Total	83.0, 79.3–86.7 (296)	17.0, 13.3–20.7 (75)	100.0 (441)	
	≤15 ng/mL	>15 ng/mL		
Spontaneous quitter	94.3, 91.2–97.4 (279)	5.7, 2.6–8.8 (17)	67.1, 59.4–74.8 (296)	0.0531
Later quitter	86.2, 79.4–93.0 (125)	13.8, 7.0–20.6 (20)	32.9, 25.2–40.6 (145)	
Total	91.6, 88.7–94.6 (404)	8.4, 5.4–11.3 (37)	100.0 (441)	

Values are expressed as %, 95% CI and (*n*).

*Wald chi-square test for independence was used to assess differences in characteristics of women who were biochemically confirmed quitters and those who were not confirmed as quitters.

Table 2

Characteristics of women by biochemical confirmation of smoking cessation during pregnancy.

	Saliva cotinine ≤10 ng/mL (*n* = 397)	Saliva cotinine >10 ng/mL (*n* = 44)	*p*-value*
Self-reported quit status			
Spontaneous quitter	69.8, 62.2–77.3 (277)	43.2, 25.4–61.0 (19)	0.0106
Later quitter	30.2, 22.7–37.8 (120)	56.8, 39.0–74.6 (25)	
Maternal age (years)			
<20	19.1, 15.6–22.5 (74)	14.0, 0.1–27.8 (6)	0.7407
20–29	72.4, 68.9–75.9 (281)	76.7, 61.8–91.7 (33)	
≥30	8.5, 5.8–11.2 (33)	9.3, 0.3–18.3 (4)	
Marital status			
Married or partnered	83.7, 80.0–87.4 (329)	74.4, 56.4–92.4 (32)	0.3217
Not married	16.3, 12.6–20.0 (64)	25.6, 7.6–43.6 (11)	
Highest level of education			
Completed primary school or less	31.0, 24.8–37.1 (122)	36.4, 23.4–49.3 (16)	0.0735
Incomplete secondary school	50.0, 42.3–57.7 (197)	34.1, 17.7–50.4 (15)	
Completed secondary or higher	19.0, 11.0–27.0 (75)	29.5, 17.2–41.9 (13)	
Work status			
Employed or student	27.3, 17.9–36.7 (104)	26.8, 8.2–45.4 (11)	0.9379
Unemployed	72.7, 63.3–82.1 (277)	73.2, 54.5–91.8 (30)	
Parity			
0	39.7, 33.9–45.5 (148)	22.5, 9.8–35.2 (9)	0.0446
≥1	60.3, 54.5–66.1 (225)	77.5, 64.8–90.2 (31)	
Average no. prenatal care visits	8.2, 7.8–8.6 (386)	7.5, 6.4–8.6 (42)	0.1904
Smoking allowed in home			
Yes	38.9, 30.2–47.5 (154)	59.1, 47.6–70.6 (26)	0.0136
No	61.1, 52.5–69.8 (242)	40.9, 29.4–52.4 (18)	
Partner or other household member smokes			
Yes	70.4, 66.3–74.4 (273)	78.6, 60.0–97.1 (33)	0.3598
No	29.6, 25.6–33.7 (115)	21.4, 2.9–40.0 (9)	
How often around smokers			
Never	17.4, 11.3–23.6 (68)	7.0, 0–15.3 (3)	0.1042
Rarely	23.6, 19.9–27.3 (92)	16.3, 0.8–31.8 (7)	
Sometimes	43.3, 39.1–47.5 (169)	46.5, 27.4–65.6 (20)	
Always	15.6, 12.5–18.8 (61)	30.2, 21.2–39.3 (13)	
Average no. cigarettes smoked per day before pregnancy	10.3, 9.5–11.1 (387)	12.3, 10.1–14.4 (44)	0.1405
No. cigarettes smoked per day before pregnancy			
<10	46.0, 39.4–52.6 (178)	34.1, 12.0–56.1 (15)	0.2249
10–19	32.0, 24.0–40.1 (124)	27.3, 5.5–49.1 (12)	
≥20	22.0, 17.7–26.2 (85)	38.6, 19.1–58.2 (17)	
Received provider advice to quit smoking			
Yes	63.2, 55.8–70.6 (249)	63.6, 49.4–77.8 (28)	0.9580

	Saliva cotinine ≤10 ng/mL (*n* = 397)	Saliva cotinine >10 ng/mL (*n* = 44)	*p*-value*
No	36.8, 29.4–44.2 (145)	36.4, 22.2–50.6 (16)	

Values are expressed as % or mean, 95% CI and (*n*).

Sample size varied by each item due to missing values.

*Wald chi-square test for independence was used to assess differences in characteristics of women who were biochemically confirmed quitters and those who were not confirmed as quitters.