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Motivational interviewing telephone counseling to increase postpartum maintenance of abstinence from tobacco

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ABSTRACT

Although many women quit smoking while pregnant, rates of relapse after delivery are high. We examined the effectiveness of motivational interviewing (MI) in maintaining postpartum abstinence from smoking among pregnant women who recently quit smoking ($N = 382$), randomized to receive five brief MI phone counseling calls or to a prenatal and postpartum care as usual control condition. Relapse to smoking was assessed at 3, 6, and 12 months postpartum based on self-report and urine cotinine. Cox regressions compared conditions on relapse outcomes and hazard ratio of total number of MI calls was examined to probe dose-response effects. Results revealed no difference in the hazard ratio of relapse between treatment condition and no dose-response effect of total number of MI calls. Phone counseling in the prenatal and postpartum period did not facilitate maintenance of abstinence among new mothers. Considerations for future intervention development studies on relapse prevention during the postpartum period are discussed.

1. Introduction

For many women, pregnancy offers for extended contact with the healthcare system and the opportunity for the promotion of positive health behavior change, such as the cessation of smoking. Many women quit smoking during pregnancy, but nearly half of those who quit relapse to smoking after delivery (Park et al., 2009; Ratner et al., 2000; Rockhill et al., 2016). Relapsing to smoking during the postpartum period puts the health of the woman and her child in jeopardy. Even when parents or other individuals in close proximity to the infant smoke outside or otherwise away from the infant, infants are still exposed to environmental tobacco smoke (ETS; i.e., second hand smoke) through dust, surfaces, and air (Matt et al., 2004). In children, ETS is associated with reduced lung function, increased risk of lower respiratory tract illnesses, exacerbation of asthma, and increased risk for sudden infant death syndrome (Chan-Yeung & Dimich-Ward, 2005). The effect of parental ETS exposure in childhood on the respiratory symptoms in adulthood is an effect that is robust to control for personal smoking in adult life (Pugmire et al., 2014). Thus, helping women maintain abstinence is essential to avoid the many harms associated with smoking and ETS.

Many factors may contribute to postpartum relapse to cigarette smoking including having a partner who smokes, greater smoking prior to pregnancy (Ratner et al., 2000), feeling unhappy or not sure about the pregnancy, history of depression (Park et al., 2009), level of nicotine dependence, stress, lack of social support, smokers in the household, concerns about weight gain, and intentions to quit temporarily (Hymowitz et al., 2003). Conversely, maintenance of cessation postpartum is influenced by self-efficacy or confidence in one's ability to refrain from smoking. According to Social Cognitive Theory (Bandura, 1986, 1997, 1999), cognitive processes interact with social and environmental factors to exert determinative influence on behavior. Among cognitive processes, self-efficacy is key for establishing and maintaining

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health behavior change. Perceived self-efficacy affects health behavior directly and indirectly via its impact on outcome expectations, goals, and situational and personal barriers and facilitators to healthful behavior (Bandura, 2004). In particular, women with greater confidence that they would not smoke in a variety of situations six weeks postpartum were more than twice as likely be abstinent 6 and 12 months after delivery than were women with less confidence (Mullen et al., 1999). Further, self-efficacy, in addition to other Transtheoretical Model (TTM; described below) constructs, was associated with smoking 12-months post-delivery (Thyrian et al., 2006b). Even though self-efficacy can be high during pregnancy, this confidence may be artificially influenced by the context of pregnancy (Stotts et al., 1996), leaving the women vulnerable to relapse during the postpartum period.

The TTM (Prochaska & Velicer, 1997) describes stages in the intentional behavior change process for smokers, such that individuals in earlier stages of change are less likely to be ready to become non-smokers. Stages of change can be used to tailor techniques to counsel postpartum women on smoking cessation (Thyrian et al., 2006a). For example, women in different stages of change need different intervention strategies in the progress of behavior change. According to the TTM, behavior change occurs over time via cognitive, affective, and behavioral processes (Prochaska & DiClemente, 1992; Velicer et al., 1990). Upon learning of their pregnancy, many women may move quickly into the "action" stage of change, making the decision to quit without resolving their ambivalence about smoking (Stotts et al., 1996). Consequently, smoking self-efficacy can decrease postpartum (Ratner et al., 2000). An important factor for helping women maintain cessation postpartum may be to increase self-efficacy expectations surrounding an individual's ability to resist smoking urges. Self-efficacy can be bolstered by identifying high-risk situations and building skills to overcome the barriers that decrease self-efficacy and increase the risk of relapse. Interventions can also provide support and psychoeducation to establish and solidify expectations that relapse to smoking places themselves, their newborn, and others exposed to smoke at risk.

Motivational interviewing (MI), a counseling style that facilitates behavior change, can be extended to maintenance by helping clients explore and resolve any ambivalence about sustaining health behavior changes (Miller & Rollnick, 2012). The MI style involves the use of an empathic, non-confrontational approach that conveys respect, understanding, and compassion for the client's position. Specific MI skills include using a communication style that involves asking open-ended questions and reflective listening, in addition to strategies that help individuals weigh the pros and cons of maintenance of change (Rollnick et al., 2010). Among the guiding principles of MI is supporting an individual's self-efficacy (Miller, 1995; Miller & Rollnick, 2002) to help them refrain from smoking and avoid relapse. In addition, identifying potential barriers to change and providing psychoeducation surrounding risk are important for behavior change and these are integral to MI. From an MI perspective, a person's own reasons for change are also very important. MI specifically aims to elicit a patient's own values and reasons for change. Additionally, a strength of MI is that individuals state their reasons for change and likely make a verbal commitment to change; literature indicates that commitment talk predicts behavior change (Hodgins et al., 2009). MI appears to be effective in promoting smoking cessation in pregnant and postpartum women. For example, relapse rates were significantly lower for women who received a brief MI relative to controls (Valanis et al., 2001). In another study, an MI-focused proactive intervention during the 3 months postpartum (i.e., the period during which women are most susceptible to relapse; Suplee, 2005) promoted progress in the behavioral process of change in smokers (Thyrian et al., 2007). The intervention may have reduced the probability of postpartum relapse, but it was not possible for researchers to biologically verify abstinence because approximately half of the sample did not attend the in-person follow-up visit.

Extending smoking cessation treatment into the postpartum period is recommended (Johnson et al., 2000). Unfortunately, the randomized controlled trial literature does not support the effectiveness of postpartum smoking cessation interventions for preventing relapse, particularly when women quit smoking as the result of an external intervention rather than spontaneously (Levitt et al., 2007; Su & Buttenheim, 2014). Because of the high relapse rates reported in the first few months postpartum, the focus of this study was to explore maintenance of smoking cessation postpartum once women had quit, rather than to produce cessation by way of study intervention. We tested the efficacy of an intervention that was primarily grounded in MI principles, which bridges the gap from the prenatal to the postpartum period to determine if the program would facilitate maintenance of abstinence among a demographically diverse sample of women. Specifically, the primary objective of this study was to test whether a phone counseling intervention designed to enhance self-efficacy and to promote commitment to staying quit would help women who quit smoking during pregnancy to maintain long-term abstinence post-partum. The aims of this study were to: 1) compare likelihood of postpartum smoking relapse among women receiving sustained MI counseling via phone versus women receiving usual care (CON) at 3-, 6-, and 12-months postpartum; and 2) examine the effect of treatment dosage on smoking relapse within the MI condition. We hypothesized that postpartum smoking relapse rates of women receiving sustained MI counseling via phone would be reduced when compared to those receiving usual care (CON) at 3, 6, and 12 months postpartum. We also examined the effect of treatment dosage (i.e., number of MI counseling calls) on smoking relapse within the MI condition.

2. Method

2.1. Participants

Participants were pregnant women ($N = 382$) presenting for a prenatal appointment at 59 participating clinical sites in Rhode Island and Southeastern Massachusetts communities. Women who recently quit smoking or were still smoking were targeted for recruitment. Eligibility was based on the following criteria: smoked at least one cigarette per day or did so within a month of becoming pregnant, at least 18 years of age, less than 20 weeks gestation, spoke English or Spanish, expected to deliver only one infant, not living with another woman already enrolled in the study, and had access to a working phone and video player (to be able to view materials provided). Women were excluded if they reported current suicidal ideation, psychosis, anxiety or mood disorders, or hospitalization for a psychiatric disorder in the past three years based on a brief diagnostic screener administered during the phone survey completed prior to randomization.

Women who reported current smoking at the time of recruitment were encouraged to quit (see procedures below) and subsequently excluded if they had not quit smoking at baseline (i.e., self-reported smoking more than 5 cigarettes in the past week during the baseline telephone survey or in-person visit). Given the paucity of data on relapse prevention with underserved postpartum women and to maximize generalizability, we did not exclude women who reported some smoking "slips" during the past week. Importantly, the level of smoking permitted at baseline was far below the threshold considered to occur during a relapse (i.e., smoking 5 or more cigarettes per day for 3 consecutive days (Ockene et al., 2000; Shiffman et al., 1996)). Thus, all women self-reported that they had quit smoking and reported either total abstinence or low levels of smoking during the past week at baseline. Accordingly, cotinine data were collected at baseline, but were not used to exclude individuals from participating.

2.2. Procedures

Procedures were approved by the Institutional Review Boards of Brown University, Memorial Hospital of RI, Pawtucket, RI, and St. Francis Hospital, Hartford, CT. During one of their prenatal

appointments, the project was explained to prospective participants. Those who expressed interest completed a study registration form and received a "Quit Kit" (i.e., cessation materials including a motivational video and guide to quitting smoking for pregnant women). Given the focus on facilitating maintenance of cessation rather than cessation, women who indicated that they were still smoking were encouraged to quit using the materials provided, and to contact the research team after they had. If individuals who were smoking had not made contact within two weeks, they were contacted by research staff and encouraged to use the materials provided to stop smoking. Women who were still smoking

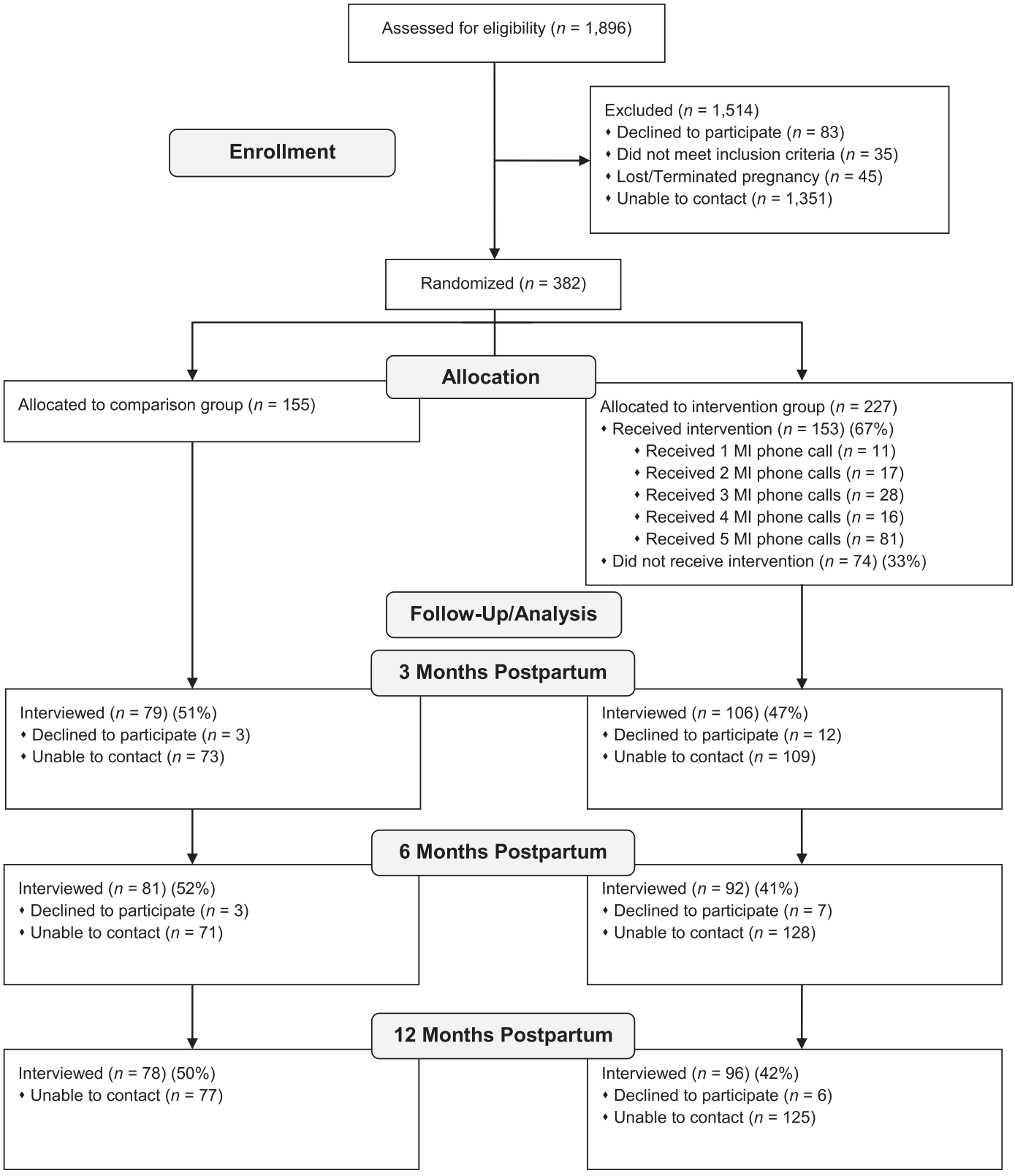

Fig. 1. Script MI consort flow diagram.

received two calls from research staff to check-in regarding their smoking status prior to 28 weeks of pregnancy. Women who indicated, at either their first prenatal visit with the study or upon being contacted by study staff, they had quit smoking (i.e., smoked ≤5 cigarettes in the last 7 days), underwent verbal informed consent. Following informed consent, participants completed the baseline phone survey. They were scheduled for an in-person baseline study visit. After baseline assessment had concluded, participants were randomly assigned to the intervention or control arm of the study (described below). Evaluators who conducted the surveys were blinded to condition until the process measures on the follow-up surveys.

During recruitment, an update to the computer operating system inadvertently altered the computer date/time system on which the randomization algorithm was dependent. Until this error was detected, all new participants ($n = 64$) were assigned to the intervention group during a period of approximately eight months (62 of these had available data and were utilized in these analyses). These women were not significantly different from the other women in the intervention group on age (Welch's two sample *t*-test [i.e., does not assume equal variances across groups]: $t[105.12] = -1.88$, $p = 0.06$), race ($\chi 2[2] = 2.42$, $p = 0.30$), income ($\chi 2[3] = 6.94$, $p = 0.07$), public assistance ($\chi 2[1] = 1.66$, $p = 0.20$), or employment ($\chi 2[4] = 4.36$, $p = 0.36$), suggesting a lack of selection bias. Though this was a breach of the randomization protocol, all involved were unaware that the randomization algorithm had been changed. Accordingly, those in charge of recruitment and enrollment would have been unable to predict the next treatment allocation or to selectively enroll patients based on anticipated allocation (Kahan et al., 2015). Sensitivity analyses were also conducted removing participants who were enrolled during the time in which the randomization error occurred, finding no difference with the results with these participants retained. Therefore, these participants were included in analyses. Enrollment, intervention allocation, and follow-up/data analysis by group is shown in Fig. 1.

Follow-up assessments were conducted by phone at 3, 6, and 12 months post-delivery. In-person sessions were also scheduled at each time point in order to procure biological verification of self-reported abstinence, in addition to self-report measures. Data was collected both via phone and in person for women who completed both visits to ensure that we collected as much data as possible in case the woman failed to keep the appointment for the urine collection.

2.3. Intervention conditions

2.3.1. Motivational interviewing intervention (MI)

Intervention materials and MI-counseling guides were created based on the MI trainer's prior research (Borrelli et al., 2002). Although the intervention was largely grounded in MI, some cognitive-behavioral therapy techniques were also incorporated, for example, challenging thoughts and identifying schemas. Intervention content was based on themes identified in qualitative focus groups that examined the influences that affect maintenance of abstinence among former smokers. Formative evaluation was used to tailor the content of sessions so they could be delivered efficiently over the phone.

The resulting MI intervention consisted of 5 phone-based counseling sessions, approximately 15–20 min in length for each call, following a treatment manual. Detailed content of the calls is included in Supplementary Materials. The first two calls were scheduled 1 month prior and just prior to the anticipated delivery date (29–37 weeks gestation). The remaining three phone calls occurred during the first two months postpartum, with the first call occurring approximately one week postpartum. Educational handouts on smoking cessation were sent to participants to complement the content discussed in the calls. Calls addressed topics such as insufficient social support, skills, self-efficacy, commitment to staying quit, and relapse prevention. As an incentive to participate in the phone counseling calls, a $20 gift card was offered following the completion of call 3. Participants were called during a 2 to 3-week window surrounding the scheduled call date, followed by a letter for those who could not be reached. Attempts to reach participants continued even after the window had elapsed, and were discontinued once the participant reached the scheduled 3-month follow-up window.

2.3.2. Fidelity

The three interventionists were doctoral-level psychologists or doctoral candidates who completed 12 h of training from a certified MI trainer who also met weekly with the interventionists to provide feedback on audiotapes of the phone calls regarding adherence to MI and to the protocol. Following each call, the interventionist completed an intervention checklist created for the project. All telephone calls were audio-recorded to examine adherence to the protocol. The MI trainer listened to the audiotapes weekly to provide feedback and supervision to the counselor. During this supervision, training continued in the form of role-plays and educational modules if necessary.

2.3.3. Control (CON)

Women assigned to the control condition received the "Quit Kit" at their first prenatal visit with the study but did not receive any counseling or other form of study-related intervention. They received prenatal and postpartum care as usual from their healthcare providers and were contacted by study staff for follow-up assessments only.

2.4. Measures

2.4.1. Focal variables

2.4.1.1. Smoking status. Self-report. At each follow-up assessment, participants were asked 1) if they had smoked *any cigarettes at all, even a puff* (those who said 'no' were considered 'abstainers') and 2) if they had smoked *five or more cigarettes each day for at least three days in a row* (those who said 'yes' were considered 'relapsers'). The referent time point was *since [self-reported quit date], when you quit this time* at baseline and *since the last time we spoke to you* at the three follow-up time points.

2.4.1.2. Cotinine. For all assessments, NicoMeter™ Urine test strips (SEREX, Inc., Maywood, New Jersey) were used to test urine samples for cotinine, the predominant metabolite of nicotine. The test strip was placed directly into a urine specimen provided by the participant. The strip was read as the lowest of seven zones that appeared with a red color. Each zone corresponded to a cotinine level (in ng/ml) from 0 = 0–100, 1 = 100–250, 2 = 250–1000, 3 = 1000-2000, 4 = 2000-5000, 5 = 5000-10,000, 6 ≥10,000. A cutoff point of 250 ng/ml was used to determine smoking status (Parker et al., 2002) with zones grouped accordingly (i.e., 0–1 = non-smoker/abstaining, ≥2 = smoker/relapse).

2.4.1.3. Treatment dosage. The number of MI calls completed (0–5) within the MI condition.

2.4.2. Covariates used to inform imputation

We utilized a rigorous multiple imputation protocol that accounted for key variables that have been empirically shown to impact missing data (described in detail below).

2.4.2.1. Demographic information. At baseline, participants reported their age, education, race, receipt of public assistance, household income, and employment status; employment status was assessed again at all follow-ups.

2.4.2.2. Avoidance of environmental tobacco smoke. At all assessments, the *Avoidance of Environmental Tobacco Smoke Scale* (Martinelli, 1998) was used to measure self-reported ETS in the home. The scale consists of 10 items ranging from 1 (*almost never true*) to 4 (*almost always true*), with higher total scores across items indicating better avoidance behavior

around ETS.

2.4.2.3. Hassles. At baseline and 3 months, a shortened version of the *Abbreviated Hassles Index* (Romano et al., 1991), consisting of 9 items to measure "the irritating, frustrating, distressing demands that to some degree characterize everyday transactions with the environment" (Kanner et al., 1981; Romano et al., 1991). Total scale scores range from 0 to 9, with participants reporting a *yes* or *no* response to each hassle such that higher total scores indicate more daily hassles.

2.4.2.4. Stress. The 4-item version of the *Perceived Stress Scale* (PSS; Cohen et al., 1983) was used at baseline and 3 months to measure the frequency with which individuals perceived their environment and their experiences to be stressful during the last month. Items range from 0 to 4 (0 = *never*, 4 = *very often*) with greater scores indicating greater perceived stress.

2.4.2.5. Depressive symptoms. Depressive symptoms were assessed at baseline and 3 and 6 months, using the *Center for Epidemiologic Studies Depression Scale* (CES—D; Radloff, 1977), a 20-item self-report scale designed to measure frequency of depressive symptoms in a general population. Each item is scored between 0 and 3 (0 = *less than 1 day*, 3 = *5–7 days*), with higher scores representing greater depression.

2.4.2.6. Partner smoking status and support. Smoking status. At all assessments, do you presently have a husband or partner who lives with you or spends a lot of time with you? (No/Yes) was asked. Those who responded yes were asked, does this person smoke cigarettes as this time? (No/Yes).

Support. At all assessments, the *Partner Interaction Questionnaire* (PIQ; Mermelstein et al., 1986) was used to assess the frequency and impact of smoking-related interactions between the participants and the person who *most closely follows [their] efforts to quit smoking.* Participants responded to the 20 items from the PIQ on a 5-point scale indicating frequency of positive or negative supportive behavior (0 = *never*, 4 = *very often*) with positive and negative subscales calculated.

2.4.2.7. Confidence and importance of staying quit. At all assessments, two items from the *Confidence Questionnaire* (Baer & Lichtenstein, 1988; Condiotte & Lichtenstein, 1981) were used to assess importance (*On a scale of 1 to 10, how much do you WANT to stay quit as of right now?,* 1 = *definitely do NOT want to stay quit*, 10 = *definitely WANT to stay quit*) and confidence (*On a scale of 1 to 10, how CONFIDENT are you that you can stay quit as of right now?,* 1 = *not at all confident*, 10 = *very confident*). As these items were assessed via phone and in-person at each assessment, an average of the two reports was computed. These were asked at evaluation, as well as during MI counseling. Responses provided in counseling calls were used only for treatment, rather than data analysis.

2.4.2.8. Smoking for weight control. Participants were asked about weight-control motivated smoking and weight concerns at baseline, 3 and 6 months using two items. The first assessed how long the woman would tolerate remaining at her pregnancy weight before she would resume smoking (*You would go back to smoking cigarettes if you didn't lose your pregnancy weight:* 1 = *within the first month after giving birth*, 2 = *1–3 months after giving birth*, 3 = *3–6 months after giving birth*, 4 = *6–12 months after giving birth*, 5 = *you would NOT go back to smoking because of weight gain or not being able to lose your pregnancy weight*). They were also asked how much weight they would have to gain to go back resume smoking (1 = *less than 10 lbs.*, 2 = *10–20 lbs.*, 3 = *20–30 lbs.*, 4 = *more than 30 lbs.*, 5 = *you would NOT go back to smoking due to weight gain*).

2.4.2.9. Stage of change for postpartum abstinence. Stage of change based on the TTM was assessed at baseline. The stage of change for abstinence postpartum is determined based on 3 items assessing plan regarding smoking after the baby is born, likelihood of smoking during the first six months after the baby is born, and smoking since first prenatal visit (Stotts et al., 2000). Responses are used to determine four categorical classifications (1 = precontemplation, 2 = contemplation, 3 = preparation, 4 = action).

2.4.2.10. Perceived health risks to child. At all assessments, participants rated their belief that smoking would harm (how much do you think that your smoking could harm your [unborn baby's/child's] health?, 1 = not harm at all, 2 = somewhat harm, 3 = greatly harm) and staying quit would help their baby's health (if you stay quit, how much do you think that would help to avoid health problems for your [unborn child/child]?, 1 = not help at all, 2 = somewhat help, 3 = help a lot). The questions were tailored for pre- and post-natal visits (i.e., the questions referred to the unborn baby during prenatal visits and to the child at the postnatal visits).

2.5. Data analysis approach

All analyses were conducted in R (R Core Team, 2017). Each observation included the focal outcome variable (binary smoking relapse; 0 = non-smoking, 1 = relapse) at the 3-, 6-, and 12-month assessment waves. We computed a smoking status variable that combined information from the three sources of information about smoking status at each assessment (3, 6, and 12 months): cotinine (i.e., >1 (250 mg/nl)), in person self-report, and phone self-report (i.e., smoking ≥5 cigarettes on 3 consecutive days; Ockene et al. (2000)). We trusted any data source for smoking status that was available unless there were conflicting responses, in which case, a report of smoking superseded a report of non-smoking. Observations also included two focal predictors: the experimental condition and the total number of MI calls received. Missing data was common across time points (52.1% at 3 months; 54.7% at 6 months; 54.7% at 12 months).

Visual inspection of matrix plots and correlations relating missingness on focal variables to values of variables that were theoretically or empirically related suggested that although missingness was systematic, there were known predictors of missingness. These findings, as well as the likelihood of obtaining unrealistic estimates from penalized imputation (i.e., missing = smoking; Hedeker et al. (2007)), informed the decision to conduct multiple imputation analyses as our primary analytic approach. Multiple imputation using chained equations (Azur et al., 2011) was used to impute missing data in thirty datasets across twenty iterations, including our focal variables and other key variables: age, race (White, Black, or Other), public assistance (No/Yes), income (less than 10,000; less than 30,000; less than 50,000; more than 50,000), employment status (full-time; part-time; unemployed; student; other), avoidance of environmental tobacco (10–40), hassles (0–9), stress (0–16), depressive symptoms (0–60), partner smoking status (No/Yes), partner support (positive and negative behavior related to quitting (0–40)), confidence and importance of staying quit (1−10), smoking for weight control (two items scored 1–5), likelihood of smoking during the first six months after the baby is born (1–4), perceived risk to child (two items scored 1–3), and cotinine status (Smoking/Non-Smoking). Data from all time points at which the variable was assessed were used in the imputation with the exception of cotinine; only baseline data were used as it would be redundant with focal variables to include data from other time points in the imputation. Imputed means, standard deviations, and distribution densities were visually examined to assess convergence across iterations. Pooled parameter estimates are reported for all models (Rubin, 1987).

We conducted four Cox proportional hazard regressions (Cox, 1972) to evaluate the relationship between treatment group or total MI calls and relapse. Survival time (time-to-event [relapse]) was modeled using Cox proportional hazard regressions to determine if group (MI vs. CON; Models 1, 2) or total number of MI calls (Models 3, 4) predicted relapse.

Time (3-, 6-, 12-months postpartum) and Event (relapse, the outcome variable) were included in the model.

Model 1 examined the relationship between relapse and treatment group in the full sample. Model 2 used an, "as treated" approach, which paralleled Model 1 but omitted participants in the treatment group who received zero MI calls. Model 3 examined the relationship between relapse and total MI calls in the full sample. Model 4 paralleled Model 3 but omitted participants in the control group (i.e., evaluated the relationship between MI calls and relapse in the treatment group). Model coefficients were exponentiated to compute odds ratios.

Although women who indicated during the baseline phone survey that they had smoked more than 5 cigarettes during the past week were not enrolled in the study, in-person data collected at baseline suggested that some participants were smoking. Specifically, 315/382 (82%) completed the in-person visit and, of them, 140 (44%) had a cotinine level measured to be ≥250 ng/ml. This suggested either continued smoking at baseline or possible relapse prior to the receipt of the study intervention. As a result, it was possible that the focal outcome of the Cox proportional hazard regressions (0 = non-smoking, 1 = relapse) had already occurred at baseline. Because of this, one additional sensitivity analysis (Model 5) was conducted, which paralleled Model 1, but omitted participants whose data suggested smoking/relapse at baseline. Independent sample *t*-tests and chi-squared tests were used to compare groups on descriptive measures.

3. Results

Characteristics of participants are displayed in Table 1. Those recruited spanned in age from 18 to 43 years ($M = 24.5$, $SD = 5.2$). Most participants characterized themselves as White (60%) and not Latina (84%). The majority had a high school education or less (71%), an annual income of $30,000 or less (70%), received public assistance (59%), and reported that their partner smoked (63%). The largest proportion of participants (48%) reported being unemployed. Participants randomly assigned to the two experimental groups were not significantly different by any demographic characteristics except receipt of public assistance, with a higher proportion of the MI group reporting receiving some form of assistance.

Women in the MI condition averaged 2.6 (2.1) phone counseling calls, with 74 (33%) completing 0 calls, 11 (5%) completing 1 call, 17 (7%) completing 2 calls, 28 (12%) completing 3 calls, 16 (7%) completing 4 calls, and 81 (36%) completing 5 calls. Half of the intervention group accepted at least one prenatal call (50%) and approximately half of the sample accepted at least one postpartum call (48%).

Rates of retention are shown in Fig. 1. Approximately 40–50% of participants were retained (i.e., evaluated) at each of the three follow-up time points. Significantly more participants were retained in the control condition (52%) than in the MI condition (41%) at 6 months postpartum, X^2 (1, $N = 382$) = 5.1, $p = 0.02$, but retention did not vary by condition at the other two time points. Participants who were retained for the study were similar demographically, but at the 3-month postpartum evaluation, women who were lost to follow-up were more likely to be younger (% lost follow-up aged 20 years or younger = 64%, 21–24 = 47%, 25–28 = 51%, 29 or older = 43%) and on public assistance (% on public assistance lost follow-up = 65%) than those who were reached. Baseline cotinine levels were not associated with retention, suggesting that women who may have already relapsed at baseline (based on cotinine) were just as likely to be retained for study assessments as those who were abstaining at baseline.

Smoking/relapse status by condition at each of the three postpartum assessments is shown in Table 2. There were no significant differences in relapse at any time point assessed by either self-reported smoking or measured cotinine by condition. Rates of imputed smoking abstinence were moderate in both conditions, with 43.7–46.0% of women maintaining cessation during the three postpartum follow-up assessments. Results from Cox proportional hazard regressions are presented in

Table 1
Baseline participant characteristics by group.

Variable	Category	All %(n)	Control (*n = 155*) %(n)	Intervention (*n = 227*) %(n)	*p*-Value
Age group	≤20	27.2 (104)	31.0 (48)	24.7 (56)	0.54
	21–24	29.3 (112)	26.5 (41)	31.3 (71)	
	25–28	22.8 (87)	21.9 (34)	23.3 (53)	
	29 and up	20.7 (79)	20.6 (32)	20.7 (47)	
Education	Less than HS	28.4 (107)	26.1 (40)	29.9 (67)	0.31
	HS Graduate/GED	43.2 (163)	49.0 (75)	39.3 (88)	
	Some College/ Tech School	0.02 (6)	1.3 (2)	1.8 (4)	
	College Graduate	26.8 (101)	23.5 (36)	29.0 (65)	
Race	White	61.5 (233)	59.1 (91)	63.1 (142)	0.16
	Black	15.8 (60)	20.1 (31)	12.9 (29)	
	Other	22.7 (86)	20.8 (32)	24.0 (54)	
Assistance	Yes	58.6 (219)	52.3 (80)	62.9 (139)	0.04
	No	41.4 (155)	47.7 (73)	37.1 (82)	
Language	English	86.7 (331)	83.9 (130)	88.5 (201)	0.26
	Spanish	8.4 (32)	9.0 (14)	7.9 (18)	
	Other	5.0 (19)	7.1 (11)	3.5 (8)	
Income	<10k	39.2 (131)	34.1 (46)	42.7 (85)	0.28
	10–30K	30.2 (101)	35.6 (48)	26.6 (53)	
	30–50K	15.0 (50)	14.1 (19)	15.6 (31)	
	50K+	15.6 (52)	16.3 (22)	15.1 (30)	
Employment	Employed full-time	29.6 (113)	29.0 (45)	30.0 (68)	0.99
	Employed part-time	14.7 (56)	14.2 (22)	15.0 (34)	
	Unemployed	47.4 (181)	47.7 (74)	47.1 (107)	
	Student	3.4 (13)	3.9 (6)	3.1 (7)	
	Other	5.0 (19)	5.2 (8)	4.8 (11)	
Stage of change	Precontemplation	3.5 (13)	3.9 (6)	3.2 (7)	0.75
	Contemplation	35.8 (133)	38.6 (59)	33.9 (74)	
	Preparation	42.9 (159)	39.9 (61)	45.0 (98)	
	Action	17.8 (66)	17.6 (27)	17.9 (39)	
Partner smokes	Yes	63.4 (187)	65.5 (78)	61.9 (109)	0.53
	No	36.6 (108)	34.5 (41)	38.1 (67)	
Cotinine reading	0: 0–100 ng/ml	30.2 (95)	31.3 (40)	29.4 (55)	0.60
	1: 100–250 ng/ml	25.4 (80)	27.3 (35)	24.1 (45)	
	2: 250–1000 ng/ml	11.1 (35)	7.8 (10)	13.4 (25)	
	3: 1000–2000 ng/ml	3.8 (12)	3.9 (5)	3.7 (7)	
			1.6 (2)	4.3 (8)	

(*continued on next page*)

Table 1 (*continued*)

Variable	Category	All %(n)	Control (*n* = *155*) %(n)	Intervention (*n* = *227*) %(n)	*p*-Value
	4: 2000–5000 ng/ml	3.2 (10)			
	5: 5000–10,000 ng/ml	8.9 (28)	9.4 (12)	8.6 (16)	
	6: >10,000 ng/ml	17.5 (55)	18.8 (24)	16.6 (31)	

Table 3. Models 1 and 2 revealed no relationship between treatment condition and relapse, regardless of excluding participants in the treatment group who received no MI calls. Models 3 and 4 revealed no relationship between total MI calls and relapse in either the full sample or the treatment group alone. Results of the sensitivity analysis (Model 5) revealed that, although excluding participants who were smoking at baseline from analyses strengthened the effect of treatment on relapse, this effect did not reach statistical significance.

4. Discussion

The results of this study suggested that provision of MI counseling delivered via phone during the prenatal and postpartum period did not increase postpartum maintenance of abstinence. Risk of relapse was similar in both conditions during the three postpartum follow-up assessments. Although self-reported relapse at baseline was low, urine cotinine levels suggested that many women may have already relapsed to smoking by the time of the baseline assessment. This, coupled with the high proportion of women found in the pre-contemplation or contemplation stage of change for postpartum smoking abstinence at baseline (i.e., planning to smoke after pregnancy, unsure of plan, or reporting smoking postpartum was at least somewhat likely; (Stotts et al., 2000)), may have contributed to low rates of maintained cessation. Relapse during pregnancy is very common, with one study reporting a 92% chance that women who smoked during the second week of a cessation effort during pregnancy would be smoking at the end of pregnancy (Higgins et al., 2006). Nicotine replacement therapy (NRT) used for cessation of smoking during pregnancy increases smoking cessation rates measured in late pregnancy by approximately 40% (Coleman et al., 2015) and use of pharmacotherapy in combination with MI phone counseling may have been able to produce more robust effects of maintenance.

The reasons why the intervention did not have the anticipated effect are unclear, but several possibly relevant factors should be noted. Study participants were difficult to reach, which contributed to lower than anticipated rates of participation in both intervention and evaluation components of the study. As noted above, only about a third of the intervention group received the "full dose" of 5 intervention calls, with approximately half of participants accepting a call in the postpartum period. While counselors worked very hard to find an acceptable time to speak with the women, including evenings and weekends when necessary, many women were repeatedly unavailable and some may have been avoidant of calls due to relapse or other factors. This sample was demographically diverse and underserved, and it should be noted that these factors may have influenced participants' ability to engage with intervention calls. Given the proportion of the sample on public assistance and unemployed, these women simply may have been very busy with competing demands such as with doctor's visits or work. These findings signal that interventions should consider the substantial and diverse burdens on new mothers from underserved communities and aim to strike a balance between not overburdening the mother (i.e., offering convenient, flexible, brief interventions) and delivering an efficacious intervention. Similarly, there were high rates of missing assessment data across time points (52–55%). Since research suggests that many women relapse during first two weeks postpartum (Suplee, 2005), an intervention call was planned for one week postpartum. Unfortunately, only approximately 18% the intervention group accepted a call in this window. Correspondingly, while an assessment at 1-month postpartum was planned, women were not receptive to taking calls at

Table 2
Smoking status by condition and time.

Variable	Category	3 Months				6 Months				12 Months			
		All	CON % (n)	MI % (n)	p	All	CON % (n)	MI % (n)	p	All	CON % (n)	MI % (n)	p
Smoking status	Yes	116	61.5 (48)	64.8 (68)	0.77	120	69.1 (56)	69.6 (64)	1.0	127	67.5 (52)	78.1 (75)	0.16
	No	67	38.5 (30)	35.2 (37)		53	30.9 (25)	30.4 (28)		46	32.5 (25)	21.9 (21)	
Smoked a cigarette, even a puff?	Yes	95	54.4 (43)	49.5 (52)	0.51	97	61.7 (50)	51.1 (47)	0.16	109	65.4 (51)	60.4 (58)	0.50
	No	89	45.6 (36)	50.5 (53)		76	38.3 (31)	48.9 (45)		65	34.6 (27)	39.6 (38)	
Smoked ≥5 cigarettes/day for 3+ days in a row?	Yes	36	21.4 (15)	22.3 (21)	0.89	52	33.8 (26)	30.2 (26)	0.63	58	38 (27)	35.6 (31)	0.76
	No	128	78.6 (55)	77.7 (73)		111	66.2 (51)	69.8 (60)		100	62 (44)	64.4 (56)	
Consider self a current smoker?	Yes	57	35.6 (26)	31.3 (31)	0.55	72	48.7 (38)	37 (34)	0.12	82	52.1 (38)	45.8 (44)	0.42
	No	115	64.4 (47)	68.7 (68)		98	51.3 (40)	63 (58)		87	47.9 (35)	54.2 (52)	
Cotinine (ng/ml)	0–100	29	19.4 (14)	15 (15)	0.10	25	15.2 (12)	14.1 (13)	0.56	25	21.9 (16)	9.4 (9)	0.15
	100–250	33	19.4 (14)	19 (19)		27	15.2 (12)	16.3 (15)		18	8.2 (6)	12.5 (12)	
	250–1000	11	11.1 (8)	3 (3)		5	2.5 (2)	3.3 (3)		7	1.4 (1)	6.3 (6)	
	1000-2000	12	1.4 (1)	11 (11)		10	3.8 (3)	7.6 (7)		5	4.1 (3)	2.1 (2)	
	2000-5000	4	2.8 (2)	2 (2)		10	2.5 (2)	8.7 (8)		13	6.8 (5)	8.3 (8)	
	5000–10,000	11	6.9 (5)	6 (6)		14	8.9 (7)	7.6 (7)		17	6.8 (5)	12.5 (12)	
	10,000+	72	38.9 (28)	44 (44)		80	51.9 (41)	42.4 (39)		84	50.7 (37)	49 (47)	

Note. *p*-Value corresponds to chi-square test of smoking by condition.

Table 3
Pooled parameter estimates of cox proportional hazard regressions of postpartum relapse to smoking based on intervention or intervention dose by model.

	HR	HR 95% CI		Estimate standard error	Degrees of freedom	*p*-Value
		Low	High			
Predictors						
Model 1						
Group	0.99	0.73	1.35	0.16	139.77	0.95
Model 2						
Group	1.04	0.75	1.45	0.17	165.73	0.81
Model 3						
Intervention dose	1.01	0.95	1.08	0.03	293.85	0.67
Model 4						
Intervention dose	1.02	0.94	1.11	0.04	313.05	0.57
Model 5						
Group (sensitivity)	0.84	0.57	1.25	0.20	541.77	0.40

Note: HR = hazard ratio.
Model 1: smoking status by treatment group;
Model 2: smoking status by treatment group, excluding those without MI calls;
Model 3: smoking status by total MI calls; missing MI calls recoded to 0;
Model 4: smoking status by total MI calls in the treatment group only;
Model 5: smoking status by treatment group, omitting participants whose data suggested smoking/relapse at baseline.

that time. Consequently, this assessment was removed from the study protocol. MI delivered by telephone during this period may be unworkable for postpartum mothers and integration within the context of prenatal visits may be more feasible or efficacious.

In previous work in this area, pregnant smokers who received self-help materials and both prenatal and postpartum phone counseling relapsed to smoking more slowly than those who only received prenatal counseling and materials or materials alone, however, rates of relapse were comparable by 12 months postpartum (McBride et al., 1999). Notably, sociodemographic characteristics in the present study (e.g., predominantly unemployed, low-income, 39% racial minority, younger) differed from those in the aforementioned study and call acceptance rates were lower, which may have contributed to discrepant findings. Although this possibility exists, in the present study, results did not significantly differ when participants who did not accept any intervention calls were removed from analyses. Furthermore, women who completed a higher number of MI calls did not have a reduced risk of relapse compared to those who received fewer MI calls. Thus, more work is needed to develop effective interventions for this critical population. Importantly, some research on Medicaid recipients shows that the provision of financial compensation for accepting counseling calls resulted in greater rates of call acceptance, which, in turn, produced greater rates of abstinence from smoking (Fraser et al., 2017). Financial incentives may be one way to promote engagement in the postpartum period, and have promise for promoting cessation among socioeconomically disadvantaged pregnant and postpartum women (Higgins et al., 2012).

One of the reasons why we didn't achieve the anticipated outcome may be due to factors related to the sociodemographic characteristics of this sample that were noted previously. Intervention delivery will likely need to be adapted to consider other communication channels or to reduce burden to be better received. Given the suboptimal intervention participation in the present study, other types of interventions that are less intensive (e.g., text messaging) may facilitate greater participation and promote increased maintenance of cessation. Tailored messaging content (i.e., matched to participant preferences, smoking history, and barriers to cessation) in smoking intervention studies have high usage and encourage quit attempts (e.g., Rodgers et al., 2005), but application during pregnancy and the postpartum period is limited. In one study, an intervention comprised of tailored self-help content (e.g., based on baseline characteristics such as motivation to quit, confidence in quitting during pregnancy, other smokers in one's environment) and text messages for pregnant smokers (MiQuit) was not reported to result in statistically significant differences between in smoking outcomes (Naughton et al., 2012) and showed limited evidence to support increased rates of cessation among pregnant women in another (Naughton et al., 2017). While digital interventions for preventing postpartum relapse are feasible (Wen et al., 2014) and may be effective for smoking cessation during pregnancy, particularly when delivered via text-message or computer (Griffiths et al., 2018), the available evidence indicates limited efficacy in the prenatal, but not the postpartum period (Abroms et al., 2017). More research is needed to determine if increased tailoring of intervention content or delivery schedules, and modes of delivery (i.e., text messaging versus smartphone applications) are effective delivery platforms for facilitating or maintaining abstinence during pregnancy and postpartum. While it is possible that a less intensive intervention may have increased engagement, some research has shown greater abstinence in the postpartum period with more intensive interventions. Specifically, one study that provided financial incentives, in-home counseling, and support to others in the home, in addition to phone counseling during the postpartum period, resulted in greater rates of postpartum abstinence relative to those who received prenatal counseling only (Alaniz et al., 2019). Nonetheless, similar to the current study, this study reported significant attrition and finding ways to increase treatment retention is essential.

Factors that cause women to smoke during the postpartum period are not identical to those that cause women to smoke while pregnant. Therefore, successful intervention programs may shift the focus of intervention efforts to specifically target these factors as they evolve across pregnancy and the postpartum period. Women report that they begin smoking again during the postpartum period due to: stress for caring for the newborn, weaning from breast feeding, having a partner who smokes, social pressures, the presence of familiar smoking cues, feeling sad and irritable, and weight gain (Fang et al., 2004). As having friends who smoke or a partner who smokes predicts postpartum return to smoking (Mullen et al., 1997; Stotts et al., 2000), one's social network may be an important area for intervention. While the intervention used in the current study included content designed to help women with enlisting social support and for asking others to limit their household smoking, informed by past research with predominantly low-income pregnant women suggesting that social factors (e.g., family members smoking, attending gatherings with friends who smoke) are a perceived barrier to staying quit (Risica et al., 2016), the extent to which women followed this advice is unknown. Focus group data show that women in a low-income setting may value advice from friends and relatives about smoking during pregnancy over advice from professionals (Dunn et al., 1998). Therefore, educational efforts might be more effective when delivered from networks of women (Dunn et al., 1998) or using peer-support programs (Ford et al., 2013). The importance of interventions targeting tobacco cessation maintenance in the postpartum period cannot be understated. Future research would likely benefit from community-based participatory research. Community smoking interventions that encompass the partners and close family members of a pregnant woman (Haslam, 2000) may be more effective.

The following limitations should be noted. First, exclusion criteria (e.g., for mood disorders) may limit generalizability. Second, very few women reported the use of NRT (3 at 3-months, 3 at 6-months, and 8 at 12-months). As a result, it is not possible to distinguish positive cotinine results that are due to NRT use, NRT plus smoking, or cigarette smoking alone. Because the use of NRT was so infrequent, we included these women in analyses, but future research should be attentive to the possible conflation of smoking and NRT usage. Third, some covariates were not assessed at all follow-ups to reduce participant burden. This was a particularly important consideration given that the population and the period under study, but this decision did limit the ability to use covariates to inform the imputation at later timepoints. Fourth, a randomization error assigned 64 initial participants to the intervention

group. Analyses were conducted to ensure against selection bias, but there are likely unmeasured and/or unknown characteristics on which these women may differ. Sensitively analyses indicated that dropping these women did not change the pattern of results; nonetheless, this limitation should be noted. Fifth, while cotinine data were collected at baseline, they were not used to exclude individuals from participating. While this may have resulted in enrolling some women who were not abstinent at baseline, excluding women who had not been completely abstinent but reported they had quit smoking would have limited generalizability; sensitivity analyses removing these participants did not differ from those with these participants retained. Finally, as previously noted, follow-up rates were low, likely due to characteristics of the sample as has been shown in other cessation studies (Alaniz et al., 2019; Kamke et al., 2019). Although sophisticated imputation procedures were used to account for missing data, higher retention is preferable and reducing attrition in the postpartum period should be prioritized.

5. Conclusions

MI phone counseling during the prenatal and postpartum period did not facilitate greater maintenance of smoking cessation in the present study. Rates of participation in the intervention and assessments were lower than expected, suggesting a need for interventions that are more acceptable and yield greater participation. Extending abstinence from smoking during pregnancy into permanent cessation of smoking has tremendous potential to improve the health of women and their children. More work is needed in this area of high importance.

CRediT authorship contribution statement

C.M.: writing-original draft; writing- reviewing, editing; formal analysis

L.M.: writing-original draft; writing-reviewing, editing; formal analysis

A.S.: formal analysis; software

B.B.: funding acquisition; conceptualization; project administration; supervision

E.J.: project administration, supervision

C.L.: supervision

D.P.: conceptualization

P.M.R.: funding acquisition; conceptualization; project administration; supervision; writing-reviewing, editing

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