Systematic Review of Interventions for Racial/Ethnic-Minority Pregnant Smokers

Yukiko Washio, Ph.D. and Heather Cassey, B.A.

1Treatment Research Institute, Philadelphia PA, 19106, U.S.A
2Temple University, Department of Psychological, Organizational, and Leadership Studies, Philadelphia PA, 19122, U.S.A

Abstract

Introduction—Large disparities exist in smoking rates during pregnancy by racial/ethnic status.

Aims—The current review examined controlled studies that predominantly included racial/ethnic-minority pregnant smokers for providing smoking cessation treatment.

Methods—Two authors independently conducted the literature searches in the standard databases using a combination of the keywords with minority, pregnancy, smoking, and cessation identifiers.

Results—The searches identified nine articles that met the inclusion criteria. Only two studies exclusively targeted specific minority groups. Most of them provided some form of brief smoking cessation counseling, with two combining with incentives and one combining with pharmacotherapy. Two studies provided intensive cognitive interventions. Pregnant smokers of American Indian or Alaska Native, Hispanic subgroups, and Asian or Pacific Islander are under-studied.

Conclusions—Future studies to treat minority pregnant smokers could target under-studied minority groups and may need to directly and intensely target smoking behavior, address cultural and psychosocial issues in an individualized and comprehensive manner, and analyze cost-benefit of an intervention.

Keywords
Smoking cessation interventions; smoking during pregnancy; racial/ethnic-minority; pregnant smokers; systematic review

INTRODUCTION

Seventeen percent of women of childbearing age (i.e., eighteen to forty-four years) smoked cigarettes between 2009 and 2011 in the United States (U.S.), and more than ten percent of
pregnant women continued smoking during their pregnancy (National Center for Health Statistics [NCHS], 2012). Maternal smoking during pregnancy is particularly concerning because of the elevated health risks for mothers and infants (Bailey et al., 2012; Jones et al., 2013; Slotkin, 1998; Ness et al., 1999). Specifically, smoking during pregnancy increases the risk of ectopic pregnancy, spontaneous abortion, placental abruption, placenta previa, and even infertility (Cnattingius, 2004). Adverse health effects for the fetus include intrauterine growth retardation (IUGR), which has been implicated in hypoglycemia and hypocalcemia, as well as increased risk of necrotizing enterocolitis and death (Soothill, Nicolaides, & Campbell, 1987; Lin et al., 1980; Bernstein, Horbar et al., 2000; Bernstein, Plociennik et al., 2000). In addition to the risks from maternal smoking during pregnancy, passive exposure to parental smoking following birth further increases the child’s risk for sudden infant death syndrome, asthma, altered respiratory and cardiovascular function, infection, behavior problems, sleep difficulties, and cancer (Langley et al., 2012; Neuman et al., 2012; Treyster & Glitterman, 2011; Yolton et al., 2010; Zhang & Wang, 2013). These risks are additional to broader health risks of smoking-related illnesses (U.S. Department of Health and Human Services [USDHHS], 2001).

Women who smoke during pregnancy are more likely to be young (Stueve & O’Donnell, 2007); be born in U.S. (Haskins et al., 2010; Ockene et al., 2002; Rugulies, Scherzer, & Krause, 2008); be low-income (Weaver et al., 2008); be less educated (Higgins et al., 2009; King et al., 1997); have previous births (Haskins et al., 2010; Ockene et al., 2002); have a partner who smokes (Ockene et al., 2002); be highly addicted to nicotine (Haskins et al., 2010; Ockene et al., 2002); be less likely to perceive risk to the fetus (Ockene et al., 2002); be under stress from intimate partner violence and other life events (Haskins et al., 2010; Holden et al., 2012; Prusakowski et al., 2011); and have psychiatric disorders (i.e., generalized anxiety, bipolar, depression, oppositional disorder, conduct disorder, and attention deficit hyperactivity disorder; Flick et al., 2006; Kodl & Wakschlag, 2004).

In addition, substantial racial/ethnic disparities exist in smoking rates during pregnancy, with American Indian or Alaska Native (19.6 percent), White (10.8 percent), Black or African American (9.7 percent), Hispanic (2.0 percent), and Asian or Pacific Islander (1.6 percent; NCHS, 2012). Prenatal smoking rates also differ tremendously within the American Indian or Alaska Native population, with more than seventy percent in the Northwest Territories (Godel et al., 1992), about forty percent in the Washington, Wisconsin, and Minnesota states (Adams, Harvey, & Prince, 2005; Davis, Helgerson, & Waller, 1992; Scott et al., 2005), and two percent in the New Mexico state (Schiff & Rogers, 1999). Consequent diversity in the infant death rate has been observed with sixteen percent in the Northern Plains and five percent in the Navajo Indian Health Service Area (Bulterys et al., 1990). Although the overall smoking rate among pregnant Hispanic women is as low as 2.0 percent, large disparities among Hispanic subgroups exist (i.e., 12.2 percent for Puerto Rican, 7.1 percent for Cuban, 1.4 percent for Mexican, and 0.7 percent for Central and South American; NCHS, 2012). The rate of preterm birth and low birth weight babies has decreased by eleven percent during 1990s, which was largely accounted for by improved prenatal care utilization and smoking cessation (Schempf & Decker, 2010; Williamson et al., 1989).
Because of differential rates of smoking during pregnancy by racial/ethnic groups, adverse neonatal outcomes may also differ by racial/ethnic status. The term “minority” will be used to indicate “racial/ethnic minority in the U.S.” for the rest of this paper. Pregnant African American and Hispanic women have a greater risk of delivering infants with low birth weight compared to White counterparts, partially attributable to maternal smoking (Moore & Zaccaro, 2000; Ngui, Cortright, & Blair, 2009; Nkansah-Amankra, 2010). The proportion of infant deaths and babies with low birth weight attributable to maternal smoking is significantly higher among American Indian and Alaska Native women than other races/ethnicities (England et al., 2012; Salihu et al., 2003). Prenatal tobacco exposure was significantly associated with persistent asthma among children who are Mexican, Puerto Rican, and Black (Akuete et al., 2011).

Therefore, there is clear reason to target minority women for smoking cessation interventions and to tailor these interventions to meet their unique needs. Minority women are aware of the health risks associated with tobacco use and are often motivated to quit (USDHHS, 2001); however, differential rates of smoking among minority groups may be due to significant barriers to participating in tobacco cessation programs or to gaining access to tobacco cessation resources particularly during pregnancy (Glasgow et al., 2000; King et al., 1997). These barriers may include: inaccessible health care providers, lack of insurance, lack of transportation, lack of child care, issues with immigration status, language barriers, cultural health beliefs, level of acculturation, and other sociocultural barriers (English, Merzel, & Moon-Howard, 2010; King et al., 1997; Koh et al., 2010).

Minority women also tend to be overrepresented by lower socioeconomic status, which is associated with greater rates of smoking during pregnancy and less access to treatment (American Psychological Association, 2013; King et al., 1997). Smokers of lower socioeconomic status are as likely to attempt to quit smoking as those of higher socioeconomic status; however, they are less likely to be successful in quitting because of limited access to smoking cessation resources and other psychosocial determinants (Fitzgerald, 2012; Kotz & West, 2009).

A recent study showed that being advised to quit smoking by a health professional, use of nicotine replacement therapy (NRT), and having a complete home smoking ban were positively associated with successful cessation among minority smokers (Trinidad et al., 2011). Racial/ethnic disparities existed among these variables. Asian/Pacific Islander smokers were the least likely among all of the minority groups to visit a physician (Tong et al., 2011) and receive advice to quit smoking (Chen & Hawks, 1995; Tong et al., 2011). African American, Hispanic, and Asian/Pacific Islander smokers were less likely to use NRT, compared to White counterparts (Trinidad et al., 2011), and the same applies to pregnant smokers of these minority groups (Gaither et al., 2009). African American smokers were the least likely to have a complete home smoking ban, while Hispanic and Asian/Pacific Islander smokers were the most likely to have a complete home smoking ban (Trinidad et al., 2011).

The meta-analysis of interventions for pregnant smokers has been recently conducted (Lumely et al., 2009); however, no review has focused on interventions for minority...
pregnant smokers. The purposes of the present study are 1) to systematically review controlled studies of smoking cessation during pregnancy that predominantly included minority women and 2) to suggest ways to expand studies on minority pregnant smokers and improve smoking cessation rates based on the findings.

METHODS

Inclusion Criteria

All randomized and quasi-randomized controlled studies that were published in English and in peer-reviewed journals and met the following criteria were included for this review.

1. Studies that aimed at smoking cessation during pregnancy,
2. Studies that treated pregnant women who were smoking at the time of entering the study,
3. Studies that included minority pregnant smokers as more than fifty percent of the participants,
4. Studies that included minority pregnant smokers in the U.S.,
5. Studies that reported smoking cessation outcomes.

Smoking cessation outcomes included biochemically-verified smoking abstinence with breath, saliva, or urine samples and/or self-reported smoking abstinence.

Search Methods

Two authors independently conducted the literature searches for this review in April 2013. The literature searches covered published studies in the following standard databases: PubMed, MEDLINE, PsycINFO, and EBSCOhost; between 1946 and April 2013. We used a combination of the keywords with minority identifiers: minority, American Indian, Alaska Native, Asian American, Black, African American, Hispanic, Latina, Native Hawaiian, or Pacific Islander; pregnancy identifiers: pregnant or pregnancy; smoking identifiers: smoking, tobacco, or nicotine; and cessation identifiers: cessation, reduction, or abstinence. We adhered to the definitions of minority populations according to the U.S. Office of Management and Budget (Centers for Disease Control and Prevention, 2012). The authors compared their review results with each other and discussed any discrepancies in the results. An author with more experiences in general clinical research and research on pregnant smokers (Y. W.) ultimately resolved the discrepancies to complete the review. Other investigators senior to the author (Y. W.) were available for consultation as needed.

RESULTS

The database searches produced a total of 376 titles identified as relevant to the topic. Once duplicates were removed, a total of 174 titles remained for abstract screening. The abstracts were screened based on the above inclusion criteria leading to the removal of 159 abstracts and leaving fifteen articles for full-text screening. We removed six of these articles after full-text screening because two of the six articles had predominantly White participants (i.e.,
> fifty percent), and four did not report smoking cessation outcomes at the time of report (Figure 1).

Table 1 shows nine reviewed studies in a chronological and alphabetical order. Six of nine studies included Black or African American pregnant smokers as more than fifty percent of the participants (Cinciripini et al., 2010; El-Mohandes et al., 2012; Gielen et al., 1997; Lillington et al., 1995; Ondersma et al., 2012; Windsor et al., 1993), with one of them specifically targeting this group (El-Mohandes et al., 2012). Two studies included Hispanic pregnant smokers as more than fifty percent of the participants (Dornelas et al., 2006; Malchodi et al., 2003), and the remaining study specifically targeted Alaska Native pregnant smokers (Patten et al., 2010). The following subsections will summarize findings on demographic characteristics of minority pregnant smokers and intervention components and relevant outcomes across nine reviewed studies. [Insert Table 1 Here]

### Demographic Characteristics

A total of 1,233 Black or African American pregnant smokers, 416 Hispanic pregnant smokers, thirty-five Alaska Native pregnant smokers, and six mixed-racial/ethnic pregnant smokers were treated in the reviewed studies. The average age range of participants was 23.3–27.9 years old and entered treatment during the first and second trimesters (Cinciripini et al., 2010; El-Mohandes et al., 2012; Gielen et al., 1997; Lillington et al., 1995; Malchodi et al., 2003; Ondersma et al., 2012; Patten et al., 2010; Windsor et al., 1993). Most of the participants were not pregnant for the first time (79%; Gielen et al., 1997; Lillington et al., 1995; Patten et al., 2010); had education of twelve years or less (76%; Cinciripini et al., 2010; El-Mohandes et al., 2012; Malchodi et al., 2003; Patten et al., 2010); were unemployed (66%; Cinciripini et al., 2010; El-Mohandes et al., 2012; Malchodi et al., 2003); were Medicaid-eligible (68%; Cinciripini et al., 2010; El-Mohandes et al., 2012); were unmarried (83%; Cinciripini et al., 2010; Malchodi et al., 2003; Patten et al., 2010); and reported depression or other mood disorders (80%; Cinciripini et al., 2010; El-Mohandes et al., 2012). The range of the number of cigarettes smoked per day during pregnancy was 7.5–13.3 (Cinciripini et al., 2010; Gielen et al., 1997; Malchodi et al., 2003; Ondersma et al., 2012), and one study reported that the average number of cigarettes smoked at prepregnancy was 16.3, having decreased that number during pregnancy to 9.8 (Cinciripini et al., 2010). At treatment baseline, participants had salivary cotinine levels ranging from 114 to 211 ng/ml (Gielen et al., 1997; El-Mohandes et al., 2012; Patten et al., 2010; Windsor et al., 1993).

All but two studies defined prenatal smoking based on self-reported smoking during pregnancy (Cinciripini et al., 2010; Gielen et al., 1997; Lillington et al., 1995; Ondersma et al., 2012; Patten et al., 2010; Windsor et al., 1993) or the week prior to becoming pregnant (Malchodi et al., 2003). Four studies excluded participants based on exclusive use of smokeless tobacco (Malchodi et al., 2003), a recent history of alcohol and substance abuse or dependence (Dornelas et al., 2006; El-Mohandes et al., 2012), or psychiatric illness or psychological instability (Cinciripini et al., 2010; Dornelas et al., 2006; El-Mohandes et al., 2012).
Intervention Components

Seven of nine studies provided some form of brief intervention (El-Mohandes et al., 2012; Gielen et al., 1997; Lillington et al., 1995; Malchodi et al., 2003; Ondersma et al., 2012; Patten et al., 2010; Windsor et al., 1993), three studies of which combined brief intervention with a more intensive approach, such as nicotine replacement therapy (i.e., nicotine patches; El-Mohandes et al., 2012) and use of financial incentives for completing homework to develop cognitive behavioral skills (Lillington et al., 1995) and maintaining smoking abstinence (Ondersma et al., 2012). Two of nine studies provided an intensive intervention alone including cognitive behavioral therapy to reduce interpersonal stress and improve the quality of relationship with significant others (Cinciripini et al., 2010) and psychotherapy with follow-up stress management training via telephone consultation (Dornelas et al., 2006).

Only one study (El-Mohandes et al., 2012) stratified participants by baseline salivary cotinine levels to adjust the dosage of trans-dermal nicotine patch. Two studies tailored the intervention to the culture of participants by employing peer counselors from the similar socioeconomic background and creating a video with members from the same community (Malchodi et al., 2003; Patten et al., 2010). None of the studies provided a comprehensive psychosocial intervention to address individual psychosocial problems and needs such as with individually tailored psychosocial counseling, case management, and community referrals.

Intervention Outcomes

Smoking outcomes—Smoking abstinence and reduction outcomes at the end of pregnancy and early postpartum are summarized in Table 1. All nine studies reported end-of-pregnancy smoking abstinence. Eight of nine studies reported biochemically verified point-prevalent smoking abstinence at the end of pregnancy either by cotinine level as nicotine metabolite via urine or saliva (Cinciripini et al., 2010; Gielen et al., 1997; Malchodi et al., 2003; Ondersma et al., 2012; Patten et al., 2010; Windsor et al., 1993) or by carbon monoxide level via breath (Dornelas et al., 2006; El-Mohandes et al., 2012; Ondersma et al., 2012). Not all interventions showed significant point-prevalent smoking abstinence at the end of pregnancy or during postpartum. El-Mohandes et al. (2012) showed significant treatment effects; however, the trend of salivary cotinine values over time was not significant in either condition (Experimental condition; p = .07).

Four studies reported postpartum point-prevalent smoking abstinence, varying in reporting time periods from six-week postpartum to six-month postpartum (Cinciripini et al., 2010; Dornelas et al., 2006; Gielen et al., 1997; Lillington et al., 1995). Three of these studies provided biochemically-verified outcomes, showing high postpartum relapse rates (Cinciripini et al., 2010; Dornelas et al., 2006; Gielen et al., 1997).

Reduction in smoking during pregnancy was reported in three studies defined as a fifty percent decrease in cotinine levels from baseline to the end of pregnancy (Gielen et al., 1997; Windsor et al., 1993) or as decrease in the number of cigarettes smoked per day during pregnancy (Malchodi et al., 2003). Not all reports showed significant smoking
reduction. Two studies reported results in continuous smoking abstinence during pregnancy either in the past thirty days (Ondersma et al., 2012) or three-month and six-month post-treatment (Cinciripini et al., 2010), both of which showed longer continuous abstincence in the experimental condition than in the comparison condition (E [23%] vs. C [21%]) for three-month post-treatment & E [11%] vs. C [9%] for six-month post-treatment in Cinciripini et al., 2010; E1 [26%] vs. C [4%]; p = .04 & E1+E3 [22%] vs. E2+C [7%; p = .03] in Ondersma et al., 2012).

Birth outcomes—Birth outcomes were reported in three studies, showing differences in birth weight (206g [p = .18] favoring the experimental condition in El-Mohandes et al., 2012; 448g [p ≤ .01] favoring quitters over heavy smokers [7+ per day] in Malchodi et al., 2003; 200g favoring quitters over smokers in Windsor et al., 1993). Significant inverse correlations were found between birth weight and the number of cigarettes smoked per day (r = −0.295; p < .01) and carbon monoxide levels (r = −0.391; p < .001; Malchodi et al., 2003). One study also reported a significant difference in gestational age, favoring the experimental condition over the comparison condition (39.4 vs. 38.4 weeks; p = .02; El-Mohandes et al., 2012).

Other significant treatment effects—Ondersma et al. (2012) reported that computer-delivered brief intervention significantly increased the rate of talking to doctors and nurses about smoking (E1+E3 [61%] vs. E2+C [30%]; p =.02). Cinciripini et al. (2010) reported that cognitive behavioral therapy focused on interpersonal relationship significantly improved depression (p = .04).

Characteristics of quitters—Quitters were significantly younger (24.3 vs. 28.4; p = .04), had fewer pregnancies (3.2 vs. 6.4; p = .0001), had less depressive symptoms (33% vs. 68%, p = .048), and had smoked fewer cigarettes per day during the past seven days (2.2 vs. 7.2; p = .0001; El-Mohandes et al., 2012). Participants were more likely to quit if they had made three or more quit attempts prior to treatment (quitters [48%] vs. smokers [28%]), had family support (quitters [61%] vs. smokers [33%; p = .008), and had support from friends (quitters [43%] vs. smokers [21%]; p = .015; Gielen et al., 1997).

DISCUSSION

We systematically reviewed controlled studies that provided smoking cessation treatment to predominantly minority pregnant smokers. Only two of nine reviewed studies targeted specific minority pregnant smokers, one for African American pregnant smokers (El-Mohandes et al., 2012) and the other for Alaska Native pregnant smokers (Patten et al., 2010). Among seven studies which included a racial/ethnic-mix of pregnant smokers, only two studies showed a breakdown of smoking outcomes by racial/ethnic status (Lillington et al., 1995; Windsor et al., 1993).

Demographic Characteristics

Demographic characteristics of pregnant smokers in this review match those found in the literature for Black or African American (B/AA) and American Indian or Alaska Native (AI/AN) pregnant smokers (Brownson et al., 1992; Hickman, Delucchi, & Prochaska, 2010;
Masho et al., 2013; Maxson et al., 2012; Nguyen et al., 2012; Orr et al., 2005; Orr, Blazer, & Orr, 2012; Plotsch, Morgan, & Pieper, 2003 for B/AA; Eichner et al., 2010; Geishirt-Cantrell et al., 2005; King et al., 1997 for AI/AN). Culturally specific characteristics have been also identified, that are unique to the B/AA and AI/AN populations, including stress based on experiences of racial discrimination (B/AA; Nguyen et al., 2012), tobacco sale as a major income venue (AI/AN; Hodge et al., 2004), and ceremonial significance of tobacco (AI/AN; Hodge & Struthers, 2006; King et al., 1997).

Only one of the studies reviewed targeted AI/AN pregnant smokers, and the efficacy to treat AI/AN pregnant smokers has not been established (Patten et al., 2010). The results were unfortunate given that much emphasis in the study was placed on considering cultural approach to tobacco among AI/AN populations and incorporating feedback from AI/AN pregnant women and that culturally adapted interventions are generally four times more effective than their counterparts (Griner & Smith, 2006). Targeting AI/AN pregnant smokers is a public health priority considering their high prenatal smoking rate and significantly higher rates of pregnancy complications and adverse neonatal outcomes including sudden infant death (Bulterys, 1990; Kim et al., 2009 & 2010; Patten et al., 2010; Petersen et al., 1984). AI/AN populations are, in comparison with other Americans, at higher risk for a number of physical problems (e.g., diabetes, oral health diseases, unintentional injuries and trauma, certain infectious diseases), mental health problems (e.g., depression, posttraumatic stress disorder, suicide), and high levels of comorbidity among these problems (Beals et al., 2009; Gone, 2007; Manson, 2001; Rhoades, 2000). Geographically limited access to healthcare and receiving the fewest healthcare dollars per capita, compared to other vulnerable groups (e.g., veterans, Medicaid recipients, federal prisoners), may contribute to the highest risk for the health problems (Beals et al., 2009; Indian Health Service, 2002). We should not ignore, however, that a significant diversity exists within the AI/AN population. There are 562 federally recognized tribal governments (Bureau of Indian Affairs, 2002), which are located across thirty-five states. These tribal governments share 200 different languages (Fleming, 1992), resulting in a tremendous diversity in prenatal smoking rates and infant death rates (Adams et al., 2005; Bulterys et al., 1990; Davis et al., 1992; Godel et al., 1992; Schiff & Rogers, 1999; Scott et al., 2005).

Potential barriers for accessing AI/AN pregnant smokers and gaining their family support include that AI/AN families tend to be larger than those of any other ethnic group (averaging 4.6 members; King et al., 1997), and AI/AN women are the central caregiver of the family and kin networks prioritizing concerns of other family members more than their own (Jones et al., 2012; King et al., 1997), that families living on tribal lands were, in comparison with other Americans, more than ten times more likely to live in substandard housing lacking complete plumbing or complete kitchen facilities (U.S. Census Bureau, 2000), and that native communities tend to have an explicit commitment to cultural preservation and revitalization partially due to insecure political, legal, and economic relationships with the U.S. federal government (Gone, 2007). More AI/AN young women smoke cigarettes compared to other racial/ethnic-minority groups, potentially contributing to severity in nicotine dependence and lower motivation to quit (Flores-Mateo et al., 2005; Tong et al., 2011).
In case of Hispanic populations, pregnant residents of low socioeconomic, predominantly Hispanic neighborhoods were less likely to smoke during pregnancy and, as a result, have improved birth outcomes, compared to those living in other low socioeconomic neighborhoods (Shaw & Pickett, 2010 & 2013). The evidence indicates strong family and community influences on health behavior and outcomes of pregnant women living in Hispanic cultures in the U.S. (Chalela, Velez, & Ramirez, 2007; Pletsch & Johnson, 1996; Pollak et al., 2010). Such positive family and community influences seem to dissipate as Hispanic pregnant women acculturate to other low-income minority groups, which tend to be more casual about smoking during pregnancy (Bethel & Schenker, 2005; Fitzgerald, 2012; Johnsen et al., 2002; King et al., 1997).

It should be also emphasized that large disparities in prenatal smoking rates exist among Hispanic subgroups in the U.S., with Puerto Rican women exceeding the overall Hispanic prenatal smoking rate by more than ten percent (NCHS, 2012). Family and community influences on pregnancy outcomes as described above do not apply to the health of Puerto Ricans, either (Turra & Goldman, 2007). Given that Hispanics remain the most populous minority group in the U.S., and the Puerto Rican population, which is at most risk of prenatal smoking, is the second largest Hispanic subgroup in the U.S. (Ennis, Rios-Vargas, & Albert, 2011), targeting at-risk Hispanic subgroups such as Puerto Ricans may be critical in designing an intervention for minority pregnant smokers.

No study has focused on demographic characteristics of Asians or Pacific Islander pregnant smokers. While the A/PI prenatal smoking rate is the lowest compared to any other minority group, Pacific Islanders have a higher rate of using cigarettes, cigars, and smokeless tobacco, compared to other Asian Americans (Wu et al., 2013). Lower perception of harm in smoking, perceived prevalence of peer cigarette smoking, peer approval of cigarette use, previous drug use, truancy, and lower academic performance are all associated with smoking among A/PI adolescent populations (Yang et al., 2013). Certain Asian immigrants may carry culturally specific trauma leading to smoking among pregnant women as a result of acculturating to the low socioeconomic culture in the U.S. (King et al., 1997). Although the overall smoking prevalence among A/PI populations declined since the millennium (18.0 percent in 2002 to 11.1 percent in 2010), A/PI males are still at increased risk for using tobacco products than females (Wu et al., 2013). Despite the fact that A/PI populations are more likely to have a complete home smoking ban (Trinidad et al., 2011), smoking by A/PI males would still put A/PI pregnant women at risk for second-hand smoke exposure. The literature delineates an importance of examining A/PI pregnant populations and intervening with A/PI smoking populations.

**Interventions for Minority Pregnant Smokers**

Treatment effects on the smoking outcomes of the reviewed studies were not consistently significant among the reviewed studies. Differences in inclusion and exclusion criteria for pregnant smokers in these studies might have also impacted on the smoking outcomes. Given that pregnant smokers with less severe smoking histories and fewer psychosocial issues benefited the most in treatment (Gielen et al., 1997; El-Mohandes et al., 2012), an
intervention may be required to adjust its intensity to more heavily dependent smokers and tailor to individual psychosocial and cultural needs.

Smoking during pregnancy is highly correlated with alcohol and other substance use during pregnancy (Cannon et al., 2012; Gaalema et al., 2013; Passey et al., 2014; Tuten et al., 2012) and, therefore, correlated with psychosocial characteristics and issues common among alcohol- and other substance-dependent pregnant women (Cannon et al., 2012; Chaudhury et al., 2010; Higgins et al., 2009; Holbrook & Kaltenbach, 2012; Orr et al., 2012; Subramanian et al., 2012; Yoon et al., 2007). Prenatal alcohol and substance use and associated psychosocial problems have been addressed in the context of comprehensive and intensive prenatal interventions, with consistently significant improvements in both alcohol and substance abstinence/management during pregnancy and neonatal outcomes (Grant et al., 2005; Jones et al., 2008; Jones et al., 2010).

Culturally adapted interventions are generally four times more effective than their counterparts (Griner & Smith, 2006). For example, Indigenous pregnant women outside of the U.S. including New Zealand, Australia, and Canada also mark a high smoking prevalence (twenty-five percent – sixty-one percent; Butler et al., 2004; Gilchrist et al., 2004; Heaman & Chalmers, 2005). Although efficacy has not been established yet, efforts to provide evidence-based treatments have been made, such as providing brief intervention combined with nicotine replacement therapy for Aboriginal and Torres Strait Islander pregnant smokers in Australia (Eades et al., 2012). A recent survey of Indigenous pregnant smokers or ex-smokers in Australia revealed that family-based support, rewards on smoking abstinence, advice and support from health professionals are seen as potentially helpful for smoking cessation. Pregnant ex-smokers also thought that stress management and peer/community support are potentially helpful (Passey, Sanson-Fisher, & Stirling, 2013). Maori community workers in New Zealand highlighted that Maori way’s relating to each other, face-to-face interaction, family-oriented value, and providing personal experiences of quitting smoking are considered critical to identify Maori pregnant smokers and build rapport and maintain communication with them for maximizing treatment effects (van Esdonk, Glover, Kira, & Wagemakers, 2013).

Intensive and comprehensive care for treating prenatal smoking typically costs more than a brief intervention approach (e.g., $65.32 per patient in intensive counseling vs. $9.70 in brief intervention; Dornelas et al., 2006; Windsor et al., 1993); however, additional healthcare costs due to ongoing health problems resulting from prenatal smoking should also be taken into consideration. Prenatal smoking puts infants at risk for premature or low birth weight, costing up to $50,000 or more per baby during its first year of life (March of Dimes, 2009). The adjusted neonatal and first-year infant costs that are attributable to maternal smoking are between $1,538.09 and $1,838.20 (Miller et al., 2001). The adjusted smoking attributable expenditures for mothers are $4,780.89 from medical costs and lost productivity (Centers for Disease Control and Prevention, 2002). Mothers who continued smoking during pregnancy were significantly more likely to wean breastfeeding early (Higgins et al., 2010), costing health care services between $508.72 and $730.52 in 2013 dollars during the first year of life per infant (US BF Committee, 2002). As such, fairly immediate health cost-savings could be realized by providing intensive and comprehensive care for prenatal smoking in addition to.
long-term savings (e.g., due to asthma, altered respiratory and cardiovascular function, cancer, etc.). The following section will summarize future directions for intervening with minority pregnant smokers.

**Future Directions for Intervening with Minority Pregnant Smokers**

**Minority groups**—This review revealed that interventions for certain minority pregnant smokers, especially for American Indian or Alaska Native (AI/AN), Hispanic subgroups, and Asians or Pacific Islanders (A/PI), have been under studied. Future studies on minority pregnant smokers could target under-studied minority pregnant smokers including AI/AN as a minority group with a highest smoking prevalence, a specific Hispanic subgroup such as Puerto Rican pregnant smokers with a relatively higher smoking prevalence, and A/PI pregnant women at risk for prenatal smoking and second-hand smoke exposure. Potential studies for A/PI should not be limited to intervention studies on prenatal smoking and could include surveys and interviews to learn more about the unique psychosocial characteristics and needs for treatment and intervention on second-hand smoke exposure. Future studies on interventions for predominantly minority pregnant smokers could also show breakdown of smoking outcomes by racial/ethnic status.

**Interventions for minority pregnant smokers**—This review revealed that interventions for predominantly minority pregnant smokers may need to more intensely address smoking behavior and psychosocial and cultural issues directly contributing to prenatal smoking via continuous motivational enhancement for smoking abstinence (e.g., feedback, financial incentives, and pharmacotherapy) and intensive counseling for cognitive behavioral skills to stay abstinent from smoking, as has been the case with general pregnant smokers (Lumley et al., 2009). This approach may also include stratifying minority pregnant smokers by severity in smoking rates and psychosocial and cultural issues to adjust the intensity of treatment. Making interventions tailored to individual needs may increase sensitivity to the cultural and socioeconomic barriers of minority pregnant smokers and reduce vulnerability, potentially contributing to treatment retention and effectiveness (Graham et al., 2006; Lumley et al., 2009). Future studies on interventions for minority pregnant smokers may also include a component to analyze cost-benefit of the intervention.

**CONCLUSION**

The current study systematically reviewed nine studies that treated predominantly minority pregnant smokers. Demographic characteristics, intervention components, and intervention outcomes of the studies were reviewed. Future studies to treat minority pregnant smokers could target under-studied minority groups such as American Indian or Alaska Native, Hispanic subgroups, and Asians or Pacific Islanders and may need to directly and intensely target smoking behavior, addressing cultural and psychosocial issues in an individualized and comprehensive manner, adjust the intensity of the intervention according to the severity and needs, and analyze cost-benefit of an intervention.
Acknowledgments

We would like to thank Drs. A. Thomas McLellan and Michael G. McDonell for reviewing the manuscript. We would also like to thank Drs. McDonell, Gayle S. Morse, Joseph E. Trimble, and Julii Green for consulting on the American Indian/Native American populations.

Funding support: This study was supported by an NIH grant, 5P50DA027841.

References

Adams AK, Harvey HE, Prince RJ. Association of maternal smoking with overweight at age 3 y in American Indian children. The American Journal of Clinical Nutrition. 2005; 82(2):393–398. [PubMed: 16087984]

Akuete K, Oh SS, Thyne S, Rodriguez-Santana JR, Chapela R, Meade K, Tcheurekdjian H. Ethnic variability in persistent asthma after in utero tobacco exposure. Pediatrics. 2011; 128(3):e623–e630.10.1542/peds.2011-0640 [PubMed: 21859918]

American Psychological Association. Ethnic and racial minorities & socioeconomic status. 2013. Retrieved July 16, 2013, from http://www.apa.org/pi/ses/resources/publications/factsheet-erm.aspx

Bailey BA, McCook JG, Hodge A, McGrady L. Infant birth outcomes among substance using women: Why quitting smoking during pregnancy is just as important as quitting illicit drug use. Maternal and Child Health Journal. 2012; 16(2):414–422.10.1007/s10995-011-0776-y [PubMed: 21424740]

Beals J, Belcourt-Ditloff A, Freedenthal S, Kaufman C, Mitchell C, Whitesell N, Walters K. Reflections on a proposed theory of reservation-dwelling American Indian alcohol use: Comment on Spillane and Smith (2007). Psychological Bulletin. 2009; 135(2):339–343. discussion 344–336. 10.1037/a0014819 [PubMed: 19254084]

Bernstein IM, Horbar JD, Badger GJ, Ohlsson A, Golan A. Morbidity and mortality among very-low-birth-weight neonates with intrauterine growth restriction. American Journal of Obstetrics and Gynecology. 2000; 182(1):198–206.10.1016/S0002-9378(00)70513-8 [PubMed: 10649179]

Bernstein IM, Plociennik K, Stahle S, Badger GJ, Seeker-Walker R. Impact of maternal cigarette smoking on fetal growth and body composition. American Journal of Obstetrics and Gynecology. 2000; 183(4):883–886.10.1067/mob.2000.109103 [PubMed: 11035331]

Bethel JW, Schenker MB. Acculturation and smoking patterns among Hispanics: A review. American Journal of Preventative Medicine. 2005; 29(2):143–148.10.1016/j.amepre.2005.04.014

Brownson RC, Jackson-Thompson J, Wilkerson JC, Davis JR, Owens NW, Fisher EB Jr. Demographic and socioeconomic differences in beliefs about the health effects of smoking. American Journal of Public Health. 1992; 82(1):99–103. [PubMed: 1536345]

Butler S, Williams M, Paterson J, Tukuitonga C. Smoking among mothers of a Pacific Island birth cohort in New Zealand: Associated factors. New Zealand Medical Journal. 2004; 117(1206):1–11.

Bulterys M, Morgenstern H, Welty TK, Kraus JF. The expected impact of a smoking cessation program for pregnant women on infant mortality among Native Americans. American Journal of Preventive Medicine. 1990; 6(5):267–273. [PubMed: 2268455]

Bureau of Indian Affairs. Indian entities recognized and eligible to receive services from the United States Bureau of Indian Affairs. Federal Register. 2002; 67

Cannon MJ, Dominique Y, O’Leary LA, Sniezek JE, Floyd RL. Characteristics and behaviors of mothers who have a child with fetal alcohol syndrome. Neurotoxicology and Teratology. 2012; 34(1):90–95.10.1016/j.ntt.2011.09.010 [PubMed: 22001355]

Centers for Disease Control and Prevention. Enterobacter sakazakii Infections Associated with the Use of Powdered Infant Formula — Tennessee, 2001. 2002.

Centers for Disease Control and Prevention. Definitions: Racial and ethnic minority populations. 2012. Retrieved July 16th, 2013 from http://www.cdc.gov/minorityhealth/populations/REMP/definitions.html

Chalela P, Velez LF, Ramirez AG. Social influences, and attitudes and beliefs associated with smoking among border Latino youth. The Journal of School Health. 2007; 77(4):187–195.10.1111/j.1746-1561.2007.00190.x [PubMed: 17425521]
Chaudhury R, Jones HE, Wechsberg W, O’Grady KE, Tuten M, Chisolm MS. Addiction severity index composite scores as predictors for sexual-risk behaviors and drug-use behaviors in drug-using pregnant patients. The American Journal of Drug and Alcohol Abuse. 2010; 36(1):25–30.10.3109/00952990903544810 [PubMed: 2041393]

Chen MS Jr, Hawks BL. A debunking of the myth of healthy Asian Americans and Pacific Islanders. American Journal of Health Promotion. 1995; 9(4):261–268.10.4278/0890-1171-9.4.261 [PubMed: 10150729]

Cinciripini PM, Blalock JA, Minnix JA, Robinson JD, Brown VL, Lam C, Karam-Hage M. Effects of an intensive depression-focused intervention for smoking cessation in pregnancy. Journal of Consulting and Clinical Psychology. 2010; 78(1):44–54.10.1037/a0018168 [PubMed: 20099949]

Cnattingius S. The epidemiology of smoking during pregnancy: Smoking prevalence, maternal characteristics, and pregnancy outcomes. Nicotine & Tobacco Research. 2004; 6(2):S125–S140.10.1080/14622200410001669187 [PubMed: 15203816]

Davis RL, Helgerson SD, Waller P. Smoking during pregnancy among northwest Native Americans. Public Health Reports. 1992; 107(1):66–69. [PubMed: 1738811]

Dornelas EA, Magnavita J, Beazoglou T, Fischer EH, Oncken C, Lando H, Gregonis E. Efficacy and cost-effectiveness of a clinic-based counseling intervention tested in an ethnically diverse sample of pregnant smokers. Patient Education and Counseling. 2006; 64(1–3):342–349.10.1016/j.pec.2006.03.015 [PubMed: 16859864]

Eades SJ, Sanson-Fisher RW, Wenitong M, Panaretto K, D’Este C, Gilligan C, Stewart J. An intensive smoking intervention for pregnant Aboriginal and Torres Strait Islander women: A randomised controlled trial. Medical Journal of Australia. 2012; 197(1):42–46. [PubMed: 22762231]

Eichner JE, Wang W, Zhang Y, Lee ET, Welty TK. Tobacco use and cardiovascular disease among American Indians: The strong heart study. International Journal of Environmental Research and Public Health. 2010; 7(10):3816–3830.10.3390/ijerph7103816 [PubMed: 21138962]

El-Mohandes AA, Windsor R, Tan S, Perry DC, Gantz MG, Kiely M. A randomized clinical trial of trans-dermal nicotine replacement in pregnant African-American smokers. Maternal and Child Health Journal. 2012; 17(5):897–906.10.1007/s10995-012-1069-9 [PubMed: 22761006]

England LJ, Kim SY, Shapiro-Mendoza CK, Wilson HG, Kendrick JS, Satten GA, Callaghan WM. Maternal smokeless tobacco use in Alaska Native women and singleton infant birth size. Acta Obstetricia et Gynecologica Scandinavica. 2012; 91(1):93–103.10.1111/j.1600-0412.2011.01273.x [PubMed: 21902677]

English KC, Merzel C, Moon-Howard J. Translating public health knowledge into practice: Development of a lay health advisor perinatal tobacco cessation program. Journal of Public Health Management and Practice. 2010; 16(3):E9–E19.10.1097/PHH.0b013e3181e38387

Ennis, SR.; Ríos-Vargas, M.; Albert, NG. The Hispanic population: 2010. US Department of Commerce, Economics and Statistics Administration, US Census Bureau; 2011.

Fitzgerald EM. Evidence-based tobacco cessation strategies with pregnant Latina women. The Nursing Clinics of North America. 2012; 47(1):45–54.10.1016/j.cnur.2011.11.001 [PubMed: 22289397]

Fleming CM. The next twenty years of prevention in Indian country: Visionary, complex, and practical. American Indian and Alaska Native Mental Health Research. 1992; 4(3):85–88. [PubMed: 1504178]

Flick LH, Cook CA, Homan SM, McSweeney M, Campbell C, Parnell L. Persistent tobacco use during pregnancy and the likelihood of psychiatric disorders. American Journal of Public Health. 2006; 96(10):1799–1807.10.2105/AJPH.2004.057851 [PubMed: 1708576]

Flores Mateo G, Morchon Ramos S, Masuet Aumatell C, Carrillo Santisteve P, Manchon Walsh P, Ramon Torrell JM. Age of smoking initiation as predictor in smoking cessation. Aten Primaria. 2005; 35(9):466–471. [PubMed: 15919020]

Gaalema DE, Higgins ST, Pepin CS, Heil SH, Bernstein IM. Illicit drug use among pregnant women enrolled in treatment for cigarette smoking cessation. Nicotine & Tobacco Research. 2013; 15(5):987–991.10.1093/ntt/nst220 [PubMed: 23072871]

Gaither KH, Huber LRB, Thompson ME, Hu't-Hudson YM. Does the use of nicotine replacement therapy during pregnancy affect pregnancy outcomes? Maternal and Child Health Journal. 2009; 13(4):497–504. http://dx.doi.org/10.1007/s10995-008-0361-1. [PubMed: 18478321]
Gielen AC, Windsor R, Faden RR, O’Campo P, Repke J, Davis M. Evaluation of a smoking cessation intervention for pregnant women in an urban prenatal clinic. Health Education Research. 1997; 12(2):247–254. http://dx.doi.org/10.1093/her/12.2.247. [PubMed: 10168576]

Gilchrist D, Woods B, Binns CW, Scott JA, Gracey M, Smith H. Aboriginal mothers, breastfeeding and smoking. Australian and New Zealand Journal of Public Health. 2004; 28(3):225–228.10.1111/j.1467-842X.2004.tb00700.x [PubMed: 15707168]

Glasgow RE, Whitlock EP, Eakin EG, Lichtenstein E. A brief smoking cessation intervention for women in low-income planned parenthood clinics. The American Journal of Public Health. 2000; 90(5):786–789.10.2105/AJPH.90.5.786 [PubMed: 10800431]

Godel JC, Pabst HF, Hodges PE, Johnson KE, Froese GJ, Joffres MR. Smoking and caffeine and alcohol intake during pregnancy in a northern population: Effect on fetal growth. CMAJ: Canadian Medical Association Journal. 1992; 147(2):181–188. [PubMed: 1623464]

Gone JP. “We never was happy living like a Whiteman”: Mental health disparities and the postcolonial predicament in American Indian communities. American Journal of Community Psychology. 2007; 40(3–4):290–300.10.1007/s10464-007-9136-x [PubMed: 17906926]

Graham H, Francis B, Inskip HM, Harman J. Socioeconomic life course influences on women’s smoking status in early adulthood. Journal of Epidemiology and Community Health. 2006; 60(3):228–233.10.1136/jech.2005.039784 [PubMed: 16476753]

Grant TM, Ernst CC, Streissguth A, Stark K. Preventing alcohol and drug exposed births in Washington state: Intervention findings from three parent-child assistance program sites. The American Journal of Drug and Alcohol Abuse. 2005; 31(3):471–490.10.1081/ADA-200056813 [PubMed: 16161730]

Griner D, Smith TB. Culturally adapted mental health intervention: A meta-analytic review. Psychotherapy. 2006; 43(4):531–548.10.1037/0033-3204.43.4.531 [PubMed: 22122142]

Haskins A, Bertone-Johnson E, Pekow P, Carbone E, Chasan-Taber L. Correlates of smoking cessation at pregnancy onset among Hispanic women in Massachusetts. American Journal of Health Promotion. 2010; 25(2):100–108.10.4278/ajhp.090223-QUAN-77 [PubMed: 21039290]

Heaman MI, Chalmers K. Prevalence and correlates of smoking during pregnancy: A comparison of aboriginal and non-aboriginal women in Manitoba. Birth. 2005; 32(4):299–305.10.1111/j.0730-7659.2005.00387.x [PubMed: 16336371]

Hickman NJ 3rd, Delucchi KL, Prochaska JJ. A population-based examination of cigarette smoking and mental illness in Black Americans. Nicotine & Tobacco Research. 2010; 12(11):1125–1132.10.1093/ntr/ntq160 [PubMed: 20855413]

Higgins ST, Heil SH, Badger GJ, Skelly JM, Solomon LJ, Bernstein IM. Educational disadvantage and cigarette smoking during pregnancy. Drug and Alcohol Dependence. 2009; 104(S1):S100–S105.10.1016/j.drugalcdep.2009.03.013 [PubMed: 19442460]

Higgins TM, Higgins ST, Heil SH, Badger GJ, Skelly JM, Bernstein IM, Preston AM. Effects of cigarette smoking cessation on breastfeeding duration. Nicotine & Tobacco Research. 2010; 12(5):483–488.10.1093/ntr/ntq031 [PubMed: 20391411]

Hodge FS, Geishirt-Cantrell BA, Struthers R, Casken J. American Indian internet cigarette sales: Another avenue for selling tobacco products. American Journal of Public Health. 2004; 94(2):260–261. [PubMed: 14759938]

Hodge FS, Struthers R. Persistent smoking among Northern Plains Indians: Lenient attitudes, low harm value, and partiality toward cigarette smoking. Journal of Cultural Diversity. 2006; 13(4):181–185. [PubMed: 17338487]

Holbrook A, Kaltenbach K. Co-occurring psychiatric symptoms in opioid-dependent women: The prevalence of antenatal and postnatal depression. The American Journal of Drug and Alcohol Abuse. 2012; 38(6):575–579.10.3109/00952900.2012.696168 [PubMed: 22783380]

Holden KB, McKenzie R, Pruitt V, Aaron K, Hall S. Depressive symptoms, substance abuse, and intimate partner violence among pregnant women of diverse ethnicities. Journal of Health Care for the Poor and Underserved. 2012; 23(1):226–241.10.1353/hpu.2012.0022 [PubMed: 22643473]

Indian Health Service. Final report of the Restructuring Initiative Workgroup, Rockville, MD. 2002.
Johnsen L, MacKirnan D, Spring B, Pingitore R, Sommerfeld BK. Smoking as subculture? Influence on Hispanic and non-Hispanic White women’s attitudes toward smoking and obesity. Health Psychology. 2002; 21(3):279–287.10.1037/0278-6133.21.3.279 [PubMed: 12027034]

Jones EJ, Appel SJ, Eaves YD, Moneyham L, Oster RA, Ovalle F. Cardiometabolic risk, knowledge, risk perception, and self-efficacy among American Indian women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2012; 41(2):246–257.10.1111/j.1552-6909.2012.01339.x

Jones HE, Heil SH, Tuten M, Chisolm MS, Foster JM, O’Grady KE, Kaltenbach K. Cigarette smoking in opioid-dependent pregnant women: Neonatal and maternal outcomes. Drug and Alcohol Dependence. 2013; 131(3):271–277.10.1016/j.drugalcdep.2012.11.019 [PubMed: 23279924]

Jones HE, Kaltenbach K, Heil SH, Stine SM, Coyle MG, Arria AM, Fischer G. Neonatal abstinence syndrome after methadone or buprenorphine exposure. New England Journal of Medicine. 2010; 363(24):2320–2331.10.1056/NEJMoa1005359 [PubMed: 21142534]

Jones HE, Martin PR, Heil SH, Kaltenbach K, Selby P, Coyle MG, Fischer G. Treatment of opioid-dependent pregnant women: Clinical and research issues. Journal of Substance Abuse Treatment. 2008; 35(3):245–259.10.1016/j.addct.2007.10.007 [PubMed: 18248941]

Kim SY, England L, Dietz PM, Morrow B, Perham-Hester KA. Prenatal cigarette smoking and smokeless tobacco use among Alaska native and white women in Alaska, 1996–2003. Maternal and Child Health Journal. 2009; 13(5):652–659.10.1007/s10995-008-0402-9 [PubMed: 18712464]

Kim SY, England L, Dietz PM, Morrow B, Perham-Hester KA. Patterns of cigarette and smokeless tobacco use before, during, and after pregnancy among Alaska Native and white women in Alaska, 2000–2003. Maternal and Child Health Journal. 2010; 14(3):365–372.10.1111/j.1523-536X.2007.00194.x [PubMed: 19139981]

King TK, Borrelli B, Black C, Pinto BM, Marcus BH. Minority women and tobacco: Implications for smoking cessation interventions. Annals of Behavioral Medicine. 1997; 19(3):301–313.10.1007/BF02892295 [PubMed: 9603705]

Kodl MM, Wakschlag LS. Does a childhood history of externalizing problems predict smoking during pregnancy? Addiction Behaviors. 2004; 29(2):273–279.10.1016/j.addbeh.2003.08.003

Koh HK, Oppenheimer SC, Massin-Short SB, Emmons KM, Geller AC, Viswanath K. Translating research evidence into practice to reduce health disparities: A social determinants approach. American Journal of Public Health. 2010; 100(S1):S72–S80.10.2105/AJPH.2009.167353 [PubMed: 20147686]

Kotz D, West R. Explaining the social gradient in smoking cessation: It’s not in the trying, but in the succeeding. Tobacco Control. 2009; 18(1):43–46.10.1136/tc.2008.025981 [PubMed: 18936053]

Langlely K, Heron J, Smith GD, Thapar A. Maternal and paternal smoking during pregnancy and risk of ADHD symptoms in offspring: testing for intrauterine effects. Am J Epidemiol. 2012; 176(3):261–268.10.1093/aje/kwr510 [PubMed: 22791738]

Lillington L, Royce J, Novak D, Ruvalcaba M, Chlebowski R. Evaluation of a smoking cessation program for pregnant minority women. Cancer Practice. 1995; 3(3):157–163. [PubMed: 7599672]

Lin CC, Moawad AH, Rosenow PJ, River P. Acid-base characteristics of fetuses with intrauterine growth retardation during labor and delivery. American Journal of Obstetrics and Gynecology. 1980; 137(5):553–559. [PubMed: 7386549]

Lumley J, Chamberlain C, Dowswell T, Oliver S, Oakley L, Watson L. Interventions for promoting smoking cessation during pregnancy. Cochrane Database of Systematic Reviews. 2009; (3):CD001055.10.1002/14651858.CD001055.pub3 [PubMed: 19588322]

Malchodi CS, Oncken C, Dornelas EA, Caramanica L, Gregonis E, Curry SL. The effects of peer counseling on smoking cessation and reduction. Obstetrics and Gynecology. 2003; 101(3):504–510.10.1016/s0029-8444(02)03070-3 [PubMed: 12636954]

Manson, SM. Behavioral health services for American Indians: Need, use, and barriers to effective care. In: Roubideaux, MDY., editor. Promises to keep: Public health policy for American Indians and Alaska Natives in the 21st century. Washington, DC: American Public Health Association; 2001. p. 167-192.

March of Dimes. [Accessed October 15, 2012] Prematurity Campaign. http://www.marchofdimes.com/mission/prematurity_costs.html

J Smok Cessat. Author manuscript; available in PMC 2016 May 01.
Masho SW, Bishop DL, Keyser-Marcus L, Varner SB, White S, Svikis D. Least explored factors associated with prenatal smoking. Maternal and Child Health Journal. 2013; 17(7):1167–1174.10.1007/s10995-012-1103-y [PubMed: 22903305]

Maxson PJ, Edwards SE, Ingram A, Miranda ML. Psychosocial differences between smokers and nonsmokers during pregnancy. Addictive Behaviors. 2012; 37(2):153–159.10.1016/j.addbeh.2011.08.011 [PubMed: 22000409]

Miller DP, Villa KF, Hogue SL, Sivapathasundaram D. Birth and first-year costs for mothers and infants attributable to maternal smoking. Nicotine & Tobacco Research. 2001; 3(1):25–35.10.1080/14622200125305 [PubMed: 11260808]

Moore ML, Zaccaro DJ. Cigarette smoking, low birth weight, and preterm births in low-income African American women. Journal of Perinatology. 2000; 20(3):176–180.10.1038/sj.jp.7200336 [PubMed: 10802843]

National Center for Health Statistics. Health, United States, 2011: With Special Feature on Socioeconomic Status and Health. Hyattsville, MD: 2012.

Ness RB, Grisso JA, Hirschinger N, Markovic N, Shaw LM, Day NL, Kline J. Cocaine and tobacco use and the risk of spontaneous abortion. New England Journal of Medicine. 1999; 340(5):333–339.10.1056/NEJM199902043400501 [PubMed: 9929522]

Ngui E, Cortright A, Blair K. An investigation of paternity status and other factors associated with racial and ethnic disparities in birth outcomes in Milwaukee, Wisconsin. Maternal and Child Health Journal. 2009; 13(4):467–478.10.1016/j.societ.2009.02.009 [PubMed: 18618323]

Nguyen KH, Subramanian SV, Sorensen G, Tsang K, Wright RJ. Influence of experiences of racial discrimination and ethnic identity on prenatal smoking among urban black and Hispanic women. Journal of Epidemiology and Community Health. 2012; 66(4):315–321. http://dx.doi.org/10.1136/jech.2009.107516. [PubMed: 20974840]

Nkansah-Amankra S. Neighborhood contextual factors, maternal smoking, and birth outcomes: Multilevel analysis of the South Carolina PRAMS Survey, 2000–2003. Journal of Women’s Health. 2010; 19(8):1543–1552.10.1089/jwh.2009.1888

Neuman A, Hohmann C, Orsini N, Pershagen G, Eller E, Kjaer HF, Bergstrom A. Maternal smoking in pregnancy and asthma in preschool children: a pooled analysis of eight birth cohorts. Am J Respir Crit Care Med. 2012; 186(10):1037–1043.10.1164/rccm.201203-0501OC [PubMed: 22952297]

Ockene J, Ma Y, Zapka J, Pbert L, Valentine Goins K, Stoddard A. Spontaneous cessation of smoking and alcohol use among low-income pregnant women. American Journal of Preventive Medicine. 2002; 23(3):150–159.10.1016/S0749-3797(02)00492-0 [PubMed: 12350446]

Ondersma SJ, Svikis DS, Lam PK, Connors-Burge VS, Ledgerwood DM, Hopper JA. A randomized trial of computer-delivered brief intervention and low-intensity contingency management for smoking during pregnancy, Nicotine & Tobacco Research. 2012; 14(3):351–360.10.1093/ntr/ntr221 [PubMed: 22157229]

Orr S, Newton E, Tarwater PM, Weismiller D. Factors associated with prenatal smoking among Black women in Eastern North Carolina. Maternal and Child Health Journal. 2005; 9(3):245–252.10.1007/s10995-005-0010-x [PubMed: 16088364]

Orr ST, Blazer DG, Orr CA. Maternal prenatal depressive symptoms, nicotine addiction, and smoking-related knowledge, attitudes, beliefs, and behaviors. Maternal and Child Health Journal. 2012; 16(5):973–978.10.1007/s10995-011-0822-9 [PubMed: 21607614]

Patten CA, Windsor RA, Renner CC, Enoch C, Hochreiter A, Nevak C, Brockman T. Feasibility of a tobacco cessation intervention for pregnant Native American women. Nicotine & Tobacco Research. 2010; 12(2):79–87.10.1093/ntr/np1180 [PubMed: 20018946]

Petersen LP, Leonardson G, Wingert RI, Stanage W, Gergen J, Gilmore HT. Pregnancy complications in Sioux Indians. Obstetrics and Gynecology. 1984; 64(4):519–523. [PubMed: 6483300]

Pletsch PK, Johnson MK. The cigarette smoking experience of pregnant Latinas in the United States. Health Care for Women International. 1996; 17(6):549–562. [PubMed: 9119774]

Pletsch PK, Morgan S, Pieper AF. Context and beliefs about smoking and smoking cessation. MCN: The American Journal of Maternal/Child Nursing. 2003; 28(5):320–325.

J Smok Cessat. Author manuscript; available in PMC 2016 May 01.
Pollak KI, Denman S, Gordon KC, Lyna P, Rocha P, Brouwer RN, Baucom DH. Is pregnancy a teachable moment for smoking cessation among US Latino expectant fathers? A pilot study. Ethnicity & Health. 2010; 15(1):47–59.10.1080/13557850903398293 [PubMed: 20013439]

Prusakowski MK, Shofer FS, Rhodes KV, Mills AM. Effect of depression and psychosocial stressors on cessation self-efficacy in mothers who smoke. Maternal and Child Health Journal. 2011; 15(5):620–626.10.1007/s10995-010-0640-5 [PubMed: 20607376]

Rhoades, E. American Indian health: Innovations in health care, promotion, and policy. Baltimore, MD: Johns Hopkins University Press; 2000. p. 103-400.

Rugulies R, Scherzer T, Krause N. Associations between psychological demands, decision latitude, and job strain with smoking in female hotel room cleaners in Las Vegas. International Journal of Behavioral Medicine. 2008; 15(1):34–43.10.1007/BF0303072 [PubMed: 18444019]

Salihu HM, Aliyu MH, Pierre-Louis BJ, Alexander GR. Levels of excess infant deaths attributable to maternal smoking during pregnancy in the United States. Maternal and Child Health Journal. 2003; 7(4):219–227.10.1023/A:1027319517405 [PubMed: 14682499]

Schempf AH, Decker SL. Decline in the United States Black preterm/low birth weight rate in the 1990s: Can the Economic Boom explain it? Annals of Epidemiology. 2010; 20(11):862–867.10.1016/j.annepidem.2010.07.100 [PubMed: 20933194]

Schiff M, Rogers C. Factors predicting cesarean delivery for American Indian women in New Mexico. Birth. 1999; 26(4):226–231.10.1046/j.1523-5366.1999.00226.x [PubMed: 10655827]

Scott S, Fogarty C, Day S, Irving J, Oakes M. Smoking rates among American Indian women giving birth in Minnesota. A call to action. Minnesota Medicine. 2005; 88(12):44–49. [PubMed: 16583526]

Shaw RJ, Pickett KE. 054 Another Hispanic paradox? The health benefits of Hispanic communities for non-Hispanic mothers and infant. Journal of Epidemiology & Community Health. 2010; 64(S1):A21–A22.10.1136/jech.2010.120956.54

Shaw RJ, Pickett KE. The health benefits of Hispanic communities for non-Hispanic mothers and infants: Another Hispanic paradox. American Journal of Public Health. 2013; 103(6):1052–1057.10.2105/AJPH.2012.300985 [PubMed: 23597369]

Slotkin TA. Fetal nicotine or cocaine exposure: Which one is worse? The Journal of Pharmacology and Experimental Therapeutics. 1998; 285(3):931–945. [PubMed: 9618392]

Soothill PW, Nicolaides KH, Campbell S. Prenatal asphyxia, hyperlacticaemia, hypoglycaemia, and erythroblastosis in growth retarded fetuses. British Medical Journal. 1987; 294(6579):1051–1053. [PubMed: 3107690]

Stueve A, O’Donnell L. Continued smoking and smoking cessation among urban young adult women: Findings from the Reach for Health longitudinal study. American Journal of Public Health. 2007; 97(8):1408–1411.10.2105/AJPH.2006.109397 [PubMed: 17600241]

Subramanian S, Katz K, Rodan M, Gantz M, El-Khorazaty N, Johnson A, Joseph J. An integrated randomized intervention to reduce behavioral and psychosocial risks: Pregnancy and neonatal outcomes. Maternal and Child Health Journal. 2012; 16(3):545–554.10.1007/s10995-011-0875-9 [PubMed: 21931956]

Tong EK, Tang H, Chen MS Jr, McPhee SJ. Provider smoking cessation advice among California Asian-American smokers. American Journal of Health Promotion. 2011; 25(5):S70–S74.10.4278/ajhp.100611-QUAN-186 [PubMed: 21510790]

Treyster Z, Gitterman B. Second hand smoke exposure in children: Environmental factors, physiological effects, and interventions within pediatric. Reviews on Environmental Health. 2011; 26(3):187–195.10.1515/reveh.2011.026 [PubMed: 22206195]

Trinidad DR, Perez-Stable BJ, White MM, Emery SL, Messer K. A nationwide analysis of US racial/ethnic disparities in smoking behaviors, smoking cessation, and cessation-related factors. American Journal of Public Health. 2011; 101(4):699–706.10.2105/AJPH.2010.191668 [PubMed: 21330593]

Turra CM, Goldman N. Socioeconomic differences in mortality among US adults: Insights into the Hispanic paradox. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2007; 62(3):S184–S192.
Tuten M, Fitzsimons H, Chisolm MS, Nuzzo PA, Jones HE. Contingent incentives reduce cigarette smoking among pregnant, methadone-maintained women: Results of an initial feasibility and efficacy randomized clinical trial. Addiction. 2012; 107(10):1868–1877.10.1111/j.1360-0443.2012.03923.x [PubMed: 22716774]

van Esdonk T, Glover M, Kira A, Wagemakers A. Reducing smoking in pregnancy among Maori women: “Aunties” perceptions and willingness to help. Maternal and Child Health Journal. 2013;1–7.10.1007/s10995-013-1377-8

US Breastfeeding Committee. Economic benefits of breastfeeding [issue paper]. Raleigh, NC: United States Breastfeeding Committee; 2002.

U.S. Census Bureau. Census 2000 Summary Files. 2000; 1:2, 3. (SF1, SF2, SF3). Retrieved March 3, 2014, from http://www.census.gov/main/www/cen2000.html.

US Department of Health and Human Services, P. H. S., Office of the Surgeon General. Women and smoking: A report of the Surgeon General. 2001. Retrieved July 16, 2013, from http://www.cdc.gov/tobacco/data_statistics/sgr/2001/complete_report/index.htm

Weaver K, Campbell R, Mermelstein R, Wakschlag L. Pregnancy smoking in context: The influence of multiple levels of stress. Nicotine & Tobacco Research. 2008; 10(6):1065–1073.10.1080/14622200802087564 [PubMed: 18584470]

Williamson DF, Serdula MK, Kendrick JS, Binkin NJ. Comparing the prevalence of smoking in pregnant and nonpregnant women, 1985 to 1986. Journal of the American Medical Association. 1989; 261(1):70–74.10.1001/jama.1989.03420010080037 [PubMed: 2908998]

Windsor RA, Lowe JB, Perkins LL, Smith-Yoder D, Artz L, Crawford M, Boyd NR. Health education for pregnant smokers: Its behavioral impact and cost benefit. American Journal of Public Health. 1993; 83(2):201–206.10.2105/AJPH.83.2.201 [PubMed: 8427323]

Wu LT, Swartz MS, Burchett B, Workgroup NA, Blazer DG. Tobacco use among Asian Americans, Native Hawaiians/Pacific Islanders, and mixed-race individuals: 2002–2010. Drug and Alcohol Dependence. 2013; 132(1–2):87–94.10.1016/j.drugalcdep.2013.01.008 [PubMed: 23394689]

Yang F, Cheng WJ, Ho MH, Pooh K. Psychosocial correlates of cigarette smoking among Asian American and Pacific Islander adolescents. Addictive Behaviors. 2013; 38(4):1890–1893.10.1016/j.addbeh.2012.12.012 [PubMed: 23380485]

Yolton K, Xu Y, Khoury J, Succop P, Lanphear B, Beebe DW, Owens J. Associations between secondhand smoke exposure and sleep patterns in children. Pediatrics. 2010; 125(2):e261–268.10.1542/peds.2009-0690 [PubMed: 20083521]

Yoon JH, Higgins ST, Heil SH, Sugarbaker RJ, Thomas CS, Badger GJ. Delay discounting predicts postpartum relapse to cigarette smoking among pregnant women. Experimental and Clinical Psychopharmacology. 2007; 15(2):176–186.10.1037/1064-1297.15.2.186 [PubMed: 17469941]

Zhang K, Wang X. Maternal smoking and increased risk of sudden infant death syndrome: a meta-analysis. Leg Med (Tokyo). 2013; 15(3):115–121.10.1016/j.legalmed.2012.10.007 [PubMed: 23219585]
Figure 1.
Flow chart of the selection process for systematic review.
Table 1

Randomized trials for smoking cessation during pregnancy with 50 percent or more participants of racial/ethnic minorities

| Reference            | Sample size       | Racial/ethnic status | Experimental intervention(s) | Comparison intervention(s) | Point-prevalent smoking abstinence during pregnancy | Point-prevalent smoking abstinence during postpartum | Smoking reduction |
|----------------------|-------------------|----------------------|------------------------------|----------------------------|---------------------------------------------------|---------------------------------------------------|-------------------|
| Windsor et al. 1993  | Experimental      | 52% Black or         | Health Education Methods:    | C1: Prenatal brief education by | Biochemically-confirmed smoking abstinence (saliva) after 32 gestation weeks E = 14% C1 = 9% C2 = 3% (p = .01<sup>a</sup> Among B/AA only: E = 18% C1 = 11%<sup>b</sup> (p = .03<sup>a</sup> Among White only: E = 10% C1 = 5%<sup>b</sup> (p = .08) | No information provided | Significant reducers as 50% decrease in cotinine levels from baseline E = 17% C1 = 12% (p = .07) Among B/AA only: E = 13% C1 = 12% (p = .68) Among White only: E = 21% C1 = 13% (p = .05<sup>a</sup>) |
| group (E) = 400;     | group 1 (C1) = 414;| African-American (B/AA) | 1 Cessation skills and risk 15-min counseling | 2 Social reinforcement by clinicians | 3 Social support with a buddy system | | |
| Comparison group 2 (C2) = 100 | | | | | | | |
| Lillington et al. 1995 | Experimental      | 53% Black or         | Time for a Change program:  | WIC usual care: Prenatal brief education by staff and printed information about risks of smoking during pregnancy | Self-reported smoking abstinence at 36 gestation weeks using Chi-square analysis E = 43% C = 25% (p = .005<sup>a</sup> Relative risk (RR) [95% CI] = 1.75 [1.19, 2.55]) Among B/AA only: E = 44% C = 23% (p = .004<sup>a</sup> RR [95% CI] = 1.93 [1.23, 3.03]) Among Hispanic only: E = 40% C = 30% | Self-reported smoking abstinence at 6 weeks postpartum using Chi-square analysis E = 25% C = 12% (p = .008<sup>a</sup> Relative risk (RR) [95% CI] = 2.17 [1.21, 3.91]) Among B/AA only: E = 27% C = 9% (p = .002<sup>a</sup> RR [95% CI] = 3.13 [1.48, 6.60]) Among Hispanic only: E = 20% C = 17% (not significant; p value not shown; RR [95% CI] = 1.20 [0.33, 4.36]) | No information provided |
| group (E) = 79;      | group (C) = 146    | African-American (B/AA); 43% Hispanic | 1 One-on-one counseling | 2 Self-help guide | | | |
|                      |                   | Hispanic             | 3 Postcard reminder | 4 Prize-based incentives on homework completion | | | |
| Reference                  | Sample size          | Racial/ethnic status                  | Experimental intervention(s)                                                                 | Comparison intervention(s)                                                                 | Point-prevalent smoking abstinence during pregnancy | Point-prevalent smoking abstinence during postpartum | Smoking reduction |
|----------------------------|----------------------|--------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------|-------------------|
| Gielen et al. 1997         | Experimental group (E) = 125; Comparison group (C) = 121 | 85% Black or African-American        | The ‘Smoke-Free’ Moms Project: 1. Guide to quit smoking, 2. 15-min one-on-one counseling by a peer health counselor, 3. Social reinforcement and support by clinicians | Prenatal brief education by a nurse about the risks of smoking during pregnancy with pamphlets from area voluntary agencies | Biochemically-confirmed smoking abstinence (saliva) after 28 weeks gestation using Chi-square E = 6%, C = 6% (p value not shown) | Biochemically-confirmed smoking abstinence (saliva) at 6 months postpartum using Chi-square E = 15%, C = 4% (p value not shown) | Significant reducers as 90% decrease in cotinine during third trimester from baseline using Chi-square E = 11%, C = 1% (p value not shown) |
| Malchodi et al. 2003       | Experimental group (E) = 67; Comparison group (C) = 75 | 63% Hispanic; 62.5% Black or African-American | Peer-led smoking cessation program: 1. Smoking cessation counseling by health care providers at each prenatal visit, 2. Smoking cessation counseling by lay peers matched in socio-economic and cultural status (8 contacts) | Smoking cessation counseling by health care providers at each prenatal visit | Biochemically-confirmed smoking abstinence (urine) at 36 gestation weeks using Chi-square E = 24%, C = 21% (p = .84) | No information provided | Reduction in the number of cigarettes smoked per day using t tests E = 9.1±7.3 cigs C = 4.5±5.9 cigs (p = .03)² |
| Dornelas et al. 2006       | Experimental group (E) = 53; Comparison group (C) = 52 | 66% Hispanic; 11% Black or African-American; 6% multi-racial/ethnic | Clinic-based counseling intervention: 1. One 90-min psychotherapy session, 2. Bi-monthly prenatal telephone calls from the therapist | Personalized quit message by a physician with an educational booklet | Biochemically-confirmed smoking abstinence (breath) at 36±2 gestation weeks using Chi-square E = 28%, C = 10% (p = .02)² | Biochemically-confirmed smoking abstinence (breath) at 6 months postpartum using Chi-square E = 9%, C = 4% (p = .25) | No information provided |
| Cinciripini et al. 2010     | Experimental group (E) = 128; | 54% Black or African-American; 9% Hispanic | Cognitive behavioral analysis system of psychotherapy (CBASP) | Smoking cessation and health and wellness education: 10 60-min individual counseling | Biochemically-confirmed smoking | Biochemically-confirmed smoking abstinence (saliva) at 3 months | No information provided |
| Reference | Sample size | Racial/ethnic status | Experimental intervention(s) | Comparison intervention(s) | Point-prevalent smoking abstinence during pregnancy | Smoking reduction |
|-----------|-------------|----------------------|-----------------------------|---------------------------|--------------------------------------------------|------------------|
| Patterson et al. 2010 | Experimental group (E) = 17; Comparison group (C) = 18 | 100% Alaska Native | Y-K Delta Regional Hospital clinical cessation program | Brief face-to-face counseling at the first visit with written materials | Biochemically-confirmed smoking abstinence (saliva) at 6 days or more post-randomization using an exact test E = 0%; C = 6%; (p = 1.0) | No information provided |
| El-Mohandes et al. 2012 | Experimental group (E) = 26; Comparison group (C) = 26 | 100% Black or African-American | Nicotine replacement therapy + SCRIPT | 5A’s Model counseling with a cessation guide and follow-up support | Biochemically-confirmed smoking abstinence (breath) at end-of-pregnancy (on average 14 gestation weeks) using Fisher exact tests E = 19%; C = 0%; (p = .05) | No information provided |
| Onderama et al. 2012 | Experimental group 1 (E1) = 26; Experimental group 2 (E2) = 28; Experimental | 82% Black or African-American | Experimental intervention 1: Computer-delivered brief intervention only | Usual care from prenatal care providers & engagement in a computer program with a brief series of questions and video clips on musical preferences | Biochemically-confirmed smoking abstinence (breath) at 10 weeks post-randomization | No information provided |
| Reference | Sample size | Racial/ethnic status | Experimental intervention(s) | Comparison intervention(s) | Point-prevalent smoking abstinence during pregnancy | Point-prevalent smoking abstinence during postpartum | Smoking reduction |
|-----------|-------------|----------------------|------------------------------|---------------------------|-----------------------------------------------|-----------------------------------------------|------------------|
|           |             |                      | Experimental intervention 2: |                           | using logistic regression                      |                                         |                   |
|           |             |                      | group 3 (E3) = 30; Comparison |                           | E1 = 30% (7/23)                              |                                         |                   |
|           |             |                      | group 3 (E3) = 30; Comparison |                           | E2 = 9% (2/22)                               |                                         |                   |
|           |             |                      | group 3 (E3) = 30; Comparison |                           | E3 = 19% (5/26)                              |                                         |                   |
|           |             |                      | group 3 (E3) = 30; Comparison |                           | C = 9% (2/23)                                |                                         |                   |
|           |             |                      | Experimental intervention 3: |                           | (OR[95% CI] = 5.7[0.9, 34.3]; p = .06 between E1 vs. C) |                                         |                   |
|           |             |                      | Experimental intervention 1 + |                           |                                             |                                         |                   |
|           |             |                      | Experimental intervention 2   |                           |                                             |                                         |                   |
|           |             |                      | Experimental intervention 2   |                           |                                             |                                         |                   |

Experimental intervention 2: Lower intensity contingency management
1. Website-based instruction
2. Patient-initiated
3. A maximum of 5 reinforcement episodes with $50 gift cards at prenatal care visits

Experimental intervention 3: Experimental intervention 1 + Experimental intervention 2

Note:

\(a\) - Statistical significance; CI - Confidence interval.

\(b\) Quit rates by race are not shown for the C2 group in Windsor et al. (1993).