








Socio-demographic and psychological features associated with smoking in pregnancy

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INTRODUCTION

Smoking in pregnancy is a serious health issue, since both mother and fetus are subject to toxic substances of cigarettes.⁽¹⁾ Smoking during pregnancy has been associated, among others, with placenta *previa*, spontaneous abortions, preterm delivery, low birth weight, and high fetal mortality.⁽²⁾ In addition, several morbid conditions have been described in children of pregnant smokers, even years after delivery.

Regardless of the increasing knowledge about its harms, cigarette use during pregnancy still is a common behavior in several regions of the world. A systematic review, performed with data from more than 100 countries, found that, worldwide, 52.9% of women who smoked daily continued to do it during pregnancy.⁽³⁾ Though, it is important to

recognize that many pregnant women voluntarily quit, with reported rates ranging from 4% to 70%.⁽⁴⁾

Smoking during pregnancy has been associated with several socio-demographic features including mother's age, poor educational level, and low economic class.⁽⁵⁻⁷⁾ It has also been associated with some psychological characteristics, including high levels of anxiety, depression, and perceived stress.⁽⁸⁻¹⁰⁾ On the other hand, quitting has been associated mainly with higher educational levels, planned gestation, first pregnancy, non-smoking partners, and lower levels of anxiety.⁽¹¹⁻¹³⁾

Due to the widespread knowledge about the harms of tobacco, pregnant women frequently do not provide trustful information regarding their smoking habits.⁽¹⁾ Studies on smoking during pregnancy have reported disagreements of 28% to 50%, between self-reports and

ABSTRACT

Objective: To investigate how social and psychological characteristics differ between pregnant women who smoke and do not smoke. To explore associations between social and psychological features with changes of smoking habits by the end of pregnancy.

Methods: A case-control study was set up. Smokers cases were never-smokers and ex-smokers controls. Pregnant women (n=328) from public prenatal services were interviewed. Socio-demographic data and psychological variables – personality traits, anxiety, depression, perceived stress, maternal fetal-attachment - were measured. Saliva samples were collected to measure cotinine and to check self-informed smoking status. In addition, 66 smokers were also assessed regarding smoking habits by late pregnancy. Smoking status was defined as a dependent variable. Exposure factors were analyzed through odds ratios. Logistic models and contingency tables were employed according to the nature of variables. “Qualitative change in smoking” was defined as a dependent variable for the last evaluation, and a logistic regression model was built. **Results:** Lower schooling, higher age, use of alcohol and drugs, living without a partner, and passive smoking showed associations with smoking. Anxiety, depression and perceived stress also exhibited positive association with smoking. Among personality traits, only Neuroticism was associated with smoking. None of the variables were associated with qualitative change in smoking by the end of pregnancy. **Conclusion:** Smoking during pregnancy is associated with more unfavorable social conditions. Pregnant women who smoke exhibit more negative psychological states than nonsmokers, including a profile of accentuated Neuroticism. None of the investigated variables could predict changes in smoking during pregnancy.

Keywords: Smoking; Pregnancy; Psychology; Psychosocial factors; Personality traits; Big five factor model of personality; Perceived stress; Anxiety; Depression.

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cotinine tests.⁽¹⁴⁾ Nevertheless, most studies on socio-demographic and psychological features of pregnant women who smoke lack biological assessments, which may have adversely influenced the results.

The overall prevalence of smoking in Brazil has progressively decreased along the past decades, but the proportion of Brazilian pregnant women who smoke still is estimated to be 14.7%.⁽³⁾ Despite the relevance of the matter and several studies published in the field, to the best of our knowledge, there is not a published manuscript specifically designed to explore psychological features associated with smoking in Brazilian pregnant women.⁽¹⁵⁻²⁰⁾

The objective of the present study was to compare socio-demographic and psychological features among Brazilian pregnant women classified as smokers and non-smokers, whose smoking status had been confirmed by biochemical tests. In addition, it was also explored if any of these features could be associated with quitting or reducing smoking at the end of the pregnancy.

METHODS

A case-control investigation was conducted, where pregnant smokers were the case group and pregnant non-smokers the control group. All women completed a first assessment, not later than a gestational age of 24 weeks. In addition, smokers also completed a second assessment around delivery.

A convenience sample of pregnant women attending prenatal care at six public health units in the city of Ribeirão Preto, Brazil, were sequentially invited to participate in the study from July, 2015 through October, 2018.

All women were at least 18 years old, with gestational less than 24 weeks ages. They were classified according to self-reported smoking status in: (i) regular smokers: women who smoked more than 100 cigarettes in lifetime, and at least one cigarette a day in the past six months; (ii) former smokers: women who smoked at least 100 cigarettes in lifetime, but did not smoke any in the past six months, and (iii) never smokers: women who smoked less than 100 cigarettes in lifetime, and did not smoke any in the past six months. Regular smokers were included in a smoker group (SG), while never smokers and former smokers were combined in a non-smoker group (NSG).

Women who reported occasional smoking only, or who had started or stopped smoking in the past six months, were not included. Additional exclusion criteria were illiteracy, use of psychiatric medications, severe co-morbidities, and self-reported smoking status discordant of salivary cotinine measurements. Women who reported use of psychiatric medications and severe comorbidities were excluded due to the potential influence of these factors on smoking related psychological outcomes. Therefore, this exclusion criteria was proposed to control possible biased outcomes.

Women of the SG gave information about their smoking history, including number of cigarettes smoked a day, years of smoking, and answered the Brazilian version of the Fagerström Test of Nicotine Dependence (FTND).⁽²¹⁾ Information about smoking habits was also obtained a second occasion, just before or a few weeks after delivering.

Aiming at verifying self-reported smoking status, saliva samples were collected of all volunteers for cotinine measurements, at conclusion of the first evaluation. The employed methodology involved liquid-liquid extraction and gas chromatography for the quantification of nicotine and cotinine. The detection limit of this method is 10ng/ml for nicotine and 6 ng/ml for cotinine.⁽²²⁾ Participants whose smoking status was discordant through biochemical assessment were excluded.

First assessment

All women were interviewed by the same researcher (ATLF), who employed an instrument covering the items: (i) socio-demographic variables, including economic status evaluated by the Brazilian Economic Classification Criteria, which ranges from A (highest) to D/E (lowest), and number of complete years of schooling; (ii) clinical variables related with pregnancy, such as number of gestations and abortions; (iii) pregnancy intention; (iv) anxiety and depression, using the Brazilian version of the Hospital Anxiety and Depression Scale; (v) perceived stress, measured by the Brazilian version of the 10 points Perceived Stress Scale; (vi) use of alcohol and illicit drugs; (vii) exposure to passive smoking in the workplace and at home; (viii) maternal fetal-attachment, and (ix) personality traits, evaluated by the Personality Markers Scale that assess personality according to the Big Five Personality theory.⁽²³⁻²⁶⁾

All women, regardless of their smoking status, received an educational leaflet about the hazards of smoking in pregnancy, at the end of the first interview.

Second assessment

The women who composed the SG were interviewed for a second time regarding smoking behavior. Such assessment was conducted near delivery, approximately 36 weeks of the gestation period. The women who could not be interviewed at that time were contacted after delivery. The reached women were asked about current smoking and the number of cigarettes smoked a day.

This study was approved by the Institutional Ethics Committee, and all volunteers signed informed consents before answering the questions and provide saliva samples.

Data Analysis

The two groups created a binary response variable of retrospective causal origin. Smoking status was defined as a dependent variable. Exposure factors were analyzed by odds ratio (OR) measurements, according to the type of independent variable: quantitative analysis

were performed by logistic models, while categorized variables were analyzed by contingency tables.

Exploratory analyses were performed involving independent variables, in order to identify possible sources of bias. Exposure factor analyses were performed with univariate models. Adjusted analyses were done employing Mantel-Haenzel OR calculations for psychological variables in relation to outcome, according to results of exploratory analysis.

An univariate logistic regression model was employed to investigate potential influences of variables identified in the first interview, on changes in smoking habits at the end of pregnancy. A binary variable of qualitative changes was assumed at this time: quitting or decrease versus stability or increase of the number of cigarettes smoked a day.

In order to explore possible biases on associations involving psychological factors, an adjusted analysis involving the variables anxiety, depression, perceived stress, maternal-fetal attachment and the five personality factors was performed. Independent measures that showed significant correlations with these variables in the preliminary exploratory analysis were selected.

RESULTS

A total of 328 volunteers were initially interviewed. Fifty-nine of these subjects were excluded of the analysis due to the following reasons: (i) not fitting the smoking

status categories fixed for the study: 15; (ii) not providing saliva samples to biochemical analyses: 21; (iii) incongruence between smoking status report and cotinine salivary levels: 9; (iv) psychiatric disorders: 5; (v) organic comorbidities: 3; (vi) intellectual difficulties to understand several questions: 6.

The final sample consisted of 269 participants, 94 included in the SG and 175 in the NSG. Among the 94 smokers, 66 (70.2%) were called for a second assessment interview at the end of pregnancy. Most of these subjects assessed were evaluated in the third trimester, averaging 37.5 weeks. Twenty-three of them were evaluated after childbirth, with a median postpartum interval of 4.4 weeks. Due to technical problems, saliva cotinine measurements were not available for checking the self-reported smoking status at the second interview.

The SG reported that it had started smoking at a mean age of 14.9 ± 3.0 years, and a mean smoking history of 13 ± 5.9 years. The SG smoked, on average, 11 ± 9.2 cigarettes a day, and its mean FTND was 4.4 ± 2.3 , indicating, on average, addiction to nicotine of moderate degree.

Both groups showed gestational ages around 15 weeks (Table 1). Smoking during pregnancy was associated with a higher number of previous pregnancies and spontaneous abortions. Cigarette consumption was also associated with older age. Regarding intention to become pregnant, being a smoker was associated with

Table 1. Socio-demographic features and obstetric history of pregnant women according to their smoking status.

	Smokers (n = 94)	Non-Smokers (n = 175)	OR	95% CI	p
Age (years)	28.4 ± 5.5	25.7 ± 5.6	1.09	1.04-1.14	<0.001
Gestational age (weeks)	15.0 ± 5.1	14.6 ± 4.8	1.02	0.97-1.07	0.498
Pregnancies	3.5 ± 1.6	2.1 ± 1.1	1.86	1.57-2.21	<0.001
Spontaneous abortions	0.6 ± 0.8	0.2 ± 0.5	2.36	1.60-3.48	<0.001
Ratio abortions/pregnancies	0.1 ± 0.2	0.1 ± 0.1	8.07	1.91-34.08	0.005
Pregnancy intention*					
Planned	40 (43%)	82 (47%)	0.49	0.28-0.87	0.012
Unplanned	9 (10%)	49 (28%)	0.19	0.08-0.44	<0.001
Unwanted to be a mother*	44 (47%)	44 (25%)	1	-	-
Marital status					
Living without a partner	27 (29%)	28 (16%)	2.12	1.15-3.90	0.014
Living with a partner*	67 (71%)	147 (84%)	1	-	-
Employed					
Yes	28 (30%)	95 (54%)	0.36	0.21-0.62	<0.001
No*	66 (70%)	80 (46%)	1	-	-
Attended school years					
< 8	46 (49%)	21 (12%)	10.18	4.31-24.07	<0.001
8-11	31 (33%)	75 (43%)	1.92	0.98-3.79	0.055
≥ 12*	17 (18%)	79 (45%)	1	-	-
Economic class					
B	12 (13%)	40 (23%)	0.37	0.15-0.89	0.021
C	59 (63%)	108 (62%)	0.67	0.35-1.28	0.225
D/E*	22 (24%)	27 (15%)	1	-	-

*Reference category; *Data available for 93 smokers.

smaller chances of having a planned or an unplanned pregnancy. Pregnant smokers also showed smaller chances of being employed and belonging to the highest economic class. In addition, smoking during pregnancy was associated with having under eight years of education and to living without a partner (Table 1).

Pregnant women who smoked exhibited higher chances of drinking alcohol and using illicit drugs in the previous month. They also showed higher chances of having tried cannabis along their lives, and to be subject to passive smoking at home (Table 2).

Concerning the psychological features, the SG showed significant higher chances of exhibiting higher scores on anxiety, depression and perceived stress (Table 3). Both groups showed similar records of maternal-fetal attachment. Neuroticism was the only

factor of personality associated with smoking during pregnancy (Table 3).

Adjusted analyses of all variables for confounding factors did not generate significant changes in the OR values initially identified.

Mean number of daily smoked cigarettes did not significantly change between the first and second interview (11.7±9.3 X 8.9±7.5). Thirty-two (48.5%) women reduced the number of cigarettes smoked a day, while four (6.1%) quit smoking by late pregnancy. Thirty (45.4%) women kept smoking the same amount, or even increased the number of cigarettes smoked a day. The univariate logistic regression model did not detect any significant association between basal socio-demographic or psychological features with qualitative changes in smoking behavior at the end of pregnancy (Table 4).

Table 2. Use of alcohol, illicit drugs, and passive smoking in pregnant women according to their smoking status.

	Smokers (n = 94)	Non-Smokers (n = 175)	OR	95% CI	p
Drinking in the past month					
Yes	52 (55%)	33 (19%)	5.33	2.92-9.71	<0.001
No*	42 (45%)	142 (81%)	1	-	-
Use of illicit drugs in the past month					
Yes	5 (5%)	1 (1%)	9.78	1.13-89.95	0.019
No*	89 (95%)	174 (99%)	1	-	-
Past experimentation with cannabis					
Yes	75 (81%)	32 (18%)	18.62	8.30-41.77	<0.001
No*	18 (19%)	143 (82%)	1	-	-
Use of cannabis in the past month*					
Yes	15 (16%)	0	-	-	-
No*	78 (84%)	175 (100%)	-	-	-
Passive smoking at home					
Yes	51 (54%)	34 (19%)	4.92	2.72-8.89	<0.001
No*	43 (46%)	141 (81%)	1	-	-
Passive smoking at the workplace**					
Yes	3 (11%)	13 (14%)	1.45	0.52-4.01	0.474
No*	24 (89%)	77 (86%)	1	-	-

*Reference category; +Data available for 93 smokers; **Data available for 27 smokers and 90 non-smokers.

Table 3. Psychological features of pregnant women according to their smoking status.

	Smokers (n = 94)	Non-Smokers (n = 175)	OR	95% CI	p
Anxiety	10.1 ± 4.66	7.0 ± 4.33	1.15	1.09-1.21	<0.001
Depression	8.3 ± 3.94	6.1 ± 3.48	1.17	1.09-1.25	<0.001
Perceived stress	24.7 ± 9.36	18.5 ± 8.87	1.07	1.04-1.10	<0.001
Maternal-fetal attachment	75.8 ± 17.81	78.3 ± 13.44	0.99	0.97-1.01	0.190
Factors of personality					
Agreeableness	20.7 ± 3.86	20.3 ± 3.01	1.03	0.96-1.11	0.397
Conscientiousness	22.0 ± 2.84	22.3 ± 2.82	0.97	0.88-1.06	0.457
Neuroticism	16.4 ± 4.45	14.0 ± 4.71	1.11	1.06-1.18	<0.001
Openness	14.9 ± 5.03	14.6 ± 4.14	1.02	0.96-1.08	0.557
Extraversion	18.1 ± 4.85	17.0 ± 4.40	1.05	0.99-1.11	0.080

Table 4. Results of univariate logistic regression model evaluating potential predictors of qualitative changes on smoking status at the end of pregnancy.

	OR*	95% CI	p
Age	0.98	0.89-1.07	0.664
Marital status	1.16	0.41-3.31	0.772
Employment	0.97	0.34-2.79	0.961
Attended school years	1.29	0.67-2.48	0.440
Economic class	0.38	0.10-1.41	0.148
Intention to get pregnant	1.38	0.82-2.31	0.223
Drinking in the past month	0.70	0.26-1.85	0.472
Past experimentation with cannabis	0.82	0.25-2.68	0.745
Use of cannabis in the past month	0.37	0.09-1.57	0.179
Passive smoking at home	1.05	0.39-2.77	0.928
Smoking years	0.98	0.91-1.07	0.718
Cigarettes smoked a day	0.98	0.93-1.04	0.501
Test of Fagerström	1.07	0.87-1.33	0.484
Anxiety	0.98	0.87-1.09	0.706
Depression	1.08	0.95-1.24	0.238
Perceived stress	1.01	0.95-1.07	0.662
Maternal-fetal attachment	0.98	0.96-1.01	0.258
Agreeableness	1.02	0.89-1.16	0.775
Conscientiousness	0.92	0.76-1.11	0.397
Neuroticism	1.07	0.96-1.19	0.231
Openness	0.93	0.84-1.02	0.112
Extraversion	0.96	0.87-1.05	0.396

*Dependent variables: quit smoking/decrease smoking (n=36) versus stability/increase smoking (n=30).

DISCUSSION

The present results indicate that smoking during pregnancy is associated with a set of socio-demographic variables. Pregnant smokers were older, had less schooling and a greater number of previous gestations and abortions. In addition, they were more likely to use alcohol, illicit drugs and to be exposed to passive cigarette smoke at home. On the other hand, having a better economic class, being employed, and having a planned or unplanned pregnancy were negatively associated with smoking. Regarding psychological features, pregnant smokers exhibited higher scores of anxiety, depression, perceived stress, and personality with elevated degree of Neuroticism.

Smoking is mediated, among others, by social contexts which place individuals at greater risk of adopting risky habits. For instance, low levels of educational attainment would be associated with less knowledge and perception of the harms of smoking.⁽²⁷⁾ Low levels of education are also associated with adoption of poorly adapted coping strategies for stressful events.⁽²⁸⁾ It is possible that pregnant women with low educational levels lack a repertoire of effective strategies for dealing with daily stress and use cigarettes as a way to regulate its effects.

Low economic status is a recognized risk factor for smoking in general and during pregnancy. Thus, the present results confirm previous findings. Although some studies have not identified an association between unemployment and smoking in pregnancy, the results

of this study agree with several others.⁽¹⁸⁻²⁰⁾ It is important to recognize that low economic status, poor education and unemployment tend to run together.

Cases and controls also showed differences regarding the number of previous pregnancies and miscarriages. Several studies have confirmed the association between smoking and multiparity.^(12,17) However, this association could be only expression of poorer educational conditions. The abortions/pregnancies ratio was employed here as a way to correct the number of miscarriages for the variable amount of pregnancies exhibited by the volunteers. Although smoking is a well-known factor for spontaneous abortions, these results preclude making causal assumptions, mainly because they are about current smoking in pregnancy and past history of miscarriages. However, it is fair to assume that these women possibly smoked in previous pregnancies, contributing to a higher number of abortions among them.

Using the category "unwanted to be mother" as a reference in analysis, it was observed an inverse association between both, "planned" and "unplanned" pregnancies, with smoking. This suggests that the desire to become pregnant, even if it is an unplanned one, may decrease the chances of smoking among women.

Pregnant women living without a partner exhibited higher chances to be smokers. Such results agree with previous literature, and may be attributed, at least in part, to worsen socioeconomic status and poor schooling among single mothers.^(20,29) Besides, pregnant women

without a partner may lack the necessary emotional support for dealing with issues during the pregnancy, making smoking cessation difficult.

Pregnant women who smoked showed higher chances of referring passive smoking at home, and this may only reflect the finding that smoking tend to concentrate in certain social environments. However, it may also represent a lack of knowledge about the risks of second-hand smoking even in the pregnancy.

The identification of socio-demographic variables linked to smoking during pregnancy should be taken into account when planning anti-tobacco interventions for pregnant women. The association between less schooling and smoking, for example, shows that these women may have greater difficulties in understanding the value of quitting during pregnancy, and the strategies that lead to cessation. The association between smoking and living without a partner suggests that these women may benefit from social support such as group interventions.

The relation between smoking in pregnancy with the consumption of alcohol and illicit drugs, mainly marijuana, was not unexpected, since these associations have been frequently described. As cigarettes and alcohol are legal substances, even in pregnancy, they are more detectable through self-report than illicit substances. Therefore, the identification of smoking by pregnant women, should point to health care providers the need to inquire about the use of illicit drugs.

This is the first study that investigated personality traits in Brazilian pregnant smokers. Personality trait is defined as an individual predisposition that determines a tendency to exhibit consistent patterns of thoughts, feelings, and behaviors.⁽³⁰⁾ The present finding linking Neuroticism with smoking has already been reported, although negative associations with Extraversion, Conscientiousness or Socialization were not found at this time.⁽⁵⁾ High scores on Neuroticism are linked to a propensity to experience negative states such as tension, depression, frustration, guilt, insecurity, and difficulties in coping with stressful situations. Moreover, such individuals seem to have a poorly adapted pattern in their choice of coping strategies. Some studies suggest that high scores on Neuroticism are related to use of ineffective coping strategies such as emotion-focused coping.^(31,32)

In this sense, personality could act on smoking behavior as a way of selecting situations in which smoking would be most reinforcing, depending on the personality traits. For people with high Neuroticism scores, smoking will be more pleasurable because of its immediate anxiolytic and relaxing effects.⁽³³⁾ The association of Neuroticism with smoking comes closer to an explanatory model of self-medication, in which is assumed that neurotics, having a tendency to negative states, would be better able to develop nicotine dependence, because they found in it a way to alleviate these affects.⁽³⁴⁾ At the same time, paradoxically, there are evidences that smoking can

aggravate such states, which would therefore be expressed in a "more" neurotic personality type.⁽³⁵⁾

The present study did not find an association between smoking status and the degree of maternal-fetal attachment. Nevertheless, smoking in pregnancy was associated with higher levels of negative affect, including anxiety, depression and perceived stress. These are well known associations, but the basis of the phenomena are not completely clear.^(11,13,36) Negative affect could be a causal explanation and predispose people to smoke.^(37,38) However, paradoxically, there are reports that former smokers exhibit fewer symptoms of anxiety, depression, and lower stress levels compared to baseline measurements.^(39,40) On the other hand, it is common for women to represent cigarette smoking as an effective way to deal with negative states. Moreover, pregnancy involves increases of anxious and depressed states due to hormonal changes, as well as it represents a phase which carries a higher overall stress load. Among pregnant women who were established smokers, and probably used cigarettes as an apparatus to deal with personal difficulties, it is speculated that this pattern will continue during pregnancy.

The findings of this study involving associations of smoking in pregnancy with anxiety, depression, perceived stress and Neuroticism are important elements to be addressed in cessation interventions. It points to the need to educate women about the potential role of smoking on worsening negative states, and learning appropriate behaviors to deal with anxiety, depression, and stress. Strategies to reduce negative states, such as relaxation and exercise, constitute some components that could be emphasized into cessation approaches among pregnant women. In addition, intervention groups limited to pregnant women could increase their motivation to quit, as they would be placed in a judgment-free and more identifiable environment.

This study also investigated eventual associations between social and psychological characteristics in early pregnancy and changes in smoking habits at the time of delivery. Only four women quit smoking, and a univariate logistic regression model involving potential predictors of qualitative changes in smoking status did not find any significant item. It is important to recognize that the number of women interviewed at the end of pregnancy was small and insufficient to obtain definitive answers.

This study exhibits several limitations. An active search strategy was adopted to locate pregnant smokers through data from electronic medical records and information from nurses. While this made possible an acceptable number of pregnant smokers, it inserted a convenience sampling bias. On the other hand, very strict criteria were adopted to define smoking status. Thus, information of occasional smokers and women who changed their smoking status in the six months prior to pregnancy diagnosis was not obtained. In this context, the results of this study reflect more the findings of well-established smokers compared to

non-smokers. The CG included both never smokers and ex-smokers, what may also have influenced the final results. Lost to follow-up prevented a second evaluation of all smokers initially assessed. Although smoking status was verified for every volunteer through biochemical assessment at first assessment, the same was not possible for the participants by late pregnancy.

In conclusion, smoking during pregnancy is associated with more unfavorable social conditions. Pregnant smokers exhibit a higher number of pregnancies and miscarriages, and are also more prone to engage in health risky behaviors, like drinking and use of illicit drugs. Psychological variables associated with smoking suggest that pregnant smokers exhibit more negative psychological states than nonsmokers, including a personality profile of accentuated Neuroticism. It is advisable to take all these factors in account when designing anti-tobacco interventions specifically for this group of women. None of the investigated

psychological variables could predict smoking changes during pregnancy.

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AUTHOR CONTRIBUTIONS

ATLF: conceived study design, collected data, organized data for statistical analysis, interpreted results, wrote manuscript. ALRJ: contributed for study design, performed statistical analysis, wrote manuscript. NCG: performed biochemical analysis and interpretation, wrote manuscript. BSM: performed biochemical analysis and interpretation, wrote manuscript. JABM: conceived study design, coordinated data collection, organized final data for statistical analysis, interpreted results, wrote manuscript.

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