Original investigation

The Association of Panic Disorder, Posttraumatic Stress Disorder, and Major Depression With Smoking in American Indians

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Abstract

Introduction: Rates of cigarette smoking are disproportionately high among American Indian populations, although regional differences exist in smoking prevalence. Previous research has noted that anxiety and depression are associated with higher rates of cigarette use. We asked whether lifetime panic disorder, posttraumatic stress disorder, and major depression were related to lifetime cigarette smoking in two geographically distinct American Indian tribes.

Methods: Data were collected in 1997–1999 from 1506 Northern Plains and 1268 Southwest tribal members; data were analyzed in 2009. Regression analyses examined the association between lifetime anxiety and depressive disorders and odds of lifetime smoking status after controlling for sociodemographic variables and alcohol use disorders. Institutional and tribal approvals were obtained for all study procedures, and all participants provided informed consent.

Results: Odds of smoking were two times higher in Southwest participants with panic disorder and major depression, and 1.7 times higher in those with posttraumatic stress disorder, after controlling for sociodemographic variables. After accounting for alcohol use disorders, only major depression remained significantly associated with smoking. In the Northern Plains, psychiatric disorders were not associated with smoking. Increasing psychiatric comorbidity was significantly linked to increased smoking odds in both tribes, especially in the Southwest.

Conclusions: This study is the first to examine the association between psychiatric conditions and lifetime smoking in two large, geographically diverse community samples of American Indians. While the direction of the relationship between nicotine use and psychiatric disorders cannot be determined, understanding unique social, environmental, and cultural differences that contribute to the tobacco-psychiatric disorder relationship may help guide tribe-specific commercial tobacco control strategies.

Introduction

Several studies have shown that individuals with a history of psychiatric disorders have a disproportionately high rate of cigarette use,¹ with an estimated 45% of all cigarettes in the United States consumed by people with symptoms of mental illness.² Symptoms of anxiety,^{3,4} depression,^{5–7} and negative affect^{8,9} have also been related to cigarette smoking. Rates of anxiety and depressive disorders are generally 1.5 to 3 times higher among smokers than nonsmokers,^{7,10} with panic disorder and posttraumatic stress disorder (PTSD) often strongly associated with current smoking.^{11–13} Conversely, the odds of current cigarette use among people with lifetime depressive or anxiety disorders is twice that of their unaffected counterparts.¹⁴ Findings from the National Epidemiologic Survey on Alcohol and Related Conditions indicated that approximately 21% and 22% of individuals with mood and anxiety disorders, respectively, also met clinical criteria for nicotine dependence.¹⁵

Rates of cigarette smoking in the general US population are declining,^{16,17} yet commercial non-ceremonial tobacco use remains disproportionately high among American Indians.^{16,18,19} Cigarette smoking is an established risk factor for emphysema,²⁰ cancer,^{21,22} and cardiovascular disease,^{23,24} all of which are on the rise among American Indians. Although tobacco use is the most preventable cause of death in American Indian communities,²⁵ multiple systemic, cultural, social, and environmental barriers exist that interfere with access to and utilization of tobacco control programs.²⁶ While the deleterious health consequences associated with tobacco represents a major public health problem for the 562 federally-recognized tribes, notable differences in tobacco use exist across the tribes.

For example, data from the Indian Health Service noted that the prevalence of current cigarette smokers in the Northern Plains and Alaska regions was twofold higher than American Indians residing in the Pacific Coast and Southwest areas.²⁷ In the Strong Heart Study, the average number of cigarettes smoked per day was two times higher in the Northern Plains in comparison to American Indians in Arizona.^{28,29} Furthermore, lung cancer death rates and smoking prevalence showed a strong, positive correlation, with rates of lung cancer nearly six times higher in the Northern Plains than the Southwest.²⁷ Likewise, a community study of American Indians residing in two geographic regions reported that current cigarette use was 2.5 to 5 times higher among Northern Plains men and women than among their Southwest counterparts, with differential sociodemographic factors correlated with current cigarette use.³⁰ Among Southwest tribal members, male gender and younger age predicted cigarette use, whereas in the Northern Plains, marital status and time spent living on a reservation were associated with current smoking status. Because this community study did not adjust for psychiatric disorders, it remains unclear whether such factors partially account for observed tribal differences in commercial tobacco use. Further, although the study assessed lifetime alcohol use, it did not assess associations between cigarette smoking and lifetime alcohol disorders. Because alcohol abuse and dependence are associated with psychiatric disorders as well as with cigarette smoking,³¹ controlling for alcohol disorder status may help to clarify any relationship between smoking and anxiety or depressive disorders. Anxiety disorders, especially PTSD, and major depression are common among American Indians,^{31,32} yet no research has examined the association between anxiety, depression, and cigarette smoking in this population.

The National Epidemiologic Survey on Alcohol and Related Conditions found that both lifetime and 12-month nicotine dependence among American Indians/Alaska Natives were associated with

any mood, anxiety, personality, alcohol, and drug use disorders.³³ The National Epidemiologic Survey on Alcohol and Related Conditions did not isolate these relationships relative to different geographic regions, and therefore it is possible that associations between nicotine use, psychiatric disorders, and substance disorders may vary among the tribes. Using the same epidemiologic dataset from the Northern Plains and Southwest tribal regions as the present study, we had previously reported on the associations between non-ceremonial smokeless tobacco (ST) use with panic disorder, PTSD, and major depression.³⁴ In the Northern Plains sample, the odds of lifetime ST use was approximately 1.5 times higher among those with PTSD than those without, even after accounting for various sociodemographic variables, cigarette smoking status, and lifetime panic disorder and major depression. However, in the Southwest tribe, ST use was not significantly related to any of the psychiatric disorders, highlighting the importance of examining the potential inter-tribal differences. Although this earlier study focused on ST use and its association with lifetime anxiety and depressive disorders, significant evidence suggests that the nicotine–psychiatric disorder relationships are much stronger when sampling cigarette smoking as the mode of administration.¹

We therefore explored potential tribal differences in the relationships between psychiatric disorders and non-ceremonial, commercial cigarette smoking among community-dwelling American Indians residing in the Northern Plains and Southwest regions of the United States. Our primary goals for each tribe were to (1) describe rates of smoking among respondents with a lifetime history of panic disorder, PTSD, major depression, and alcohol abuse or dependence; (2) determine whether panic disorder, PTSD, and major depression are independently associated with smoking after accounting for sociodemographic factors and lifetime alcohol use disorders; and, (3) determine whether comorbid anxiety, depression, and alcohol use increase the odds ratio of smoking risk beyond its association with individual psychiatric disorders.

Methods

Study Design, Sample, and Procedures

The American Indian Service Utilization, Psychiatric Epidemiology, Risk and Protective Factors Project (AI-SUPERPFP) was a large-scale effort to better understand the prevalence of psychiatric disorders and health service use among reservation-dwelling tribal members located in the Northern Plains and Southwest areas. Those aged between 15–54 in June 1997, were official tribal members, and who lived within 20 miles of the reservation were invited for participation. Data collection began in July 1997 and concluded in August 1999. The sample was grouped by age (four strata) and sex (two strata) by using stratified random sampling procedures.³⁵ Sample weights were used for differential probabilities of selection and non-response within strata.³⁶ Study design and sampling methods used in the AI-SUPERPFP are described in greater detail elsewhere.³⁷ For our analyses, only participants who had complete data on non-ceremonial cigarette smoking history and lifetime psychiatric disorders were included (Northern Plains: $N = 1506$; Southwest: $N = 1268$). The AI-SUPERPFP negotiated all tribal and university human subjects ethical review processes, and written informed consent was obtained from each participant at the outset of the study.

Measures

Demographics

Demographic information included sex, age, marital status (married/cohabitating vs. all other categories), education (attending school

less than 12 years vs. 12 years or more), and employment status (working full/part time vs. all other categories).

Smoking History

The preface to the tobacco module in the AI-SUPERPPF specified that cigarette smoking questions were related to commercial, non-ceremonial tobacco use. Lifetime smoking status was defined by a response of “yes” to the question, “Have you ever smoked at least five packs of cigarettes (100 cigarettes) in your entire life?” The 100 cigarette rule was based on criteria from the National Health Interview Survey.³⁸

Psychiatric Disorders

The University of Michigan Composite International Diagnostic Interview (AI-SUPERPPF-CIDI) was used to assess lifetime panic disorder, major depression, and alcohol abuse or dependence according to Diagnostic and Statistical Manual-IV criteria. In the AI-SUPERPPF, PTSD was diagnosed by using a modified version of the World Health Organization Composite International Diagnostic Interview³⁹ and updated to Diagnostic and Statistical Manual-IV standards.

Statistical Analyses

The Northern Plains and Southwest tribes were compared on demographic characteristics and lifetime prevalence of panic disorder, PTSD, major depression, and alcohol use disorders according to smoking status (lifetime smokers vs. nonsmokers). For each tribe, the strength of the association between individual psychiatric disorders and the odds of lifetime smoking was examined using logistic regression analyses fitted to three separate models adjusted for age, sex, education, marital status, and employment status. The association of each psychiatric disorder with smoking in the Northern Plains and Southwest tribes was then estimated, adjusting for demographics and the two remaining lifetime psychiatric diagnoses. A final model was constructed to estimate the association between the individual

psychiatric disorders with smoking after adjusting for demographics, comorbid psychiatric conditions, and lifetime alcohol use disorder diagnosis in both the Northern Plains and Southwest tribes. Results were reported with odds ratios and 95% confidence intervals.

Regression analyses investigated the association between lifetime psychiatric disease burden (defined as having 0, 1, 2, or 3 or more of the following psychiatric disorders: panic disorder, PTSD, major depression, and alcohol use disorder) and the odds of smoking in the two tribes, adjusting for sociodemographic variables. In an effort to examine any trend between the odds of lifetime smoking status with increasing psychiatric disease burden in the Northern Plains and Southwest tribes, a final, similarly adjusted logistic regression model was calculated. All statistical tests were two-sided adjusted Wald tests, analyzed using Stata 9 for Windows (Stata Corporation, College Station, TX).

Results

Sample Description

Table 1 presents participant characteristics by region and lifetime smoking status. The prevalence of lifetime smoking was higher in the Northern Plains than in the Southwestern tribe (70% vs. 33%, $P < .01$). Smokers in the Northern Plains were older than nonsmokers ($P = .02$), whereas smokers in the Southwest were younger than nonsmokers ($P < .01$). The proportion of females was higher among nonsmokers in the Southwest ($P < .01$) but not in the Northern Plains. Compared with nonsmokers, smokers in the Northern Plains were less likely to graduate from high school ($P < .01$) and more likely to be married or living with their partners ($P < .01$).

Lifetime panic disorder did not differ by smoking status in either tribe. Lifetime PTSD was more common among lifetime smokers than nonsmokers in the Northern Plains ($P < .01$), with a similar tendency among smokers in the Southwest ($P = .07$). The prevalence of lifetime major depressive disorder was higher among smokers than nonsmokers in the Northern Plains ($P = .02$) as well as in the

Table 1. Participant Characteristics by Region and Lifetime Smoking Status^a, 1997–1999

Characteristic	Northern plains tribe, N = 1506 ^b		Southwest tribe, N = 1268 ^b	
	Lifetime smokers	Nonsmokers	Lifetime smokers	Nonsmokers
Demographic				
Total, %	70	30	33	67
Age, mean years (SD)	34 (12)*	33 (11)	32 (11)**	35 (12)
Female, %	52	49	41**	64
Attended ≥12 years of school, %	28**	39	38	40
Married or living with partner, %	55**	44	60	60
Currently employed, %	56	56	59	61
Lifetime psychiatric diagnoses				
Panic disorder, %	2	3	6	4
Posttraumatic stress disorder, %	16**	10	19	15
Major depressive disorder, %	9*	5	14**	9
Alcohol use disorder, %	40**	22	42**	15
Number of psychiatric diagnoses				
None, %	52	70	44	69
1, %	33**	21	37**	22
2, %	12**	8	14**	7
3 or more, %	4**	2	5**	2

^aLifetime smokers are defined as individuals who have smoked at least 100 cigarettes (five packs) in their lifetime.

^bNumbers shown are actual counts. Survey-weighted sample sizes were 1489 Northern Plains participants and 1274 Southwest participants.

* $P < .05$; ** $P < .01$.

Southwest ($P < .01$). The prevalence of alcohol use disorder ($P < .01$) and the total number of psychiatric diagnoses ($P < .01$) were also higher among smokers than nonsmokers in both locations.

Panic Disorder, PTSD, Major Depression, and Smoking Status

Table 2 presents adjusted estimates of lifetime smoking odds ratios by tribe associated with panic disorder, PTSD, and major depression diagnoses.

Individual Psychiatric Conditions Model

For Northern Plains participants, the odds of lifetime smoking were not associated with any psychiatric disorder in the models adjusted for demographic features. In the Southwest tribe, the adjusted odds of lifetime smoking were 2.1 times higher among those with panic disorder (95% confidence interval [CI]: 1.1, 3.8, $P = .02$), 1.7 times higher for those with PTSD (95% CI: 1.2, 2.3, $P < .01$), and 2.0 times higher among those diagnosed with major depression (95% CI: 1.3, 2.9, $P < .01$).

Psychiatric Comorbidity and Alcohol Use Models

Among Northern Plains participants, lifetime smoking was not associated with any of the three psychiatric diagnoses after adjusting for demographic variables and the two remaining lifetime diagnoses. In the Southwest, the adjusted odds of smoking among those diagnosed with major depression remained 1.6 times higher than those without major depression after adjustment for demographics, panic disorder, and PTSD (95% CI: 1.1, 2.5, $P = .02$). Lifetime smoking was not associated with any psychiatric disorder in either tribe after controlling for the diagnosis of an alcohol use disorder.

Psychiatric Disease Burden and Smoking Status

Figure 1 depicts the lifetime smoking odds ratios associated with increasing numbers of comorbid psychiatric diagnoses adjusted for demographic factors by tribe. Separate point estimates and confidence intervals are shown for each tribe, and dotted lines connect the point estimates for each tribe, suggesting a positive trend in both cases. Odds ratio estimates, shown beside each plotted point estimate, were compared to those of individuals without the psychiatric disorders noted. Confidence intervals increased in width as the

number of psychiatric disorders increased, given the smaller number of participants in the higher comorbidity groups. For each tribe, the adjusted odds ratios for all trends were significant ($P < .001$).

Discussion

We found that the rate of lifetime cigarette use among Northern Plains tribal members was approximately twice as high as that observed in the Southwest tribe. Age-adjusted cigarette smoking rates in the general US population during the same time period that the AI-SUPERPPF was conducted ranged between 23%–25%,⁴⁰ highlighting the high burden of nicotine use especially in the Northern Plains. The tribes differed, however, in the patterns of associations between psychiatric disorders and cigarette smoking status. Specifically, the overall rate of lifetime panic disorder among participants was comparable to that reported by national studies,^{32,41} but contrary to the findings of previous cross-sectional^{12,42} and prospective^{4,43,44} studies, rates did not differ by smoking status. As in majority populations,^{2,11,16} the prevalence of lifetime PTSD and major depression in both tribes was substantially higher among smokers than nonsmokers. Finally, lifetime alcohol use disorders were associated with a nearly twofold increase in smoking prevalence, reflecting the common relationship between alcohol and nicotine use.^{45,46}

In the Northern Plains, where 70% of participants were lifetime smokers, no individual psychiatric condition was independently associated with smoking status. The substantially higher rates of lifetime non-ceremonial, commercial cigarette smoking in the Northern Plains relative to the Southwest tribe and the general US population, and the high incidence of lung cancer among Northern Plains inhabitants²⁷ represents an alarming public health crisis. The dramatic rates of lifetime smoking suggests that the pervasiveness of commercial cigarette smoking may be more socially acceptable, and to some degree, commonplace within that region.⁴⁷ Younger age of smoking initiation, lenient attitudes toward smoking, broader use of commercial as opposed to traditional tobacco products in ceremonies, intra-familial modeling of cigarette usage, and limited options for smoking cessation may be contributing factors to the systemic use of commercial tobacco products in certain American Indian communities.^{26,30,33} Symptoms and disorders of anxiety and depression may therefore have less influence on smoking rates in

Table 2. Odds Ratios by Tribe for Adjusted Lifetime Smoking Status^a, 1997–1999

	Basic model ^b	Psychiatric comorbidity model ^c	Psychiatric/alcohol comorbidity model ^d
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Northern plains tribe			
Panic disorder	1.6 (1.0, 2.7)	1.5 (0.9, 2.6)	1.3 (0.8, 2.2)
Posttraumatic stress disorder	1.4 (1.0, 2.1)	1.4 (0.9, 2.0)	1.1 (0.8, 1.7)
Major depression	0.8 (0.4, 1.8)	0.7 (0.3, 1.6)	0.6 (0.3, 1.5)
Southwest tribe			
Panic disorder	2.0 (1.3, 2.9)*	1.6 (1.1, 2.5)	1.5 (1.0, 2.3)
Posttraumatic stress disorder	1.7 (1.2, 2.3)**	1.4 (1.0, 2.0)	1.2 (0.8, 1.7)
Major depression	2.1 (1.1, 3.8)**	1.6 (0.8, 3.1)*	1.5 (0.8, 2.9)

CI = confidence interval; OR = odds ratio.

^aLifetime smokers are defined as individuals who have smoked at least 100 cigarettes (five packs) in their lifetime.

^bSociodemographic factors include age, sex, education, marital status, and employment status.

^cAdjusted for sociodemographic factors and the two remaining lifetime psychiatric diagnoses.

^dAdjusted for sociodemographic factors, other lifetime psychiatric diagnoses, and alcohol use disorder diagnosis.

* $P < .05$; ** $P < .01$.

Figure 1. Adjusted lifetime smoking odds ratios by psychiatric burden and tribe, 1997–1999.

those American Indian communities where commercial tobacco use is highly prevalent.

Conversely, in the Southwest where smoking rates were substantially lower, smokers had twice the odds of lifetime diagnoses of panic disorder, PTSD, and major depression than did nonsmokers. In tribal communities where cigarette smoking rates are at or below general US population estimates, psychiatric distress may play a larger role in influencing patterns of tobacco consumption. However, when we conducted the fully-adjusted model to control alcohol use disorder history, depression was no longer linked to smoking in the Southwest tribe. The lack of association of specific psychiatric disorders with smoking status, after relevant regression adjustments, contrasts with findings in majority populations.¹ Although studies may differ in the assessment of psychiatric disorders, the definition of smoking status, and the statistical methods used to adjust for covariates, our failure to observe this association is noteworthy.

The lack of association between individual psychiatric disorders and smoking in the Northern Plains, and the weaker association in the Southwest after adjusting for demographics, comorbid psychiatric conditions, and alcohol use disorders, underscores the complexity of studying these relationships both within and across tribes. Our previous study analyzing ST users within the AI-SUPERPPF yielded a different pattern of findings than those observed with cigarette smoking.³⁴ Specifically, ST use was comparable between the two tribes (30%), whereas in the present study, the rate of lifetime cigarette smoking was nearly double in the Northern Plains than the Southwest. Additionally, while the odds ratio of ST use with PTSD was significant in the Northern Plains tribe and no psychiatric disorders were significantly associated with ST use in the Southwest, the reverse pattern was found when investigating lifetime cigarette smoking—psychiatric disorders were associated with smoking in the Southwest region, whereas no such association reached significance in the Northern Plains tribe.

Previous analyses of the AI-SUPERPPF cohort suggest other factors that might influence tobacco consumption in tribal communities. For example, federally-defined poverty, while common in both tribes, was higher in the Northern Plains.⁴⁸ Poverty has been associated with higher rates of psychiatric disorders,^{49,50} smoking,^{51,52} and alcohol use.⁵³ Furthermore, adverse life experiences including

trauma, violence, relocation, and familial disruption, appear to pre-date the first onset of substance dependence symptoms, with more frequent adversities increasing symptom risk in a dose-dependent manner.⁵⁴ The highest rates of adverse life events occurred in the Northern Plains, especially among women.⁵⁴ Historically-based traumas selectively impacting Indigenous populations, such as forced relocation, ethnic cleansing, disruption of the family through boarding school placements, religious conversion, and inhibition of spiritual practices have cumulatively undermined the health of this population and created massive disparities in health equality in comparison to the general US population.^{33,55} Future research using more complex statistical path modeling may help to illuminate tribal differences in the effect of individual psychiatric disorders, operating through poverty, adversity, and historical trauma on rates of cigarette smoking. Better understanding tribe-specific contributing factors to tobacco consumption may help guide the delivery, implementation, and sustainability of tobacco control programs.

Trend analyses showed an increasingly stronger association between psychiatric disorders and cigarette use in both tribes after baseline demographic factors were controlled. A greater psychiatric disease burden, defined as any combination of comorbid panic disorder, PTSD, major depression, and alcohol use disorder, yielded an increased odds of lifetime smoking. Notably, the impact of psychiatric disease burden appeared to be much greater in the Southwest than in the Northern Plains, despite overall lower rates of lifetime smoking. For example, a 2.5 odds risk for cigarette use was noted for Southwest tribal members with at least one psychiatric disorder, whereas in the Northern Plains, this same level of risk was found only among those with three or more comorbid psychiatric conditions. When considering those with three or more comorbid conditions, a more than fourfold increase in odds risk for lifetime smoking was found among members of the Southwest tribe. This same psychiatric disease burden analysis conducted with ST users in the Northern Plains and Southwest tribes showed a similar pattern, yet the odds ratios for cigarette smoking are approximately double than those observed in the ST sample.³⁴ Previous epidemiologic studies have reported similar incremental increases in cigarette use among people with more than one co-occurring psychiatric disorder.⁵⁶ Psychiatric disease burden may be a particularly informative way of studying the relationship with nicotine use, especially among understudied and minority populations, in which analyses of individual psychiatric disorders may be hampered by sample size limitations.

Behavioral models propose that anxiety sensitivity, negative affectivity, and stimulus regulation may be associated with a person's susceptibility to nicotine use^{5,9} and failed quit attempts,^{57,58} given their reinforcing function for regulating uncomfortable physiologic and emotional states. Biological factors, such as exaggeration of the hypothalamic-pituitary-adrenal axis, have been implicated as a mechanism in panic disorder,⁵⁹ PTSD,⁶⁰ major depression,⁶¹ and nicotine use.^{62,63} Anxiety disorders and depression often co-occur in epidemiologic studies, including American Indian samples,³¹ and rates of nicotine dependence increase with greater psychiatric comorbidity.¹⁵ The synergistic effects of environmental, behavioral, and biological factors invite further inquiry, as they may contribute to the mediation and moderation of the psychiatric-smoking relationship in different populations.¹

This study has several limitations. First, the major limitation is that the direction of the relationship between cigarette smoking status and psychiatric disorders cannot be established. Causality between these variables cannot be determined, and a myriad of

social, environmental, and cultural factors likely mediate and moderate this relationship. While relying on lifetime cigarette smoking and psychiatric disorder status maximized our sample size for analyses, we do not know if psychiatric distress predated the onset of tobacco use or vice versa. Some data suggests that cigarette use may predate the onset of psychiatric symptoms,^{13,64} whereas other studies suggest that premorbid psychiatric disorders predict later onset tobacco use.⁵ Given that American Indians and Alaska Natives tend to show a younger age of smoking onset than the general US population,⁵⁵ understanding the temporal relationship between nicotine use and psychiatric distress may help guide tobacco control efforts. Second, lifetime smoking status was defined by using the “100 cigarette rule,” so we could not examine the effect of the relationship of daily smoking, the amount of daily smoking, or nicotine dependence with psychiatric disorders. These additional tobacco constructs are strongly associated with the risk of anxiety^{15,65} and depressive^{6,66} disorders.

Third, our analyses were limited to Diagnostic and Statistical Manual-IV-defined disorders. We lacked dimensional measures of symptom severity and assessments of other constructs implicated in nicotine use, such as anxiety sensitivity and negative affectivity. Anxiety sensitivity, or the fear of fear-related symptoms, may be particularly important to assess in future studies with American Indians, since high anxiety sensitivity is associated with greater risk of panic symptoms among daily smokers⁶⁷ and increased difficulty during quit attempts because of more intense withdrawal symptoms.⁶⁸ The factor structure of anxiety sensitivity has been investigated in Northern Plains tribal populations,⁶⁸ but its role as a potential mediator between anxiety and smoking in American Indians has yet to be studied.

Fourth, a number of additional health risk factors related to nicotine use and psychiatric disorders were not included in our regression models. For example, relative to the majority US population, American Indians and Alaska Native report lower rates of leisure time physical activity and higher rates of obesity.²⁵ Individuals with depressive disorders also tend to report lower rates of physical activity than their nondepressed counterparts.⁶⁹ These health risk behaviors, alongside tobacco and alcohol use, contribute to the rising burden of several chronic diseases, such as cancer and diabetes, in the American Indian community. Future research may wish to examine how these variables interrelate with each other in the temporal development of chronic disease. The development of early interventions targeting these health risk factors within the tribes may help reverse these health disparities. Fifth, our analyses were based on trends in tobacco use, psychiatric distress, and alcohol use during the mid to late 1990s. Although our findings may not be representative of current trends among the tribes on these variables, changes in nicotine use and utilization of tobacco cessation programs for American Indians have lagged far behind observed trends in the majority US population.⁴⁰ Finally, these results cannot be generalized to all American Indians, because considerable diversity exists in geography, culture, urbanization, and availability of smoking cessation programs.

The extensive use of commercial tobacco, coupled with barriers to accessing healthcare and prevention programs and escalating rates of chronic diseases known to be caused by tobacco products, represents a major public health crisis for most American Indian communities. Anxiety and depressive disorders are treatable conditions, yet they may benefit from culturally-designed smoking prevention programs, especially since persistence of anxiety and depressive symptoms are associated with failed quit attempts.^{1,26}

The unique differences between Northern Plains and Southwest tribes in the prevalence of psychiatric disorders³¹ and smoking³⁰ underscore the value of investigating these associations within each tribe. Future research should examine at-risk populations, such as younger American Indians, and use prospective designs to ascertain the directionality of relationships between commercial tobacco use and psychiatric disorders and symptoms. Studies to identify personal, psychosocial, familial, and cultural factors that protect against smoking initiation among American Indians are especially warranted.

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Declaration of Interests

None declared.

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References

1. Ziedonis D, Hitsman B, Beckham JC, et al. Tobacco use and cessation in psychiatric disorders: National Institute of Mental Health report. *Nicotine Tob Res.* 2008;10(12):1691–1715. doi:10.1080/14622200802443569 905756217 [pii].
2. Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: a population-based prevalence study. *JAMA.* 2000;284(20):2606–2610. doi:joc00268 [pii].
3. Patton GC, Carlin JB, Coffey C, Wolfe R, Hibbert M, Bowes G. Depression, anxiety, and smoking initiation: a prospective study over 3 years. *Am J Public Health.* 1998;88(10):1518–1522.
4. Zvolensky MJ, Feldner MT, Leen-Feldner EW, McLeish AC. Smoking and panic attacks, panic disorder, and agoraphobia: a review of the empirical literature. *Clin Psychol Rev.* 2005;25(6):761–789. doi:S0272-7358(05)00053-X [pii] 10.1016/j.cpr.2005.05.001.
5. Breslau N, Peterson EL, Schultz LR, Chilcoat HD, Andreski P. Major depression and stages of smoking: A longitudinal investigation. *Arch Gen Psychiatry.* 1998;55(2):161–166.
6. Epstein JF, Induni M, Wilson T. Patterns of clinically significant symptoms of depression among heavy users of alcohol and cigarettes. *Prev Chronic Dis.* 2009;6(1):A09. doi:A09 [pii].
7. Wilhelm K, Wedgwood L, Niven H, Kay-Lambkin F. Smoking cessation and depression: current knowledge and future directions. *Drug Alcohol Rev.* 2006;25(1):97–107. doi:J2PWH8R312521663 [pii] 10.1080/09595230500459560.
8. Glassman AH. Cigarette smoking: implications for psychiatric illness. *Am J Psychiatry.* 1993;150(4):546–553.

9. Zvolensky MJ, Sachs-Ericsson N, Feldner MT, Schmidt NB, Bowman CJ. Neuroticism moderates the effect of maximum smoking level on lifetime panic disorder: a test using an epidemiologically defined national sample of smokers. *Psychiatry Res.* 2006;141(3):321–332. doi:S0165-1781(05)00227-1 [pii] 10.1016/j.psychres.2005.07.019.
10. Johnson EO, Breslau N. Is the association of smoking and depression a recent phenomenon? *Nicotine Tob Res.* 2006;8(2):257–262. doi:KJ2875W202507824 [pii] 10.1080/14622200600576644.
11. Feldner MT, Babson KA, Zvolensky MJ. Smoking, traumatic event exposure, and post-traumatic stress: a critical review of the empirical literature. *Clin Psychol Rev.* 2007;27(1):14–45. doi:S0272-7358(06)00098-5 [pii] 10.1016/j.cpr.2006.08.004.
12. Morissette SB, Brown TA, Kamholz BW, Gulliver SB. Differences between smokers and nonsmokers with anxiety disorders. *J Anxiety Disord.* 2006;20(5):597–613. doi:S0887-6185(05)00087-3 [pii] 10.1016/j.janxdis.2005.08.003.
13. Zvolensky MJ, Bernstein A. Cigarette smoking and panic psychopathology. *Curr Dir Psychol Sci.* 2005;14(6):301–305.
14. Strine TW, Mokdad AH, Balluz LS, et al. Depression and anxiety in the United States: findings from the 2006 Behavioral Risk Factor Surveillance System. *Psychiatr Serv.* 2008;59(12):1383–1390. doi:10.1176/appi.ps.59.12.1383 59/12/1383 [pii].
15. Grant BF, Hasin DS, Chou SP, Stinson FS, Dawson DA. Nicotine dependence and psychiatric disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Arch Gen Psychiatry.* 2004;61(11):1107–1115. doi:61/11/1107 [pii] 10.1001/archpsyc.61.11.1107.
16. American Lung Association. *Estimated Prevalence and Incidence of Lung Disease by Lung Association Territory.* Washington, DC: American Lung Association; 2006.
17. Centers for Disease Control and Prevention. Cigarette smoking among adults—United States, 2001. *MMWR Morb Mortal Wkly Rep.* 2003;52(40):953–956. doi:mm5240a1 [pii].
18. Caraballo RS, Yee SL, Gfroerer J, Mirza SA. Adult tobacco use among racial and ethnic groups living in the United States, 2002–2005. *Prev Chronic Dis.* 2008;5(3):A78. doi:A78 [pii].
19. U.S. Surgeon General. *Patterns of Tobacco Use Among U.S. Youth, Young Adults, and Adults. 30 Years of Progress: A Report of the Surgeon General.* Rockville, MD: U.S. Department of Health and Human Services, Public Health Service. Office of the Surgeon General; 2014:703–767. www.surgeongeneral.gov/library/reports/50-years-of-progress/sgr50-chap-13.pdf. Accessed January 28, 2015.
20. MacNee W. Pathogenesis of chronic obstructive pulmonary disease. *Proc Am Thorac Soc.* 2005;2(4):258–266; discussion 290–251. doi:2/4/258 [pii] 10.1513/pats.200504-045SR.
21. American Cancer Society. *Cancer Facts and Figures 2006.* Atlanta, GA: American Cancer Society; 2006.
22. Bliss A, Cobb N, Solomon T, et al. Lung cancer incidence among American Indians and Alaska Natives in the United States, 1999–2004. *Cancer.* 2008;113(5 suppl):1168–1178. doi:10.1002/cncr.23738.
23. Kannel WB, Wolf PA. Peripheral and cerebral atherothrombosis and cardiovascular events in different vascular territories: insights from the Framingham Study. *Curr Atheroscler Rep.* 2006;8(4):317–323.
24. Zhang Y, Galloway JM, Welty TK, et al. Incidence and risk factors for stroke in American Indians: the Strong Heart Study. *Circulation.* 2008;118(15):1577–1584. doi:10.1161/CIRCULATIONAHA.108.772285 CIRCULATIONAHA.108.772285 [pii].
25. Cobb N, Espey D, King J. Health behaviors and risk factors among American Indians and Alaska Natives, 2000–2010. *Am J Public Health.* 2014;104(S3):481–489. doi:10.2105/AJPH.2014.301879.
26. Fu SS, Rhodes KL, Robert C, Widome R, Forster JL, Joseph AM. Designing and evaluating culturally specific smoking cessation interventions for American Indian communities. *Nicotine Tob Res.* 2014;16(1):42–49. doi:10.1093/ntr/ntt111.
27. Plescia M, Henley SJ, Pate A, Underwood M, Rhodes K. Lung cancer deaths among American Indians and Alaska Natives, 1990–2009. *Am J Public Health.* 2014;104(S3):388–395. doi:10.2105/AJPH.2013.301609.
28. Welty TK, Lee ET, Yeh J, et al. Cardiovascular disease risk factors among American Indians: the Strong Heart Study. *Am J Epidemiol.* 1995;142(3):269–287.
29. Welty DA, Rhoades TK, Yeh J, et al. Changes in cardiovascular disease risk factors among American Indians: the Strong Heart Study. *Am J Epidemiol.* 2002;155(2):97–106.
30. Nez Henderson P, Jacobsen C, Beals J. Correlates of cigarette smoking among selected Southwest and Northern plains tribal groups: the AI-SUPERPPF Study. *Am J Public Health.* 2005;95(5):867–872. doi:95/5/867 [pii] 10.2105/AJPH.2004.050096.
31. Beals J, Manson SM, Whitesell NR, Spicer P, Novins DK, Mitchell CM. Prevalence of DSM-IV disorders and attendant help-seeking in 2 American Indian reservation populations. *Arch Gen Psychiatry.* 2005;62(1):99–108. doi:62/1/99 [pii] 10.1001/archpsyc.62.1.99.
32. Grant BF, Hasin DS, Stinson FS, et al. The epidemiology of DSM-IV panic disorder and agoraphobia in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *J Clin Psychiatry.* 2006;67(3):363–374.
33. Moghaddam JF, Dickerson DL, Yoon G, Westermeyer J. Nicotine dependence and psychiatric and substance use disorder comorbidities among American Indians/Alaska Natives: findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Drug Alcohol Depend.* 2014;144:127–133. doi:10.1016/j.drugalcdep.2014.08.017.
34. Sawchuk CN, Roy-Byrne P, Noonan C, et al.; AI-SUPERPPF Team. Smokeless tobacco use and its relation to panic disorder, major depression, and posttraumatic stress disorder in American Indians. *Nicotine Tob Res.* 2012;14(9):1048–1056. doi:10.1093/ntr/ntt331.
35. Cochran WG. *Sampling Techniques.* New York, NY: John Wiley and Sons; 1977.
36. Kish L. *Survey Sampling.* New York, NY: John Wiley and Sons; 1965.
37. Beals J, Manson SM, Mitchell CM, Spicer P. Cultural specificity and comparison in psychiatric epidemiology: walking the tightrope in American Indian research. *Cult Med Psychiatry.* 2003;27(3):259–289.
38. Centers for Disease Control and Prevention. NHIS—Adult tobacco use information. 2009. www.cdc.gov/nchs/nhis/tobacco/tobacco_glossary.htm. Accessed January 28, 2015.
39. World Health Organization. *Composite International Diagnostic Interview (CIDI), version 1.0.* Geneva, Switzerland: World Health Organization; 1990.
40. Centers for Disease Control. 1997–September 2013; age adjusted current smoking estimates (03/2014 revised). 2014. www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201403_08.pdf. Accessed January 28, 2015.
41. Kessler RC, Chiu WT, Jin R, Ruscio AM, Shear K, Walters EE. The epidemiology of panic attacks, panic disorder, and agoraphobia in the National Comorbidity Survey Replication. *Arch Gen Psychiatry.* 2006;63(4):415–424. doi:63/4/415 [pii] 10.1001/archpsyc.63.4.415.
42. Zvolensky MJ, Schmidt NB, McCreary BT. The impact of smoking on panic disorder: an initial investigation of a pathoplastic relationship. *J Anxiety Disord.* 2003;17(4):447–460. doi:S0887618502002220 [pii].
43. Bernstein A, Zvolensky MJ, Schmidt NB, Sachs-Ericsson N. Developmental course(s) of lifetime cigarette use and panic attack comorbidity: an equifinal phenomenon? *Behav Modif.* 2007;31(1):117–135. doi:31/1/117 [pii] 10.1177/0145445506295056.
44. Goodwin RD, Lewinsohn PM, Seeley JR. Cigarette smoking and panic attacks among young adults in the community: the role of parental smoking and anxiety disorders. *Biol Psychiatry.* 2005;58(9):686–693. doi:S0006-3223(05)00503-2 [pii] 10.1016/j.biopsych.2005.04.042.
45. Durazzo TC, Gazdzinski S, Meyerhoff DJ. The neurobiological and neurocognitive consequences of chronic cigarette smoking in alcohol use disorders. *Alcohol Alcohol.* 2007;42(3):174–185. doi:42/3/174 [pii] 10.1093/alcalc/aggm020.

46. Jensen MK, Sorensen TI, Andersen AT, et al. A prospective study of the association between smoking and later alcohol drinking in the general population. *Addiction*. 2003;98(3):355–363. doi:304 [pii].
47. Nez Henderson P, Kanekar S, Wen Y, et al. Patterns of cigarette smoking initiation in two culturally distinct American Indian tribes. *Am J Public Health*. 2009;99:2020–2025. doi:10.2105/AJPH.2008.155473.
48. Shore JH, Beals J, Orton H, Buchwald D. Comorbidity of alcohol abuse and dependence with medical conditions in 2 American Indian reservation communities. *Alcohol Clin Exp Res*. 2006;30(4):649–655. doi:ACER76 [pii] 10.1111/j.1530-0277.2006.00076.x.
49. Jenkins R, Bhugra D, Bebbington P, et al. Debt, income and mental disorder in the general population. *Psychol Med*. 2008;38(10):1485–1493. doi:10.1017/S0033291707002516 S0033291707002516 [pii].
50. Weich S, Lewis G. Poverty, unemployment, and common mental disorders: population based cohort study. *BMJ*. 1998;317(7151):115–119.
51. Baumann M, Spitz E, Guillemin F, et al. Associations of social and material deprivation with tobacco, alcohol, and psychotropic drug use, and gender: a population-based study. *Int J Health Geogr*. 2007;6:50. doi:1476-072X-6-50 [pii] 10.1186/1476-072X-6-50.
52. Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *JAMA*. 1998;279(21):1703–1708. doi:joc72105 [pii].
53. Galea S, Nandi A, Vlahov D. The social epidemiology of substance use. *Epidemiol Rev*. 2004;26(1):36–52. doi:10.1093/epirev/mxh007 26/1/36 [pii].
54. Whitesell NR, Beals J, Mitchell CM, Keane EM, Spicer P, Turner RJ. The relationship of cumulative and proximal adversity to onset of substance dependence symptoms in two American Indian communities. *Drug Alcohol Depend*. 2007;91(2–3):279–288. doi:S0376-8716(07)00247-5 [pii] 10.1016/j.drugalcdep.2007.06.008.
55. Whitesell NR, Beals J, Big Crow C, Mitchell CM, Novins DK. Epidemiology and etiology of substance use among American Indians and Alaska Natives: risk, protection, and implications for prevention. *Am J Drug Alcohol Abuse*. 2012;38(5):376–382. doi:10.3109/00952990.2012.694527.
56. Breslau N, Novak SP, Kessler RC. Psychiatric disorders and stages of smoking. *Biol Psychiatry*. 2004;55(1):69–76. doi:S0006322303003172 [pii].
57. Brown RA, Kahler CW, Zvolensky MJ, Lejuez CW, Ramsey SE. Anxiety sensitivity: relationship to negative affect smoking and smoking cessation in smokers with past major depressive disorder. *Addict Behav*. 2001;26(6):887–899.
58. Piasecki TM, Jorenby DE, Smith SS, Fiore MC, Baker TB. Smoking withdrawal dynamics: III. Correlates of withdrawal heterogeneity. *Exp Clin Psychopharmacol*. 2003;11(4):276–285. doi:10.1037/1064-1297.11.4.276 2003-09137-003 [pii].
59. Abelson JL, Khan S, Liberzon I, Young EA. HPA axis activity in patients with panic disorder: review and synthesis of four studies. *Depress Anxiety*. 2007;24(1):66–76. doi:10.1002/da.20220.
60. Rasmusson AM, Vythilingam M, Morgan CA III. The neuroendocrinology of posttraumatic stress disorder: new directions. *CNS Spectrums*. 2003;8(9):651–656, 665–657.
61. Pariante CM, Lightman SL. The HPA axis in major depression: classical theories and new developments. *Trends Neurosci*. 2008;31(9):464–468. doi:10.1016/j.tins.2008.06.006 S0166-2236(08)00164-1 [pii].
62. Rasmusson AM, Picciotto MR, Krishnan-Sarin S. Smoking as a complex but critical covariate in neurobiological studies of posttraumatic stress disorders: a review. *J Psychopharmacol*. 2006;20(5):693–707. doi:0269881106060193 [pii] 10.1177/0269881106060193.
63. Rohleder N, Kirschbaum C. The hypothalamic-pituitary-adrenal (HPA) axis in habitual smokers. *Int J Psychophysiol*. 2006;59(3):236–243. doi:S0167-8760(05)00268-0 [pii] 10.1016/j.ijpsycho.2005.10.012.
64. Klungsoyr O, Nygard JF, Sorensen T, Sandanger I. Cigarette smoking and incidence of first depressive episode: an 11-year, population-based follow-up study. *Am J Epidemiol*. 2006;163(5):421–432. doi:kwj058 [pii] 10.1093/aje/kwj058.
65. Koenen KC, Hitsman B, Lyons MJ, et al. A twin registry study of the relationship between posttraumatic stress disorder and nicotine dependence in men. *Arch Gen Psychiatry*. 2005;62(11):1258–1265. doi:62/11/1258 [pii] 10.1001/archpsyc.62.11.1258.
66. Dierker L, Donny E. The role of psychiatric disorders in the relationship between cigarette smoking and DSM-IV nicotine dependence among young adults. *Nicotine Tob Res*. 2008;10(3):439–446. doi:10.1080/14622200801901898 791305195 [pii].
67. Zvolensky MJ, Kotov R, Bonn-Miller MO, Schmidt NB, Antipova AV. Anxiety sensitivity as a moderator of association between smoking status and panic-related processes in a representative sample of adults. *J Psychiatr Res*. 2008;42(1):69–77. doi:S0022-3956(06)00206-8 [pii] 10.1016/j.jpsychires.2006.09.012.
68. Zvolensky MJ, Baker KM, Leen-Feldner E, Bonn-Miller MO, Feldner MT, Brown RA. Anxiety sensitivity: association with intensity of retrospectively-rated smoking-related withdrawal symptoms and motivation to quit. *Cogn Behav Ther*. 2004;33(3):114–125.
69. Song MR, Lee YS, Baek JD, Miller M. Physical activity status in adults with depression in the National Health and Nutrition Examination Survey, 2005–2006. *Public Health Nurs*. 2012;29(3):208–217. doi:10.1111/j.1525-1446.2011.00986x22512422.