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The role of prepartum motivation in the maintenance of postpartum smoking abstinence

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Abstract

Objective—Motivation plays an important role in a variety of behaviors, including smoking cessation, and is integral to theory and treatment of smoking. For many women, pregnancy offers a motivational shift that helps them stop smoking and maintain abstinence during pregnancy.

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However, women's motivation to maintain smoking abstinence postpartum is not well-understood and may play a role in high postpartum relapse rates. The current study utilized multiple measures of prepartum motivation to maintain smoking abstinence to predict postpartum smoking abstinence.

Design—As part of a randomized clinical trial on postpartum smoking relapse prevention, pregnant women who quit smoking during pregnancy reported their motivation to continue smoking abstinence at a prepartum baseline session. Continued smoking abstinence was assessed at 8 and 26 weeks postpartum.

Main Outcome Measure—Biochemically verified continuous abstinence from smoking.

Results—Direct relationships among multiple measures of motivation were significant, and ranged in strength from weak to moderate. All motivation measures individually predicted continuous smoking abstinence, after controlling for treatment group, demographics, and pre-quit tobacco use. When tested simultaneously, a global motivation measure and parenthood motives for quitting remained significant predictors of abstinence. Backward selection modeling procedures resulted in a reduced model of prepartum predictors of postpartum abstinence including global motivation, parenthood motives, and stage of change.

Conclusion—Global motivation for smoking abstinence and parenthood motives for quitting are particularly important motivational constructs for pregnant women's continued smoking abstinence.

Keywords

motivation; smoking abstinence; postpartum relapse prevention

Motivation plays an important role in behavioral regulation across a variety of domains, including addictive behaviors such as cigarette smoking (e.g., Baker, Brandon, & Chassin, 2004). For example, relapse prevention theory (Marlatt & Gordon, 1985; Witkiewitz & Marlatt, 2004), a prominent model of addiction, posits that motivation is a critical ingredient to quitting smoking and maintaining abstinence because high levels of motivation are necessary to enact coping behaviors during situations with high risk for relapse. Similarly, when describing the rationale for a prominent intervention for addictive behaviors, (i.e., motivational interviewing), Miller and colleagues (1995) noted that “the key element for lasting change is a motivational shift that instigates a decision and commitment to change.”

Pregnancy confers a motivational shift with respect to smoking for many women. From one third to one half of pregnant smokers spontaneously quit smoking during pregnancy (Tong, England, Dietz, & Asare, 2008). Women usually quit early in their pregnancy (Fingerhut, Kleinman, & Kendrick, 1990) because of the widespread knowledge of health effects to the fetus (USDHHS, 2001, 2004) and the resulting social pressure to quit (Curry, Grothaus, McBride, Lando, & Pirie, 2001; Manfredi, Cho, Crittenden, & Dolecek, 2007). Unfortunately, up to 80% of the women who quit smoking during pregnancy relapse by one year postpartum (Colman & Joyce, 2003; Fingerhut et al., 1990; Handel et al., 2009), with variations in motivation for maintaining postpartum abstinence playing an important role in these high relapse rates. For example, for some women, quitting smoking during pregnancy may represent “suspension” of smoking, rather than a more generalized, long-term motivation to quit (Stotts, DiClemente, Carbonari, & Mullen, 2000). Stotts and colleagues found that 24% to 32 % of pregnant quitters were not motivated to maintain abstinence postpartum (Stotts, DiClemente, Carbonari, & Mullen, 1996; Stotts et al., 2000). Thus, although many women may exhibit a similar behavior change (quitting smoking) during pregnancy, heterogeneity exists in the motivation to maintain abstinence after childbirth, which may explain high rates of postpartum relapse.

The research to date on motivation and smoking relapse has focused on several conceptualizations of motivation including abstinence goal, specific motives for quitting, stages of change, and a more general, global motivation for staying smoke-free. However, no previous studies have examined the relative efficacy of these conceptualizations in the prediction of postpartum abstinence.

Abstinence Goal

Researchers have used potential quitters' abstinence goal to approximate their underlying motivational state (e.g., Hall, Havassy, & Wasserman, 1990; Shmueli, Fletcher, Hall, Hall, & Prochaska, 2008). Abstinence goal typically reflects a goal of total abstinence versus options reflecting less than total abstinence (e.g., reducing smoking, no goal of abstinence). A goal of total abstinence has predicted a lower risk of returning to smoking, reduced likelihood of relapse following a slip (Hall et al., 1990), and a more positive decisional balance regarding cessation (Prochaska et al., 2004). Along these lines, a goal of temporary abstinence during pregnancy predicted relapse to smoking postpartum (Polanska, Hanke, Sobala, Lowe, & Jaakkola, 2010). Assessments of abstinence goals, however, do not directly assess a person's underlying motivational state, which could vary in intensity or in quality among individuals with a total abstinence goal. These nuances may be particularly important in pregnant women who quit smoking, as total abstinence goals have failed to predict coping strategies linked to smoking cessation (Scheibmeir, O'Connell, Aaronson, & Gajewski, 2005).

Specific Motives for Quitting

Self-determination theory (Deci & Ryan, 2000), a prominent theory of behavioral regulation, has investigated motivation by examining the sources of a person's motivation, distinguished broadly as autonomous (internal to the person) or controlled (external to the person). Autonomous motivation has been linked to reductions in smoking in adolescents (Williams, Cox, Kouides, & Deci, 1999) and long-term continuous abstinence among adults (Williams, Gagne, Ryan, & Deci, 2002). Likewise, Curry and colleagues (1990) classified specific motives for quitting as either intrinsic (e.g., health concerns, self-control) or extrinsic (e.g., immediate reinforcement, social influence). This approach also allowed for the assessment of idiosyncratic motives among pregnant women (i.e., pregnancy motives and parenthood motives). Compared to women who continued to smoke during pregnancy, pregnancy-related motives were significantly higher among women who quit smoking by 28 weeks prepartum, and intrinsic motives, relative to extrinsic motives, better predicted postpartum abstinence (Curry et al., 2001), and better predicted abstinence among the general population of smokers (Curry et al., 1990). These results suggest that intrinsic motives for quitting are important predictors of abstinence across populations, and that specific, idiosyncratic motives might also be necessary to appropriately capture motivation among pregnant women (e.g., pregnancy and parenthood motives).

Stages of Change

Another well-known measure of motivation is derived from the transtheoretical model (Prochaska & DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992). The stages of change construct is posited to capture the “temporal, motivational, and constancy” aspects of behavior change (DiClemente et al., 1991, p. 295). Assessing stage of change involves classifying current and former smokers into discrete categories of readiness to quit based on self-reported intent to quit smoking, expected time-frame for quitting smoking, and actual quit attempts (for current smokers) or length of time quit (for former smokers; DiClemente et al., 1991). Temporally closer intent (e.g., seriously considering quitting in 30 days versus 6 months), along with the presence of quit attempts, indicates greater motivation to quit.

The stages of change construct has been the subject of considerable controversy with critiques asserting that it lacks a theoretical basis (Davidson, 1992), includes arbitrary time points for separation into categories (Armitage, 2009; Herzog & Blagg, 2007), and displays a lack of standardized measurement or scoring (Herzog & Blagg, 2007; Littell & Girvin, 2002). Despite these criticisms, stage of change consistently predicts smoking abstinence (Prochaska et al., 1992). For pregnant quitters, who are all currently abstinent (and would therefore be in the action stage), a reformulated and validated stage of change algorithm has been developed in previous research (Stotts et al., 2000). This reformulated stage of change measure includes postpartum abstinence goal, the perceived likelihood of postpartum return to smoking, and whether or not the woman had smoked a puff since becoming pregnant (Stotts et al., 2000). Studies using this reformulated stage of change assessment have demonstrated that a more advanced stage of change predicts a decreased likelihood of postpartum relapse at 6 weeks and at 3, 6, and 12 months postpartum (Stotts et al., 2000). Although stage of change was not developed as a measure of motivation specifically, both the content of the items used to assess it as well as its use in previous studies to predict cessation success, particularly with pregnant women (Stotts et al., 2000), prompted its inclusion as one conceptualization of motivation. Notably, however, its operational definition conflates motivation with self-efficacy and behavior. Thus, its predictive power may lie partially in these constructs rather than motivation per se.

Global Motivation

In addition to distinguishing various qualities or types of motivation, the construct of motivation can also be considered a global, more general level of commitment or desire to reach a stated goal (see Deci & Ryan, 2000, for a discussion of these perspectives). The Texas Smoking Abstinence Motivation Scale (TSAMS; Castro et al., 2010) was created to assess motivation more globally, through direct endorsement of statements that reflect commitment and desire to be abstinent from smoking (e.g., “I am extremely motivated to be smoke-free,” “My desire to be a non-smoker is very strong,” “I am completely committed to being smoke-free”). This approach complements and adds to other motivation measures by (1) allowing individuals to fall anywhere along the continuum from unmotivated to extremely motivated, rather than forcing them into discrete categories, (2) assessing global motivation directly rather than approximating motivation from stated goals or behaviors, and (3) separating the effects of a general level of motivation for behavior change or maintenance from specific motives that may vary with particular populations or life-events. The TSAMS has been shown to have good psychometric properties (e.g., Cronbach's $\alpha = .94$), to load on a single factor, and to predict cessation and relapse across several diverse samples of smokers receiving treatment (Castro et al., 2010), but has not been used previously among pregnant women.

Study Purpose

The current study examined the predictive utility of multiple measures of motivation for postpartum smoking abstinence among pregnant quitters. Measures were compared with respect to their predictive utility for postpartum abstinence, and a parsimonious model was formed for predicting postpartum abstinence from prepartum motivation. Furthermore, the predictive utility of the TSAMS was examined and extended to the novel context of pregnant women.

Method

Participants

Participants were 251 English-speaking pregnant women who quit smoking during pregnancy or within 2 months prior to pregnancy. To be included, participants had to be at

least 18 years old, have smoked an average of more than 1 cigarette per day during the year prior to pregnancy, and have a functioning home or personal cell phone. Women reporting a high risk pregnancy were not included.

Procedures

Pregnant women were recruited from the Houston metropolitan area from a local health care system, and through newspaper, radio, bus, and clinic advertisements, to participate in a randomized clinical trial evaluating a postpartum smoking relapse prevention program. Participants completed a baseline orientation session during their 30th to 33rd week of pregnancy. Following this session, participants were randomized into one of three intervention groups: Usual Care (UC), Motivation And Problem Solving (MAPS), or an enhanced Motivation And Problem Solving (MAPS+). The MAPS and MAPS+ groups did not differ on baseline characteristics, percentage of participants who were abstinent at 8 and 26 weeks postpartum, or other variables related to length and adherence to treatment. As such, MAPS and MAPS+ were combined for all analyses. Full details of the interventions and the trial results are provided elsewhere (Reitzel et al., 2010). In addition to one baseline assessment, participants attended two additional on-site assessments at 8 and 26 weeks postpartum.

Measures

Demographics—Demographics collected at baseline included race/ethnicity, education, age, and partner status.

Tobacco use—Prequit tobacco use was assessed at baseline through self-reported number of cigarettes smoked per day and time from waking to first cigarette of the day.

Abstinence goal—Participants selected their abstinence goal regarding postpartum smoking from the following list of possible goals: (1) Total abstinence; to never use again, (2) Total abstinence, but think I could slip and maintain abstinence, (3) Occasional use when urges strongly felt, (4) Temporary abstinence, and (5) No goal of abstinence at this time. In line with prior research (e.g., Hall et al., 1990), and because of small cell sizes for some categories, abstinence goal was scored as dichotomous, with total abstinence versus all other responses. Further, analyses of the dichotomized measure versus the full set of categories yielded equivalent results.

Stages of change—Following Stotts and colleagues (2000), a three-part algorithm was used to assess stage of change in pregnant quitters. First, personal goal with regard to smoking after delivery was assessed. Goals of “controlling smoking” or “go back to smoking” classified participants in the precontemplation stage, while reporting “not sure” placed participants in the contemplation stage. Among participants who wanted to “stay off cigarettes,” self-reported likelihood of smoking in the first 6 months after the baby was born further separated this group into contemplation (“extremely likely”) and preparation (“not very likely”). Finally, among participants responding “not at all likely” to smoke in the first 6 months postpartum, a behavioral challenge (have you smoked “even a puff” since your last prenatal visit?) further delineated these women. A “yes” response placed the participants in the preparation stage, while a “no” response placed the participants in the action stage.

Reasons for quitting—Reasons for quitting assessed intrinsic motives for quitting with items related to health concerns (“Because I have noticed physical symptoms that smoking is hurting my health”) and self-control (“To show myself that I can quit smoking if I really want to”), and extrinsic motives for quitting with items related to immediate reinforcement (“So that my hair and clothes won't smell”) and social influence (“Because people I am close

to will be upset with me if I don't quit"). This version also added pregnancy ("Because I am concerned about my baby's health") and parenthood ("Because I don't want my children to know me as a smoker") motives for quitting, with two items to assess each of these subscales (Curry et al., 2001). Responses were combined to form means for each motives subscale.

Global motivation—Participants responded to a series of 10 statements (e.g., "My motivation to be a non-smoker is at an all time high," "I want to be a non-smoker," "Being smoke-free is very important to me") on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*). Responses were combined to form a mean TSAMS score, and the scale demonstrated adequate reliability (Cronbach's $\alpha = .95$).

Smoking abstinence—Smoking abstinence was biochemically verified at enrollment through expired carbon monoxide levels. Continuous abstinence from smoking was assessed at 8 and 26 weeks postpartum through self-report of no smoking since delivery date and biochemically verified through expired carbon monoxide levels of <10 ppm (Hajek et al., 2001) and/or a cotinine value of <20 ng/ml (McBride et al., 1999). Two abstinence outcomes were created, including a completers outcome, where abstinence data of those lost to follow-up were considered missing, and an intention-to-treat (ITT) outcome, where those lost to follow-up were considered relapsed.

Statistical Analyses

To assess the utility of the disparate motivation measures, a variety of approaches were used. First, the relationships among the motivation measures were examined with simple correlations and regressions. Second, continuation ratio (CR) logit models were fit for continuous abstinence through weeks 8 and 26 postpartum with baseline measures of motivation as predictors. CR logit models are appropriate when ordered categories (e.g., relapsed at Week 8, abstinent at Week 8 but relapsed at Week 26, and abstinent through Week 26) represent a progression through stages (Agresti, 2002; Allison, 2001; Bender & Benner, 2000; McGowan, 2000). The CR logit models operate by modeling the conditional probability of being abstinent at the current assessment point, given that a participant has been abstinent through the most recent assessment point. As a general strategy, the effect of each predictor on postpartum abstinence was evaluated using separate, individual models, controlling for demographics (race/ethnicity, education, age, and partner status), prequit tobacco use (time to first cigarette and cigarettes per day), and treatment group (UC vs. MAPS/MAPS+). Then, the unique contribution of each predictor was examined in a model that included all motivation predictors in a single model adjusting for the covariates ("full-set" model). Finally, to select a parsimonious reduced model, a backward model selection method was used, successively dropping non-significant variables from the full-set model and re-fitting reduced models until all remaining variables were statistically significant at .10 (Hocking, 1976). All p values for CR logit models were based on likelihood ratio tests (LRTs; Cohen, Cohen, West, & Aiken, 2003). CR logit models were first conducted using the ITT abstinence outcome. In addition, given high follow-up rates at the 8 and 26 week postpartum assessments (80% and 78%, respectively), a separate set of analyses was conducted using the completers abstinence outcome.

Results

Participant Characteristics

The sample was ethnically diverse (35% White, 31% African American, 32% Hispanic, 2% Other). Nineteen percent had less than high school/GED education, and 29% had a 12th grade education only. Mean age was 24.6 years ($SD = 5.32$). Thirty-two percent of the

women were married, 30% were living with a significant other, and 34% were single. Participants reported smoking an average of 10 cigarettes per day prequit, with 78% reporting a time to first cigarette greater than 5 minutes.

Associations among Motivation Measures

For these analyses, various measures of association were calculated for relationships between continuous measures, between continuous and categorical measures, and between categorical measures. Table 1 displays these results, as well as means and standard deviations (or category percentages) for each variable. Overall, there were moderate relationships among most of the measures of motivation with strength ranging from .02 to .64.

Associations of Motivation Measures with Postpartum Abstinence

Table 2 presents the results of the CR logit models, specifically, the odds ratios for the association of the motivation measures with postpartum abstinence controlling for treatment group, demographics, and prequit tobacco use (control variables not shown). For both ITT and completers, each motivation measure contributed significantly to the prediction of abstinence in the individual models. Figure 1 displays estimated ITT abstinence probabilities at 8 and 26 weeks for each motivation measure separately. Of the Reasons for Quitting, the intrinsic motives subscale was selected as a representative rather than showing each of the Reasons for Quitting separately as all subscales demonstrated the same pattern. To represent TSAMS and intrinsic motives, scores were divided into categories for illustrative purposes.

In the full-set ITT model, only TSAMS and parenthood motives uniquely and significantly predicted abstinence, such that higher baseline levels of global motivation and parenthood motives predicted greater likelihood of postpartum abstinence. In the full-set completers model, only TSAMS significantly predicted abstinence, and parenthood motives approached significance, $p = .079$.

The far right section of Table 2 displays the results of the backward selection modeling to yield a parsimonious model of postpartum abstinence prediction. Forward stepwise selection was also examined and resulted in the same outcome. For both ITT and completers samples, backward selection suggested a reduced model of TSAMS motivation, parenthood motives, and stage of change. Higher baseline levels of TSAMS and parenthood motives predicted greater likelihood of postpartum smoking abstinence. For stage of change, none of the contrasts presented (with precontemplation as the reference group) were significant; however, post-hoc analyses revealed that the baseline action stage predicted higher probabilities of postpartum abstinence than both preparation ($p = .016$) and contemplation ($p = .051$) stages. Precontemplation rates of abstinence were not different from action ($p = .827$). Figure 2 displays ITT estimated abstinence probabilities for the reduced model.

Discussion

Motivation plays a pivotal role in the initiation and maintenance of behavior change including the cessation of addictive behaviors such as smoking. Multiple conceptualizations of motivation exist in the smoking cessation literature including abstinence goal, specific motives for quitting, stage of change, and general, global motivation. The current study demonstrated several key findings regarding the predictive utility of these disparate motivation measures for the maintenance of postpartum smoking abstinence: (1) All prepartum measures of motivation to maintain smoking abstinence individually predicted postpartum abstinence, (2) a relatively new, global measure of motivation (TSAMS) was significantly and positively related to all specific motives for quitting (intrinsic, extrinsic,

pregnancy, and parenthood), to total abstinence goal, and to stage of change, (3) global motivation predicted postpartum abstinence as well as or better than the other motivation measures tested, and when tested simultaneously, only global motivation and parenthood motives provided unique predictive utility over and above the other motivation measures, and (4) backward selection modeling procedures suggested that for pregnant quitters, global motivation, parenthood motives, and stage of change comprised a parsimonious model of abstinence prediction. These findings demonstrate the critical role of motivation, conceptualized in multiple ways, in maintaining behavior change.

Of particular importance, these results demonstrate the utility of assessing a general, global level of motivation for cessation maintenance. This particular measure (TSAMS) reflects motivation for positive behavior change and maintenance, a key mechanism in social cognitive and relapse prevention theory (Witkiewitz, Marlatt, & Walker, 2005), as well as a target of effective treatments for addiction (Miller & Rollnick, 2002). Unlike self-determination theory (Deci & Ryan, 2000), which theoretically conceptualizes motivation along a qualitative continuum (from extrinsic to intrinsic), the TSAMS characterized motivation in terms of a global level or quantity of motivation, without regard for these qualitative distinctions. In the current study, the TSAMS added predictive utility, over and above specific motives for quitting (e.g., extrinsic, intrinsic, etc.), which are more directly derived from self-determination theory (Curry et al., 1990). Still, with items such as “Being smoke-free is very important to me,” the TSAMS may reflect greater internalization and integration with self, characteristics of relatively intrinsic, rather than extrinsic, motivation. In pregnant women, intrinsic reasons for quitting have predicted abstinence postpartum (Curry et al., 2001). In the current study, intrinsic motives do not independently predict abstinence when considered simultaneously with other motivation measures, which could be due in part to the conceptual and empirical overlap between the global measure and the concept of intrinsic motivation. Indeed, zero-order relationships revealed a moderate relationship ($r = .43, p < .001$). Furthermore, these results support previous work linking the TSAMS to smoking cessation among diverse populations (Castro et al., 2010), and extend the scope of this measure to include maintenance of change and to pregnant/postpartum women.

Parenthood motives for quitting were also important, uniquely predicting abstinence (along with TSAMS) above and beyond the other motivation measures (for ITT and marginally for completers). The importance of parenthood motives and the lack of prediction for pregnancy motives (in the full-set and reduced models) were expected given this sample. First, pregnancy concerns likely do not motivate behavior at 8 and 26 weeks postpartum. Curry et al. (2001) found that baseline pregnancy motives predicted cessation *during* pregnancy, but did not predict postpartum abstinence. Unlike pregnancy motives, parenthood motives continue after birth and are likely to be highly salient at 8 and 26 weeks postpartum. Also, whereas many smokers attempting to quit experience decreases in motivation over time, which precipitates relapse (Hedeker & Mermelstein, 1996; Piasecki, Fiore, McCarthy, & Baker, 2002), the continued salience of parenthood motives may facilitate abstinence behavior maintenance efforts, and consequently, the maintenance of abstinence engagement (Simmons, Heckman, Ditre, & Brandon, 2010). This finding highlights the importance of specific motives for quitting that may vary with the particular population studied.

In addition to TSAMS and parenthood motives, backward selection suggested including stage of change in the reduced model. Although the specific contrasts presented were not significant in this reduced model, post-hoc probing revealed that the baseline action stage predicted greater likelihood of postpartum abstinence than the preparation and contemplation stages. There was not a significant difference between baseline action and precontemplation stages. However, contrasts involving precontemplation were likely less

reliable due to the relatively small number of women in this stage (10 % compared to approximately 30% in other stages). Although selected in the reduced model, stage of change did not pass the more stringent test of significance in the full-set model. Empirically, stage of change overlaps with global motivation (zero-order relationships revealed a strong relationship with TSAMS, $r = .61, p < .001$), and the algorithm for stage of change for pregnant quitters includes items beyond a purely motivational assessment (i.e., self-efficacy and behavior). These items potentially added explanatory power not attributable to motivation per se, which may have captured unexplained variance in the reduced models. Indeed, past research indicated that the self-efficacy item alone was comparable to the total stage of change algorithm (Stotts et al., 2000) and that a single item regarding likelihood of staying off cigarettes predicted better than the original (non-pregnancy) stage of change algorithm (Sciamanna, Hoch, Duke, Fogle, & Ford, 2000). Future research would benefit from disentangling motivation from self-efficacy and behavior when examining the construct of stage of change.

Finally, considering these findings broadly, they support the importance of motivation in behavioral maintenance as posited in prominent theories of addictive behavior (e.g., relapse prevention theory). The findings also extend the significance of motivation beyond what is found in treatment guidelines (Fiore, Bailey, Cohen, et al., 2000), which focus on motivation as it pertains to initiating a quit attempt but do not discuss the potential importance of motivation in *maintaining* abstinence. The current study suggests that levels of motivation for smoking abstinence are important predictors of future abstinence behavior, even across a powerful and life-changing event (childbirth). Given this context, and given the substantial time that passed from prepartum motivation assessment to postpartum abstinence reports, these results provided a stringent test of the role of motivation in maintaining behavior.

Future research should continue to examine more dynamic accounts of motivation, such as ecological momentary assessments (Stone & Shiffman, 1994) or motivational engagement after quitting (Simmons et al., 2010), to provide a more complete picture of the link between motivation and smoking abstinence across various life stages (e.g., pregnancy to parenthood) and life events (e.g., caring for a newborn). Motivation levels can change over small increments of time (Hughes, Keely, Fagerstrom, & Callas, 2005) and decrements in motivation occur prior to relapse (Hedeker & Mermelstein, 1996; Piasecki et al., 2002). Interventions designed to be responsive to motivational shifts, or interventions designed to impact specific motivational targets may be particularly effective (Reitzel et al., 2010). The current study provides some evidence for designing interventions to target both a general, global level of motivation for smoking abstinence, as well as more specific motivational components that are appropriate for certain populations or situations (e.g., parenthood).

Limitations

The current study did not test the full representation of potential motivation measures available in the literature. For example, the contemplation ladder (Biener & Abrams, 1991), another common measure of intention to quit, was not included in the current study. In addition, direct self-report measures of motivation and readiness to quit smoking, similar to the TSAMS measure here, have recently been published. In particular, Kahler and colleagues (2007) recently created and examined an 8-item inventory of “commitment to quitting smoking.” This measure predicted abstinence over and above importance of quitting and self-efficacy for quitting in a sample of smokers who drank heavily. This lends further support to the utility of such global, direct measures of motivation. Future research might investigate several available assessments of motivation.

While the TSAMS performed well as a predictor of maintenance of postpartum smoking abstinence in this study, more research is needed to assess the utility of the TSAMS. Castro

and colleagues (2010) have examined the psychometric properties, and the convergent and discriminant validity of the measure, but future research should also replicate the relationship between the TSAMS and continued smoking abstinence among smokers who have already quit (as in the current study), as well as whether the TSAMS can be used to improve treatment or the selection of treatments for specific subpopulations.

Furthermore, although ethnically/racially diverse, the majority of the sample was married or living with their spouse/partner, and had at least a high school education. Therefore, these results may not generalize to women with less education and to women without a partner. Future research should explore motivation among even lower socioeconomic status women, where continued postpartum smoking abstinence may be even more difficult to achieve.

In sum, as with many behavioral domains, motivation appears to play an important role in maintaining smoking abstinence, as greater motivation predicted greater likelihood of postpartum abstinence. By examining links to abstinence over time, and by comparing the overall fit of various models, results suggested a reduced model of motivation that included global motivation, parenthood motives, and stage of change. Furthermore, given that stage of change represents a construct broader than motivation per se, and given that global motivation and parenthood motives predicted in the full-set model containing all motivation variables, results suggested that that global motivation and parenthood motives for quitting are particularly important motivational constructs for pregnant women's postpartum smoking abstinence.

References

- Agresti, A. Categorical data analysis. 2nd. Hoboken, NJ: John Wiley & Sons; 2002.
- Allison, PD. Logistic regression using the SAS system: Theory and application. Cary, NC: SAS Institute and Wiley; 2001.
- Armitage CJ. Is there utility in the transtheoretical model? *British Journal of Health Psychology*. 2009; 14(2):195–210.10.1348/135910708X368991 [PubMed: 18922209]
- Baker TB, Brandon TH, Chassin L. Motivational influences on cigarette Smoking. *Annual Review of Psychology*. 2004; (55):463–491.10.1146/annurev.psych.55.090902.142054
- Bender R, Benner A. Calculating ordinal regression models in SAS and S-Plus. *Biometrical Journal*. 2000; 42(6):677–699.10.1002/1521-4036(200010)42:6<677::AID-BIMJ677>3.0.CO;2-O
- Biener L, Abrams DB. The Contemplation Ladder: validation of a measure of readiness to consider smoking cessation. *Health Psychology*. 1991; 10(5):360–365.10.1037/0278-6133.10.5.360 [PubMed: 1935872]
- Blais MR, Sabourin S, Boucher C, Vallerand RJ. Toward a Motivational Model of Couple Happiness. *Journal of Personality and Social Psychology*. 1990; 59(5):1021–1031.10.1037/0022-3514.59.5.1021
- Castro Y, Mazas CA, Costello TJ, Businelle MS, Heppner WL, Correa-Fernandez V, et al. The Texas Smoking Abstinence Motivation Scale validation. 2010 Unpublished raw data.
- Cohen, J.; Cohen, P.; West, SG.; Aiken, LS. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd. Mahwah, NJ: Lawrence Erlbaum Associates; 2003.
- Colman GJ, Joyce T. Trends in smoking before, during, and after pregnancy in ten states. *American Journal of Preventive Medicine*. 2003; 24(1):29–35.10.1016/S0749-3797(02)00574-3 [PubMed: 12554021]
- Curry SJ, Wagner EH, Grothaus LC. Intrinsic and extrinsic motivation for smoking cessation. *Journal of Consulting and Clinical Psychology*. 1990; 58(3):310–316.10.1037/0022-006X.58.3.310 [PubMed: 2195084]
- Curry SJ, Grothaus L, McBride C, Lando H, Pirie P. Motivation for smoking cessation among pregnant women. *Psychology of Addictive Behaviors*. 2001; 15(2):126–132.10.1037/0893-164X.15.2.126 [PubMed: 11419228]

- Deci EL, Ryan RM. The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*. 2000; 11(4):227–268.10.1207/S15327965PLI1104_01
- DiClemente CC, Prochaska JO, Fairhurst SK, Velicer WF, Velasquez MM, Rossi JS. The process of smoking cessation: An analysis of precontemplation, contemplation, and preparation stages of change. *Journal of Consulting and Clinical Psychology*. 1991; 59(2):295–304.10.1037/0022-006X.59.2.295 [PubMed: 2030191]
- Fingerhut LA, Kleinman JC, Kendrick JS. Smoking before, during, and after pregnancy. *American Journal of Public Health*. 1990; 80(5):541–544.10.2105/AJPH.80.5.541 [PubMed: 2327529]
- Fiore, MC.; Bailey, WC.; Cohen, SJ., et al. *Treating Tobacco Use and Dependence: Clinical Practice Guideline*. Rockville, MD: U. S. Department of Health and Human Services; 2000.
- Hajek P, West R, Lee A, Foulds J, Owen L, Eiser JR, et al. Randomized controlled trial of a midwife-delivered brief smoking cessation intervention in pregnancy. *Addiction*. 2001; 96(3):485–494.10.1046/j.1360-0443.2001.96348511.x [PubMed: 11255587]
- Hall SM, Havassy BE, Wasserman DA. Commitment to abstinence and acute stress in relapse to alcohol, opiates, and nicotine. *Journal of Consulting and Clinical Psychology*. 1990; 58(2):175–181.10.1037/0022-006X.58.2.175 [PubMed: 2335634]
- Handel G, Hannover W, Roske K, Thyrian JR, Rumpf HJ, John U, et al. Naturalistic changes in the readiness of postpartum women to quit smoking. *Drug and Alcohol Dependence*. 2009; 101(3):196–201.10.1016/j.drugalcdep.2009.01.011
- Hedeker D, Mermelstein RJ. Application of random-effects regression models in relapse research. *Addiction*. 1996; 91(Supplement):S211–S229.10.1111/j.1360-0443.1996.tb02340.x [PubMed: 8997794]
- Herzog TA, Blagg CO. Are most precontemplators contemplating smoking cessation? Assessing the validity of the stages of change. *Health Psychology*. 2007; 26(2):222–231.10.1037/0278-6133.26.2.222 [PubMed: 17385974]
- Hocking RR. The analysis and selection of variables in linear regression. *Biometrics*. 1976; 32:1–49.10.2307/2529336
- Hughes JR, Keely JP, Fagerstrom KO, Callas PW. Intentions to quit smoking change over short periods of time. *Addictive Behaviors*. 2005; 30(4):653–662.10.1016/j.addbeh.2004.08.011 [PubMed: 15833571]
- Kahler CW, LaChance HR, Strong DR, Ramsey SE, Monti PM, Brown RA. The commitment to quitting smoking scale: Initial validation in a smoking cessation trial for heavy social drinkers. *Addictive Behaviors*. 2007; 32(10):2420–2424.10.1016/j.addbeh.2007.04.002 [PubMed: 17478057]
- Koestner, R.; Losier, GF. Distinguishing three ways of being highly motivated: A closer look at introjection, identification and intrinsic motivation. In: Deci, EL.; Ryan, RM., editors. *Handbook of Self-determination Research*. Rochester, NY: University of Rochester Press; 2002. p. 101–121.
- Littell JH, Girvin H. Stages of change: A critique. *Behavior Modification*. 2002; 26(2):223–273.10.1177/0145445502026002006 [PubMed: 11961914]
- Manfredi C, Cho YI, Crittenden KS, Dolecek TA. A path model of smoking cessation in women smokers of low socio-economic status. *Health Education Research*. 2007; 22(5):747–756.10.1093/her/cyl155 [PubMed: 17182971]
- Marlatt, GA.; Gordon, JR. *Relapse Prevention*. 1. New York: Guilford Press; 1985.
- McBride CM, Curry SJ, Lando HA, Pirie PL, Grothaus LC, Nelson JC. Prevention of relapse in women who quit smoking during pregnancy. *American Journal of Public Health*. 1999; 89(5):706–711.10.2105/AJPH.89.5.706 [PubMed: 10224982]
- McGowan, MJ. Ordinal outcomes with the continuation ratio model; Paper presented at the Proceedings of the Northeast SAS Users Group Conference; Philadelphia, PA. 2000 September.
- Miller, WR.; Rollnick, S. *Motivational Interviewing: Preparing People for Change*. New York, NY: The Guilford Press; 2002.
- Miller, WR.; Zweben, A.; DiClemente, CC.; Rychtarik, RG. *Motivational enhancement therapy manual: A clinical research guide for therapists treating individuals with alcohol abuse and dependence (No 94-3723)*. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health; 1995.

- Piasecki TM, Fiore MC, McCarthy DE, Baker TB. Have we lost our way? The need for dynamic formulations of smoking relapse proneness. *Addiction*. 2002; 97(9):1093–1108.10.1046/j.1360-0443.2002.00216.x [PubMed: 12199822]
- Polanska K, Hanke W, Sobala W, Lowe J, Jaakkola J. Predictors of smoking relapse after delivery: Prospective study in Central Poland. *Maternal and Child Health Journal*. 2010 10.1007/s10995-010-0639-y
- Prochaska JJ, Rossi JS, Redding CA, Rosen AB, Tsoh JY, Humfleet GL, et al. Depressed smokers and stage of change: Implications for treatment interventions. *Drug and Alcohol Dependence*. 2004; 76(2):143–151.10.1016/j.drugalcdep.2004.04.017 [PubMed: 15488338]
- Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*. 1983; 51(3):390–395.10.1037/0022-006X.51.3.390 [PubMed: 6863699]
- Prochaska JO, DiClemente CC, Norcross JC. In search of how people change: Applications to addictive behaviors. *American Psychologist*. 1992; 47(9):1102–1114.10.1037/0003-066X.47.9.1102 [PubMed: 1329589]
- Reitzel LR, Vidrine JJ, Businelle MS, Kendzor DE, Costello TJ, Li Y, et al. Preventing postpartum smoking relapse among diverse low-income women: A randomized clinical trial. *Nicotine and Tobacco Research*. 2010; 12(4):326–335.10.1093/ntr/ntq001 [PubMed: 20154055]
- Ryan RM. Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*. 1982; 43(3):450–461.10.1037/0022-3514.43.3.450
- Scheibmeir MS, O'Connell KA, Aaronson LS, Gajewski B. Smoking cessation strategy use among pregnant ex-smokers. *Western Journal of Nursing Research*. 2005; 27(4):411–427.10.1177/0193945904272649 [PubMed: 15870236]
- Sciamanna CN, Hoch JS, Duke GC, Fogle MN, Ford DE. Comparison of five measures of motivation to quit smoking among a sample of hospitalized smokers. *Journal of General Internal Medicine*. 2000; 15(1):16–23.10.1046/j.1525-1497.2000.11198.x [PubMed: 10632829]
- Shmueli D, Fletcher L, Hall SE, Hall SM, Prochaska JJ. Changes in psychiatric patients' thoughts about quitting smoking during a smoke-free hospitalization. *Nicotine and Tobacco Research*. 2008; 10(5):875–881.10.1080/14622200802027198 [PubMed: 18569762]
- Simmons VN, Heckman BW, Ditte JW, Brandon TH. A measure of smoking abstinence-related motivational engagement: Development and initial validation. *Nicotine and Tobacco Research*. 2010; 12(4):432–437.10.1093/ntr/ntq020 [PubMed: 20190004]
- Stone AA, Shiffman S. Ecological momentary assessment (EMA) in behavioral medicine. *Annals of Behavioral Medicine*. 1994; 16(3):199–202.
- Stotts AL, DiClemente CC, Carbonari JP, Mullen PD. Pregnancy smoking cessation: A case of mistaken identity. *Addictive Behaviors*. 1996; 21(4):459–471.10.1016/0306-4603(95)00082-8 [PubMed: 8830904]
- Stotts AL, DiClemente CC, Carbonari JP, Mullen PD. Postpartum return to smoking: Staging a 'suspended' behavior. *Health Psychology*. 2000; 19(4):324–332.10.1037/0278-6133.19.4.324 [PubMed: 10907650]
- Tong VT, England LJ, Dietz PM, Asare LA. Smoking Patterns and Use of Cessation Interventions During Pregnancy. *American Journal of Preventive Medicine*. 2008; 35(4):327–333.10.1016/j.amepre.2008.06.033 [PubMed: 18779027]
- U. S. Department of Health and Human Services. Women and smoking: A report of the Surgeon General. Atlanta, GA: U. S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion Office on Smoking and Health; 2001.
- U. S. Department of Health and Human Services. The health consequences of smoking: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2004.

- Williams GC, Cox EM, Kouides R, Deci EL. Presenting the facts about smoking to adolescents: Effects of an autonomy-supportive style. *Archives of Pediatrics and Adolescent Medicine*. 1999; 153(9):959–964. [PubMed: 10482213]
- Williams GC, Gagne M, Ryan RM, Deci EL. Facilitating autonomous motivation for smoking cessation. *Health Psychology*. 2002; 21(1):40–50.10.1037/0278-6133.21.1.40 [PubMed: 11846344]
- Witkiewitz K, Marlatt GA. Relapse prevention for alcohol and drug problems: That was zen, this is tao. *American Psychologist*. 2004; 59(4):224–235.10.1037/0003-066X.59.4.224 [PubMed: 15149263]
- Witkiewitz K, Marlatt GA, Walker D. Mindfulness-based relapse prevention for alcohol and substance use disorders. *Journal of Cognitive Psychotherapy*. 2005; 19(3):211–228.10.1891/jcop.2005.19.3.211

Figure 1.

Individual model estimated probabilities (and standard errors) of postpartum abstinence at weeks 8 and 26. Probabilities estimated for a White, married woman of mean age, who smoked her first cigarette > 5 minutes after waking, who smoked the mean number of cigarettes per day, who had at least a high school education, and was treated with MAPS/MAPS+. TSAMS and motives for quitting were treated as continuous variables in analyses, but were split into four categories for illustrative purposes. Only intrinsic motives for quitting are presented for brevity, as all specific motives demonstrated the same pattern. TSAMS = Texas Smoking Abstinence Motivation Scale.

Figure 2.

Reduced model estimated probabilities (and standard errors) of postpartum abstinence at weeks 8 and 26. Probabilities estimated for a White, married woman of mean age, who smoked her first cigarette > 5 minutes after waking, smoked the mean number of cigarettes per day, had at least a high school education, and was treated with MAPS/MAPS+. For TSAMS, analyses assumed the mean score for parenthood motives and precontemplation stage of change. For stage of change, analyses assumed the mean score for TSAMS and parenthood motives. For parenthood motives, analyses assumed the mean score for TSAMS and precontemplation stage of change. TSAMS and parenthood motives were treated as continuous variables in analyses but were split into four categories for illustrative purposes. TSAMS = Texas Smoking Abstinence Motivation Scale.

Table 1

Interrelationships among Multiple Motivation Measures

	TSAMS	Intrinsic Motives	Extrinsic Motives	Pregnancy Motives	Parenthood Motives	Abstinence Goal	Stage of Change
TSAMS	--	.425***	.143*	.447***	.288***	.324***	.635***
Intrinsic Motives		--	.280**	.562**	.409**	.121 [†]	.322***
Extrinsic Motives			--	.175**	.166**	.063	.018
Pregnancy Motives				--	.518**	.195**	.329***
Parenthood Motives					--	.135*	.210**
Abstinence Goal						--	.318***
Stage of Change							--
Mean (SD)	4.45 (.67)	3.71 (1.05)	2.03 (1.12)	4.76 (.48)	4.68 (.71)		
Category %						68.5% Total Abstinence 30.3% Other	10.4% Precontemplation 29.5% Contemplation 30.3% Preparation 29.5% Action

Note. For continuous measures (TSAMS, Intrinsic Motives, Extrinsic Motives, Pregnancy Motives, and Parenthood Motives) relationship strength represents Pearson's r correlation coefficients. For Abstinence Goal, relationships to continuous measures represent regression coefficients from linear regression (β), while relationship to Stage of Change represents a contingency coefficient. For Stage of Change, relationships to continuous measures represent Spearman correlation coefficients. TSAMS = Texas Smoking Abstinence Motivation Scale.

p < .001;
**
p < .01;
*
p < .05;
[†]
p < .06.

Table 2
Summary of Continuation Ratio Logit Models Predicting Continuous Abstinence over Time

Predictor (Baseline)	Individual Models			Full-Set Models			Reduced Models		
	OR (95% CI)	p		OR (95% CI)	p		OR (95% CI)	p	
ITT									
TSAMS	3.78 (2.26, 6.34)	<.0001		2.61 (1.27, 5.38)	.006		3.00 (1.52, 5.91)	.0007	
Stage of change		<.0001			.127			.051	
	..			..			..		
Precontemplation (ref)									
Contemplation	1.07 (.41, 2.78)	.897		.55 (.18, 1.67)	.294		.55 (.19, 1.62)	.283	
Preparation	1.67 (.66, 4.28)	.274		.57 (.18, 1.85)	.352		.53 (.17, 1.67)	.282	
Action	4.38 (1.72, 11.2)	.001		1.07 (.30, 3.79)	.916		1.14 (.35, 3.78)	.827	
Other (ref)	..			..			..		
Abstinence Goal									
Total Abstinence	2.07 (1.19, 3.62)	.014		1.43 (.76, 2.70)	.264		Not selected ¹		
Reasons for Quitting									
Intrinsic	1.69 (1.30, 2.19)	<.0001		1.16 (.83, 1.63)	.375		Not selected		
Extrinsic	1.26 (1.02, 1.55)	.028		1.14 (.91, 1.44)	.253		Not selected		
Pregnancy	2.52 (1.33, 4.78)	.002		.86 (.39, 1.88)	.705		Not selected		
Parenthood	2.46 (1.39, 4.37)	.001		1.80 (1.01, 3.31)	.042		1.90 (1.08, 3.33)	.014	
Completers									
TSAMS	4.13 (2.35, 7.25)	<.0001		3.31 (1.46, 7.51)	.003		3.79 (1.77, 8.12)	.0003	
Stages of change		<.0001			.091			.043	
	..			..			..		
Precontemplation (ref)									
Contemplation	1.23 (.44, 3.45)	.698		.59 (.18, 1.97)	.393		.58 (.18, 1.84)	.353	
Preparation	1.54 (.57, 4.19)	.396		.43 (.12, 1.54)	.192		.39 (.11, 1.36)	.142	
Action	4.77 (1.75, 13.0)	.002		.97 (.24, 3.91)	.973		.98 (.26, 3.65)	.978	
Other (ref)	..			..			..		
Abstinence Goal									
Total Abstinence	1.83 (1.01, 3.35)	.047		1.21 (.60, 2.44)	.601		Not selected		
Reasons for Quitting									
Intrinsic	1.75 (1.33, 2.32)	<.0001		1.09 (.75, 1.58)	.664		Not selected		
Extrinsic	1.31 (1.04, 1.65)	.019		1.19 (.92, 1.55)	.183		Not selected		

Predictor (Baseline)	Individual Models		Full-Set Models		Reduced Models	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
ITT						
Pregnancy	2.82 (1.40, 5.66)	.002	1.02 (.44, 2.35)	.966	Not selected	
Parenthood	2.45 (1.31, 4.56)	.001	1.77 (.91, 3.42)	.079	1.87 (1.02, 3.43)	.032

Note. Analyses adjusted for demographics (race/ethnicity, education, age, and partner status), tobacco use (time to first cigarette and cigarettes per day), and treatment group. Odds ratios reflect relationship to abstinence. TSAMS = Texas Smoking Abstinence Motivation Scale.

I The variable was deleted from the model with the backward selection method.