

**Pregnancy and Smoking:
A literature review that investigates the unique challenges that women
experience during and after pregnancy**

The negative health consequences of tobacco have so thoroughly permeated society that the World Health Organization (WHO) has labeled the current use of tobacco the “Tobacco Epidemic”.¹ Among the global population of individuals who smoke, women are a subpopulation that have proven to be particularly vulnerable to the adoption and effects of tobacco use over their lifespan.²⁻³ Presently, research indicates that the global smoking population is on its way to becoming increasingly female as the tobacco industry begins to market its products to women in developing countries.⁴ To better understand and address the issue of smoking during pregnancy and the postpartum period, this literature review intends to examine the challenges that smoking presents to women.

PREVALENCE

FEMALE SMOKING PREVALENCE

GLOBAL

Among the population of global tobacco users, the proportion of them who are women has been increasing for several years.⁵ In 2006 the prevalence of smoking among women was 9%, which accounted for 200 million of the 1 billion global smokers.⁶ While it is believed that men’s smoking rates have peaked and are now decreasing, it is projected that women’s smoking will reach a prevalence of 20% globally by 2025.⁷

CANADA/ONTARIO

In Canada, national smoking prevalence data is collected by the Canadian Community Health Survey (CCHS) and the Canadian Tobacco Use Monitoring Survey (CTUMS), both of which are sample surveys with a cross-sectional design.⁸ The CCHS targets Canadians aged 12 and over and in 2009 it demonstrated that 17.7% of females smoked (compared to 22.6% of Canadian males).⁸ To further understand female smoking prevalence, data from the 2007/08 CCHS demonstrates that among females in Ontario, the highest prevalence of “current smokers” was 24% in the 25-29 age group. Notably, the most recent data from Statistics Canada shows that Canadian females in this age group also had the highest rate of pregnancies in 2005.⁹

The CTUMS targets Canadians aged 15 and over with a focus on youth and young adults aged 15-24. Its 2009 data demonstrated that the male smoking rate had significantly decreased from 33% in 2008 to 26% in 2009. However, no such statistically significant difference was detected in the prevalence of female young adult smoking from 2008 to 2009 (22% vs. 20%, respectively).

PREGNANT SMOKING PREVALENCE

Within this realm of females who smoke, there is a subpopulation of pregnant women who smoke. In the United States, combined data from 2008 and 2009 indicates that the rate of past month cigarette use was 15.3% among pregnant women.¹⁰ According to the CCHS, in 2005, 10% of women in Ontario aged 20-44 who gave birth in the past five years had smoked during their most recent

pregnancy; of these women, 5% had smoked daily while 5% had smoked occasionally.¹¹ More recently, CCHS data demonstrates that during the period of 2007 and 2008, 15% of pregnant women aged 15-49 years were current smokers in Ontario (as per their self-description).¹²

In a comprehensive effort to help understand, promote and improve the health of new mothers across Canada, the Public Health Agency of Canada conducted a Maternal Experience Survey (MES). The survey was administered to mothers 15 years of age or older who gave birth to a single child in Canada during a three-month period prior to the 2006 Canadian Census of the Population.¹³ Among a number of issues that it investigated, the MES considered women who smoked prior to, during and following pregnancy. It found that overall 10.5% of Canadian women smoked either daily or occasionally during the last trimester of their pregnancy.¹³ Among these women, 42.4% smoked 10 or more cigarettes per day while 57.6% smoked 1 to 9 cigarettes per day.¹³ Maternal smoking was higher among multiparous women than primiparous women (11.7% and 9.1%, respectively).¹³ As well, women living in households that were at or below the low-income cut-off were more likely to smoke (20% vs. 7%).¹³

CHALLENGES WITH ESTIMATING PREVALENCE OF SMOKING IN PREGNANCY

Each of the prevalence rates presented above are based solely on self-reports given by the survey participants. None of the smoking status self-reports

were biochemically validated. This is problematic because research studies have demonstrated that self-reports of smoking status underestimate smoking prevalence.¹⁴⁻¹⁵ In pregnant women, studies have found the non-disclosure rate to range from 23-28%.¹⁴⁻¹⁵ Therefore it is reasonable to suggest that all available global, national and provincial reports of smoking prevalence rates, particularly among pregnant women, are underestimates. It is important to consider this with respect to research, policy and practice.

HEALTH

MATERNAL

The health consequences of smoking in women are generally considered to be more pervasive than in men for a number of reasons. The 2004 Report of the U.S. Surgeon General on women and smoking comprehensively details the health consequences of tobacco use among women and concludes that smoking is a major cause or risk factor for various cancers, heart disease and COPD, as well as a major risk factor for negative menstrual and reproductive outcomes.¹⁶

For pregnant women who smoke, research has demonstrated that a modest increase in the risk for ectopic pregnancy and spontaneous abortion exist.¹⁶ As well, smoking during pregnancy is associated with increased risks of various complications including abruptio placentae, placenta previa, and premature rupture of membranes.¹⁶⁻¹⁷ A modest increase in risk for preterm delivery is also associated with smoking during pregnancy.¹⁶

FETAL

When a woman who is pregnant smokes, the negative effects of smoking pose health risks to both her and her fetus.¹⁸ Nicotine is a chemical that is known to cross the placenta.¹⁹ In fact, the amniotic fluid and fetal circulation demonstrate higher levels of nicotine than found in the mother's own plasma and circulation.²⁰ Research indicates that nicotine decreases the availability of oxygen to the fetus, increases fetal heart rate and reduces breathing movement of the fetus.²⁰⁻²¹

INFANT

The 2006 Report of the Surgeon General on the health consequences of involuntary exposure to tobacco smoke concluded that there was sufficient evidence (Level 1) to infer a causal relationship between exposure of an infant to second-hand smoke and Sudden Infant Death Syndrome (SIDS) as well as maternal exposure to second-hand smoke and a reduction in birth weight.²² The report qualified the evidence between maternal second-hand smoke exposure and pre-term delivery or childhood cancer as suggestive (Level 2).²² Additionally, children exposed to second-hand smoke are at an increased risk of acute respiratory infections, ear problems, and more severe asthma.²² Inadequate evidence (Level 3) prevented the report from drawing a causal relationship of second-hand smoke exposure with; spontaneous abortion and perinatal death, infant deaths, congenital malformations, cognitive development, behavioural development, and height/growth.²²

WHY CONTINUE TO SMOKE

Data shows that women are more likely to quit smoking or smoke fewer cigarettes during pregnancy than at any other time in their life.²³⁻²⁴ However, many women do not quit smoking while pregnant, with studies showing that more than half of all women continue to smoke.²⁵ The reinforcing and psychoactive effects of nicotine as well as the behavioural conditioning and social reinforcement of smoking make cigarettes highly addictive.²⁶ Addiction is a major barrier to reduction and cessation for pregnant women who smoke.²⁵ Additionally, it may be more difficult for women to reduce or quit smoking during pregnancy because pregnant women seem to metabolize nicotine faster than non-pregnant women.²⁷⁻²⁸ Aside from physical factors that impact women's smoking, many psychosocial and environmental aspects are related as well.

Research demonstrates that smoking and exposure to smoking during and after pregnancy is related to lower socioeconomic status among women in Canada.²⁹ Smoking during pregnancy tends to be higher among women in the lowest income households as well as women who have not graduated from high school.²⁹ Sellstrom and colleagues (2008) demonstrated that the relationship between smoking during pregnancy and socioeconomic status may be related to neighbourhood factors such as the quality of available maternity care, social norms and attitudes and mapping of tobacco retail locations.³⁰

In the general population, individuals with mental health and addictions issues tend to have higher smoking prevalence.^{31,32,33} Evidence suggests that

this trend is also true in the subpopulation of pregnant women. Goodwin and colleagues (2007) investigated the association of mental health disorders and nicotine dependence in the United States through a face-to-face general population survey of 43,093 nationally representative Americans.³⁴ Of the 12.4% of female participants who qualified as nicotine dependant, 57.5% also had a mental health disorder.³⁴ As well, nicotine dependence during pregnancy significantly predicted mental disorder, mood disorder, major depression, dysthymia, and panic disorder.³⁴ Alcohol and drug use is also associated with higher rates of smoking during pregnancy.³⁵

SMOKING CESSATION AMONG PREGNANT WOMEN

Some research cites pregnancy as a potential motivator of health-related behaviour change.³⁶ Indeed, women who smoke are more likely to quit during pregnancy than at any other time in their lives.²³ Evidence of substantially higher quit rates among pregnant women,³⁷⁻³⁸ as well as women who intend to become pregnant in the near future³⁹⁻⁴⁰ compared to the general population has led researchers to consider pregnancy's role as a potential "teachable moment." McBride and colleagues define teachable moments as "...naturally occurring events thought to motivate individuals to spontaneously adopt risk-reducing health behaviors."³⁶ However, research also shows that many women do not quit smoking spontaneously during pregnancy and in fact up to seventy percent continue to smoke.²⁵ Concern for fetal health is a common reason why women suddenly quit smoking during pregnancy.⁴¹ This motivation is often temporary

and specific to the pregnancy stage as 70-90% of women relapse to smoking within one year postpartum.⁴² Pregnancy, then, does not appear to be a long-term motivator for changing smoking behaviour. However, it may be a good entry point for reaching women who smoke. More research is needed on how to transform and extend this impetus for change into the postpartum period and beyond.

Over the last few decades, researchers have investigated the use of various interventions for promoting smoking cessation during pregnancy. In a Cochrane systematic review, Lumley and colleagues evaluated the effect of these interventions.²³ The review included 72 trials, with data on smoking cessation outcomes provided by 56 randomized controlled trials (RCTs) and 9 cluster RCTs (sample size of over 20,000 and 5,000 respectively).²³ A variety of interventions were investigated in these trials, either individually or in combinations. The most common main intervention strategy investigated was based on cognitive behavioural therapy, followed by stages of change, feedback, incentives and pharmacotherapy. The authors concluded that pregnant women do benefit from smoking cessation interventions.²³ Specifically, they observed a significant reduction in smoking in late pregnancy (RR 0.94; 95% CI 0.93-0.96). As well, a reduction in low birth weight (RR 0.83; 95% CI 0.73-0.95), a reduction in preterm birth (RR 0.86; 95% CI 0.74-0.98), and an increase in mean birth weight by 53.91g (95% CI 10.44 g - 95.38 g) were observed.²³ Although interpretation of this must be cautious because considerable heterogeneity existed in the combined data ($I^2 >60\%$).²³ While subgroup analyses were

performed to consider the differential effectiveness between types of intervention strategies, the heterogeneity for subgroups remained relatively high.²³

The majority of treatments that have been investigated to help pregnant women quit or reduce smoking are psychosocial interventions, which include counselling, self-help, and behavioural treatment.⁴³ This latter treatment encompasses cognitive behaviour approaches, motivational interviewing and contingency management therapy.⁴⁴ Psychosocial interventions are designed to increase smoking cessation based on psychological or social support mechanisms.⁴³

The Canadian Action Network for the Advancement, Dissemination and Adoption of Practice-informed Tobacco Treatment's (CAN-ADAPTT) Clinical Practice Guideline for pregnant and breastfeeding women recommends that all pregnant women who smoke should be offered smoking cessation interventions.⁴⁵ Furthermore, it is recommended that counselling be the first line of treatment offered to pregnant women.⁴⁵ The U.S. Department of Health and Human Services' (USDHHS) Clinical Practice Guideline on Treating Tobacco Use and Dependence recommends that pregnant smokers be provided with in-person psychosocial interventions that exceed the minimal advice to quit.⁴³ This recommendation is based on a meta-analysis that found that psychosocial interventions significantly increased the abstinence rate among pregnant smokers when compared to usual care.⁴³

An interesting form of behavioural therapy that has shown promise in the context of various forms of substance use disorders is contingency management

therapy,⁴⁶ whereby an individual with a drug dependency experiences a positive consequence, such as rewards or incentives, for positive behaviour, such as meeting specific behavioural (drug abstinence) goals.⁴⁷ Donatelle and colleagues were the first to investigate the application of this form of behavioural therapy in a population of pregnant and postpartum women with nicotine dependence.⁴⁸ The randomized controlled trial they conducted demonstrated significant differences in the percentages of smokers who were biochemically confirmed as abstinent at eight months gestation and at two months postpartum.⁴⁸ The most recent research in this area has been done by Heil and colleagues who also demonstrated the potential effectiveness of voucher-based reinforcement therapy to help pregnant smokers quit smoking.⁴⁹ In their research, contingent vouchers significantly increased point-prevalence abstinence at the end of pregnancy (41% vs 10%; $p=0.003$) and at the 12-week postpartum assessment (24% versus 3%; $p=0.006$).⁴⁹ Additionally, Higgins and colleagues later used data from the trial completed by Heil and colleagues above, as well as 2 other controlled trials, to investigate the effect of voucher-based contingency management on birth outcomes⁵⁰ – they found that participants assigned to the contingent treatment arm; (a) delivered babies with a higher mean birth weight and, (b) had an overall lower percentage of low birth weight deliveries.⁵⁰

THE USE OF NRTs DURING PREGNANCY

Women who are motivated to reduce or quit smoking but, for whatever reason, are unable to, may require more comprehensive assistance during their

efforts.⁴³ Nicotine replacement therapy (NRT) is a smoking cessation aid that has been shown to minimize withdrawal symptoms and increase cessation rates in the general population.⁵¹ Pregnant women who smoke are less likely to use NRT due to concerns about safety and efficacy.^{52,53,54,55} Some research shows that NRT is preferable to smoking during pregnancy because 1) NRT contains only nicotine and not the many other toxins in tobacco smoke,⁴³ and 2) the fetus tends to be exposed to less nicotine with NRT than with cigarettes.⁵⁶ However, trials investigating the use of NRT during pregnancy have shown mixed results.

Recent research has demonstrated that NRT in pregnancy may not significantly increase smoking cessation rates. A large trial by Coleman and colleagues investigated the efficacy of adding a nicotine patch to behavioural cessation support for women who smoked during pregnancy. Results revealed that the patch did not increase the rate of abstinence from smoking nor did it decrease the risk of adverse pregnancy or birth outcomes associated with cigarette consumption.⁵⁷

Several other randomized controlled trials (RCT) have examined the use of NRT during pregnancy and found similar results. Wisborg and colleagues investigated the effect of nicotine patch use during pregnancy on cotinine-validated smoking cessation.⁵⁸ No difference in smoking abstinence was observed between the placebo and intervention group.⁵⁸ Kapur and colleagues conducted a double-blind, placebo-controlled randomized trial of the nicotine patch during pregnancy.⁵⁹ Although more pregnant women in the intervention group quit smoking, the difference was not statistically significant.⁵⁹ Pollak and

colleagues investigated the use of various forms of NRT (patch, gum, lozenge) and behavioural therapy on smoking cessation during pregnancy.⁶⁰ In this randomized trial, over two times more women who received the combination of NRT and behavioural therapy remained abstinent at 7 weeks and 38 weeks gestation, when compared to women who only received the behaviour intervention.⁶⁰ However, there was no statistically significant difference in smoking abstinence during postpartum between the two groups.⁶⁰

Regarding NRT safety, an RCT that investigated treatment with nicotine gum for smoking cessation during pregnancy determined that the use of nicotine gum did not increase quit rates, however it did increase birth weight and gestational age.⁶¹ Findings of an earlier systematic review and meta-analysis by Coleman and colleagues investigating both efficacy and safety of NRT suggested that infant health outcomes seemed to be more positive for women using NRT than women who smoked during pregnancy, but not significantly. There was insufficient evidence to make conclusions about the efficacy of NRT during pregnancy in this review.⁶²

Due to insufficient evidence of effectiveness, the USDHHS clinical practice guideline excludes pregnant women from its recommendation that clinicians should encourage the use of numerous effective smoking cessation medications to patients who are attempting to quit smoking. The Canadian Action Network for the Advancement, Dissemination and Adoption of Practice-informed Tobacco Treatment's (CAN-ADAPTT) guideline for pregnant and breastfeeding women has stated that behavioural interventions should be attempted before

pharmacotherapy. Additionally, intermittent dosing nicotine replacement therapies (such as lozenges, gum) are preferred over continuous dosing of the patch, after a risk-benefit analysis, if counselling is found ineffective among pregnant and breastfeeding women.⁴⁵

While the results on effectiveness are mixed, NRT may still be a viable option for some pregnant women who have been unable to quit smoking through other methods. The research on safety and protective factors for fetal health seem positive, and therefore this option should still be explore with pregnant women who want to quit or reduce.

THE ROLE OF PARTNER SUPPORT

Canadian data regarding pregnant women's indirect exposure to tobacco smoke has been captured by the CTUMS survey. Of the women surveyed, 23.4% reported living with an individual who smoked during their pregnancy.¹³ Women are at an increased risk of smoking while pregnant if they live with others who smoke.⁷¹ Male partners may play an even greater role in women's smoking as pregnant women living with a partner who smokes are less likely to stop smoking during their pregnancy and more likely to relapse postpartum.⁶³ Additionally, women have described having a partner who smokes as a significant challenge in their efforts to quit or reduce smoking.⁶⁴

Partner support has been identified as a method to help support and increase pregnancy-related and postpartum smoking abstinence. Male partners who are supportive and empathetic appear to increase chances of smoking

cessation for women who are pregnant.⁶⁵⁻⁶⁶ However, a recent review of partner interventions found that there is little evidence for the efficacy of including or targeting partners to help pregnant women reduce or quit.⁶⁷ This review also found, however, that few interventions have been developed that target or include partners, and therefore more research is needed to explore the effectiveness of partner support and how to elicit this support through interventions.

Smoking and pregnancy can often result in conflict between partners or changes to relationship dynamics.⁶⁸ For example, one study found that women experience pressure from partners to quit and may be more vulnerable to abuse as a result.⁶⁹ Research supports the inclusion of the partner in smoking cessation interventions for pregnant women. However, the evidence showing women's increased vulnerability to abuse results in a recommendation to intervene with each partner independently rather than counseling a woman in the presence of her partner.⁶⁹

A recent pilot RCT investigated increasing a woman's social support for smoking cessation during pregnancy and postpartum.⁷⁰ In this study the participant's "supporter" was a female non-smoking friend or family member. Results showed a non-significant trend for increased smoking cessation among women in the intervention group.⁷⁰ Further research is required to determine whether partner and social support is effective to help women quit smoking during pregnancy and how this can be incorporated into smoking cessation interventions for pregnant and postpartum women.

POSTPARTUM RELAPSE

UNDERSTANDING RELAPSE

The rate of smoking relapse can be as high as 85% in women during the postpartum period.⁷¹ In Canada, the Canadian Maternity Experiences Survey found that 47% of women who quit smoking during their pregnancy resumed smoking daily or occasionally after giving birth.¹³ To understand this relapse and ultimately address it, researchers have investigated factors that influence women's resumption to smoking in the postpartum period.

Predictors of postpartum relapse to smoking include having higher nicotine dependence, postpartum depression and more friends or family who smoke.⁷² Studies have also revealed low education and low income,⁷³ alcohol use,⁷⁴ African American ethnicity,⁷¹ weight gain,⁷⁵ and living with another individual who smokes⁷⁶ as significant predictors of relapse to smoking. Lastly, women who are younger in age and who lack social support and prenatal care and experience stressful life events are more likely to relapse to smoking.^{71,75} Women who breastfeed tend to have lower rates of relapse to smoking in the postpartum period.⁷⁷

Solomon and colleagues investigated the circumstances around the first postpartum cigarette and found the cigarette tended to be unplanned, in the presence of another individual who smoked and while experiencing a negative mood.⁷² Gaffney and colleagues have demonstrated a significant association between ongoing infant irritability or crying and return to smoking postpartum.⁷⁸

Considering the many new challenges mothers of infants face, Levine and colleagues explored whether women are open to receiving interventions to prevent relapse in the postpartum period.⁷⁹ A survey of 36 women who quit smoking during pregnancy and either relapsed or remained abstinent in the postpartum period revealed that both groups considered the opportunity to talk to a counsellor about relapse acceptable. The women who were surveyed acknowledged the value of receiving interventions that addressed mood, stress and weight concerns.⁷⁹

The common intent of the above research studies is ultimately to inform the development of more targeted intervention strategies. While risk factors such as postpartum depression, stress, partner's smoking and breastfeeding status have been identified as predictors of relapse, the inclusion and consideration of these factors in smoking cessation and relapse prevention interventions remains inconsistent.

RELAPSE PREVENTION

Various approaches have been implemented to prevent postpartum smoking relapse. In a pilot study, French and colleagues evaluated the effectiveness of nurse-delivered home-visiting program during the postpartum period that included a low-intensity relapse prevention intervention.⁸⁰ They found that three times more women in the intervention group remained abstinent at 6 months postpartum than in the control group.⁸⁰ However, the positive effects of in-person counselling to prevent relapse have not been consistently observed. Hannover

and colleagues conducted a randomized controlled trial of a smoking cessation/relapse prevention intervention in postpartum period that consisted of face-to-face counselling 40 days after delivery and telephone counselling 4 and 12 weeks later.⁸¹ Although the intervention showed a small effect on smoking cessation rates, no effect was observed on postpartum relapse prevention.⁸¹

Reitzel and colleagues have demonstrated that compared to providing usual care alone, also addressing women's motivations, emotions and problem solving skills reduced postpartum smoking relapse among women who quit smoking during pregnancy.⁸²

As mentioned earlier, some studies have found that the most common reason why women quit smoking during pregnancy is out of concern for fetal health.⁴¹ Fetal health as the reason for not smoking may contribute to understanding high relapse rates, as it is a temporary and external motivator that does not extend into the postpartum period. A qualitative study by Bottorff and colleagues found that some women who relapsed postpartum explained that they had never really quit.⁸³ They had quit temporarily for someone else- either their baby or a health care provider- rather than for themselves, planned to return to smoking, looked forward to it and did not consider their smoking again as relapse.⁸³ Interventions intended to reduce relapse postpartum, then, should include a component that addresses changing motivation to quit from short-term and external to long-term and internal, or focused on women's health.⁸⁴

In addition to focusing on women's health and long-term benefits of cessation, interventions should have a postpartum relapse prevention component

built in to them.⁸⁵ The focus should be not just about cessation for the duration of the pregnancy, but should also address the impending postpartum period. Research supports extending cessation interventions so that they continue throughout the postpartum period as a method of preventing relapse.⁸⁶ Skill development through intervention is another research supported method of preventing relapse, for example, increasing women's confidence in their ability to stay quit.⁸⁷

SMOKING AND BREASTFEEDING

The initiation and continuation of breastfeeding is lower among mothers who smoke.^{88,89,90} While the protective effect of breast milk is well established, research indicates that a smoking environment may reduce the acquisition of these protective effects.⁹¹ Although nicotine is passed through the breast milk, the health effects of this absorption have not been demonstrated.⁹² As well, nicotine has not been shown to physiologically affect the process of lactation.⁹³ Rather, research points to the effects of psychosocial factors and general motivation to breastfeed as moderators of lactation.⁹³ The American Pediatric Association removed nicotine as a stated contraindication for breastfeeding in 2001, suggesting that an infant's overall health would fair better in a smoking environment with breastfeeding than in a smoking environment with bottle-feeding.⁹⁴ A recent retrospective study by Karmaus and colleagues illustrated the protective effect of breastfeeding in the context of parental smoking.⁹⁵ The study assessed the joint effect of three risk factors – maternal smoking,

breastfeeding and recurrent lower respiratory tract infections on childhood asthma. Using data from the Isle of Wight birth cohort study, they found that the effect of prenatal smoking on childhood asthma was attenuated by at least 3 months of breastfeeding.⁹⁵ Further analyses by Higgins and colleagues investigated the effects of smoking cessation on breastfeeding duration and found that women who stopped smoking tended to breastfeed for longer periods of time.¹⁰ Ultimately, however, the effect of nicotine ingested by infants who are nursed has not been adequately investigated and so remains unknown.⁷⁷

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