

Smoking cessation in pregnancy: psychosocial interventions and patient-focused perspectives

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Background: Smoking during pregnancy causes obstetric and fetal complications, and smoking cessation may have great benefits for the mother and the child. However, some pregnant women continue smoking even in pregnancy.

Objective: To review the literature addressing the prevalence of smoking during pregnancy, explore psychosocial factors associated with smoking, and review the evidence of psychosocial interventions for smoking cessation during pregnancy in recent years.

Literature review: Computerized Internet search results in PubMed for the years spanning from 2004 to 2014, as well as references cited in articles, were reviewed. A search for the keywords “smoking cessation pregnancy” and “intervention” and “clinical trials” yielded 52 citations. Thirty-five citations were identified as useful to this review for the evidence of psychosocial interventions for smoking cessation during pregnancy.

Results: The prevalence of smoking during pregnancy differs by country, reflecting the countries' social, cultural, and ethnic backgrounds. Women who had socioeconomic disadvantages, problems in their interpersonal relationships, higher stress, depression, less social support, and who engaged in health-risk behaviors were more prone to smoking during pregnancy. Psychosocial interventions, such as counseling, are effective methods for increasing smoking cessation.

Conclusion: Smokers may have various psychosocial problems in addition to health problems. It is important to understand each individual's social situation or psychosocial characteristics, and a psychosocial intervention focused on the characteristics of the individual is required.

Keywords: women's health, smoking cessation, pregnancy, psychosocial intervention

Introduction

Smoking is a primary risk factor associated with preventable death and diseases, including reproductive problems.¹ Maternal cigarette smoking is associated with increased risks for ectopic pregnancy, premature rupture of membranes, placental abruption, placenta previa, miscarriage, stillbirth, preterm birth, low birth weight, small size for gestational age, and congenital anomalies.²

Many studies suggest that there are benefits to smoking cessation during pregnancy,¹⁻⁵ and smoking cessation during pregnancy is very important. The process of pregnancy itself may have an impact on a woman's smoking habit.⁶⁻⁸ Approximately one-third of female ex-smokers identified “reproductive events” as their motivating factor for quitting smoking.⁹ Pregnancy provides a window of opportunity for cessation^{2,3} and may be a meaningful time to encourage smoking cessation. Smoking cessation reduces the risk of complications during delivery and of health problems for the baby, and furthermore, benefits a woman's long-term health.

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However, some proportion of women continue smoking even during pregnancy. Kaneko et al reported that although pregnant women were aware of the ill effects of smoking on the health of their unborn babies and their children, many mothers were unable to stop smoking or maintain smoking cessation.¹⁰ Smoking among pregnant women is a health problem not only because of its inherent medical risks but also because it is associated with various psychosocial problems. Many tobacco-control programs for pregnant women have included multiple approaches, such as health education, counseling, cognitive or behavioral therapy, and pharmacologic intervention.

This overview addresses the prevalence of smoking and smoking cessation during pregnancy, psychosocial factors associated with smoking, and recent psychosocial interventions for smoking cessation during pregnancy.

Literature review

Articles from a computerized search in PubMed that was carried out for the years spanning from 2004 to 2014, as well as references cited in articles, were reviewed. A search on psychosocial interventions, for the keywords “smoking cessation pregnancy” and “psychosocial intervention”, yielded 18 citations. A more general search for the keywords “smoking cessation pregnancy” and “intervention” and “clinical trials” yielded 52 citations. Surgical and pharmacological interventions were not included, and only English-language reports were included. Among the 52 clinical trials, eleven of them focused on smoking or relapse in postpartum or breastfeeding duration, two of them focused on pregnant women under special circumstances (drug-dependent women, pregnant adolescents), and four of them focused on women’s families. The remaining 35 manuscripts were reviewed.

This paper focuses on smoking during pregnancy and the psychosocial factors of smoking mothers, as well as on psychosocial interventions for smoking cessation.

Smoking prevalence during pregnancy

From the 2013 World Health Organization (WHO) report, 22% of the world’s adult population aged 15 years and over are estimated to be current tobacco smokers, including 36% of men and 8% of women.² The prevalence of tobacco use differs by WHO region and by country.²

Some women quit smoking when they became pregnant; however, some women continued smoking even after they became pregnant. Numerous epidemiological studies

have reported the prevalence of smoking among pregnant women.^{4,9,11–25} Recent data reported by various countries are shown in Table 1.^{4,9,12–24}

In high-income countries, the prevalence of smoking during pregnancy is approximately 10%–20%. In the US, for example, the prevalence of smoking during pregnancy has been reported at 15.2%–17.6%.^{4,15} The prevalence may differ further by state, for example, 8.9% in Colorado and 21.5% in Tennessee.⁴

In the UK, the prevalence of smoking during pregnancy in the UK Millennium Cohort Study was approximately 20%, including light smokers (fewer than ten cigarettes per day), and approximately 8% when only heavy smokers (more than ten cigarettes per day) were counted.²⁰ Another British report indicated that 13.6% of English mothers reported that they were still smoking at delivery time.²⁵

In other high-income countries, the prevalence of smoking during pregnancy is reported to be at 13.5% in Australia,¹⁶ 10.5% in Canada,¹⁸ 13% in Germany,²⁴ 8.9% in Norway,¹⁴ and 5.8%–7.8% in Japan.^{9,17} In Japan, the prevalence of smoking during pregnancy is comparatively low compared with other high-income countries. The prevalence of smoking among the female population is also low in East Asian countries (eg, 9.7% in Japan, 6.8% in Korea, 2.4% in People’s Republic of China).²⁶

Caleyachetty et al estimated the current tobacco use in pregnant women in low-income and middle-income countries, and the pooled prevalence of current tobacco smoking in pregnant women ranged from 0.6% in the African region to 3.5% in the Western Pacific region.²⁷ In these countries, the prevalence of smoking during pregnancy is generally lower than in high-income countries.

Smoking prevalence during pregnancy is relatively low in Southeast Asian countries, except in Singapore: 1.3% in Philippines, 0.9% in Thailand, and 11.5% in Singapore.²³ However, in these countries, a high proportion of pregnant women are exposed to passive smoking: 69.8% in Philippines, 58.6% in Thailand, and 42.0% in Singapore.²³ In Latin American countries, the prevalence of smoking during pregnancy is 0.8% in Ecuador and Guatemala. In other Latin American countries, the prevalence is 6.1% (Brazil), 10.3% (Argentina), and 18.3% (Uruguay).²² Tobacco use during pregnancy is culturally acceptable in these countries.²⁸

The prevalence of smoking during pregnancy reflects the prevalence of smoking among women in each country. The prevalence of smoking during pregnancy differs by

Table 1 Prevalence of smoking during pregnancy

Authors	Publication year	Country	Prevalence of smoking during pregnancy	Sample size	Survey year
Murphy et al ¹²	2013	Ireland	12.1%	907	2010–2011
Miyazaki et al ⁹	2013	Japan (female nurses)	7.8%	49,927	2001–2007
Tong et al ⁴	2013	US	15.2%	10,485	2003
Krstev et al ¹³	2012	Serbia	37.2%	2,668	2008
Ystrom et al ¹⁴	2012	Norway	8.9%	835	2008
Maxson et al ¹⁵	2012	US	17.6%	1,518	2004–2008
Li et al ¹⁶	2012	Australia	13.5%	294,814	2010
Hayashi et al ¹⁷	2011	Japan	5.8%	180,855	2001–2005
Al-Sahab et al ¹⁸	2010	Canada	10.5%	6,421	2005–2006
Kabir et al ¹⁹	2009	Ireland	20.6%	7,648	2005
		Ireland	23.4%	7,593	2003
Pickett et al ²⁰	2009	UK	23.0%	18,225	2000–2001
Bachir and Chaaya ²¹	2008	Lebanon	25.7%	538	1997–1998
Bloch et al ²²	2008	Argentina	10.3%	796	2004–2005
		Uruguay	18.3%	716	
		Brazil	6.1%	749	
		Ecuador	0.8%	746	
		Guatemala	0.8%	752	
		Philippines	1.3%	316	–
Ostrea et al ²³	2008	Thailand	0.9%	106	–
		Singapore	11.5%	61	–
		Germany	13.0%	647,392	2005

country and the associated social, cultural, historical, and ethnic backgrounds.

Smoking cessation in pregnancy

Approximately one-third to half of women who smoked cigarettes before pregnancy quit smoking during pregnancy.^{4,14,20,29} Many pregnant women try to quit smoking because of awareness of the negative health effects, and some cessation intervention programs may affect their behavioral change. Quitting smoking at any point during pregnancy has shown benefits; even quitting smoking in the second or third trimester can improve fetal growth.³⁰

In the US, based on 2008 data from the Pregnancy Risk Assessment Monitoring System (PRAMS) in eight states, and 2003 data from the revised birth certificate program (BC), 24.4% of women in PRAMS and 17.3% of women in BC smoked cigarettes prepregnancy.⁴ Among women who smoked prepregnancy, 42.6% in PRAMS and 35.1% in BC quit smoking at some point during their pregnancy.⁴ Smoking fewer cigarettes per day (less than or equal to five cigarettes per day) prepregnancy, having a higher education, not participating in the Special Supplement Nutrition Program for Women, Infants, and Children, and having an

infant who weighed >2.5 kg were associated with smoking cessation.⁴

In the UK Millennium Cohort Study, 54% of mothers had never smoked, 12% were ex-smokers, and 34% were smokers just before the pregnancy.⁵ Of the smokers, 81% quit or decreased the amount they smoked during the course of the pregnancy. However, 6.8% of the smokers did not change their smoking habits during pregnancy. The odds of low birth weight (<2.5 kg) for babies born to mothers who changed their smoking habits during pregnancy were reduced by 34%.⁵

Smoking during pregnancy and associated factors

Smoking during pregnancy may have negative effects on the growth and development of the fetus. This is an important health problem, not only because of a lack of awareness of the harmful effects of smoking on women but also because of the various negative factors that are associated with smoking behavior during pregnancy. A systematic review revealed that women with lower income, higher parity, no partner, low levels of social support, and who are more likely to access publically funded maternity care and feel criticized by society are more likely to continue to smoke in pregnancy.³¹

Sociodemographic factors are related to smoking during pregnancy. In the UK Millennium Cohort Study, smoking was much more prevalent among younger women, unmarried cohabiting women, women living in poverty, women with lower educational qualifications, and single mothers.²⁰ Krstev et al reported in a nationwide, population-representative survey in Serbia that smoking mothers were more likely to have less education, lower family socioeconomic status, and household members who smoked inside their home.¹³ Al-Sahab et al revealed that Canadian mothers who smoked during pregnancy were more likely to have a lower household income, to be living in rural and semi-urban areas, and to be single mothers.¹⁸ These findings are similar to other studies.^{14,15,21,32}

Social factors, for example, tobacco-control measures, are associated with smoking prevalence. In Ireland, there was a significant decline in maternal smoking prevalence after the Irish workplace smoking ban.¹⁹ The smoking prevalence was 23.4% in 2003 and 20.6% in 2005,¹⁹ and recently, 12.1% was reported in 2013.¹²

Planning one's pregnancy and attitudes toward child-bearing are related to smoking while pregnant. Flower et al reported that 43% of mothers studied did not plan their pregnancy, and those women who planned their pregnancy were less likely to smoke than those who did not plan the pregnancy.⁵ The proportion of women who did not change their smoking behavior during pregnancy was 4.5% in mothers who planned their pregnancy, whereas it was 10.7% in mothers who did not plan their pregnancy.⁵ Al-Sahab et al reported that failure to attend prenatal classes was associated with smoking during pregnancy.¹⁸ The delay of prenatal care entry, or having no prenatal care at all, was associated with smoking during pregnancy.^{21,29}

Maternal psychosocial characteristics are associated with smoking status. Pickett et al reported that pregnant smokers have a higher prevalence of problematic interpersonal relationships within their family of origin, with peers and neighbors, and in their intimate relationships, compared with quitters and nonsmokers.²⁰ Maxson et al reported that women not in a committed relationship were roughly twice as likely to smoke at some point during their pregnancy, compared with women in committed relationships.¹⁵ As for psychosocial factors, smokers reported greater neuroticism, depression, perceived stress, and negative paternal support, while also reporting less extraversion, agreeableness, conscientiousness, self-efficacy, social support, positive paternal support, and perceived social standing.¹⁵ Jesse et al reported that African American women with more

stress and fewer social support were significantly more likely to smoke.³² Individual psychosocial characteristics, or problematic interpersonal relationships, affected their smoking habits.

There was an association between women's smoking habits and other health-related behavior problems. Jesse et al reported that smoking prevalence during pregnancy was 38.5%, and the prevalence of substance use was 27.7%, among African American and white low-income women recruited from an urban prenatal clinic.³² Women who smoked were significantly more likely to report substance use.³² Smoking is significantly related to the regular and occasional use of illegal substances, and pregnant smokers are prone to have other health-related behavior problems, compared with women who had never smoked.²⁰ These findings may reflect some mental tendency toward addiction.

Women who have socioeconomic disadvantages, problems in their interpersonal relationships, higher stress, depression, less social support, and engage in health-risk behaviors were more prone to smoking during pregnancy. Women who smoke may experience difficulty accessing prenatal care. These findings emphasize the importance of social support and psychosocial interventions that address smoking cessation during pregnancy. Integrating social support may reduce health-risk behaviors, eliminate health disparities, and improve maternal and infant quality of life.³²

Paradoxes related to smoking behavior

Many studies performed in high-income countries reported that socioeconomic disadvantages increase maternal smoking.⁴ Although the US Hispanic population is likely to live in socioeconomically deprived areas and to have low socioeconomic status, they have rates of infant mortality and low birth weight that are comparable with those of non-Hispanic whites,¹¹ a phenomenon that is well known as the "Hispanic paradox". Potential explanations for this finding include the selective migration of healthy women, social support and access to kin networks, and the promotion of more health-conscious behaviors in Hispanic cultures.¹¹ However, the prevalence of smoking during pregnancy is very low among Hispanics in the US,^{4,11} which is reported to be 4.9% in Hispanics, 17.7% in non-Hispanic whites, and 15.1% in non-Hispanic blacks.⁴ The promotion of more health-conscious behaviors in the Hispanic culture might affect the smoking prevalence during pregnancy among Hispanic-American women. Shaw and Pickett reported that

living in counties composed of 5% or more Hispanic residents was associated with a lower likelihood of maternal smoking during pregnancy for all ethnic groups.¹¹

Smoking cessation aids

Various strategies have been developed to support smoking cessation in pregnancy, including psychosocial interventions, such as counseling and pharmacological therapies (ie, nicotine replacement therapies). Psychosocial intervention showed a moderate effect on smoking cessation.^{2,3} Smoking cessation counseling and support programs offered during prenatal care effectively encouraged pregnant women to quit smoking.³

Those who should not routinely use medication for smoking cessation are pregnant women, adolescents, smokeless tobacco users, and light smokers.³ Psychosocial intervention is the first line of treatment for pregnant women.³

Psychosocial intervention approach

Psychosocial interventions are defined as non-pharmacological strategies that use cognitive behavioral, motivational, and supportive therapies to help women to quit. These strategies may include counseling, health education, feedback, financial incentives, and social support from peers and/or partners, as well as dissemination trials.³¹ The US Public Health Service Clinical Practice Guidelines recommend that whenever possible, pregnant smokers should be offered person-to-person psychosocial interventions that exceed minimal advice to quit.³ A meta-analysis of eight studies showed that psychosocial interventions are significantly more effective than usual care in getting pregnant women to quit while they are pregnant.³

The WHO recommends that health care providers should routinely offer advice and psychosocial interventions for tobacco cessation to all pregnant women who are either current tobacco users or recent tobacco quitters.² The WHO offers a strong recommendation for using psychosocial interventions on tobacco-use cessation in pregnancy. The quality of evidence is considered to be “moderate” because it is difficult to generalize the effectiveness of these treatments to the global population, as the evidence is limited and derived from select small populations.²

The “5 A’s” intervention model is an evidence-based model successfully used by busy clinicians to address patient smoking.³ The 5 A’s include Ask, Advise, Assess, Assist, and Arrange, and are described below.³

- Ask about tobacco use in any form, the amount of use, and document this in the patient record.

- Advise patients who smoke to quit in a clear, strong, and personalized manner.
- Assess the patient’s willingness to make a quit attempt.
- Assist in the quit attempt for those who are willing.
- Arrange follow-up.

Review of psychosocial intervention research

A total of 35 published studies focusing on psychosocial interventions for smoking cessation in pregnant women were reviewed. Three studies of them were design and study protocols; one study of them focused on smoking relapse. The remaining 31 citations are summarized in Table 2.^{33–63}

Psychosocial intervention programs include health education, face-to-face counseling, telephone counseling, Internet websites, text messaging, and other self-help materials, and multicomponent intervention programs. The main outcome measures are feasibility, participation rate, self-reported smoking behavior, and cotinine levels, and breath CO concentration.

Counseling and interviewing method was the intervention most used in studies listed in Table 2. de Vries et al reported the effect of counseling intervention by midwives.⁶⁰ The 7-day abstinence 6 weeks after intervention was 19% in experimental group compared to 7% in control group.⁶⁰ Dornelas et al reported the effectiveness of intervention delivered by mental health counselors and planned telephone calls.⁵⁴ The abstinence at end of pregnancy was 28.3% in intervention group, and 9.6% in control group ($P=0.015$).⁵⁴ Counseling is an effective method for smoking cessation; however, not all these studies showed a statistically significant effect.

Women’s preparation stage and attempt to quit may affect the intervention effect.^{55,57} Aveyard et al showed that the point prevalence of quitting was higher in intervention group than in control group among women in preparation stage; however, the effect of intervention was not great in women in precontemplation and contemplation stages.⁵⁷ Rigotti et al showed that telephone-delivered smoking counseling based on the motivational stage is effective in tobacco abstinence among light smokers (less than ten cigarettes per day) and among women who attempted to quit before enrollment intervention program.⁵⁵ These studies revealed the effectiveness of counseling among pregnant women who have a certain motivation.

Intervention programs based on the 5 A’s intervention model were provided,^{38,40,41,48,59} and the effectiveness of the studied method for smoking cessation was reported. For example,

Table 2 Clinical trials focused on psychosocial intervention conducted among pregnant women in 2004–2014

Authors	Publication year	Country	Intervention programs	Effect on smoking status	Additional findings
Herbec et al ³³	2014	UK	Intervention (n=99): internet-based smoking cessation intervention for pregnant smokers (MumsQuit), an interactive, personalized, structured quit plan; control (n=101): non-personalized website that provided brief standard advice	Continuous 4-week abstinence assessed at 8 weeks post-baseline – 28.3% in MumsQuit, 20.8% in control, OR (MumsQuit/control) = 1.5, CI = 0.8–2.9	Women in intervention group logged in more often, viewed more pages, and spent more time browsing the website. MumsQuit is a helpful form for pregnant women who seek cessation support online
Pollak et al ³⁴	2013	US	Intervention (n=15): SMS via cell phone, SGR; control (n=16): SMS	Seven-day point prevalence abstinence at end of pregnancy – intervention: 13.4%, control: 7.5%	The pilot study suggested that the support messages were effective. The SGR arm was more effective than message only
Wilkinson et al ³⁵	2012	Australia	Intervention (n=87): attend a 1-hour “Healthy Start to Pregnancy” workshop; control (n=181): usual care	Percentage of women smoking before (pre) and during pregnancy – intervention: 18.0% (pre), 16.3%; control: 18.1% (pre), 17.0%	Women who attended the workshop increased their consumption of fruit and vegetables, met fruit guidelines, had a higher diet quality score, and clinically relevant increases in physical activity. There was not a significant difference for smoking between groups
Eades et al ³⁶	2012	Australia	Intervention: tailored advice and support to quit smoking using evidence-based communication skills, engaging the woman’s partner and other adults in supporting the quit attempts; control: advice to quit smoking and further support and advice by general practitioners at scheduled antenatal visits	Smoking rate at 36 weeks – intervention: 89%, control: 95%, risk ratio (intervention/control) = 0.93, CI = 0.86–1.08	There was no significant intervention effect
Naughton et al ³⁷	2012	UK	Intervention (n=102): tailored self-help smoking cessation intervention (MiQuit), text message via personal mobile phone; control (n=105): nontailored self-help leaflet	Self-reported 7-day point prevalence at 3-month follow-up – intervention: 22.9%, control: 19.6%, OR (intervention/control) = 1.22, CI = 0.62–2.41	Delivering tailored smoking cessation support via leaflet and text message is feasible and acceptable. MiQuit had positive effects on self-efficacy, harm beliefs, determination to quit, and setting a quit date
Ondersma et al ³⁸	2012	US	A computer delivered 5 A’s-based brief intervention (CD-5As) and a computer-assisted, simplified, and low-intensity contingency management (CM-Lite); a sample was assigned to four groups: CD-5As (n=26), CM-Lite (n=28), CD-5As + CM-Lite (n=30), treatment as usual (n=26)	Percent of abstinence as measured by cotinine – CD-5As: 43.5% (OR = 10.1, CI = 1.4–75.0), CM-Lite: 13.6% (OR = 0.6, CI = 0.1–4.2), CD-5As + CM-Lite: 15.4% (OR = 0.7, CI = 0.1–4.0), treatment as usual (control): 17.4%	CD-5As was successful in smoking cessation. CM-Lite did not affect smoking
El-Mohandes et al ³⁹	2011	US	Intervention (n=262): cognitive behavioral therapy with ten sessions; control (n=238): usual care	There was no significant interventional effect on smoking behavior during pregnancy	The intervention had a significant protective effect against smoking in the postpartum period
Windsor et al ⁴⁰	2011	US	Intervention (n=544): brief routine advice to quit, video, a pregnant woman’s guide to quit smoking, counseling; control (n=549): brief routine advice to quit, comparison (n=96): pre-trial group	Cessation rate – intervention: 12.0%, control: 10.0%, comparison: 4.2% (ns)	Significant reduction* rate was higher in the experimental group than in the control group

Manfredi et al ⁴¹	2011	US	Twelve clinics were randomized to three dissemination strategies: Group 1: core dissemination; Group 2: core dissemination + telephone counseling access; Group 3: core dissemination + telephone counseling access + outreach visits Intervention (n=80): vouchers exchangeable for retail items contingent on biochemically verified abstinence; control (n=74): vouchers independent of smoking status	Implementation outcomes were post-baseline in the percent of smokers reporting to receipt/exposure provider advice, self-help booklet, videos, posters, and an adjunct intervention Seven-day point prevalence smoking abstinence at end of pregnancy – intervention: 36%, control: 8%, OR (intervention/control) = 7.3, CI = 2.7–19.5 The 30-day abstinence rate at 2 months post-baseline – intervention: 26.1%, control: 10.5% (P=0.201) Percent of continuous abstinence (no smoking on any day) at 3 months after end of treatment – CBASP: 23.4%, HW: 21.0%, OR (CBASP/HW) = 1.2, CI = 0.6–2.1 Percent of quits at end of pregnancy – intervention: 13.0%, control: 3.6% (ns)	Compared with baseline, more smokers in the post-dissemination received a self-help booklet and complete an adjunct intervention
Washio et al ⁴²	2011	US	Intervention (n=80): vouchers exchangeable for retail items contingent on biochemically verified abstinence; control (n=74): vouchers independent of smoking status	Smoking abstinence at the end of pregnancy was significantly greater in the incentive group than the control group. Maternal weight gain did not differ significantly between treatment conditions The intervention is an efficacious adjunct to routine prenatal care by promoting provider advice and smoking reduction Pregnant women with high level of depressive symptoms may benefit from a depression-focused treatment	
Tsoh et al ⁴³	2010	US	Intervention (n=23): 15-minute Video Doctor sessions and provider cueing; control (n=19): usual care		
Cinciripini et al ⁴⁴	2010	US	CBASP group (n=128): smoking cessation counseling and depression-focused intervention; HW group (n=129): smoking cessation counseling and HW program		
Hennrikus et al ⁴⁵	2010	US	For all subjects, the single counseling session and information were provided. Intervention (n=54): supporters received monthly contacts from a counselor; control (n=28): supporters were not contacted	Intervention group subjects reported that their supporters had provided support behaviors more frequently and were more committed to helping them to quit	
Patten et al ⁴⁶	2010	US	Intervention (n=17): counseling, telephone calls, video, and cessation guide; control (n=18): counseling and written materials	The program was not feasible or acceptable among Alaska Native pregnant women. Alternative approaches are needed	
Ruger et al ⁴⁷	2009	US	Intervention (n=156): delivered MI, whose components were tailored to each client's stage; control (n=146): standard prenatal care at the clinic site (UC)	The total cost of MI was \$311.8 per participant, and the total cost of UC was \$4.82 per participant	
Stotts et al ⁴⁸	2009	US	A sample was assigned to three groups: BP based on the 5 A (n=120); BP and US feedback (BP + US) (n=120); MI-based counseling and US feedback (MI + US) (n=120)	Intervention effects were found conditional upon level of baseline smoking. Light smokers quit at significantly higher rates particularly in the MI + US group. Heavy smokers were unaffected by the intervention	
Bullock et al ⁴⁹	2009	US	Baby BEEP groups received weekly calls and beeper access to the nurse (social support). A sample was assigned to four groups: social support + booklets (n=170), social support (n=175), booklets (n=179), control (n=171)	The percentage of early and middle quitters (by 32 weeks of gestation) were 19.2% in social support + booklets group, 21.3% in social support group, 20.2% in booklets group, and 15.7% in control group	

(Continued)

Table 2 (Continued)

Authors	Publication year	Country	Intervention programs	Effect on smoking status	Additional findings
Katz et al ⁵⁰	2008	US	Cigarette smoking, environmental tobacco smoke exposure, depression, and intimate partner violence were the four risks targeted. Individualized counseling provided an integrated and tailored approach to the multiple risks reported by each woman	Forty-eight percent of women had smoking risk. Sixty-one percent of women reported a single risk, and 39% had multiple risks. Most intervention women had a positive view of their relationship with the counselor, and found the session content helpful Main outcome is cost-effectiveness	Multiple risk behavioral interventions can be implemented in a prenatal care setting
Ruger et al ⁵¹	2008	US	Intervention (n=156): delivered MI, whose components were tailored to each client's stage of readiness; control (n=146): standard prenatal care at the clinic site (UC)		For smoking cessation, MI costs more but provided no additional benefit compared to UC. For prevention relapse, MI is relatively cost-effective
Parker et al ⁵²	2007	US	A smoker's guide, monetary incentive lottery program, a motivational telephone counseling intervention (MI); no MI calls (n=52), one call (n=92), two calls (n=49), three calls (n=165)	Quit rate by number of calls received – no calls: 9.6%, one call: 13.0%, two calls: 16.3%, three calls: 23.0%, OR (three calls received/others) = 1.84, CI = 1.04–3.27	Telephone counseling is acceptable to low-income pregnant smokers. Feasibility and cost-effectiveness were suggested. This report focuses on the women randomly assigned to one intervention group
Park et al ⁵³	2007	US	Four hundred and forty-two pregnant smokers were recruited from two sources; the health plan and CBP. Intervention: telephone-delivered smoking counseling based on the motivational stage; control: modified best practice intervention	Smoking cessation at end of pregnancy in intervention group – the health plan: 16%, CBP: 18%	Smoking cessation outcomes did not differ by two disparate recruitment sources
Dornelas et al ⁵⁴	2006	US	Intervention (n=53): counseling intervention delivered by mental health counselors, with planned telephone calls; control (n=52): usual care by health care provider	Abstinence rates at end of pregnancy – intervention: 28.3%, control: 9.6% (P=0.015)	This model for intervention was cost-effective and was associated with significantly lower smoking rates at end of pregnancy
Rigotti et al ⁵⁵	2006	US	Intervention (n=220): telephone-delivered smoking counseling based on the motivational stage; control (n=222): brief smoking counseling	Seven-day tobacco abstinence rate at end of pregnancy – intervention: 10.0%, control: 7.5%, OR = 1.37, CI = 0.69–2.70	The intervention increased end-of-pregnancy tobacco abstinence among light smokers (intervention 19.1% vs control 8.4%, OR = 2.58, CI = 1.1–6.1), and among women who attempted to quit in pregnancy before enrollment
Higgins et al ⁵⁶	2006	US	Intervention (n=66): voucher-based incentives delivered contingent on biochemically verified abstinence; control (n=63): incentives independent of smoking status	Percent of smoking at end of pregnancy – 79% in intervention, 92% in control among women smoked in the initial 2 weeks	Smoking in the initial 2 weeks predicted smoking at the end of pregnancy assessment independent of treatment condition

Aveyard et al ⁵⁷	2006	UK	Intervention programs are based on the TTM. Arm A: controls. Standard smoking cessation advice (n=289); Arm B: self-help manuals based on TTM (n=305); Arm C: self-help manuals plus computer program based on TTM (n=324)	Point prevalence of quitting at 30 weeks of gestation among women in preparation stage – intervention (B and C): 22.4%, control: 9.1%. OR (B and C/A) =2.88 (P=0.09)	Women in the TTM-based intervention were more likely to make positive movements in stage. The effect of intervention was not great on women in precontemplation and contemplation stages (prevalence of quit was 6.4% in control, 4.7% in intervention, not significant) There were no significant differences between the groups on change
Campbell et al ⁵⁸	2006	Australia	Group-randomized trial: SD: an SD condition which received a mail-out of program resources; ID: an ID which included SD condition plus feedback, training, ongoing support with midwife facilitator	The cessation proportion in the post-dissemination – SD: 6.4%, ID: 10.5%	
Ayadi et al ⁵⁹	2006	US	5 A's smoking cessation counseling intervention across three disparate settings: 1) a clinical trial, 2) a national pregnant smokers telephone quit line, 3) a rural managed care organization	Main outcome is cost-effectiveness	The costs of the 5 A's vary depending on the intensity and nature of the intervention, but in this study, the analysis shows a narrow range across the three disparate settings
de Vries et al ⁶⁰	2006	the Netherlands	Intervention (n=141): counseling, a video, self-help guide, booklet; control (n=177): routine care	Percent of 7-day abstinence 6 weeks after intervention – intervention: 19%, control: 7%	Multilevel analysis revealed significant differences between both conditions. The intervention resulted in significant effects on smoking behavior for pregnant women but not for partner smoking
Ma et al ⁶¹	2005	US	Intervention: SI based on national clinical practice guidelines tailored to the woman's stage of change; control: usual care	Abstinence at delivery (SI/usual care): OR =3.36, CI =1.17–9.62	Women in the SI condition were more likely to quit during pregnancy. Factors associated at baseline were later week of pregnancy at baseline, quitting spontaneously, while women who lived with a smoker were less likely to quit
Tappin et al ⁶²	2005	UK	Intervention (n=351): MI at home by midwives; control (n=411): standard health promotion information	Percent of quitting of women – intervention: 4.8%, control: 4.6%, relative risk (intervention/control) =1.05, CI =0.55–1.98	Intervention did not significantly increase smoking cessation. Birth weight did not differ significantly
Aveyard et al ⁶³	2005	UK	Intervention programs are based on the TTM. Arm A: controls. Standard smoking cessation advice; Arm B: self-help manuals based on TTM; Arm C: self-help manuals plus computer program based on TTM	Main outcome is perceived stress of pregnant women	Intensive advice to stop smoking was not associated with increases in stress

Note: *A baseline saliva cotinine had to be ≥ 50 ng/mL and follow-up to be $\leq 50\%$ lower than the baseline.

Abbreviations: OR, odds ratio; CI, 95% confidence interval; SMS, short message service; SGR, scheduled gradual reduction; ns, not significant; CBASP, cognitive behavioral analysis system of psychotherapy; HW, health and wellness; MI, motivational interviewing; BP, best practices counseling; US, ultrasound; CBP, community-based practices; TTM, trans-theoretical model; SD, simple dissemination; ID, incentive dissemination; SI, special intervention; BEEP, a pocket pager.

Windsor et al reported the effectiveness of intervention from the Smoking Cessation and Reduction in Pregnancy Treatment method, a randomized clinical trial of pregnant smokers based on the 5 A's concept.⁴⁰ The control group patients received brief routine advice to quit, while the experimental group received the advice, in addition to a video, a written guide, and a ≤ 10 -minute counseling session.⁴⁰ The final cessation rate was 12% in the experimental group and 10% in the control group; in contrast, in pretrial comparison groups, the cessation rate was 4.2%.⁴⁰ The rate of patients who reduced their smoking significantly, defined as patients with a baseline saliva cotinine ≥ 50 ng/mL and with a $\leq 50\%$ reduction rate, was 18% in the experimental group and 13% in the control group.⁴⁰

Depression is an individual factor associated with smoking during pregnancy. Cinciripini et al reported on an intervention study focused on depression that suggests that women with higher levels of depression may benefit, in terms of abstinence and depression, from a depression-focused smoking cessation treatment.⁴⁴ For individuals with a high level of depression, an intervention that reduces depressive symptoms may facilitate cessation.⁴⁴ However, women with low levels of depression favored treatment that focused on health and wellness, rather than a depression-focused approach.⁴⁴ Katz et al reported the feasibility of implementing psychosocial and behavioral interventions in prenatal care settings, to address single or multiple risks among African American women.⁵⁰ Cigarette smoking, secondhand smoke exposure, depression, and intimate partner violence were the four risks targeted.⁵⁰ Women randomized to the intervention group, who were provided individually tailored counseling, more frequently resolved at least one of their risks than those randomized to the usual care group.⁶⁴ These findings suggest that interventions that focus on the characteristics of the individuals being treated are more effective.

The effectiveness of using a message service intervention via Internet or mobile phone was reported.^{33,34,37,43,49} For example, Tsoh et al suggested that the intervention by Video Doctor, plus provider cueing, is effective in decreasing the number of days smoked and the number of cigarettes smoked per day.⁴³ Pollak et al reported that the support messages were as effective as a counseling intervention.³⁴ Interventions using information technology may influence pregnant smokers to change their attitudes or behaviors, although it is only applicable in restricted conditions; that is, the necessary equipment is available and prepared. Messages from the health care provider and communication between smoking women and their health care providers may be important,

whether the communication comes via face-to-face counseling or remote access.

Not all intervention studies revealed an intervention effect on all outcome measures of smoking cessation, and not all intervention studies revealed good feasibility or acceptability. Wilkinson and McIntyre demonstrated the effectiveness of a workshop for improving diet and physical activity; however, there was not a significant effect on smoking behavior.³⁵ The intensity of intervention programs, outcome measures or follow-up duration, cultural reasons, women's motivation, being heavy smoker, contamination of the intervention across groups,³⁶ or patients' perceived pressure from a provider⁴⁶ may affect these results.

Some considerations of intervention studies

There are some important considerations of intervention studies. In clinical trials, participants are recruited from a specific population; for example, patients in prenatal care clinics, and those who consent to participate and those who are eligible based on the study criteria may enter the study. Smokers in the general population may be less compliant with the requirements of an intervention than smokers in clinical trials.⁶⁵ Women who continue to smoke during pregnancy and who have high levels of addiction may refuse to participate in the study.

Some intervention studies that were successful for smoking cessation featured interventions that were carried out by skilled advisors, for example, advisors who had master's degrees in counseling disciplines, as well as experience in interpersonal counseling. An individual's counseling skills may affect the success of the intervention.

Health education approach

As it is difficult for a smoker to stop smoking, particularly during and after the stressors of pregnancy, it is important to provide education on the harmful effects of smoking, and also cessation support, to young people. A decline in the smoking prevalence among the general population could decrease the smoking prevalence among pregnant women.

Providing leaflets, posters, or self-help materials is normally categorized as "low-intensity" intervention² in supporting women's smoking cessation. However, these materials are applicable to the dissemination of information on the risks of smoking while pregnant, not only for childbearing women but also for young people and those who are around childbearing women.

Summary

Women who continue to smoke during pregnancy are prone to various social disadvantages (eg, lower socioeconomic status, no partner, living in poverty), less social support, and individual problems (eg, higher stress, depression, and problems in their interpersonal relationships). Smokers may have various psychosocial problems. It is important to understand smoking mothers' social situations and psychosocial characteristics. If women enter prenatal care while smoking, there is an opportunity for clinicians to assess smoking status, counsel them to quit smoking, and provide referrals for cessation services.²⁹ Some clinical trials have provided evidence of the effectiveness of using psychosocial approaches on pregnant women who wish to quit smoking; further studies should seek new or better approaches. Successful smoking cessation may have great benefits for the mother and the child.

Disclosure

The authors report no conflict of interest in this work.

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