

Prevention and Treatment of Smoking and Tobacco Use During Pregnancy in Selected Indigenous Communities in High-Income Countries of the United States, Canada, Australia, and New Zealand



An Evidence-Based Review

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Tobacco smoking during pregnancy is the most important modifiable risk factor for adverse pregnancy outcomes and long-term health complications for mother and baby. Tobacco use during pregnancy has decreased in high-income countries but not in Indigenous women in Australia, New Zealand, the United States, and Canada. This evidence-based review focuses on tobacco use among Indigenous pregnant women in high-income countries that share a history of European colonization. Indigenous women are more likely to use tobacco because of socioeconomic disadvantage, social norms, and poor access to culturally appropriate tobacco cessation support. Complications arising from tobacco smoking during pregnancy, such as low birth weight, prematurity, perinatal death, and sudden infant death syndrome, are much higher in Indigenous populations. Effective approaches to cessation in pregnant nonindigenous women involves behavioral counseling, with or without nicotine replacement therapy (NRT). Higher nicotine metabolism during pregnancy and poor adherence may affect therapeutic levels of NRT. Only two randomized trials were conducted among Indigenous women: neither found a statistically significant difference in cessation rates between the treatment and comparison arms. Considerations should be given to (1) whole life course approaches to reduce tobacco use in Indigenous women, (2) prohibiting tobacco promotion and reducing access to alcohol for minors to prevent smoking initiation in Indigenous youth, and (3) training health-care professionals in culturally appropriate smoking cessation care to improve access to services. It is critical to ensure acceptability and feasibility of study designs, consult with the relevant Indigenous communities, and preempt implementation challenges. Research is needed into the effect of reducing or stopping smoking during pregnancy when using NRT on subsequent maternal and infant outcomes.

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ABBREVIATIONS: CpG = 5'-C-phosphate-G-3'; END = electronic nicotine device; NRT = nicotine replacement therapy; SGA = small for gestational age

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Maternal tobacco use during pregnancy is a neglected contributing factor to chronic disease that disproportionately affects Indigenous infants. This paper focuses on Indigenous pregnant women and their babies in Australia, New Zealand, the United States, and Canada. Indigenous women in these high-income countries have a high prevalence of tobacco use, and few stop smoking during pregnancy. Higher smoking prevalence is independently associated with low socioeconomic status, adolescence, and multiparity.¹ Health inequity cannot be tackled without effective strategies to control tobacco use.² This evidence-based review explores the harms and health disparities associated with Indigenous tobacco use during pregnancy, the unique factors that promote the continued use of tobacco in Indigenous women during pregnancy, and evidence-based strategies tailored to Indigenous populations. Finally, we describe gaps in evidence about translation of effective smoking cessation strategies to the Indigenous context and child health outcomes associated with alternative forms of maternal nicotine exposure.

Important Harms Associated With In Utero Tobacco Smoke Exposure

Serious consequences of smoking and tobacco use among Indigenous women during pregnancy include complications such as placenta previa, abruptio placentae, stillbirth, small for gestational age (SGA) infants, and preterm delivery.³ A US study including 2,777 pregnant women enrolled in a prenatal screening program whose nicotine exposure was approximated biochemically found that birth weights were reduced by 327 g with active tobacco smoking.⁴ The adjusted ORs for fetal death, low-birth weight at term, and preterm delivery were 3.4, 1.8, and 1.8, respectively, for pregnancies in the highest cotinine quintile.⁴ Tobacco smoke exposure has also been linked to an increased risk of sudden infant death syndrome, probably by increasing apneic events and reducing the rate of arousals.^{5,6} Maternal smoking may also render infants vulnerable to more severe respiratory infections.⁷ Additionally, smoking promotes the development of allergic disease by changing the activation profile of immune cells.⁸ Chronic sequelae include heart disease, obesity, diabetes, and behavioral and learning problems in children.^{1,9} The molecular mechanisms that link tobacco smoking during pregnancy to the early origins of disease in the offspring may involve

transgenerational epigenetic modifications that regulate gene expression. 5'-C-phosphate-G-3' (CpG) methylation at 473,844 DNA sites were investigated in cord blood samples from 1,062 infants.¹⁰ Five of the 26 CpG sites associated with intrauterine tobacco smoke exposure in infants were replicated in a cohort involving 36 samples: two in the cytochrome P450 isoform CYP1A1 and one in the aryl-hydrocarbon receptor repressor (*AHRR*) gene, which are known to be involved in the detoxification of compounds from tobacco smoke through the aryl hydrocarbon receptor signaling pathway and two CpGs in the growth factor independent 1 transcription repressor (*GFI1*) gene, which are known to have an essential role in histone modification. A remarkable concordance of CpG methylation status was found in peripheral blood mononuclear cell samples collected from 572 children aged 3 to 5 years.¹¹

Maternal tobacco smoking during pregnancy is the most important preventable risk factor for abnormal lung development in utero and a dose-related reduction in lung function at birth.¹² Low lung function at birth increases the risk for respiratory infections in early life, wheezing and asthma in childhood, and COPD in genetically susceptible individuals.¹³⁻¹⁷ The effects of maternal tobacco smoking during pregnancy on the infant's lung development are mediated by nicotinic receptors, changes in airway geometry, effects on airway epithelial cell proliferation, and oxidative mechanisms.¹⁸ Undoubtedly, reducing smoking in pregnant women has the potential to prevent chronic lung disease in two people: the mother and her baby. The benefits of pharmacotherapy for mothers who are not able to stop smoking without medication and the effects on the respiratory outcomes of the offspring have not been well studied. However, studies indicate a reduction in wheezing illnesses in infants when mothers were able to stop smoking early in pregnancy compared with outcomes in infants of those who continued to smoke.¹⁹

Abstinence should be achieved as early as possible in pregnancy, but whether there is a critical window of opportunity is unknown. If the mother stops smoking early in pregnancy, the risk of SGA births decreases to nonsmoking levels.²⁰ Although many women reduce tobacco consumption during pregnancy, there is no safe level of smoking. In a French study, it was shown that even one to five cigarettes per day can reduce birth weight by 228 g.²¹

Prevalence of and Factors Predisposing to Tobacco Use Among Indigenous Communities, Including in Pregnancy

The prevalence of smoking in Indigenous populations in Australia, New Zealand, the United States, and Canada (32%-60%) is much higher than in the nonindigenous populations in these countries (18%-23%).²² Similarly, more Indigenous pregnant women in these high-income countries smoke than do their nonindigenous counterparts.²³ More than three times the number of pregnant Indigenous women in Australia smoke compared with their nonindigenous counterparts (47% vs 13%).²⁴ Similarly high figures exist in Native Americans and Alaska Natives (26%), Canadian First Nations populations (18%-90%), and New Zealand Maori (34%) women during pregnancy.²³ Alaska Native women also report a high prevalence of prenatal smokeless tobacco use, with 56% to 60% use observed for women in rural southwest Alaska. Little is known about the prevalence of the use of electronic nicotine devices (ENDs) by Indigenous women.²³

Maternal smoking rates are much higher in lower socioeconomic groups (characterized by low income, low levels of educational attainment, and high unemployment rates).²⁵ Lower socioeconomic status for women is also associated with more psychological and emotional problems, less social support, and less residential stability.^{26,27} These stressors are compounded in pregnancy and take precedence over smoking cessation. The combination of stressful life circumstances with lower access to health care means socioeconomically disadvantaged people, including Indigenous women, face more barriers to the cessation of smoking.²⁸ Widespread use of tobacco products among Indigenous people makes it difficult for pregnant women to avoid other smokers and gain support from family and partners when attempting to stop smoking, which are factors known to impinge on successful cessation.²⁵

The normalization of smoking in many Indigenous communities is reinforced by the communal nature of smoking, in which exchanging and sharing tobacco can be a way of maintaining social cohesion.²⁹ In this cultural context, extended families can influence the initiation and maintenance of smoking, including among children.³⁰ Furthermore, children exposed to tobacco smoke in utero are more likely to become smokers themselves.²³ Specific other factors in Indigenous pregnant women include social norms

within the Indigenous communities, few nonsmoking role models, late presentation to antenatal care, insufficient knowledge of smoking harms, inadequate salience of antismoking messages, lack of awareness of therapy options, and poor access to services and pharmacotherapy.^{23,31}

Key influences on smoking among Indigenous youth are normative beliefs, boredom, peer pressure, stressors, and family. Mothers are particularly influential for young women.³²⁻³⁶ Adolescent Indigenous girls may be more influenced by social networks and peer pressure than are boys.^{32,37} Women who have smoked during pregnancy have reported that coming of age as a smoker, being able to purchase one's own supplies legally, and exposure to alcohol accelerated tobacco dependence.³⁶ Concurrent alcohol use and smoking initiation as well as earlier uptake of smoking are independent predictors of reduced intentions to stop smoking in Australian Indigenous men and women of reproductive age.³⁸ High tar and nicotine brands were marketed to Indigenous populations using Aboriginal images as recently as 1998.²⁹ In the United States in 2011, the uptake in youth smoking in diverse ethnic groups (including Indigenous people) was associated with tobacco product advertising.³⁹ Contemporary media, such as films, music videos, and internet advertising, promotes the uptake of tobacco smoking in young people.⁴⁰

The higher prevalence of smoking in Indigenous vs nonindigenous populations of Australia and New Zealand persists even after controlling for socioeconomic factors such as employment status, education, and income.²⁵ This suggests that factors beyond socioeconomic disadvantage are contributing to differences in smoking behavior. The main factor that the Indigenous peoples of Australia, New Zealand, the United States, and Canada have in common is the history of colonization and dispossession.²⁵ Colonization caused severance of ties to the land and weakening of cultural practices, including traditional languages, and loss of social cohesion. Many Indigenous peoples have a self-concept that is linked to the community and the land, so colonization caused devastating collective trauma and assault to Indigenous identities.⁴¹ Some Indigenous populations, such as Native Americans and Canadian First Nations, traditionally used tobacco for spiritual purposes, whereas others, such as the Alaska Natives and Maori, were traditionally smoke free.²³ However, recreational tobacco was introduced during colonization as a trade

currency and to subdue resistance, with a growing addiction purposefully manipulated.^{29,42} These historical, social, and cultural factors need to be taken into consideration when developing targeted approaches to smoking cessation for Indigenous pregnant women.

Disparities in Burden of Tobacco Dependence Among Indigenous Communities

Higher smoking prevalence results in a higher burden of illness, with tobacco accounting for 17% of the reversible health gap of Indigenous Australians.⁴³ SGA births and preterm births are disproportionately experienced by Indigenous peoples⁴⁴ and have not improved over the past decade.⁴⁵ Aboriginal status in itself is not linked to these adverse perinatal health effects, but tobacco use is.⁴⁴⁻⁴⁶

Indigenous Australian youth are reported to start smoking earlier than the general population.³² The earlier onset of smoking in Indigenous youth leads to higher tobacco dependence and increased risk of chronic diseases.⁴⁷⁻⁴⁹ However in adults, there is little difference in nicotine dependence scores between Indigenous and nonindigenous Australians, although no data are available for pregnant women.⁵⁰

More dependent Indigenous Australian smokers were found to be less likely to intend to stop smoking³⁸ and less likely to make a sustained cessation attempt.⁵⁰ This is also observed in Indigenous pregnant women.⁵¹

Prevention of Tobacco Dependence Among Indigenous Populations

The social determinants of being an Indigenous nonsmoker include higher household income, not having been arrested, and not having been removed from one's natural family (ie, not part of the "stolen generation").⁵² Protective influences for abstinence in Indigenous smokers can be positive role models of family members and elders.³⁶

It is uncertain whether strategies to reduce smoking initiation among Indigenous youth would translate into reduced tobacco smoking among Indigenous women during pregnancy. There is some evidence from a Cochrane review⁵³ to support the effectiveness of school and community interventions in reducing the uptake of smoking in young people in the general population. However, many of the 25 studies included contained methodological flaws.⁵³ Overall, 10 interventions,

including prevention, demonstrated effectiveness in influencing smoking behavior at primary follow-up. One program provided statistically and clinically significant short-term benefits (net change of 5.3% in smoking prevalence), and nine provided longer-lasting effectiveness. Only 16 studies were suitable for meta-analysis. For daily smokers and "ever smokers," the point estimates were consistent with a clinical benefit; however, the number of studies was small and the CIs were wide and included two studies of daily smokers (OR, 0.89; 95% CI, 0.69-1.15), and three studies of ever smokers (OR, 0.82; 95% CI 0.39-1.74).

Conversely, a Cochrane review on smoking prevention in Indigenous youth from Native American populations included only two studies and was unable to demonstrate efficacy.⁵⁴ The studies included used multicomponent community-based interventions tailored to the specific cultural aspects of the Native American population (total of 1,505 subjects). In the first study, a classroom-based group smoking prevention strategy was tried (with or without an annual community event) on reservations and in tribal schools.⁵⁵ No difference was observed in weekly smoking at the 42-month follow-up (skills: in the community group vs a control group: risk ratio [RR], 0.95; 95% CI, 0.78-1.14; skills-only group vs control group: RR, 0.86; 95% CI, 0.71-1.05). For smokeless tobacco use, a significant difference was observed between the skills-only arm and the control group (RR, 0.57; 95% CI, 0.39-0.85). The second was a skills enhancement model in three intervention and four control sites in reservation and nonreservation settings.⁵⁶ The study found positive changes for tobacco use in the intervention arm after the test ($P < .05$), which were not maintained at the 6-month follow-up. Both studies had high or unclear risk of bias in at least seven of 10 domains.

The authors concluded that more research is urgently needed in this area but should be preceded by pilot work, including focus groups, prior to intervention delivery to identify the potential components of programs that are most likely to be effective. Encouragingly, in Australia in 2014, 64% ($n = 30$) of surveyed organizations were targeting antitobacco programs to Indigenous youth as a high-priority population.⁵⁷ However, few rigorous evaluations are being undertaken; thus, current understanding of prevention of smoking uptake in Indigenous populations is very limited.

Treatment of Tobacco Dependence in Pregnancy

Guidelines for smoking cessation in pregnancy recommend behavioral counseling subsequently followed by NRT if women are otherwise unable to stop smoking.⁵⁸ The potential risk of the use of pharmacotherapy for smoking cessation during pregnancy needs to be balanced against the known and well-documented risks of continued tobacco use.

Behavioral Approaches

Meta-analyses in the general population reveal effective psychosocial interventions in pregnancy, including counseling, self-help, and contingent financial incentives.^{59,60} In a 2015 Cochrane review on incentives for smoking cessation, eight of nine trials with usable data in pregnant smokers delivered an OR of 3.6 for stopping at longest follow-up (up to 24 weeks postpartum) (95% CI, 2.4-5.4; 1,295 participants, moderate-quality studies) in favor of contingent financial incentives.⁶¹

Pharmacologic Approaches

In the general population, NRT has short-term efficacy in pregnancy compared with placebo (21% vs 12%); adherence issues can affect longer use.⁶² Use of NRT (compared with placebo and nonplacebo control treatments) in pregnancy increased smoking cessation rates by 40% (eight trials; 2,199 women; OR, 1.4; 95% CI, 1.0-1.9).⁶³ Combination NRT (transdermal patch plus an oral medication) doubled the cessation rate (OR, 1.93) compared with monotherapy in a large nonrandomized clinical study of > 3,500 pregnant smokers.⁵⁹ A 2015 Cochrane review emphasized that higher NRT doses should be tried in pregnant women.⁶³ Dosage needs to take into account the higher metabolism of nicotine in pregnant women.⁶⁴ Thus far, women who have used NRT did not have significantly different pregnancies and their babies did not have different neonatal outcomes compared with those who took placebo.⁶³ Babies whose expectant mothers used NRT had lower smoking-related complications⁶⁵ and better developmental outcomes than did babies whose mothers do not receive NRT.⁶⁶ It is recommended that first-line pharmacotherapy in pregnancy be oral intermittent forms of NRT (such as lozenges, inhalers, or spray) and then transdermal patches or a combination of the two forms of NRT.⁶⁷ Other pharmacologic smoking cessation agents such as bupropion, varenicline, and cytisine have not yet been approved for use in pregnancy in many countries due to

insufficient data on efficacy and safety in pregnancy.⁶⁷ However, the Quebec Pregnancy Cohort study involved 1,288 women who smoked tobacco before pregnancy and found that bupropion and NRT reduced the risk for prematurity, whereas only NRT was also associated with a reduced risk of SGA births.⁶⁸

Approaches for Indigenous Women in the High-Income Countries of the United States, Canada, Australia, and New Zealand

There have been only two randomized controlled trials among Indigenous pregnant smokers: in Australia for Indigenous Australians and in Alaska for Alaska Native women, both using counseling and limited access to NRT.^{69,70} The former study showed a small nonsignificant difference in smoking cessation rates between intervention (11%; intensive counseling) and control groups (5%; brief intervention). Both randomized controlled trials experienced implementation challenges with participation, privacy concerns, provider buy in, and study arm contamination.^{69,70} Table 1⁷¹⁻⁷⁹ catalogues past and current research into tobacco control and smoking cessation interventions for pregnant Indigenous women in high-income countries; only the United States, Australia, and New Zealand are included, as we are not aware of any such publications in Canada. In view of the paucity of publications on this topic, we consider this a useful summary of current research. The table presents the study, population, design, type of intervention, progress to date and, when available, trial registration, and either the published or planned outcomes.

Evidence pertaining to tobacco cessation in Indigenous peoples during pregnancy needs to be gathered for smokeless tobacco products such as chewing tobacco and native pituri (cured leaves of the shrub *Duboisia hopwoodii* of the Solanaceae family⁸⁰), reported to be used in Central Australia and the Northern Territory and observed in a few women during pregnancy.^{81,82} Alaska Native women in the United States chew iqmik, a mixture of tobacco leaves and fungus ash, during pregnancy particularly in some rural regions of Alaska.^{83,84} Approaches in the latter context include a social marketing campaign targeting the entire community in western Alaska (Yukon-Kuskokwim Delta region).⁸⁵ Another current project in Anchorage, Alaska uses urine cotinine testing to provide feedback to women about their infant's likely exposure to a tobacco-specific nitrosamine and carcinogen, NNAL (4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol) as a

TABLE 1] Completed and Ongoing Strategies Targeting Indigenous Pregnant Smokers in High-Income Countries

Study/Year	Population	Design	Intervention	Progress/Trial registration	Outcomes Planned/Published
Patten et al ⁷⁰ /2010	Alaska Native	RCT	Social modeling with story telling and community role models Counseling by an Alaska Native counselor Culturally specific self-help materials	Completed	High acceptability of intervention Retention: 83% of participants Biochemically verified smoking abstinence (0% for the intervention arm, 6% in control group)
Eades et al ⁶⁹ /2012	Indigenous Australians	RCT	Intensive counseling vs standard care	Completed	Self-reported smoking status (validated with urine cotinine measurement) between 36-wk gestation and delivery No significant difference between smoking rates in the intervention group (89%) and the usual care group (95%) (smoking in the intervention group relative to usual care group: RR, 0.93; 95% CI, 0.86-1.08; $P = .212$).
Glover et al ⁷¹ /2016	Māori	Pre- and postintervention	Training “aunties” (community health workers) in giving smoking cessation support and cards that participants could use to access subsidized NRT	Completed	33% stopped smoking while they were pregnant and 57% reduced smoking
Koller et al ⁷² /2017	Alaska Native	Cohort	Biomarker feedback intervention relating cotinine levels in the urine of pregnant women with the woman and infant’s likely exposure to the tobacco-specific carcinogen	Ongoing; NCT01605643	Tobacco exposure measured using cotinine levels during pregnancy and at delivery

(Continued)

TABLE 1] (Continued)

Study/Year	Population	Design	Intervention	Progress/Trial registration	Outcomes Planned/Published
Orima Research ⁷³ /2013	Indigenous Australians	Pre- and postintervention	Television, print, and radio advertisements Mobile phone application	Ongoing	Prompted recall of campaign advertisements in 61% 40% considered quitting as a result of the campaign
Passey et al ⁷⁴ /2013	Indigenous Australians	Pre- and postintervention	Intensive smoking cessation support for women and household members Free NRT Contingent financial incentives Group peer support	Ongoing; ACTRN12615001278527	Feasibility Acceptability 8 of 22 (42%) pregnant Aboriginal women who completed pilot program abstinent until late pregnancy (validated with expired carbon monoxide levels)
NSW Government Health ⁷⁵ /2017	Indigenous Australians	Pre- and postintervention	Smoking cessation support to women and household members Free NRT Practice change strategies to make smoking cessation part of routine care	Ongoing	Pregnancy smoking rates Maternal and child health indicators No. of quit attempts Rates of passive smoking No. of health service staff who provide smoking cessation care Awareness, knowledge, and confidence of staff in providing smoking cessation care
Gould et al ⁷⁶ /2016	Indigenous Australians	Pilot pre- and postintervention Cluster RCT in planning stage	Training health providers in Aboriginal medical services	Ongoing; ACTRN 12616001603404	Feasibility Acceptability Usability Sustainability Change in providers' knowledge, attitudes, and practices Provision of NRT to patients Trends in patient smoking behaviors Smoking cessation rates in patients

(Continued)

TABLE 1] (Continued)

Study/Year	Population	Design	Intervention	Progress/Trial registration	Outcomes Planned/Published
Ministry of Health ⁷⁷ /2003	Māori	Pre- and postintervention	Provision of free NRT Counseling support delivered by Māori “quitting” coaches	Ongoing	Acceptability Accessibility Cultural appropriateness Quit rates Cost-effectiveness
Glover et al ⁷⁹ /2015	Māori	RCT	Contingent financial incentives Contingent product incentives	Ongoing; ACTRN 12614000520639	Biochemically validated 7-d point prevalence Self-reported continuous abstinence Use of cessation products and services
Glover et al ⁷⁸ /2016	Māori	Pre- and post intervention	Improve access to specialist smoking cessation support through Māori midwives Contingent financial incentives	Ongoing	Improved understanding of barriers to access to specialist smoking cessation Improved understanding of barriers to referral by Māori midwives

ACTRN = Australia New Zealand Clinical Trials registration number; NCT = national clinical trial; NRT = nicotine replacement therapy; RCT = randomized control trial.

motivator to stop tobacco use in pregnancy.⁸⁶ No interventions address concurrent use of cannabis and tobacco among Indigenous pregnant women as far as we are aware.

Translation of evidence-based approaches is thus urgently needed to redress the inequity related to Indigenous maternal smoking and other tobacco use.⁸⁷ However, barriers to access to services and pharmacologic medications are a barrier in several countries, which may discriminate against and disadvantage more vulnerable women, for example, NRT not being approved for use in pregnancy in the United States and oral forms of NRT not being subsidized in Australia.⁸⁸

Treating Tobacco Dependence Prior to, During, and After Pregnancy

Opportunities to engage with Indigenous pregnant women who smoke include prior to conception, on confirmation of pregnancy, during antenatal care, and postpartum. Australian Aboriginal women who have told their stories about the trajectory of smoking from initiation through successive pregnancies illustrated many salient moments when smoking could be addressed.³⁶ Pregnancy is a teachable moment, and on becoming pregnant, Aboriginal women report a shift in role and risk perception about smoking and an urge to protect their babies.³¹ However, women also report inconsistent approaches and advice offered to them by health professionals, sometimes being told to reduce rather than stop smoking and seldom being offered pharmacologic treatment.⁸⁹ This is confirmed by Australian physicians reporting that they infrequently prescribe NRT to a pregnant smoker.⁹⁰ However, in one study, 56% (N = 99) of Indigenous Australian women considered free NRT to be a helpful approach.⁹¹

An international review showed that > 50% of health-care providers advised pregnant smokers to stop smoking, yet less than 50% offered smoking cessation therapy.⁹² A national survey of 378 Australian general practitioners and obstetricians working in a mainstream or Indigenous setting, or both, found that respondents lacked skills, confidence, and optimism in prescribing NRT for pregnant women. Although 95% believed that NRT is safer than smoking in pregnancy, only 11% always prescribed NRT.⁹⁰ Health-care providers working in antenatal settings with Indigenous Australian women reported a similar pattern of low confidence and optimism,⁹³ and less than 5% prescribed NRT.⁹⁴

Indigenous women are also exposed to tobacco smoking combined with cannabis during pregnancy.⁹⁵ Physicians in Australia less frequently ask pregnant women about cannabis smoking with tobacco and rarely about their use of ENDS (Gould, unpublished data 2017).

Other systemic barriers to smoking cessation care in pregnancy include lack of effective and culturally competent smoking cessation programs,²³ no government subsidy for oral forms of NRT that are recommended in pregnancy (in Australia),⁸⁸ and late presentation for antenatal care, which is more common in Indigenous women.⁹⁶ Thus, missed opportunities abound.

Cessation Before Conception

Preconception lifestyle programs often focus on multiple risk factors, which may include smoking, yet their effectiveness is unclear.⁹⁷ Preconception smoking cessation counseling is recommended in primary care.⁹⁸ Preconception care has been called for as part of a holistic approach for Aboriginal women.⁹⁹ Sacred Beginnings was a pilot study that examined the effectiveness of a culturally appropriate preconception health educational intervention developed by Native American tribal community members and Elders. Although overall knowledge significantly improved, changes in knowledge about smoking were not significant.¹⁰⁰ Another program was effective for preconception smoking cessation counseling.¹⁰¹

Approximately 45% of women in the general population stop smoking on finding out they are pregnant.⁹⁶ An equivalent figure is unknown for Indigenous women. Women who stop smoking spontaneously are more likely to have higher socioeconomic status, a nonsmoking partner, a lower level of nicotine dependence, low parity, and less concern about weight gain.⁹⁶

Risk for Relapse of Tobacco Use After Pregnancy

Relapse postpartum is common in the general population as well as in Indigenous smokers. Seventy percent of pregnant smokers who stopped during pregnancy relapse within 12 months after delivery.⁹⁶ A systematic review of qualitative studies about relapse in the general population revealed that extrinsic motivation to stop smoking during pregnancy for the health of the fetus appeared to prompt relapse after the baby was born.¹⁰² The stress of caring for a newborn, sleepless nights, and adjusting to a new identity as a mother were also important. Conversely, partner support and a sense

of changed identity were factors that appeared to prevent relapse.¹⁰² Indigenous Australian women report stressful life circumstances and depression as reasons to resume smoking postpartum.³⁶

Self-help booklets have been found to prevent relapse in the general pregnant population.¹⁰³ There is very little known about what strategies would help Indigenous pregnant women stay abstinent after birth, as thus far so few are stopping smoking during pregnancy, and relapse has not been examined during trials to date.⁸⁷

Opportunity for Treatment of Tobacco Dependence After Pregnancy or Between Pregnancies

In the general population in the United Kingdom, smoking cessation care is offered more inconsistently as the pregnancy progresses. Yet women reported maintaining their interest in being offered assistance throughout the whole term of pregnancy.¹⁰⁴ Aboriginal women expect smoking cessation to be raised by health professionals during pregnancy¹⁰⁵ and report trying hard to become abstinent throughout successive pregnancies, commonly relapsing after the birth and trying harder in the next pregnancy.³⁶ It is unknown whether Indigenous women would accept interpregnancy approaches, and their views would need to be sought for how to deliver advice and assistance of this sort. This approach could have merit, as pregnancies in this population are often unplanned, and women may present late for antenatal care and have fewer antenatal visits.⁹⁶

Unique Factors for Cessation Strategies Pertaining to Indigenous Communities

Indigenous concepts of healing and illness can be very different from that of nonindigenous communities. Healing often involves consultation and public processes that can include offerings and gatherings as well as shared preparing and undertaking.⁴¹ Therefore, designing smoking cessation programs requires extensive consultation with the relevant Indigenous community to ensure acceptability and feasibility.^{22,106} The history of colonization means that Indigenous people are sensitive to paternalistic approaches in which solutions are imposed on them rather than developed in partnership.⁴¹ Community-driven approaches are called for and can complement improved service delivery.²³ In New Zealand, a pilot program involving Elder female mentors—"aunties"—improved smoking cessation rates in pregnant Maori smokers at term.⁷¹

There is limited understanding of comorbidities, such as anxiety, depression, other drug use, and gestational diabetes, in Indigenous pregnant women who smoke and how these may impact on smoking cessation and proposed programs.

Evidence-Based Policy Imperatives (Stopping Promotion of Tobacco to Youth and Improving Availability/Acceptance of Tobacco Dependence Treatment)

There is merit in taking a whole life course approach with multiple intervention points to combat smoking in Indigenous women, who at some stage will be likely to experience pregnancy.³⁶ More needs to be understood about the acceptability of evidence-based approaches such as counseling and adherence to pharmacotherapy.^{60,89} Prohibiting the promotion of tobacco use through contemporary media is important to prevent uptake of smoking by young people,⁴⁰ as is reducing access to early alcohol use. Improving access to smoking and tobacco use cessation services and essential treatments is vitally important. This may involve training health providers in culturally competent smoking cessation care. Any program of research will need to be well funded and well resourced.

Research Needs Based on Identified and Important Gaps in Knowledge

More research is required in two main areas to inform future policy and practice for high-priority populations:

1. There is variability in the level of knowledge about Indigenous smoking in pregnancy across different high-income countries. For example, a recent review about smoking in four high-income countries found that much work has been done in Australia and New Zealand on attitudes of pregnant women about smoking and potential treatments, but little work has been carried out on depression, whereas in the United States and Canada, less is known about pregnant women's attitudes, but a couple of studies have focused on depression.²³ Little is known about Indigenous attitudes about evidence-based strategies researched in the general population, such as the use of contingent financial incentives, NRT, and different formats for counseling. There has yet to be a well-designed randomized trial to establish the efficacy of targeted strategies, compared with usual care, for pregnant Indigenous women. Thus, addressing systemic barriers that particularly impact Indigenous women is a high priority.

2. Comparison of pregnancy and infant outcomes, including lung function and respiratory illness, is required in mothers who reduced or stopped cigarette smoking during pregnancy and who used NRT or other nicotine sources during pregnancy.

Effects of therapeutic and “clean” sources of nicotine, such as that contained in NRT, on infant development and perinatal outcomes need to be compared with continued tobacco use through smoking; Indigenous women stand to maximally gain from this knowledge. No studies have investigated the degree of reversibility of respiratory consequences in infants whose mothers smoke cigarettes then cease smoking during pregnancy using NRT. The effect of reduction of tobacco consumption and the timing of smoking cessation during pregnancy are likely to be clinically important.

The use of ENDS during pregnancy is of great concern in the absence of safety and efficacy data. Medically administered NRT has the advantage of known pharmacodynamics and dosage, whereas exposure to nicotine through ENDS is uncertain. Preliminary studies indicate that ENDS may have similar nicotine absorption rates as NRT inhalers.¹⁰⁷ Using ENDS avoids exposure to carbon monoxide, which has a dose-response effect on birthweight.¹⁰⁸ However, a mouse model of pregnancy found exposure to e-cigarette aerosols was associated with damaging neurobiological and neurobehavioral changes in offspring.¹⁰⁹

Conclusions

Indigenous women and infants have a higher burden of disease associated with maternal tobacco use during pregnancy. The consequences of in utero tobacco exposure include increased risks of term low birth weight, prematurity, perinatal death, placenta previa, abruptio placentae, and chronic lung disease. Indigenous women are more likely to smoke during pregnancy. Influences include socioeconomic disadvantage, the normality of smoking in many Indigenous communities, and poor access to appropriate support to stop smoking. Poor access is related to systemic barriers, which include a lack of effective and culturally appropriate smoking cessation programs, no government subsidy for oral forms of NRT in Australia, no approval for use of NRT during pregnancy in the United States, and low confidence among health-care professionals in treating smoking in pregnancy. Treatment that is effective in nonindigenous women for smoking in pregnancy involves behavioral counseling with or without NRT. Therapeutic challenges with NRT are underdosing in the

context of higher nicotine metabolism during pregnancy and poor adherence. There is a paucity of evidence about which treatments are effective in aiding Indigenous women to stop smoking during pregnancy. Only two randomized controlled trials included smoking cessation therapy for Indigenous pregnant women: one in Indigenous Australians and a pilot study in Alaskan Natives. The Australian study compared counseling and NRT to standard care and found no statistically significant difference in smoking rates. The Alaskan study compared intensive culturally tailored counseling to brief counseling and found no benefit from the intervention. Major limitations in these studies were high loss to follow-up, low participation, and study arm contamination. This emphasizes the need to ensure acceptability and feasibility of study designs through consultation with the relevant Indigenous communities. A whole life course approach should be considered to reduce smoking among Indigenous women, who at some stage will likely become pregnant. Prohibiting the promotion of tobacco use to youth and reducing access to alcohol for minors are important to prevent smoking initiation in Indigenous youth. Improving access to smoking cessation services for Indigenous pregnant smokers may involve training health-care professionals in culturally appropriate smoking cessation care. Research is needed into the effect of reducing or stopping smoking during pregnancy with NRT on pregnancy and infant outcomes. The potential use of ENDS during pregnancy is of concern in the absence of safety and efficacy data.

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