

Preconception Markers of Dual Risk for Alcohol and Smoking Exposed Pregnancy: Tools for Primary Prevention

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Abstract

Objective: Effective preconception primary prevention strategies are needed for women who are at dual risk for alcohol and smoking exposed pregnancies. The current study seeks to identify risk factors that can be used to target intervention strategies at women who are at dual risk.

Methods: During a 2-year period from January 2007 through December 2009, 109 women at dual risk for alcohol exposed pregnancy (AEP) and smoking exposed pregnancy (SEP) and 108 women at risk only for AEP were recruited from central Virginia cities. All participants completed a battery of instruments, including assessments of sexual, smoking, and alcohol history and current behavior in each area.

Results: Several factors differentiated women at dual risk for SEP/AEP vs. AEP alone, including lower educational level and employment, higher frequency of sexual intercourse, less use of contraception, and higher frequency of alcohol use and mental disorders.

Conclusions: Several measurable factors differentiate SEP/AEP women, and these factors could be used to efficiently target primary prevention. The increased severity of women at dual risk of SEP/AEP on a variety of factors demonstrates the importance of preconception prevention efforts for these women.

Introduction

THE HEALTH RISKS AND SIDE EFFECTS of prenatal exposure to tobacco and alcohol are well documented. Despite the risks of smoking during pregnancy, 29.5% of women of childbearing age report smoking, and 16.5% of pregnant women continue to smoke.¹ It is estimated that prenatal tobacco exposure increases mortality by 150%, accounting for approximately 15% of all miscarriages and increased rates of stillbirths and postnatal mortality.²⁻⁴ Smoking exposed pregnancies (SEPs) are responsible for 20%–30% of all cases of low birth weight and contribute to other postnatal abnormalities, including severe physiologic and behavioral complications.⁴ Alcohol consumption during pregnancy is also associated with poor prenatal and postnatal outcomes,⁵ and there is no safe level of drinking during pregnancy. Even lower doses and binges represent an alcohol exposed pregnancy (AEP)⁶ that can cause fetal damage.^{7,8} Fetal alcohol syndrome (FAS) is a leading cause of mental retardation in the United States and is completely preventable.^{7,9} Fetal alcohol spectrum disorders (FASDs) are three times more common than FAS and include a range of effects that create lifelong

challenges for the individual and substantial costs to society.^{6,10} Moreover, the combined effects of smoking and drinking results in pregnancies that are at dual risk for SEP/AEP. The use of these two substances during pregnancy has been found to have a synergistic effect, accounting for a greater increase in preterm labor, low birth weight, and growth restriction than the sum of both risk behaviors combined.¹¹

Given the negative effects of tobacco and alcohol use on pregnancy, attention has been given to factors that influence remission of these behaviors upon conception. Among smokers who become pregnant, rates of spontaneous smoking cessation range from 11% to 65%,¹² with studies of samples of publicly insured women representing the lower end of this range (11%–28%) and those who are privately insured representing the higher end (40%–65%).

Those who continue to smoke during or after pregnancy are more likely to drink alcohol, and rates of smoking cessation among pregnant women who drink alcohol are lower than those found in nondrinking samples.¹³ The percentage of spontaneous quitters who relapse postpartum ranges from 61% to 76%,¹⁴ indicating that the mother may still be endangering the life of her newborn through second-hand smoke

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exposure and potentially putting herself at risk for SEP in the future. For those who do persist in smoking, successful intervention during pregnancy has proven challenging.¹⁵

Among alcohol users, most women reduce consumption after learning they are pregnant,¹⁶ but many do not recognize that they are pregnant during the early critical weeks of gestation and continue hazardous drinking.¹⁷ Studies from the Centers for Disease Control and Prevention (CDC) show that approximately one in two women of childbearing age (18–44 years) report alcohol use in the past month, and one in eight report binge drinking.¹⁸ In the United States, almost half of pregnancies are unplanned,¹⁹ of which about half occur in women who are using contraception ineffectively or intermittently.²⁰ Among women who persist in drinking during pregnancy, there is limited and mixed evidence about the effectiveness of interventions to reduce alcohol consumption.²¹ The severity of dependence associated with continued smoking and drinking during pregnancy may require a greater duration and intensity of treatment than is possible during the prenatal period, highlighting the importance of preconception identification and intervention.^{12,22}

Primary prevention efforts aimed at problematic health habits require identification of a target population or an individual risk factor that is predictive of the problem behavior. Identifying those women who are at increased risk for SEPs or AEPs or at dual risk for SEPs and AEPs could guide prevention efforts. Interventions targeting preconception smokers or drinkers may lead to benefits through several paths. First, they could improve contraception in order to delay pregnancy before smoking or drinking cessation, thus accomplishing primary prevention of AEP and SEP. Second, they could increase the duration and intensity of treatment for those women who do not stop spontaneously upon pregnancy recognition or with intervention during the prenatal period, potentially minimizing the harm related to exposure during pregnancy by reducing the duration of exposure.

By determining which women are most at risk, resources could be channeled efficiently to those who could benefit most. Research on characteristics associated with risk for AEP and SEP has helped to identify target populations through measurable risk factors, and this information has led to the design and implementation of preconception prevention strategies.^{2,23} No published information is available, however, about the predictors of risk for pregnancies that are at dual risk from alcohol and smoking, and the relationship between combined risk factors and individual risk factors is unknown. It is the purpose of the present study to provide initial empirical data on this population by comparing women at risk for SEP and AEP to those who are at risk of AEP alone.

Materials and Methods

The current study is part of a larger investigation of AEP risk reduction among sexually active, reproductive aged women (aged 18–44), who reported binge drinking (>4 drinks on one occasion) in the past 3 months and sexual activity with ineffective contraception while not intending pregnancy. Ineffective contraception included inconsistent use of one or more medically effective methods (e.g., wearing a condom sometimes), use of a medically effective method in a manner rendering it less effective (e.g., missing birth control pills), use of a medically ineffective method (e.g., withdrawal),

or no use of contraception. Participants were recruited by fliers and newspaper and internet ads from the central Virginia area surrounding the cities of Richmond and Charlottesville. This area of the country now has fairly comparable rates of smoking compared to the rest of the country, with approximately 16.4% of the adult population smoking and 15.8% of adult women smoking compared to 18.4% of the adult U.S. population smoking.²⁴ However, Virginia ranks 12th among states with nearly a million residents reporting current smoking.²⁴ As elsewhere, Virginia adults are more likely to smoke when they have less education; 30% of adults with less than a high school diploma smoke, 24.5% of those with a high school diploma smoke, and only 11.8% of those with at least some college education smoke.²⁴

Potential participants were screened for eligibility via telephone. Eligible participants were scheduled for a baseline assessment during which they provided informed consent and completed a battery of instruments. Participants were then randomized to one of three intervention conditions targeting risk for AEP and assessed again at 3 and 6 months. Data for the current analysis focus only on information provided during the baseline assessment.

During the baseline assessment, participants were administered a battery of instruments, including measures of demographic characteristics; history of sexual behavior, including pregnancy and contraception; history of smoking, alcohol, and drug use; and history of healthcare seeking behaviors. Several different instruments measuring varying constructs of binge, heavy, and dependent drinking were used. Alcohol use, sexual intercourse episodes, contraception use, and were assessed using the timeline follow-back (TLFB). This instrument uses a calendar-based method to assess drinking and other behaviors over the past 90 days.²⁵ For each day in the assessment period, participants reported the number of standard drinks consumed, whether or not they had intercourse, and the presence and type of contraception used. The TLFB provides a continuous stream of data that can be averaged, analyzed over time, and used to provide summaries of amount and frequency of drinking and other behaviors. Using the TLFB, one can determine if drinking falls in a risky category, either by exceeding the limit of 7 drinks per week for women or by reports of episodes of more than 3 drinks per occasion as defined by the National Institute on Alcohol Abuse and Alcoholism (NIAAA).²⁶ In addition, participants received the Alcohol Use Disorders Test-C (AUDIT-C), which is a three-question instrument assessing frequency of drinking, drinks per drinking day, and frequency of heavy drinking (>6 drinks) over the past year,²⁷ and portions of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), which measures past 3-month use.²⁸ Symptoms of the alcohol use disorders were measured using a modification of the TWEAK alcohol screening test²⁹ and the Mini-International Neuropsychiatric Interview (M.I.N.I.).³⁰

Contraception efficacy was assessed by dividing episodes of contraception use reported on the TLFB by episodes of intercourse to yield a rate of effective contraception. Lastly, obstetric history and treatment services use were assessed using structured interview questions. Participants in the current study were categorized based on risk for AEP alone (reported risky drinking and ineffective contraception) or dual risk of AEP/SEP (reported risky drinking and smoking cigarettes in the past 30 days and ineffective contraception).

Descriptive statistics of variability and central tendency were used to describe each group, and differences between groups were analyzed using *t* tests for continuous data and chi-square tests for categorical data.

Results

A total of 217 participants were recruited for the larger investigation, which was designed to test three interventions to reduce the risk of AEP. All women were enrolled in the study because of their risk for AEP. In examining the data, it became clear that approximately half were current smokers (50.2%, *n* = 109).

Demographic characteristics

As shown in Table 1, women at risk for SEP/AEP did not differ from women at risk of AEP in terms of age or race. Both groups were in their late 20s, with a fairly even distribution of black and white participants. However, SEP/AEP women had significantly lower educational levels than AEP women. In addition, SEP/AEP women differed in terms of marital status, with a larger proportion of women living with their current partner. SEP/AEP participants were less likely to be employed or in school and more likely to be unemployed.

Sexual behavior characteristics

Table 2 lists the sexual behavior characteristics of women in the two categories. Women at risk for SEP/AEP had earlier onset of sexual intercourse and contraception. No differences were found in pregnancy histories, with the exception of a higher number of live births among smokers. Live births refer to pregnancies that did not end in abortions, miscarriages, or ectopic pregnancies. SEP/AEP women were more likely to

have been tested for sexually transmitted diseases (STDs) and HIV. SEP/AEP women reported higher sexual frequency but did not differ from women at risk for AEP in number of sexual partners. In addition, SEP/AEP participants reported different primary contraception methods, including less use of condoms and oral contraceptives and more use of withdrawal or no contraception method. Overall, the efficacy of current contraception was lower among SEP/AEP risk women.

Substance use characteristics

As described in Table 3, the majority of SEP/AEP risk women endorsed daily smoking and smoked on an average of 24 days out of the past 30. SEP/AEP risk women smoked an average of 8.99 (standard deviation [SD] 7.25) cigarettes per day. All the women in the smoking sample were likely nicotine dependent, as they reported smoking within 30 minutes of waking, with nearly 50% smoking within 10 minutes of waking. Alcohol use disorders were more common among SEP/AEP risk women, particularly alcohol dependence. In addition, SEP/AEP risk women were more likely to have attended current or past outpatient mental health clinics, substance use services, and Alcoholics Anonymous (AA) meetings. Frequency of drinking was heavier among SEP/AEP risk women, and this group was significantly more likely to drink 4 or more days per week. In addition, SEP/AEP women were more likely to report heavy drinking as measured by AUDIT-C and TLFB measures. Rates of lifetime illicit drug use were generally low, with only a small proportion of the women reporting ever using cocaine (<9%), heroin (<5%), hallucinogens (<6%), inhalants (<2%), tranquilizers (<3%), opiates or opioids other than heroin (<11%), or stimulants (<3%). Lifetime drug use did not differ between the groups with the exception of marijuana use, which was

TABLE 1. DEMOGRAPHIC CHARACTERISTICS OF SMOKERS AND NONSMOKERS AT RISK FOR ALCOHOL EXPOSED PREGNANCY

Characteristic	Nonsmokers <i>n</i> = 108		Smokers <i>n</i> = 109		Test statistic
	Mean	SD	Mean	SD	
Age	X 27.2 (SD 6.8)		X = 28.4 (SD 7.95)		$t_{(214)} = -1.13$
Education level	X = 14.3 (SD 1.7)		X = 12.9 (SD 7.95)		$t_{(195)}^S = 5.04^{****}$
Race	<i>n</i>	<i>p</i>	<i>n</i>	<i>p</i>	chi-square ₍₃₎ = 6.11
Black	45	42.9%	60	55.1%	
White	52	40.0%	40	36.7%	
Other	14	13.3%	8	7.3%	
Asian	4	3.7%	1	0.9%	
Marital status					chi-square ₍₄₎ = 12.20*
Never married	71	65.7%	56	51.9%	
Living together	14	13.0%	35	32.4%	
Married	12	10.1%	7	6.9%	
Separated	6	5.6%	6	5.6%	
Divorced	5	4.6%	4	3.7%	
Employment					chi-square ₍₇₎ = 32.30^{****}
Employed	47	43.5%	41	38.3%	
Student	47	43.5%	23	21.5%	
Unemployed	14	13.0%	43	40.2%	

^S*t* test used Satterwaite method to correct for unequal variances.

p* < 0.05; *p* < 0.01; ****p* < 0.001; *****p* < 0.0001.

SD, standard deviation.

TABLE 2. SEXUAL HISTORY AND BEHAVIORS OF CENTRAL VIRGINIA SMOKERS AND NONSMOKERS AT RISK FOR ALCOHOL EXPOSED PREGNANCY

Characteristic	Nonsmokers n=108		Smokers n=109		Test statistic
	Mean	SD	Mean	SD	
Age of sexual debut	16.4	2.5	15.4	2.3	$t_{(219)}=3.19^{***}$
Age of onset of contraception	16.6	2.5	15.9	2.2	$t_{(218)}=2.01^*$
Age of first pregnancy	13.9	9.4	15.5	8.0	$t_{(150)}=-1.22$
no. of unplanned pregnancies	1.7	2.0	2.0	1.9	$t_{(167)}=-0.97$
no. of miscarriages	0.7	1.6	0.7	9	$t_{(165)}=0.23$
no. of abortions	0.8	0.90	0.6	1.0	$t_{(165)}=1.40$
no. of live births	0.8	1.1	1.4	1.9	$t_{(218)}^S=-2.56^*$
Number of male sex partners in 90 days (TLFB)	1.5	0.9	1.7	1.2	$t_{(200)}^S=-1.33$
Days with sexual intercourse in 90 days (TLFB)	23.0	16.1	31.6	19.7	$t_{(218)}=-3.54^{***}$
Efficacy of current contraception	32.6%	31.4%	24.7%	27.3%	$t_{(213)}^S=1.97^*$
	<i>n</i>	<i>p</i>	<i>n</i>	<i>p</i>	
Had STI testing	37	33.6	n=55	49.6	chi-square ₍₁₎ =5.76*
Had HIV testing	81	73.6	n=99	89.2	chi-square ₍₁₎ =8.84**
Primary contraception (TLFB)	52	48.2%	44	39.6%	chi-square ₍₉₎ =18.94*
Male condoms	23	21.3%	29	26.1%	
Withdrawal ^a	12	11.1%	21	8.9%	
Nothing ^a	17	15.7%	7	6.3%	
Pill	0	0	4	3.6%	
Depo-Provera	2	1.9%	0	0	
Mixed methods	0	0	2	1.8%	
Spermicide ^a	0	0	1	0.9%	
Douching ^a	1	0.9%	0	0	
Vaginal ring					

^aNot an effective contraception method

^S*t* test used Satterthwaite method to correct for unequal variances.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$.

STI, sexually transmitted infection; TLFB, timeline follow-back.

more common among SEP/AEP risk women (61.8%) than AEP risk women (45%) (chi-square₍₄₎=14.15, $p < 0.01$).

Discussion

Among a sample of women recruited based on their risk of AEP, approximately half were also at risk for SEP. The high proportion of smokers among women at risk for AEP is in itself striking and suggests a strong need for dual focused preconception interventions. Our data also suggest that SEP/AEP women engage in higher rates of and higher intensity risk behaviors. In addition to the added risk of SEP, SEP/AEP women report more behaviors that contribute to AEP risk than their AEP alone counterparts. Specifically, SEP/AEP women display heavier drinking, higher rates of dependence, increased sexual activity, and poorer contraception use and efficacy than women at risk only for AEP. These findings suggest that these women may be in need of more intensive services. Thus, even among a sample of women at risk for AEP, women at dual risk for SEP/AEP may be most in need of services and prevention efforts during the preconception period.

High rates of previous inpatient and outpatient mental health and substance abuse treatment among women at risk for AEP/SEP suggest that these treatment settings may be viable venues in which to target at-risk women for preventive interventions. Additionally, AEP/SEP women may require interventions that address their mental health needs. SEP/

AEP women have lower levels of education and employment, characteristics that may be proxies of increased risk. Future research should address the degree to which these characteristics may moderate the relationship between smoking behavior and other risk behaviors. Educational factors may also need to be considered when selecting potentially promising treatment modalities. There is no evidence about what types of treatment might be most appropriate for SEP/AEP women, but promising evidence from the AEP prevention literature suggests that interventions informed by motivational interviewing interventions may be a good place to start.³¹⁻³³

There are serious consequences to missing preconception opportunities to intervene with women at risk for AEP and SEP.³⁴ The prepregnancy period allows for early identification of risk factors that if left until pregnancy, could already have had detrimental effects on the unborn child. Fortunately, there are several reasons to believe that effective preconception interventions with SEP/AEP risk women may be possible. Screening for women at dual risk for SEP/AEP may be feasible because most of the high-risk variables can be identified quickly using self-administered questionnaires that are highly reliable in addition to clinician history taking.³⁵ Surveys of women of childbearing age have demonstrated that the introduction of prepregnancy health promotion interventions would be welcomed and of potential benefit.³⁶ A recent major review of preconception interventions determined that there is some evidence that health promotion interventions are

TABLE 3. SMOKING AND DRINKING CHARACTERISTICS OF CENTRAL VIRGINIA SMOKERS AND NONSMOKERS AT RISK FOR ALCOHOL-EXPOSED PREGNANCY

Characteristic	Nonsmokers n=108		Smokers n=109		Test statistic
	Mean	SD	Mean	SD	
How many days do you smoke of 30 days?	0	0	24.3	9.7	$t_{(109)}^S = -26.14^{****}$
Cigarettes per day	0	0	9.0	7.3	$t_{(109)}^S = -13.01^{****}$
Minutes after waking until first cigarette	N/A	N/A	27.5	48.8	
Smoking within 10 minutes of waking (n=79)	N/A	N/A	48	60.8%	
Smoking within 30 minutes of waking (n=79)	N/A	N/A	62	78.5%	
Age of first drink	15.7	2.7	14.9	3.1	$t_{(219)} = 2.10^*$
Years between first drink and regular drinking	3.3	4.5	2.8	3.6	$t_{(215)} = 1.00$
How many days in 30 with at least one drink?	9.7	7.7	13.3	9.7	$t_{(215)} = -3.02^{**}$
Number of drinks before feeling effects	2.78	2.4	3.57	2.7	$t_{(171)}^S = -1.74$
How many drinks to intoxication?	3.6	5.0	5.75	6.9	$t_{(197)}^S = -2.59^*$
Drinks/week in 90 days (TLFB)	10.6	14.8	18.8	23.9	$t_{(184)}^S = -3.06^{**}$
Drinks/drinking day in 90 days	4.0	2.6	5.1	4.9	$t_{(170)}^S = -2.05^*$
Drinking days in 90	31.1	21.8	43.9	24.5	$t_{(218)} = -4.07^{****}$
Binges (4+) in 90 days	13.8	16.8	23.7	24.1	$t_{(197)}^S = 3.52^{***}$
	n	p	n	p	
How often do you smoke?					chi-square _(2 df) = 221.0^{****}
Not at all	110	100%	0	0	
Some days	0	0	34	30.6%	
Every day	0	0	77	69.4%	
DSM-IV alcohol use disorders by M.I.N.I.					chi-square ₍₂₎ = 7.14*
None	51	46.8%	33	30.0%	
Abuse	25	22.9%	28	25.5%	
Dependent	33	30.3%	49	44.6%	
In outpatient mental health treatment currently	4	3.6%	12	10.8	chi-square ₍₁₎ = 4.34*
Has had outpatient substance abuse treatment	4	3.6%	13	11.7%	chi-square ₍₁₎ = 5.07*
Has had inpatient substance abuse treatment	4	4.6%	14	12.6%	chi-square ₍₁₎ = 4.58*
Has attended AA meetings	5	4.6%	23	20.7%	chi-square ₍₁₎ = 13.06^{**}
Frequency of drinking					chi-square ₍₃₎ = 7.87*
Monthly or less	9	8.2%	7	6.3%	
2-4 times/month	33	30.0%	19	17.1%	
2-3 times/week	49	44.6%	52	46.9%	
4+ times/week	19	17.3%	33	29.7%	
Drinks per day (Q/F measure)					chi-square ₍₄₎ = 14.34^{**}
1-2	21	19.3%	11	9.9%	
3-4	43	39.5%	32	28.8%	
5-6	26	23.9%	25	22.5%	
7-9	13	11.9%	26	23.4%	
10+	6	5.5%	17	15.3%	
Frequency of heavy drinking (6 or more drinks over 12 months from AUDIT-C)					chi-square ₍₄₎ = 11.50*
Never	8	7.3%	6	5.4%	
Less than monthly	42	38.1%	26	23.4%	
Monthly	29	26.4%	26	23.4%	
Weekly	27	24.6%	40	36.0%	
Daily/almost daily	4	3.6%	13	11.7%	

^St test used Satterthwaite method to correct for unequal variances.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$.

AA, Alcoholics Anonymous; AUDIT-C, Alcohol Use Disorder Test-C; M.I.N.I., Mini-International Neuropsychiatric Interview; N/A, not applicable; Q/F, quantity and frequency.

associated with positive maternal behavioral change, including lower rates of binge drinking.³⁶

Conclusions

Nearly half of U.S. pregnancies are unplanned, and many women do not become aware of their pregnancy status until 4-6 week postconception.¹⁷ During this first trimester, when fetal organ systems are developing, persistent drinkers and

smokers continue to expose the fetus to the teratogenic effects of alcohol, harmful prenatal effects of tobacco, or both. Screening for potential SEP/AEP among women of childbearing age, along with referral to preventive interventions, could improve health outcomes for women and their newborns. Provision of health promotion interventions before conception, particularly those adapted for and relevant to appropriate high-risk groups, may encourage changes in behavior that lead to more healthy pregnancies for mother and child.

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Disclosure Statement

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