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FACTORS ASSOCIATED WITH EARLY PREGNANCY SMOKING STATUS AMONG LOW-INCOME SMOKERS

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Abstract

Objectives—To compare pregnant women who are current smokers at their first prenatal visit with those who recently quit smoking in the 90 days prior to their first prenatal visit (i.e., spontaneous quitters) to identify differences between them and factors that predict their intake smoking status.

Methods—One hundred and thirty participants were enrolled in this cross-sectional research study. The sample was drawn from a population of pregnant women attending their first prenatal visit at a low-income obstetrics clinic in Baltimore, Maryland; the large majority of which have characteristics that previous research has identified as putting them at high-risk of continued smoking during pregnancy. Participants were recruited through referrals from clinical staff. Intake data collection occurred between March and December, 2013.

Results—Of the 130 pregnant women enrolled in the study, 126 had complete intake data. The sample included 86 current smokers and 40 recent quitters. The large majority of participants were African American with an average age of 26. Current smokers were significantly more likely than recent quitters to have: more depression symptoms; self-perceived stress; internalizing and externalizing disorder symptoms; substance use disorders; and tobacco dependence. The most significant predictors of smoking status at first prenatal visit were depressive symptoms, readiness to quit, and number of children.

Conclusions for Practice—Differences were identified at intake among this sample of pregnant women already considered to be at high-risk for continued smoking throughout their pregnancy. This study identified relevant factors associated with whether or not a woman had recently quit smoking in early pregnancy or was continuing to smoke at her first prenatal visit. Knowledge of these factors may benefit physicians in understanding and promoting smoking cessation throughout the perinatal period and specifically intervening to decrease depressive symptoms and increasing readiness to quit may improve outcomes.

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DECLARATION OF INTERESTS

The authors report no competing interests.

Keywords

smoking cessation; mental health; racial/ethnic minority populations; pregnancy

INTRODUCTION

Smoking during pregnancy is a well-known public health issue. Women who smoke during pregnancy are more likely to have a wide range of negative pregnancy outcomes including ectopic pregnancy (Horne et al., 2014), placenta previa and abruption (Aliyu et al., 2011), intrauterine growth restriction (Blatt et al., 2015), miscarriage (Pineles, Park, & Samet, 2014), preterm birth (Shah & Bracken, 2000), and low birth weight babies (U.S Department of Health and Human Services, 2004).. Unfortunately, smoking during pregnancy is not uncommon. Based on analysis of 2012 National Survey on Drug Use and Health (NSDUH) data, approximately 22.6% of pregnant females aged 12 to 44 report past-month cigarette use in their first trimester (U.S. Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality, 2012).

Previous research suggests that 20–40% of pregnant smokers spontaneously quit smoking prior to giving birth (Morasco, Dornelas, Fischer, Oncken, & Lando, 2006; Ockene et al., 2002), and several studies have examined factors associated with “spontaneous quitters.” A comprehensive review of spontaneous quitting found that women who have: more education, higher incomes, early prenatal care, no other children, intention to breastfeed, and had a previous miscarriage were more likely to have quit smoking upon learning of their pregnancy. Spontaneous quitters were also more likely to be married, lighter pre-pregnancy smokers, older when they began smoking, and were less likely to have a partner who smokes (Solomon & Quinn, 2004). Thus, it can be inferred that women with less education, lower incomes, et cetera, are “at-risk” and may be less likely to quit smoking on their own. One recent study examining psychological differences between spontaneous quitters and continuing smokers concluded that a greater understanding of psychological factors that differentiate smokers who spontaneously quit during pregnancy from those who do not is crucial to the design of more effective prenatal smoking cessation interventions (Massey & Compton, 2012). Therefore, in addition to exploring several factors that have been previously determined to be associated with spontaneous quitting in a general pregnant population (e.g., number of cigarettes smoked per day; age when began smoking; number of children; no previous miscarriage) we also seek to assess psychological factors such as depression, stress, and more global internalizing and externalizing disorder symptoms to identify which are most relevant in a low-income, less educated population.

METHODS

Sample

The sample for this study was drawn from a population of pregnant women attending their first prenatal visit at a low-income obstetrics clinic in Baltimore, Maryland who met the following study criteria: (a) self-report of past 90-day tobacco smoking or past-year tobacco

dependence (see *Measures*); (b) first or second trimester of pregnancy; and (c) between 18 to 40 years of age. Exclusion criteria were: (a) intention to terminate the pregnancy; (b) plans to relocate from the area; and (c) no past-year smoking. Participants who enrolled in the study and completed study measures were compensated with a \$15 gift card. Data collection occurred between March and December 2013. A total of 130 participants were enrolled in the study. All participants signed an informed consent form and HIPAA authorization form that were approved by the Institutional Review Boards (IRB) of University of Maryland-Baltimore, Chestnut Health Systems, and Battelle Memorial Institute.

Procedures

Participants were recruited through referrals from the clinic's medical staff. All patients who were attending their first prenatal clinic visit were screened for tobacco use per a standardized clinic protocol prior to being seen by a physician. Women who were initially screened as interested and eligible by a health care professional were brought to the clinic's research office where they received an informed consent detailing the nature of the study, procedures, benefits and risks, and compensation. Participants were enrolled into the study after signing the consent form and completing the intake measures electronically via iPad or laptop computer. Participants also provided a urine sample at intake that was tested for cotinine.

Measures

There were two types of data collected for this study: survey and urine cotinine. The self-administered electronic survey consisted of four separate measures. The first was the Global Appraisal of Individual Needs Pregnant and Postpartum Women Screener (GAIN-PPWS) that collected demographic and background variables; psychological variables such as stress and coping (Sources of Stress Screener; scale scores of 0–8 with a higher score indicative of a greater severity of sources of stress); depression and other internalizing mental health disorder symptoms (Internalizing Disorders Screener; scale scores of 0–6 with a higher score indicative of a greater severity of problems with internalizing disorders); externalizing mental health disorder symptoms (Externalizing Disorders Screener; scale scores of 0–7 with a higher score indicative of greater severity of problems with externalizing disorders); tobacco use and dependence (Tobacco Dependence Screener; 7-item scale where higher values, 3 or more, indicate support for tobacco dependence); alcohol and drug use (Substance Disorders Screener; scale scores of 0–5 with a higher score indicative of greater severity in substance use problems); motivations to quit; barriers to staying quit; and readiness to quit (scale of 0–100). The GAIN-PPWS was a modification of the GAIN (Dennis, Scott, & Funk, 2003), which is a family of evidence-based assessment instruments, web based software applications, training, coaching, and monitoring protocols that have been developed by Chestnut Health Systems in collaboration with several Federal Agencies (SAMHSA, NIDA, NIAAA), states, local governments and researchers, and has or is being used by over 250 grantees of these and other agencies (e.g., BJA, OJJDP, DOL) and foundations (Interventions, RWJF). The GAIN has scales that have demonstrated their reliability, validity, and sensitivity to change. The Tobacco Use Patterns Survey (TUPS) is a 21-item instrument that was developed for this study to measure smoking patterns before, during, and after pregnancy of both the participant and those regularly in her environment by

self-report of mean daily cigarette consumption. This survey also identified date of last cigarette smoked to measure time to relapse, and included questions on breastfeeding and environmental risks. The Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983) and the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987) were also administered to assess stress and depression symptoms, respectively. The EPDS has been found to be an effective screening tool for identifying women with depressive symptoms during pregnancy (Ryan, Milis, & Misri, 2005) and has been validated for use in pregnant populations (Murray and Cox, 1990).

The second type of data collected at each measurement wave was urine to measure cotinine (the primary metabolite of nicotine) levels. A NicCheck™ I test (Physician Sales & Service, Inc.) was used to quantify cotinine levels in the urine. The NicCheck™ I is a rapid urine test of smoking status that assesses the concentration of cotinine based on a colorimetric reaction. After dipping in the urine sample, the level of cotinine is determined by matching the test strip with a color chart. The test scale ranges from 0–14 (where 0: negative; 1–6: low; and 7–14: high nicotine consumer as reported on the product packaging insert). The lowest concentrations at which a clearly discernable positive result was visible was 2.5 µg/mL for cotinine. A “low” NicCheck I color reading correctly identified subject samples containing <1500 ng/mL of cotinine 73% of the time and the occurrence of a “high” NicCheck I color reading correctly identified subject samples containing 1500 ng/mL of cotinine 76% of the time.

Analytic Strategies

Based on responses to the intake measures, participants were classified as either “current smokers” (who reported having smoked in the past week) or spontaneous quitters (who reported having quit smoking in the past 90 days, which would be immediately prior to or in very early pregnancy). Smoking status was determined by a question on the GAIN-PPWS that asked participants the last time they smoked, with options being within the past 2 days, 3 to 7 days ago, 1 to 4 weeks ago, 1 to 3 months ago, 4 to 12 months ago, or more than 12 months ago. Smoking status was biochemically verified by NicCheck results such that any “high” cotinine results from a self-reported non-smoker over the past week were sufficient to remove the individual from analysis. All statistical analyses were conducted with StatSoft, Inc. (2013) STATISTICA, version 12. T-test for continuous variables and Chi-Square analysis for categorical variables were used to compare demographic and psychological variables between the groups. Logistic regression was used to examine predictors of quit status at intake. To help specify a correct regression model, stepwise method was applied. The model was built manually by selecting the most important predictors into the regression equation one step at a time, using criteria of statistical significance for the predictors. The module computed continuous and categorical predictors with multiple degrees of freedom, and automatically moved the latter into/out of the regression equation in single steps. At each step we computed various predictor statistics for predictors in the current model, and predictors (predictor candidates) not in the current equation. The following variables were selected as candidates for predicting quit status: EPDS, PSS, past-month internalizing disorder screener, past-year externalizing disorder screener, readiness to quit, past-month tobacco dependence, trimester of pregnancy, number of cigarettes smoked per day, previous

miscarriage, number of children, and age first began smoking. These candidate variables were selected based on previous literature as well as our desire to explore variables not yet examined.

RESULTS

Sample Characteristics

Three participants were excluded due to missing data, and one was excluded due to inconsistency between her cotinine test and self-reported smoking status. The final sample ($n=126$) was comprised of 68% current smokers ($n=86$) and 32% recent quitters ($n=40$). The majority of participants were African American (80%) and never married (75%), with an average age of 26 (range: 18–41). Over one-third of the sample (40%) reported having had a previous miscarriage/stillbirth. On average, participants had two children prior to the current pregnancy (31% had one and 26% had more than three). Sixty percent were in their second trimester while 40% were in their first trimester. Average cotinine as measured by the NicCheck™ I test for current smokers and spontaneous quitters was 0.1 and 5.6, respectively. There was a significant correlation between past 90-day tobacco use and cotinine ($r=0.34$, $p<0.001$).

Differences between Current Smokers and Spontaneous Quitters

Table 1 shows results of tests of differences between current smokers and spontaneous quitters at intake (i.e., entry to prenatal care). Spontaneous quitters, compared to current smokers, were slightly more likely to be African American, and less likely to be Caucasian and Mixed-race; slightly younger than current smokers; and slightly less likely to have had a previous miscarriage/stillbirth. None of these differences were statistically significant at $p<0.05$. Current smokers were significantly different than recent quitters in that they reported smoking initiation at a younger age (15 versus 17 years, $p=0.001$) and having completed less education (11th grade versus 12th grade, $p=0.002$). Current smokers had significantly more “smoking days” out of past 90 days (66 vs. 25, $p<0.001$) and were more likely than recent quitters to have: higher urine cotinine level result on the NicCheck™ I scale (5.6 vs. 0.3, $p<0.001$); count of depression symptoms (10.0 vs. 6.8, $p=.009$); higher self-perceived stress scores (18.4 vs. 15.3, $p=0.036$); lifetime, past-year and past-month internalizing disorders (3.1 vs. 2.3, $p=0.009$; 2.6 vs. 1.8, $p=0.006$; 1.9 vs. 1.2, $p=0.024$); lifetime and past-year externalizing disorders (2.0 vs. 1.0, $p<.001$; 1.1 vs. 0.5, $p=0.011$); lifetime substance use disorders (2.3 vs. 1.5, $p=0.025$); lifetime, past-year, and past-month tobacco dependence (3.8 vs. 2.0, $p<0.001$; 2.9 vs. 1.5, $p=0.001$; 1.9 vs. 0.3, $p<0.001$); and less readiness to quit (75% vs. 93%, $p<0.001$). There were no significant differences between the groups on count of past-year and past-month substance use ($p=0.403$; $p=0.360$); past month externalizing disorders ($p=0.251$); lifetime-, past-year, and past-month sources of stress ($p=0.751$; $p=0.209$; $p=0.603$).

Predictors of Quit Status at Intake

Table 2 shows the results of stepwise logistic regression analyses performed to investigate the best predictors of smoking status at intake. The statistical significance of individual regression coefficients (β s) tested using the Wald chi-square statistic show that the log of

odds of a woman being a smoker was positively related to Postnatal Depression Scale ($p=0.027$) and number of children ($p<0.012$) and negatively related to the readiness to quit ($p<0.001$). The similar test of the intercept showed the intercept should also be included in the model ($p=0.003$). The Somer's D statistic for the model was .646 which is interpreted as 65% fewer errors made in predicting the smoking status at intake by using the estimated probabilities than by chance alone. To verify the model, ROC curve (Sensitivity vs. 1-Specificity) was plotted. The area under the curve was 0.82 which confirms good overall model performance.

DISCUSSION

The unique contribution of this research is that it examines women who are already considered to be at high risk for continued smoking throughout pregnancy (Solomon & Quinn, 2004). Many of the participants have never been married, have multiple children, presented to prenatal care later in their pregnancy, had a previous miscarriage, and have less than a high school education. Differences were identified between current smokers and recent quitters presenting to their first prenatal visit: recent quitters started smoking at a later age, had less psychological distress, less tobacco dependence, and a greater readiness to quit. Interestingly, their reported sources of stress were similar to those of current smokers but they had significantly lower perceived stress. There may be an opportunity to focus more heavily on relapse prevention with spontaneous quitters who remain at high risk for relapsing to smoking during pregnancy, as studies have shown that physicians may not ask about smoking throughout pregnancy if patients report having quit at their first appointment (Coleman-Cowger, Anderson, Mahoney, & Schulkin, 2014). This is in addition to intervening with pregnant women who are current smokers at intake in ways that address factors that may be most relevant to their continued smoking.

What seemed to best predict whether or not a woman presented to her first prenatal visit as a smoker or a quitter was her level of depression, her readiness to quit, and the number of children she had. If a woman is not ready to quit smoking, has more depressive symptoms, and more children to care for, it is possible she may require additional smoking cessation resources during pregnancy. Depression (Zhu & Valbo, 2002) and low motivation to quit (U.S Department of Health and Human Services, 2001) have also been identified in the literature as being associated with smoking during pregnancy, and these factors are incorporated into several existing smoking cessation interventions. Less information is available on the role of existing children in smoking cessation.

Limitations

This study is not without limitations. First, it does not detail longitudinal smoking behaviors over the course of pregnancy. Data is currently being collected to examine the trajectory of smoking from pregnancy through postpartum with this population. Second, there is no inclusion of a non-smoker group to compare to our sample, thus no determination can be made as to how smokers and recent quitters compare to non-smokers on the same measures. Third, our sample is small, particularly given the number of variables tested thus increasing risk of Type I error. While there are no specific rules applicable to logistic regression

analysis in terms of adequate sample size, our sample exceeds minimum sample size of 100 typically recommended (Tabachnick & Fidell, 2001; Peng, Lee, & Ingersoll, 2002).

Implications and Future Direction

Despite the limitations, this study contributes important information on a population of pregnant smokers traditionally believed to be at greater risk for continued smoking throughout pregnancy. There may be factors more relevant than others in determining continued smoking during pregnancy, and medical staff may benefit from added vigilance when these factors are identified. Smoking cessation interventions, such as the 5 A's behavioral framework (American College of Obstetricians and Gynecologists, 2010), already exist in medical settings but may be improved upon by focusing on certain aspects, such as the assessment of mental health history and readiness to quit, and utilizing motivational interviewing to increase motivation. Assessing the number of children in the home may provide additional information on whether or not a pregnant woman is at greater risk for continued smoking throughout pregnancy.

It will be important for future research to further examine which aspects of current smoking cessation intervention work best in increasing quit rates during pregnancy. The 5A's is comprehensive though may not be fully utilized (Coleman-Cowger, Anderson, Mahoney, & Schulkin, 2014), and thus additional training may be warranted. Also important is the longitudinal study of smoking during pregnancy to better understand patterns of smoking and quitting during pregnancy and thus inform when smoking cessation and relapse prevention interventions may work best. Understanding when and how best to intervene with pregnant smokers could have a significant impact on smoking patterns and ultimately on the health of both mother and child.

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SIGNIFICANCE

What is already known about this subject?

Several factors have previously been identified to be associated with continued smoking during pregnancy (e.g., low-income, less education); however, very little is known about which predictors are most associated with spontaneous quitting at first prenatal visit among pregnant populations already considered to be high-risk for continued smoking.

What does this study add?

This study offers insight into which factors are most predictive of smoking status at first prenatal visit among primarily low-income, less educated pregnant women. Physicians who work with this population may benefit from awareness of these specific factors so that more targeted intervention may be offered (i.e., relapse prevention for spontaneous quitters and smoking cessation for continuing smokers).

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	Recent Quitters (n=40)	Current Smokers (n=86)	
Substance Disorder Screener-lifetime	1.5 (1.3)	2.3 (1.9)	2.270 (124)
Tobacco Dependence Screener-lifetime	2.0 (2.0)	3.8 (2.4)	4.049 (123)
-past year	1.5 (1.8)	2.9 (2.3)	3.443 (123)
-past month	0.3 (0.9)	1.9 (2.0)	4.468 (123)
Percent Ready to Quit	93 (18.3)	75 (26.9)	3.940 (124)
Perceived Stress Scale	15.3 (7.8)	18.4 (7.6)	2.118 (124)
Substance Disorder Screener-past year	1.1 (1.2)	1.4 (1.6)	0.839 (124)
-past month	0.3 (0.7)	0.4 (0.9)	0.919 (124)
Externalizing Disorder Screener-past month	0.4 (0.7)	0.6 (1.0)	1.152 (124)
Sources of Stress Screener-lifetime	4.4 (2.1)	4.5 (2.4)	0.318 (124)
-past year	2.6 (2.0)	3.1 (2.0)	1.262 (124)
-past month	1.6 (1.5)	1.7 (1.8)	0.522 (124)

Table 2
 Prediction of Smoking Status at Intake Using Stepwise Logistic Regression Analysis

Independent variable	β	Standard Error β	Wald Chi-Square	95.0% CI	p	OR (95CI)
<i>Intercept</i>	4.151	1.417	8.582	1.374;6.928	.003	
Postnatal Depression Scale	0.083	0.038	4.872	0.009;0.156	.027	1.086 (1.009;1.169)
Readiness to quit	-0.053	0.015	12.242	(-0.083);(-0.023)	.000	0.948 (0.920;0.977)
# of children	0.391	0.156	6.260	0.085;0.697	.012	1.478 (1.088;2.008)

Note: (Distribution: BINOMIAL, Link function: LOGIT Modeled probability that Smoking status = smoker)