Risk Factors for Smoking in Rural Women: The Role of Gender-Based Sexual and Intimate Partner Violence

Julianna M. Nemeth, PhD,¹ Amy E. Bonomi, PhD, MPH,² Bo Lu, PhD,¹
Richard G. Lomax, PhD,³ and Mary Ellen Wewers, PhD, MPH¹

Abstract

Background: Women living in Ohio Appalachia experience cervical cancer at disproportionately high rates. Intimate partner and sexual gender-based violence (GBV) and smoking are independent risk factors for cervical cancer and interact to heighten risk. Appalachian women smoke at higher rates than other Ohio women, but little is known about GBV exposure in the region. The purpose of this study was to establish prevalence of women's exposure to GBV in Ohio Appalachia and examine the association between GBV and smoking among women in the region.

Methods: A two-phase address-based random sampling approach was used in three purposefully selected Ohio Appalachian counties to identify women to complete an interviewer administered cross-sectional survey ($n = 398$). The primary exposure variable was GBV Index Score, a 4 level indices representing increasing exposure to eight abuse types. Correlation analysis and logistic regression were used to examine smoking correlations and risk.

Results: Almost 57% of women in the three selected Ohio Appalachian counties experienced GBV, with rate increasing to 77.5% among current smokers. The distribution of the GBV Exposure Index Score was significantly different across smoking status ($p < 0.0001$), with exposure of GBV increasing when moving from never, to former, to current smokers. When controlling for depression, age, and adult socioeconomic position, GBV Exposure Index was significantly associated with current smoking behavior (OR:1.62, 95% CI [1.21–2.17]).

Discussion: Professionals working to reduce disparate disease burden among women in Ohio Appalachia should consider the role GBV plays in health behavior and behavioral change interventions, including smoking and smoking cessation.

Introduction

RESIDENTS OF OHIO Appalachia, compared to other Ohioans, are burdened by smoking-attributable disease, including cancer.^{1–4} Although cancer of the lung and bronchus is elevated in Ohio Appalachia, the greatest disparity in incidence and mortality for smoking-attributable cancer is observed for cancer of the cervix.⁴ Among Ohio Appalachian women, from 2000 to 2004, the average annual age-adjusted cervical cancer incidence rate was 9.7 per 100,000 and mortality rate was 3.4 per 100,000—rates 24.4% and 41.7% higher, respectively, than among non-Appalachian residing women.⁵

Tobacco use remains the single most preventable cause of morbidity and premature mortality today.^{6–10} Its use is concentrated among populations marginalized due to education, poverty, substance abuse, disability, and geography.^{11–16} For instance, regional differences in smoking prevalence persist

for women Ohio Appalachian residents, and smoking is an established risk factor linked to elevated cervical cancer incidence and mortality in the region.^{1,3} In Ohio Appalachia, in 2012, 32.1% of women aged 19 and older smoked every day or some days—compared with 22.7% in metropolitan regions, 24.4% in rural non-Appalachian regions, and 23.3% in suburban regions of the state.¹⁷ Among Ohio Appalachian women, risk factors for smoking include low socioeconomic position in adulthood, depressive symptoms, first pregnancy before age 20, and younger age.¹⁶

In addition to smoking, a recently identified risk factor for cervical cancer is exposure to gender-based violence (GBV) against women, defined to include intimate partner violence, child sexual abuse, and forced sex in adulthood.¹⁸ A cross-sectional analysis of the 2006–2007 Kentucky Women's Health Registry demonstrated after controlling for other risk factors, women with exposure to any GBV had 2.6 times the

¹College of Public Health, The Ohio State University, Columbus, Ohio.

²College of Social Science, Michigan State University, East Lansing, Michigan.

³College of Education and Human Ecology, The Ohio State University, Columbus, Ohio.

odds of ever having cervical cancer compared to women with no exposure; whereas the odds of ever having cervical cancer increased to 6.4 among women with exposure to all three types of abuse compared to those never exposed.¹⁸

In addition, and of central importance to this study, while ever smoking (OR 2.3) and ever having experienced violence against women (OR 2.7) were both associated with cervical cancer, the combined effect of ever smoking and ever having experienced violence raised the odds of cervical cancer incidence substantially (OR 4.9).¹⁸ Although elevated rates of smoking among women in Ohio Appalachia are documented, no estimates exist for a spectrum of GBV exposure types that, if present, could contribute independently, or in interaction with smoking, to cervical cancer disparities in the region.

In addition, due to the documented relationship between various forms of GBV and smoking, GBV, if present, may also contribute to the elevated rate of smoking among Appalachian women. For instance, childhood sexual abuse is associated with smoking, smoking persistence, nicotine dependence, daily cigarettes consumed, earlier age of regular smoking onset, and more severe withdrawal symptoms among smokers attempting to quit.^{19–28} In a nationally representative U.S. sample, adolescent girls reporting a history of both physical and sexual abuse had odds of regular smoking 5.90 times that of nonexposed girls.²² In addition, multiple exposures to assaultive violence, including sexual abuse, in childhood were a robust positive predictor of cigarette smoking later in life.²⁰ Despite the increased use of tobacco by victims, women exposed to childhood sexual abuse are less likely to have received substance abuse treatment over their lifetime when compared to never exposed women.²⁹

Adult sexual and intimate partner violence exposure is also associated with smoking, along with other risk factors for smoking, including lower socioeconomic position, younger age, and increased depression.^{30–33} In the United States, current or past intimate partner violence exposure is associated with elevated odds for smoking,^{28,34–42} with current smoking odds 2.1 times that of nonexposed women.^{38,41} Multiple instances of physical and sexual abuse by a partner further accentuates this risk.³⁷

Preliminary evidence suggests that physical intimate partner violence exposure, one type of GBV, is associated with smoking among women in Ohio Appalachia.³⁴ In a population-based sample, the unadjusted odds of smoking among Ohio Appalachian women with a lifetime history of physical intimate partner violence was 3.47 times the odds of smoking among women with no exposure.⁴³ Given the cervical cancer disparity impacting women in Ohio Appalachia, further investigation is warranted to document the burden of a fuller spectrum of intimate partner and sexual GBV exposure in the region, and its association with smoking status.

This investigation used data collected from a National Cancer Institute (NCI)-funded Center for Population Health and Health Disparities study to answer the following questions: (1) What is the prevalence of a spectrum of intimate partner and/or sexual GBV abuse types among Ohio Appalachian women? (2) What is the distribution of smoking status (never, former, and current) by intimate partner and/or sexual GBV exposure among Ohio Appalachian women? (3) What is the association between cumulative exposure to a spectrum of intimate partner and/or sexual GBV abuse types and current smoking behavior among Ohio Appalachian

women, accounting for other known risk factors for smoking among women in this region, including depression, age, and adult socioeconomic position?

This investigation informs an understanding of the relationship between two known risk factors for cervical cancer development, in general, and how GBV, in particular, may contribute to elevated cervical cancer and smoking disparities among women in the region.

Materials and Methods

Study design and recruitment

A two-phase address-based sampling approach was used to recruit a random sample of women, 18 years of age or older, from three purposely selected Ohio Appalachian counties, to participate in an observational, interview-administered, cross-sectional survey.⁴⁴ A recruitment letter, household enumeration questionnaire, stamped return envelope, and \$2 bill were sent to each household randomly sampled from a U.S. Postal Service list. A household resident was asked to return the completed questionnaire. For households not responding to the first mailing, two additional mailings, without monetary incentive, were sent 3 and 6 weeks after the initial mailing. Upon its return, an eligible woman (*i.e.*, 18 or older and residing in one of the three counties) was randomly selected for participation in the study. A local research interviewer contacted the selected participant to explain and invite participation into the study and, if interested, set a time for consent and interview. The Ohio State University Institutional Review Board approved the study.

Interview procedure

During training, interviewers received instruction on a trauma-informed distress protocol⁴⁵ designed for this study. All interviews were conducted at a private location chosen by the participant. After consenting, interviewers read out loud all survey questions and response options and used REDCap electronic data capture tools to record answers on a secure laptop.⁴⁶ Consent to proceed was obtained twice during the abuse exposure question module. Upon completion, participants were offered a list of county-specific women's health resources and received a \$50 gift card.

Measures

Demographic variables included the following: age (18–29, 30–49, and ≥50 years); race (white vs. other); education (less than HS, HS diploma, General Educational Development (GED), and >high school diploma); marital status (married, divorced or separated, widowed, never been married, and living with a partner); annual household income; number and age of people living at residence of participant; and health insurance (private, government assisted, or none). In addition, the following measures were collected and/or variables derived.

GBV type and lifetime cumulative abuse exposure measures

Sexual and/or intimate partner GBV-type exposure. Sexual and/or intimate partner GBV lifetime exposure was measured by 22 questions using modified National Intimate and Sexual Violence Survey (NISVS)⁴⁷ measures and abuse-related medical restriction questions developed by the study team. Based on

prior methodological analysis,⁴⁸ lifetime sexual and/or intimate partner GBV victimization was modeled using eight abuse types—demeaning emotional abuse, fear invoking control, isolation, physical assault, medical restriction, and reproductive coercion by an intimate partner, in addition to coerced and forced sexual abuse by an intimate partner or other.

Gender-based sexual and intimate partner violence exposures index score (GBV exposure index). A four-level composite variable representing lifetime cumulative exposure to eight types of sexual and/or intimate partner GBV, the GBV Exposure Index, was created. Participants were categorized into one of four GBV Exposure Index levels: no exposure, low exposure (exposure to any one type of gender-based sexual and/or intimate partner violence), moderate exposure (exposure to any two to six types), or high exposure (exposure to seven or eight types), coded as 0–3.

Smoking measure

Smoking status. Questions from the National Health Interview Survey and the NCI-sponsored Tobacco Use Supplement to the Current Population Survey were used to assess smoking status. Participants were categorized as never smokers if they reported never having smoked 100 cigarettes in their lifetime; as former smokers if they had smoked 100 cigarettes in their lifetime, but did not smoke now; and as current smokers if they had smoked 100 cigarettes in their lifetime and now smoke cigarettes every day or most days.^{49–51}

Other risk factors for smoking

Adult socioeconomic position. A woman's adult socioeconomic position (SEP) was defined as high if the participant met the following three requirements: (1) a poverty income ratio above the sample's median cutoff point; (2) private health insurance; and (3) education >high school diploma. Otherwise, adult SEP was defined as low.¹⁶

Depressive symptomology as measured by the center for epidemiologic studies depression scale⁵². The center for epidemiologic studies depression scale (CES-D) is a 20-item instrument, range score 0–60, intended for use in the general population to assess frequency of past week feelings and behaviors associated with depression. A cutpoint of ≥ 16 as standardly used within epidemiologic surveys indicated depressive symptoms of clinical concern.⁵²

Adverse childhood experiences. Selected adverse childhood experience (ACE) exposures were measured, including parental separation or divorce, witnessing parental intimate partner violence, and parental physical and emotional abuse of participant before the age of 18. An ACE Score was totaled, with participants receiving 1 point for each ACE exposure, range 0–4.⁵³ Since it was included in the composite GBV Exposure Index score, we excluded childhood sexual abuse from this composite ACE score.

Statistical analysis

Analysis was performed in SAS, Version 9.3.⁵⁴ To answer research question 1, descriptive statistics were calculated for each abuse exposure variable.

To answer research question 2, participants were categorized by smoking status (*i.e.*, never, former, and current) and descriptive statistics were calculated for each demographic variable. Chi-square tests were performed for categorical variables and Kruskal–Wallis tests were performed for ordinal variables to determine if the distribution of each demographic and abuse exposure variable differed across smoking status.

To answer research question 3, and mirroring the modeling for smoking status on the published risk factor for smoking paper among this population,¹⁶ a multivariable logistic regression model was fit with the binary outcome of smoking status (1 = current smoker, 0 = former, and never smoker). Univariate analysis with binary smoking status was performed for all known risk factors for smoking among this population¹⁶ contained in the dataset and all abuse exposure variables, using LOGISTIC procedure in SAS. All univariate terms found to have significant associations ($p = .05$) were then added to a multivariable logistic regression model to allow for the independent effect of each variable, controlling for other known risk factors. The model fit was examined using the Hosmer–Lemeshow test and area under the receiver operating characteristic curve.⁵⁵

Results

Response rate

Details regarding response rate calculations are described elsewhere.⁴⁴ Of households sampled, 44.4% completed enumeration surveys. From responding households, eligible women were selected into the sample, of which 71.0% ($n = 408$) participated in the survey.⁴⁴

Sample characteristics, including GBV exposure, by smoking status

The analytic sample comprised 398 participants who provided complete GBV exposure histories (97.5% of sample). Of those, abuse exposure distributions by never, former, and current smoking status and demographic characteristics are presented in Tables 1 and 2, respectively. Figure 1 depicts the percentage of never, former, and current smokers by GBV Exposure Index Score. As GBV Index Score increased, the percentage of never smokers decreased. In all categories, except among those with the highest level of exposure, there were more former smokers than current smokers. Among women who reported seven or eight types of GBV exposure, 61% currently smoked, whereas only 13% were former smokers, and 26% were never smokers.

Association between GBV abuse exposure and smoking status

Of respondents, 56.8% reported never smoking, 23.1% report past smoking, and 20.1% reported current smoking. There was a significant difference in sexual and/or intimate partner GBV lifetime exposure, and for each abuse type, across smoking status, with prevalence increasing when moving from never, to former, to current smokers (Table 1). Among current smokers, 77.5% reported sexual and/or intimate partner violence lifetime exposure, compared to 69.6% among former smokers and 43.8% among never smokers ($p < 0.0001$).

The categorical distribution of the GBV Exposure Index score was also significantly different across smoking status ($p < 0.0001$), with prevalence of exposure shifting toward

TABLE 1. DISTRIBUTION OF GENDER-BASED VIOLENCE AND ADVERSE CHILDHOOD EXPERIENCES EXPOSURE BY CURRENT SMOKING STATUS

Characteristic	Total (N=398)%	Never smokers (N=226)%	Former smokers (N=92)%	Current smokers (N=80)%	p value ^a
Sexual and/or intimate partner gender-based violence lifetime exposure (any)	56.53	43.81	69.57	77.50	<0.0001
Intimate partner psychological abuse (any)	51.76	40.27	61.96	72.50	<0.0001
Demeaning emotional abuse	31.41	22.12	42.39	45.00	<0.0001
Fear invoking control	40.45	29.65	46.74	63.75	<0.0001
Isolation	43.72	33.19	52.17	63.75	<0.0001
Intimate partner physical abuse (any)	21.61	12.39	27.17	41.25	<0.0001
Physical assault	20.85	11.95	26.09	40.00	<0.0001
Medical restriction	6.03	3.98	5.43	12.50	0.0219
Sexual abuse by an intimate partner or other (any)	33.67	22.57	46.74	50.00	<0.0001
Reproductive coercion (intimate partner)	9.30	5.75	10.87	17.50	0.0067
Coerced sexual abuse	22.36	14.60	28.26	37.50	<0.0001
Forced sexual abuse	22.86	11.95	34.78	40.00	<0.0001
Gender-based violence exposures index score					<0.0001
No exposure	43.47	56.19	30.43	22.50	
Low exposure (exposure to any one type of abuse)	12.56	13.72	11.96	10.00	
Moderate exposure (exposure to any 2–6 types of abuse)	38.19	27.43	54.35	50.00	
High exposure (exposure to 7 or 8 types of abuse)	5.78	2.65	3.26	17.50	
Adverse childhood experiences exposure (ACE) score (n=396)					0.0014
No exposure	45.20	53.54	39.13	28.21	
Exposure to 1 ACE	26.77	25.66	30.43	25.64	
Exposure to 2 ACE	14.90	12.39	15.22	21.79	
Exposure to 3 ACE	6.57	3.98	8.70	11.54	
Exposure to 4 ACE	6.57	4.42	6.52	12.82	
Gender-based violence exposures index (range 0–3)					p value ^b
Mean (SD)	1.06 (1.02)	0.77 (0.94)	1.30 (0.95)	1.63 (1.02)	<0.0001
Median (Var)	1.00 (1.05)	0.00 (0.89)	2.00 (0.90)	2.00 (1.05)	
Adverse childhood experiences exposure score (n=396, range 0–4)					<0.0001
Mean (SD)	1.03 (1.21)	0.80 (1.09)	1.13 (1.22)	1.55 (1.35)	
Median (Var)	1.00 (1.46)	0.00 (1.18)	1.00 (1.48)	1.00 (1.84)	

^aChi-square test performed for categorical variables.^bKruskal–Wallis test performed for ordinal variables.

ACE, adverse childhood experiences.

higher GBV Exposure Index categories when moving from never, to former, to current smokers. Among never smokers, the mean GBV Exposure Index score (range: 0–3) was 0.77 and the median was 0 exposures, compared to a mean of 1.30 and a median of two exposures among former smokers, and a mean of 1.63 and a median of two exposures among current smokers.

Association between demographic characteristics and smoking status

The distribution of categorical age, education, marital status, adult socioeconomic position, and depressive symptoms of clinical concern were all significantly different between smoking status exposure categories (Table 2). Current smokers were less educated than former smokers who reported less education than never smokers. High adult socioeconomic position was concentrated among never smokers (50%) versus only 30% among former smokers and 15% among current

smokers. CES-D scores of clinical concern were most concentrated among current smokers (29%), followed by former smokers (21%), and then never smokers (13%).

Univariate associations with current smoking for GBV exposure and known smoking risk factors

Univariate models were fit for each of 8 sexual and/or intimate partner GBV exposure types, for the GBV Exposure Index score, for ACE (by exposure level and for the ACE composite score), and for known risk factors for smoking among rural women,¹⁶ including categorical age, adult socioeconomic position, and depressive symptoms of clinical concern (Table 3). Each type of GBV exposure and the composite GBV Exposure Index variable modeled continuously had significant associations with current smoking, as did all previously established risk factors for smoking.

TABLE 2. DISTRIBUTION OF SAMPLE DEMOGRAPHIC CHARACTERISTICS AND BY CURRENT SMOKING STATUS

Characteristic	Total (N=398)%	Never smokers (N=226)%	Former smokers (N=92)%	Current smokers (N=80)%	p value ^a
Age, categorical					0.0055
18–29 years old	13.57	15.04	5.43	18.75	
30–49 years old	31.41	26.99	33.70	41.25	
50+ years old	55.03	57.96	60.87	40.00	
Race, White					0.0867
White	96.48	97.79	96.74	92.50	
Other	3.52	2.21	3.26	7.50	
Education					0.0006
Less than high school (HS)	6.28	1.77	10.87	13.75	
HS diploma	25.63	25.22	27.17	25.00	
GED	2.51	1.33	4.35	3.75	
>HS diploma	65.58	71.68	57.61	57.50	
Marital status					<0.0001
Married	66.08	74.78	61.96	46.25	
Divorced or separated	12.06	8.85	15.22	17.50	
Widowed	8.54	7.96	13.04	5.00	
Never been married	7.54	5.75	4.35	16.25	
Living with partner	5.78	2.65	5.43	15.00	
Income at or below 100% poverty threshold (n=350)	15.14	8.67	10.98	37.50	<0.0001
Adult socioeconomic position (n=350)					<0.0001
Hi	38.00	49.49	30.49	15.28	
Low	62.00	50.51	69.51	84.72	
Depressive symptoms of clinical concern					0.0030
CES-D score					
<16	82.23	87.44	79.35	70.89	
≥16	17.77	12.56	20.65	29.11	

^aChi-square test performed for categorical variables. Kruskal–Wallis test performed for ordinal variables. GED, General Educational Development.

Association of GBV exposure index score with current smoking, controlling for risk factors for smoking

Maximum likelihood estimates from the final adjusted model for risk factors for smoking are presented in Table 4. Cumulative sexual and/or intimate partner violence exposure was independently associated with current smoking, control-

ling for age, depression, and adult socioeconomic position ($p=0.0013$). For each increased level of exposure on the GBV Exposure Index, the odds of being a current smoker were 62% higher, controlling for other known risk factors for smoking (95%CI: 1.21–2.17). Subsequently, the odds of current smoking among those with a low GBV Exposure Index score (exposure to 1 type of abuse) was 1.62 (95%CI: 1.21–2.17), among

FIG. 1. Percentage of Never, Former, and Current Smokers by Gender-based Violence Exposure Index Score.

TABLE 3. UNIVARIATE ODDS RATIOS AND 95% CONFIDENCE INTERVALS OF CURRENT SMOKING

	<i>OR (95% CI) of being a current smoker vs. nonsmoker^a</i>	<i>p value</i>
Sexual and/or intimate partner gender-based violence exposure types (<i>n</i> =398)		
No exposure to gender-based violence	1.0	
Demeaning emotional abuse	2.11 (1.27–3.49)	0.0038
Fear invoking control	3.33 (2.00–5.54)	<0.0001
Isolation	2.79 (1.68–4.64)	<0.0001
Physical assault	3.49 (2.04–5.98)	<0.0001
Medical restriction	3.10 (1.32–7.27)	0.0092
Reproduction coercion (intimate partner)	2.72 (1.33–5.57)	0.0061
Coerced sexual abuse (intimate partner or other)	2.63 (1.55–4.49)	<0.0001
Forced sexual abuse (intimate partner or other)	2.93 (1.72–4.97)	<0.0001
Gender-based violence exposures index (<i>n</i> =398)		
No exposure	1.0	
Low exposure (exposure to any one of 8 types of abuse from above)	1.64 (0.67–4.03)	0.2812
Moderate exposure (exposure to any 2–6 types of abuse)	3.08 (1.68–5.64)	0.0003
High exposure (exposure to 7 or 8 types of abuse)	13.40 (5.08–35.31)	<0.0001
Gender-based violence exposure index score (range: 0–3)	2.03 (1.56–2.64)	<0.0001
Adverse childhood experiences exposure		
No exposure	1.0	
Exposure to 1 ACE	1.66 (0.86–3.21)	0.1326
Exposure to 2 ACE	2.89 (1.41–5.93)	0.0038
Exposure to 3 ACE	3.78 (1.50–9.51)	0.0048
Exposure to 4 ACE	4.46 (1.80–11.05)	0.0012
ACE Score (range: 0–4)	1.50 (1.24–1.82)	<0.0001
Categorical Age		
18–29 years old	2.25 (1.11–4.54)	0.0241
30–49 years old	2.10 (1.21–3.62)	0.0080
50+ years old	1.0	
Adult socioeconomic position		
Low	1.0	
High	0.23 (0.12–0.46)	<0.0001
Depressive symptoms of clinical concern		
CES-D score <16	1.0	
CES-D score ≥16	2.34 (1.31–4.17)	0.0038

^aNonsmoker combines never and former smoker categories.

those with a moderate GBV Exposure Index score (exposure to 2–6 types of abuse) was 2.62 (95%CI: 1.46–4.71), and among those with a high GBV Exposure Index score (exposure to seven or eight types of abuse) was 4.24 (95%CI: 1.76–10.23) times the odds of current smoking among those with no GBV exposure, controlling for depression, age, and adult socioeconomic position. When controlling for other risk factors, including GBV Exposure score, high socioeconomic position in

adulthood was a protective factor against current smoking (OR: 0.28, 95%CI: 0.14–0.56). Current smoking prevalence was higher among women with high depressive symptomology (CES-D Score ≥16) at each level of GBV exposure (Fig. 2); however, when controlling for GBV Exposure score, age, and adult socioeconomic position, depressive symptomology was no longer independently associated with current smoking (OR: 1.55, 95%CI: 0.80–3.00).

TABLE 4. MAXIMUM LIKELIHOOD ESTIMATES FOR CURRENT SMOKING FROM MULTIVARIATE LOGISTIC REGRESSION MODEL (*N*=350)

<i>Parameter</i>	<i>df</i>	<i>Estimate</i>	<i>SE</i>	<i>OR</i>	<i>95%CI</i>	<i>Wald χ^2</i>	<i>p value</i>
Intercept	1	−1.0075	0.5195			3.7606	0.0525
Gender-based violence exposures index (No, Low, Moderate, High)	1	0.4819	0.1496	1.62	1.21–2.17	10.3792	0.0013
CES-D Score (<16, ≥16)	1	0.4369	0.3379	1.55	0.80–3.00	1.6720	0.1960
Age (18–29, 30–49, 50+)	1	−0.2976	0.1916	0.74	0.51–1.08	2.4144	0.1202
High adult socioeconomic position (Yes/High, No/Low)	1	−1.2855	0.3583	0.28	0.14–0.56	12.8723	0.0003

Area under the receiver operating characteristic (ROC) curve = 0.7318. Hosmer–Lemeshow goodness-of-fit test chi-square statistic = 4.3261₍₇₎, *p* = 0.7415.

FIG. 2. Percentage of Current Smokers by Gender-based Violence Exposure Index Category at Depression Symptom Status.

Discussion

Intimate partner and sexual GBV is a notable public health issue in Ohio Appalachia—impacting nearly 6 out of 10 women in the counties surveyed. Estimates for GBV lifetime exposure from this study, more than double a recent estimate of 25% among US women,⁵⁶ far exceed an estimate of 35% among Ohio women⁴⁷ and rival estimates among subpopulations most at risk in the United States, including multiracial women, of which 50% report lifetime exposure.⁴⁷

Due to the already established relationship between GBV exposure, increased healthcare cost, and disparate health outcomes,^{18,57–60} including increased risk for cervical cancer,¹⁸ the remarkable prevalence of GBV in the sample population suggests those working to reduce health disparities in Ohio Appalachia might consider the role of GBV exposure—both in terms of its impact on modifiable risk behaviors and health outcomes.^{5,18} Healthcare providers in Ohio Appalachia should, minimally, heed the U.S. Preventative Services Task Force recommendation that all women of child bearing age be screened for intimate partner violence, regardless of impetus for healthcare visit, and referred to counseling and community intervention services to address safety and health impact.⁶¹

Cumulative exposure to multiple forms of GBV was independently associated with smoking among women in Ohio Appalachian counties surveyed, even when controlling for other risk factors for smoking among women in the region. Among current smokers, three in four reported sexual and/or intimate partner violence lifetime exposure. Findings from this study suggest that supporting survivors of GBV through the process of cessation may promote health justice for a population currently experiencing disparate health outcomes.^{58,59,62}

In the past decade, there has been a recognition within survivor-focused advocacy programs, like rape crisis centers, domestic violence shelters, and court-based programs, of the need for trauma-informed criminal justice, mental health, and addictions services.⁶³ There is an opportunity for those working with survivors to assess for smoking and to provide prevention and smoking cessation in traditional advocacy settings.⁶⁴ Conversely, smoking cessation programs may screen for GBV exposure, and when present, address the aftermath of traumatic exposure to help survivors of violence quit smoking.⁶⁵

Despite its association, little is known about the mediating pathways between abuse exposure and smoking or abuse

exposure's impact on the cessation process. It is known that depression increases risk for smoking relapse.^{66,67} Women with GBV exposure histories are at increased risk for depression.^{58,60,68,69} Depressive symptoms are negatively correlated with the ability to cope with stress for women exposed to intimate partner violence,⁷⁰ which then creates vulnerability for addiction and cessation failure.^{71,72} In our study, among women reporting exposure to GBV, those reporting depressive symptoms of clinical concern were more likely to smoke. The highest concentration of participants with high depressive symptoms (CES-D Score ≥ 16) was among those with moderate and high GBV exposure.

However, successful reduction in depression symptoms among women trauma survivors may not be enough to support cessation success. In a cessation study of pregnant women reporting childhood trauma exposure, a treatment successful in reducing depression still had no differential impact on successful cessation, even controlling for depression symptoms at baseline; notably, increasing accumulation of childhood trauma was a significant predictor of cessation failure.⁷³ Research is needed to understand, beyond depression, the intrapersonal differences for women with accumulated GBV exposure histories, including trauma and its role in the etiology of smoking.

Future longitudinal research is necessary to investigate the relationship between GBV exposure and smoking, especially due to the social context in which both are most likely to occur, and assess the efficacy of evidence-based smoking cessation interventions within these contexts. Populations at heightened risk for sexual and intimate partner violence victimization, as well as for smoking are likely to be vulnerable for other reasons.^{12,13,47} Their vulnerability, and the chronic stress they experience due to social and structural marginalization, may influence unhealthy coping and behavior patterns, like smoking,^{71,72} as well as limit access to social support for cessation.⁷⁴

A cessation intervention designed for survivors of GBV may need to account for how the environment impacts one's ability to successfully move through cessation and how the environment needs to be changed to help with the cessation process. Although a range of intrapersonal and contextual factors may need to be addressed to promote long-term abstinence among this population,⁷⁵ no known study has assessed the efficacy of providing a trauma-informed, contextually tailored intervention to promote cessation among intimate partner or sexual violence survivors.⁷⁶

There are limitations impacting analysis and study findings. First, cross-sectional data cannot be used to determine temporality—limiting interpretations regarding the relationship between exposure to GBV, depression, and smoking.

Second, no data were collected on age at first pregnancy, a known risk factor for smoking among rural women,¹⁶ so we could not control for it in analysis. However, reproductive coercion, a factor represented as one of eight types of abuse analyzed as well as in the composite GBV Index Score, is associated with unintended pregnancy,⁷⁷ especially among adolescents.⁷⁸

Third, there was a high degree of correlation between the GBV Exposure Index Score and the ACE Score variable ($r_s = 0.45789$, $p \leq 0.0001$) causing a problem of multicollinearity when both variables were added to the adjusted multivariate logistic model. Due to its high degree of correlation with the GBV Exposure Index Score, and in consideration of the primary study aim, ACE was excluded from the final model.

Finally, there are limitations to the generalizability of our findings:

First, although we randomly sampled households and women from households, we purposefully selected three Appalachian counties for participation in the study due to existent field staff and research infrastructure in the communities. Although the county compositions include diverse representation from Ohio Appalachia and the three counties studied have comparable smoking prevalence among women (32.1%), in comparison to all of Appalachia (31.8%),⁷⁹ population estimates presented are limited to the counties studied.

Second, survey participants were of higher economic standing and more educated than the communities from which they were sampled. Survey research is liable to coverage bias through underrepresentation of smokers and women exposed to sexual and intimate partner violence.⁸⁰ In addition, less than half of households sampled in our study returned completed enumeration surveys, and prior research has demonstrated that mail survey nonresponders are more likely to be of lower socioeconomic status and have poorer health outcomes.⁸¹ Indeed, our sample was of higher socioeconomic position than the communities from which they came, and only 20% of our sample reported current smoking, when the population estimate for women in the region is approaching 32%.^{17,79}

Although the self-report of tobacco use is considered reliable in observational studies,⁸² given the low prevalence of smokers in the sample and the high correlation between current smoking, socioeconomic standing, and GBV exposure, intimate partner and sexual GBV estimates produced for this analysis are probably conservative and underrepresent the true population parameter. Caution should be given when interpreting these findings. Researchers interested in establishing GBV prevalence estimates for residents of Appalachia should seek to minimize bias resulting from coverage and nonresponse error.

Conclusions

GBV may be a fundamental determinant of health (and health disparity) among Ohio Appalachian women, and should be assessed in health settings.⁶¹ Professionals working to reduce disparate disease burden among Ohio Appalachian women should consider the role GBV plays in exhibited health behavior, behavioral interventions, and disease progression and treatment.^{15,83,84}

For tobacco cessation, efforts geared toward Ohio Appalachian women, recognizing the significant prevalence of GBV in the region and understanding how programs aimed to promote tobacco cessation may also need to address trauma and safety concerns among a majority of the client population. In an area of the country where both tobacco cessation and sexual and intimate partner violence advocacy services are limited, it also means ensuring that general practitioners and public health professionals receive training and appropriate support to refer patients to resources, if available, or to directly address GBV, mental health, and cessation in health-based settings.

Acknowledgments

We would like to offer sincere appreciation to Tiffany Thomson, Ph.D., for her work in program management, and to Juan Peng, M.S., for advising on data management and derivation.

Author Disclosure Statement

The first author received predoctoral fellowship funding through the Behavioral Cooperative Oncology Group Center

for Symptom Management and the Walther Cancer Foundation. This study was supported by a grant from the National Cancer Institute (P50 CA105632) and the Behavioral Measurement Shared Resource at The Ohio State University Comprehensive Cancer Center (P30CA016058), and the Ohio State University Center for Clinical and Translational Science (Clinical and Translational Science Award, NIH/NICRR Grant Number UL1-RR025755). Funding sources had no involvement in the study design; collection, analysis, and interpretation of data; writing of the report; or decision to submit the article for publication. The authors have no competing financial interests to report.

References

1. Kapeu AS, Luostarinen T, Jellum E, et al. Is smoking an independent risk factor for invasive cervical cancer? A nested case-control study within Nordic biobanks. *Am J Epidemiol* 2009;169:480–488.
2. Paskett ED, Fisher JL, Lengerich EJ, et al. Disparities in Underserved White Populations: The Case of Cancer-Related Disparities in Appalachia. *Oncologist* 2011;16:1072–1081.
3. World Health Organization. World cancer report. London: International Agency for Research on Cancer, 2003.
4. Fisher JL, Engelhardt HL, Stephens JA, et al. Cancer-related Disparities among Residents of Appalachia Ohio. *J Health Disparities Res Pract* 2008;2:61–74.
5. Cervical Cancer in Ohio 2000–2004. Ohio Cancer Incidence Surveillance System. Available at: www.odh.ohio.gov/ASSETS/15415A7C864E4B09BA7495A00D39B1AB/Cervical04Final.pdf Accessed November 12, 2011.
6. United States Surgeon General's Advisory Committee on Smoking and Health. Smoking and health: Report of the Advisory Committee to the Surgeon General of the Public Health Service. Princeton, NJ: Van Nostrand, 1964.
7. McGinnis JM, Foege WH. Actual causes of death in the United States. *JAMA* 1993;270:2207–2212.
8. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Correction: Actual Causes of Death in the United States, 2000. *JAMA* 2005;293:293–294.
9. Public Health Service, Office of the Surgeon General. How tobacco smoke causes disease: The biology and behavioral basis for smoking-attributable disease: A report of the Surgeon General. Rockville, MD; Washington, DC: U.S. Department of Health and Human Services, 2010.
10. Carter BD, Abnet CC, Feskanich D, et al. Smoking and mortality—beyond established causes. *N Engl J Med* 2015; 372:631–640.
11. Centers for Disease Control and Prevention. Current cigarette smoking among adults - United States, 2011. *Morb Mortal Wkly Rep* 2012;61:889–894.
12. Warner KE. Disparities in smoking are complicated and consequential. What to do about them? *Am J Health Promot* 2011;25(5 Suppl):S5–S7.
13. Warner KE, Mendez D. Tobacco control policy in developed countries: Yesterday, today, and tomorrow. *Nicotine Tob Res* 2010;12:876–887.
14. Appalachia Regional Commission. Sociodemographic, health and county economic status designation in the Appalachian region—Fiscal Year 2006. Washington, DC: Appalachia Regional Commission, 2006.
15. Wewers ME, Katz M, Fickle D, Paskett ED. Risky behaviors among Ohio Appalachian adults. *Prev Chronic Dis* 2006;3:A127.

16. Wewers ME, Salsberry PJ, Ferketich AK, Ahijevych KL, Hood NE, Paskett ED. Risk factors for smoking in rural women. *J Women's Health* 2012;21:548–556.
17. Smoking prevalence among females in Ohio, by county grouping, using 2012 Ohio Medicaid Assessment Survey (OMAS) data. Available at: https://urldefense.proofpoint.com/v2/url?u=http-3A__grc.osu.edu_omas_datadownloads_2012_omaspublicdata_index.cfm&d=AwIF3g&c=k9MF1d71ITtkuJx-PdWme51dKbmfPEvxwt8SFekBfs4&r=JZ4Q19ZPnyvZNWb5aDgFObe_-HLtEIwORxR7u0Y2JLQ&m=LVeka9wnBh3OuHwTdy8uvoLHwZaP_3a5N4678MgddO8&s=vmRd2KfXI-gzLyoYJNCiNkgYEK6MPwb5ieLSjJnvRjk&e= Accessed November 1, 2013.
18. Coker AL, Hopenhayn C, DeSimone CP, Bush HM, Crofford L. Violence against Women Raises Risk of Cervical Cancer. *J Women's Health* 2009;18:1179–1185.
19. Anda RF, Croft JB, Felitti VJ, et al. Adverse childhood experiences and smoking during adolescence and adulthood. *JAMA* 1999;282:1652–1658.
20. Cisler JM, Amstadter AB, Begle AM, et al. A prospective examination of the relationships between PTSD, exposure to assaultive violence, and cigarette smoking among a national sample of adolescents. *Addict Behav* 2011;36:994–1000.
21. De Von Figueroa-Moseley C, Landrine H, Klonoff EA. Sexual abuse and smoking among college student women. *Addict Behav* 2004;29:245–251.
22. Diaz A, Simantov E, Rickert VI. Effect of abuse on health: Results of a national survey. *Arch Pediatr Adolesc Med* 2002;156:811–817.
23. Ford ES, Anda RF, Edwards VJ, et al. Adverse childhood experiences and smoking status in five states. *Prev Med* 2011;53:188–193.
24. Roberts ME, Fuemmeler BF, McClernon FJ, Beckham JC. Association between trauma exposure and smoking in a population-based sample of young adults. *J Adolesc Health* 2008;42:266–274.
25. Swanston HY, Plunkett AM, O'Toole BI, Shrimpton S, Parkinson PN, Oates RK. Nine years after child sexual abuse. *Child Abuse Negl* 2003;27:967–984.
26. Vander Weg MW. Adverse childhood experiences and cigarette smoking: The 2009 Arkansas and Louisiana Behavioral Risk Factor Surveillance Systems. *Nicotine Tob Res* 2011;13:616–622.
27. Al Mamun A, Alati R, O'Callaghan M, et al. Does childhood sexual abuse have an effect on young adults' nicotine disorder (dependence or withdrawal)? Evidence from a birth cohort study. *Addiction* 2007;102:647–654.
28. Sato-DiLorenzo A, Sharps PW. Dangerous intimate partner relationships and women's mental health and health behaviors. *Issues Ment Health Nurs* 2007;28:837–848.
29. Simpson TL. Women's treatment utilization and its relationship to childhood sexual abuse history and lifetime PTSD. *Subst Abus* 2002;23:17–30.
30. Ackersom LK, Kawachi I, Barbeau EM, Subramanian SV. Exposure to domestic violence associated with adult smoking in India: A population based study. *Tob Control* 2007;16:378–383.
31. Yoshihama M, Horrocks J, Bybee D. Intimate partner violence and initiation of smoking and drinking: A population-based study of women in Yokohama, Japan. *Soc Sci Med* 2010;71:1199–1207.
32. Choudhary E, Coben JH, Bossarte RM. Gender and time differences in the associations between sexual violence victimization, health outcomes, and risk behaviors. *Am J Mens Health* 2008;2:254–259.
33. Capaldi DM, Knoble NB, Shortt JW, Kim HK. A systematic review of risk factors for intimate partner violence. *Partner Abuse* 2012;3:231–280.
34. Bailey BA, Daugherty RA. Intimate partner violence during pregnancy: Incidence and associated health behaviors in a rural population. *Matern Child Health J* 2007;11:495–503.
35. Breiding MJ, Black MC, Ryan GW. Chronic disease and health risk behaviors associated with intimate partner violence—18 U.S. states/territories, 2005. *Ann Epidemiol* 2008;18:538–544.
36. Hathaway JE, Mucci LA, Silverman JG, Brooks DR, Mathews R, Pavlos CA. Health status and health care use of Massachusetts women reporting partner abuse. *Am J Prev Med* 2000;19:302–307.
37. Jun HJ, Rich-Edwards JW, Boynton-Jarrett R, Wright RJ. Intimate partner violence and cigarette smoking: Association between smoking risk and psychological abuse with and without co-occurrence of physical and sexual abuse. *Am J Public Health* 2008;98:527–535.
38. Lemon SC, Verhoek-Oftedahl W, Donnelly EF. Preventive healthcare use, smoking, and alcohol use among Rhode Island women experiencing intimate partner violence. *J Womens Health Gend Based Med* 2002;11:555–562.
39. McNutt LA, Carlson BE, Persaud M, Postmus J. Cumulative abuse experiences, physical health and health behaviors. *Ann Epidemiol* 2002;12:123–130.
40. Vest JR, Catlin TK, Chen JJ, Brownson RC. Multistate analysis of factors associated with intimate partner violence. *Am J Prev Med* 2002;22:156–164.
41. Weinbaum Z, Stratton TL, Chavez G, Motylewski-Link C, Barrera N, Courtney JG. Female victims of intimate partner physical domestic violence (IPP-DV), California 1998. *Am J Prev Med* 2001;21:313–319.
42. Ackard DM, Neumark-Sztainer D, Hannan P. Dating violence among a nationally representative sample of adolescent girls and boys: Associations with behavioral and mental health. *J Gend Specif Med* 2003;6:39–48.
43. Ohio Family Health Survey. 2010. Available at: <http://grc.osu.edu/ofhs/datadownloads/index.cfm> Accessed October 11, 2013.
44. Thomson TL, Nemeth JM, Zhu D, Lu B, Ferketich AK, Wewers ME. Address-Based Sampling for Subpopulation Surveys: A replication and extension among Ohio Appalachian Women. *Public Opinion Quarterly* 2015;Under Review.
45. Draucker CB, Martsof DS, Poole C. Developing distress protocols for research on sensitive topics. *Arch Psychiatr Nurs* 2009;23:343–350.
46. Borlawsky TB, Lele O, Jensen D, Hood NE, Wewers ME. Enabling distributed electronic research data collection for a rural Appalachian tobacco cessation study. *J Am Med Inform Assoc* 2011;18:140–143.
47. Black MC, Basile KC, Breiding MJ, et al. The National Intimate Partner and Sexual Violence Survey (NISVS): 2010 summary report. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 2011.
48. Nemeth J, Thomson T, Lu B, Bonomi A, Peng J, Wewers M. Cumulative Gender-based Violence Exposure Index Score (GBV Score) and its association with current smoking. Presentation at Poster Session 3: Public Health/Epidemiology, Society for Research on Nicotine and Tobacco, Philadelphia, PA, 2015.
49. Centers for Disease C, Prevention. Cigarette smoking among adults—United States, 1992, and changes in the

- definition of current cigarette smoking. *Morb Mortal Wkly Rep* 1994;43:342–346.
50. National Health Interview Survey (NHIS). Available at: www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm Accessed November 15, 2013.
 51. National Cancer Institute-sponsored Tobacco Use Supplement to the Current Population Survey (2010–2011): <http://appliedresearch.cancer.gov/studies/tus-cps/>. US Department of Commerce, Census Bureau, 2012. Available at: Technical documentation: www.census.gov/cps/methodology/techdocs.html Accessed November 15, 2013.
 52. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:385–401.
 53. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med* 1998;14:245–258.
 54. SAS Institute. SAS 9.3 [Computer Software]. Cary, NC: SAS Institute, Inc., 2011.
 55. Hosmer DW, Lemeshow S, Sturdivant RX. *Applied logistic regression*. Hoboken, NJ: John Wiley & Sons, Inc., 2013.
 56. Walsh K, Keyes KM, Koenen KC, Hasin D. Lifetime prevalence of gender-based violence in US women: Associations with mood/anxiety and substance use disorders. *J Psychiatr Res* 2015;62:7–13.
 57. Bonomi AE, Anderson ML, Rivara FP, et al. Health care utilization and costs associated with childhood abuse. *J Gen Intern Med* 2008;23:294–299.
 58. Bonomi AE, Anderson ML, Rivara FP, Thompson RS. Health outcomes in women with physical and sexual intimate partner violence exposure. *J Womens Health (Larchmt)* 2007;16:987–997.
 59. Bonomi AE, Anderson ML, Rivara FP, Thompson RS. Health care utilization and costs associated with physical and nonphysical-only intimate partner violence. *Health Serv Res* 2009;44:1052–1067.
 60. Bonomi AE, Cannon EA, Anderson ML, Rivara FP, Thompson RS. Association between self-reported health and physical and/or sexual abuse experienced before age 18. *Child Abuse Negl* 2008;32:693–701.
 61. U.S. Preventative Services Taskforce's Screening for Intimate Partner Violence and Abuse of Elderly and Vulnerable Adults., 2013. Available at: www.uspreventiveservicestaskforce.org/uspstf12/ipvelder/ipvelderfact.pdf Accessed October 20, 2013.
 62. Bonomi AE, Anderson ML, Reid RJ, Rivara FP, Carrell D, Thompson RS. Medical and psychosocial diagnoses in women with a history of intimate partner violence. *Arch Intern Med* 2009;169:1692–1697.
 63. Campbell R, Wasco SM, Ahrens CE, Sefl T, Barnes HE. Preventing the “Second Rape”: Rape survivors' experiences with community service providers. *J Interpersonal Violence* 2001;16:1239–1259.
 64. Crane CA, Hawes SW, Weinberger AH. Intimate partner violence victimization and cigarette smoking: A meta-analytic review. *Trauma Violence Abuse* 2013;14:305–315.
 65. Crane CA, Pilver CE, Weinberger AH. Cigarette smoking among intimate partner violence perpetrators and victims: Findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Am J Addict* 2014;23:493–501.
 66. Hitsman B, Papandonatos GD, McChargue DE, et al. Past major depression and smoking cessation outcome: A systematic review and meta-analysis update. *Addiction (Abingdon, England)* 2013;108:294–306.
 67. Glassman AH, Helzer JE, Covey LS, et al. Smoking, smoking cessation, and major depression. *JAMA* 1990;264:1546–1549.
 68. Bonomi AE, Thompson RS, Anderson M, et al. Intimate partner violence and womens physical, mental, and social functioning. *Am J Prev Med* 2006;30:458–466.
 69. Campbell R, Dworkin E, Cabral G. An ecological model of the impact of sexual assault on women's mental health. *Trauma Violence Abuse* 2009;10:225–246.
 70. Craparo G, Gori A, Petrucci I, Cannella V, Simonelli C. Intimate partner violence: Relationships between alexithymia, depression, attachment styles, and coping strategies of battered women. *J Sex Med* 2014;11:1484–1494.
 71. Sinha R. Chronic Stress, Drug Use, and Vulnerability to Addiction. *Ann N Y Acad Sci* 2008;1141:105–130.
 72. Sinha R. How does stress increase risk of drug abuse and relapse? *Psychopharmacology* 2001;158:343–359.
 73. Blalock JA, Minnix JA, Mathew AR, Wetter DW, McCullough JP, Cinciripini PM. Relationship of childhood trauma to depression and smoking outcomes in pregnant smokers. *J Consult Clin Psychol* 2013;81:821–830.
 74. van den Putte B, Yzer MC, Brunsting S. Social influences on smoking cessation: A comparison of the effect of six social influence variables. *Prev Med* 2005;41:186–193.
 75. Leventhal AM. The Sociopharmacology of Tobacco Addiction: Implications for Understanding Health Disparities. *Nicotine Tob Res* 2016;18:110–121.
 76. Smith PM, Spadoni MM, Proper VM. Abuse and smoking cessation in clinical practice. *J Clin Nurs* 2014;23:361–366.
 77. Miller E, Decker MR, McCauley HL, et al. Pregnancy coercion, intimate partner violence and unintended pregnancy. *Contraception* 2010;81:316–322.
 78. Miller E, McCauley HL, Tancredi DJ, Decker MR, Anderson H, Silverman JG. Recent reproductive coercion and unintended pregnancy among female family planning clients. *Contraception* 2014;89:122–128.
 79. 2012 Ohio Medicaid Assessment Survey (OMAS) Descriptive Tables. Available at: <http://grc.osu.edu/omas/datadownloads/2012omaspublicdata/index.cfm> Accessed February 20, 2014.
 80. Johnson MP. Conflict and control: Gender symmetry and asymmetry in domestic violence. *Violence Against Women* 2006;12:1003–1018.
 81. Picavet H. National health surveys by mail or home interview: Effects on response. *J Epidemiol Community Health* 2001;55:408–413.
 82. Velicer WF, Prochaska JO, Rossi JS, Snow MG. Assessing outcome in smoking cessation studies. *Psychol Bull* 1992; 111:23–41.
 83. Murray CJ, Kulkarni S, Ezzati M. Eight Americas: New perspectives on U.S. health disparities. *Am J Prev Med* 2005;29:4–10.
 84. Lengerich EJ, Wyatt SW, Rubio A, et al. The Appalachia Cancer Network: Cancer control research among a rural, medically underserved population. *J Rural Health* 2004;20:181–187.

Address correspondence to:
Julianna Nemeth, PhD
College of Public Health
The Ohio State University
359-5 Cunz Hall
1841 Neil Avenue
Columbus, OH 43210-1351

E-mail: nemeth.37@osu.edu