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Latent Profiles of Health and Reproductive Risk and Protective Factors among Women in Appalachia

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Abstract

Women who use opiates and are involved in the criminal justice system in Appalachia may be prone to adverse health outcomes. In this study, we performed a latent class analysis of risk and protective factors on 400 drug-using women recruited from rural, Appalachian jails. A two-profile solution best fit the data. Both profiles evinced low levels of condom use, reproductive and physical health screens, and STD history. However, the primary substantive difference between the profiles was partner risk behavior: the higher risk class had main male partners with histories of injection drug use and incarceration. Results suggest that interventions need to be tailored to unique profiles of risk and protective factors, which should include taking partner risk into consideration.

Keywords

Women; Appalachia; risk profiles; substance use; partner risk; criminal justice system; latent class analysis

The recent increase in opiate use in the US has hit the Appalachian region particularly hard, and has been well-documented in the academic literature (Havens et al., 2011; Moody, Satterwhite, & Bickel, 2017; Rigg, Monnat, & Chavez, 2018). Drug use has been linked to a host of personal problems, including involvement with the criminal justice system (Staton et al., 2018) and myriad health problems (Havens et al., 2013). In the long term, drug use may be a factor that perpetuates poverty (Shannon, Perkins, & Neal, 2014).

Recent scholarship has also begun to consider that women are a special population uniquely affected by the opiate epidemic (Shannon, Havens, Oser, Crosby, & Leukefeld, 2011). For instance, women's involvement in risky lifestyles has been linked to involvement with risky male romantic partners (El-Bassel, Gilbert, White, Wu & Chang, 2011), while romantic

partners do not seem to be a risk factor for men. For example, women may be introduced to injecting drugs by male partners, or coerced into risky sexual behaviors as a result of drug seeking or drug taking (Kenski, Appleyard, von Haften, Kasprzyk, & Fishbein, 2001; Sheard & Tompkins, 2008; Staton et al., 2017). Moreover, one unique consequence for women of sexual behavior is unintended pregnancy, rates of which are reportedly elevated in Appalachia (Broecker, Jurich, & Fuchs, 2016). Additionally, women have unique substance abuse treatment needs relative to men (Shannon et al., 2011) as well as unique physical (Reiter et al., 2013) and mental health (McNeil et al., 2016) care needs that must be considered when developing and implementing interventions.

A number of interventions, from opiate substitution therapy (Fraser et al., 2018; Schwartz et al., 2017) to syringe exchange (Des Jarlais, McKnight, Goldblatt, & Purchase, 2009; Paquette & Pollini, 2018) and prescription disposal boxes (Gray, Hagemeyer, Brooks, & Alamian, 2015), to targeted individual treatments (Abbott, Weller, Delaney, & Moore, 1998; Roozen et al., 2003), have been proposed for the Appalachian region. While some have been successful (Abbot et al., 1998; Gray et al., 2015), others have struggled to demonstrate successful outcomes (Schwartz et al., 2017) and problems persist in the region.

Other areas of observational and clinical research have utilized the principles of person centered medicine in treatment planning. Person-centered medicine is the premise that people are heterogeneous and, therefore, interventions used with them should take in to account their unique characteristics (Hamburg & Collins, 2010; Redekop & Mladsi, 2013). The principles of personalized medicine are consistent with the principles of dignity and worth of the person and the importance of human relationships in the NASW Code of Ethics and congruent with recent calls made in the literature to consider substance abuse and intervention planning in Appalachia in the context of the region's unique social, geographic, economic, and political contexts (Buer, Leukefeld, & Havens, 2016; NASW, 2017; Shannon, Havens, Mateyoke-Scrivner, & Walker, 2009). Risk profiles are useful in the development of personalized medicine strategies, as they allow interventions to be targeted towards groups who fall into certain categories of risk.

This study responds to a need to consider the Appalachian contexts and addresses a gap in the literature by simultaneously examining the complex effects of these multiple risk and protective factors on a unique population of Appalachian women. Using latent class analysis, this study generates profiles that may be useful for identifying women who will benefit most from the variety of interventions that are under consideration in the literature. Targeting interventions may be particularly beneficial in this region where fatalism and distrust of medical and health workers informs health decision making (Behringer & Friedell, 2006; Dew, Elifson, & Dozier, 2007), and self-reliance is valued (Moody et al., 2017).

Current Study

In an effort to create risk profiles that are useful for designing personalized medicine strategies, the current study was designed to develop profiles of risk and protective factors of Appalachian women who have a history of drug use and involvement with the criminal

justice system. Variables that have been shown in previous research to confer risk (partner-related factors, STD history, exchanging sex for drugs or resources) and protection (condom use, reproductive health screens, general health screens) for Appalachian women were selected for inclusion. Moreover, the variables selected for the analysis are theorized to be related to the social, geographic, economic, and political contexts of the region.

Previous work with this population has been from the variable-centered perspective (Staton et al., 2017; Shannon et al., 2011). While variable-centered analyses are useful for identifying the effects of risk and protective factors while controlling for other factors, risk is complex and interactional in nature. Consequently, since the literature has already identified risk and protective factors, a logical next step is to understand if there are subgroups of people who experience risk and protective factors in heterogeneous ways (and thus have different levels of risk for different problems) or if, in fact, risk and protective factors operate homogeneously.

Method

Data

Data for this secondary analysis were collected from 400 rural, drug-using, Appalachian women recruited from jails (see Staton et al., 2017). The original study procedures were approved by IRB prior to data collection. Permission to use this de-identified data for secondary data analysis was sought and provided by the IRB of origin and a reciprocal IRB agreement was documented between the IRB of origin and the University at Buffalo IRB.

Measures

Demographic information collected from participants included age, race, marital status, and sexual orientation.

Variables used in latent class analysis.—Protective factors included in the latent class analyses included reproductive health screenings (Pap testing or mammogram in the past year), general health screens received in past year (general physical), and condom use.

Pap testing or mammogram in past year.: Two questions with yes/no responses assessed if participants had completed Pap testing or mammograms in the past year. We elected to combine responses to these questions to create a variable representing women's preventive health screenings because rates of screening were low.

Any general health screens received in past year.: Three questions were used to assess how many general health screens (eye exam, dental exam, general physical) participants had received in the past year. Given the low rates of health care usage in the population, one dichotomous item was created for the current analysis.

Condom use.: One question assessed the frequency with which a participant used a condom with a main partner. Response options ranged from one ("Never") to four ("All of the time").

Risk factors in the latent class analysis included STD history, sex exchange, main male partner ever injected drugs, and main male partner ever incarcerated.

Sexually transmitted disease history.: A count of positive responses to seven questions (syphilis, gonorrhea, chlamydia, herpes, human papilloma virus, trichomoniasis, other) was used to assess history of sexually transmitted diseases.

Sex exchange.: One question with a yes/no answer was used to assess if a participant had ever traded sex in exchange for money, drugs, food, shelter, or transportation.

Main male partner ever injected drugs.: One question with a yes/no answer was used to assess if a participant's main male partner ever injected drugs.

Main male partner ever incarcerated.: One question with a yes/no answer was used to assess if a participant's main male partner had ever been incarcerated.

Variables used for auxiliary variable analysis.—After establishing the number of classes that provided the best fit to the data, we planned to examine other variables on which the classes might differ. The auxiliary variables included yes/no responses to whether or not participants had ever used *14 different kinds of opiates or drugs* (crack, cocaine, inhalants, heroin, methadone, Oxycontin, Percocet, morphine, buprenorphine, Opana, Neurontin, anti-anxiety medications, methamphetamines, and bath salts); and yes/no responses to four *reasons for not using condoms* (having sex with only one partner, using another form of birth control, do not think about it, get high and forget).

Analysis

Latent class analysis (LCA; McCutcheon, 1987), performed in Mplus (Muthén & Muthén, 2007), was used to estimate a model of heterogeneity in the sample. Seven indicators in total were used to form the classes: three indicators of protective factors (Pap or mammogram testing in past year, general health screens in past year, condom use) and four indicators of risk factors (sexually transmitted disease history, history of sex exchange, main male partner history of ever injecting drugs, and main male partner history of incarceration). These variables were selected because previous studies established that they are risk and protective factors in this population.

In an LCA, fit statistics help researchers to understand how many profiles best fit the data (Geiser, 2013), which makes latent class analysis a more robust method of subgroup analysis than other methods (Lanza & Rhoades, 2013). Consistent with recommendations (Nylund, Asparouhov, Muthén, 2007), a variety of fit statistics, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), adjusted Bayesian Information Criterion (aBIC), and Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR-LRT), and its associated *p*-values, were used to assess model fit. The most desirable fit statistics are low AIC, BIC, and aBIC values and a VLMR-LRT test with a significant *p*-value. Entropy, which indicates the extent to which classes are different from one another, was considered as a secondary fit statistic; a value close to one is desirable (Celeux & Soromenho, 1996).

Ultimately, we planned to weigh both substantive interpretation of classes and fit statistics in deciding which solution to retain.

Latent class analysis permits analysis of variables that are not theorized to influence class membership but may still differ as a function of class membership and, thus, are of interest to researchers because they identify opportunities for intervention specific to each class. These variables are known as auxiliary variables. In this analysis, history of opiate and drug use and reasons for no condom use were treated as auxiliary variables. To examine auxiliary variables, we used the BCH (Bolck, Croon, & Hagenaars, 2004) command in Mplus. While many procedures exist for testing how auxiliary variables vary as a function of class membership, BCH is considered the most conservative because it uses a weighted inverse of the classification error probabilities (Asparouhov & Muthén, 2015). Using an ANOVA or t-test would introduce more error in to the estimation of differences and is regarded as a less desirable approach (Bakk & Vermunt, 2016).

Results

Sample Demographic Information

The median age was 32 with a range of 18 to 61 years of age. The sample was 99% White and .8% African American. The most frequently reported marital statuses were married (32%) and never married and not living as married (31.5%), followed by divorced (20.8%). A majority of the sample identified as heterosexual (79.3%), followed by bisexual (17.5%).

Results of the latent profile analysis

Table 1 contains fit statistics for the one through four class solutions. Although the AIC and BIC decrease through the four-class solution, the aBIC does not, suggesting that optimal number of classes is two or three classes. The VLMR-LRT test is significant for the two-class solution, suggesting is the model fits the data significantly better than the one-class solution. Although the VLMR-LRT was not significant in the three-class solution, we examined both the two- and three-class solutions for interpretability. The two-class solution provided the most substantive information about the data and was retained for further analysis.

Class summaries.—The first class consisted of 36.59% of the data. Protective factors were low in this class: women in this class were unlikely to have had a mammogram or Pap test and any general health screen in the past year. In addition, 73% of women in this class reported never using condoms. With respect to protective factors, 67% reported never having had an STD, 29% reported exchanging sex for drugs or other resources, none of them indicated that their main partner injected drugs, and 43% indicated that her main partner had ever been incarcerated. We termed this class High Risk Women (HRW).

The second class consisted of 63.41% of the data. Like the first class, women in this class had low levels of protective factors: 75% had not had a mammogram or Pap test in the past year and 58% had no general health screens in the past year. Moreover, 68% reported never using condoms. STD history was also similar to that of the first class: 56% reported never having an STD. However, the other risk factors were where this class diverged from the first

class: 51% reported exchanging sex, 87% reported that their main partner injected drugs, and 97% reported that their main partner had been incarcerated. We termed this class High Risk Women with High Risk Partners (HRW+HRP).

Table 2 contains class proportions and sample frequencies for variables used to form the classes in the LCA.

Results of the auxiliary variable analysis

Table 3 lists proportions of each class that endorsed (said yes) to each auxiliary variable. As expected by the sampling methodology, a substantial portion of both classes endorsed use of a variety of drugs. In both classes, use of opiates (for instance, Neurontin, Percocet, and methadone) was prominent. Use of anti-anxiety medications and methamphetamine was also prominent. In general, the proportion of each class who endorsed use of a specific drug was higher in the HRW+HRP class than in the HRW class. The only exception was cocaine use, where the proportion who had used was greater in the HRW class than in the HRW+HRP class (10.00% vs. 3.18%).

We also examined the proportion of each class who endorsed not using condoms for four specific reasons. More than half of women in both classes indicated that they did not use condoms because they were having sex with only one partner. A small proportion of women in both classes (3.5% in the HRW+HRP class and 11.9% in the HRW class) indicated they did not use condoms because they were using another form of birth control, which suggests that use of other forms of birth control is low. A substantial proportion of the HRW+HRP class indicated that they do not use condoms because they do not think about it (48.6%) and they get high and forget (34.9%). A smaller proportion of the HRW class indicated they do not use condoms for these reasons (20.7% and 3.2%, respectively).

All women in this analysis evince some level of risk, which may be conferred on them by virtue of limited access to healthcare services and reproductive healthcare services. However, the HRW+HRP class had enhanced levels of risk conferred by the men with whom they had sex because of the men's histories of injection drug use and incarceration.

Discussion

This person-centered analysis of a sample of drug using women living in Appalachia who were recruited from jails suggests two profiles of risk. LCA permits the study of multiple variables simultaneously, and allows us to classify this population into two distinct risk groups, which demonstrates that there are distinct levels of risk attributable largely to partner characteristics. This analysis also represents a response to calls for contextual considerations of this issue and extends the literature by suggesting that risk and protective factors for women in Appalachia with substance use problems are not homogenous, despite that the region is often perceived as having a homogenous population. For some women, namely those in the HRW+HRP class, risk profiles were elevated over and above HRW alone by virtue of the main male partners who had histories of incarceration and injection drug use. The presence of this class is emblematic of how drug use can be intertwined with the social, economic, and geographic contexts of the Appalachian region, as other research has noted

(Buer, Leukefeld, & Havens, 2016). Findings from other research with Appalachian women indicate that elevated risk is associated with criminal justice involvement (Staton et al., 2018), HCV infection (Havens et al., 2013) and can impact unintended pregnancy (Brown, Goodin, & Talbert, 2018; Oza-Frank, Conrey, Bouchard, Shellhaas, & Weber, 2018; Shannon, Nash, & Jackson, 2016; Wiener & Waters, 2018). Future research should consider if risk profiles are related to treatment entry and outcome variables, criminal justice involvement, and poverty variables.

While differences in reproductive health screens, general health screens, STD history, and condom use are minimal between the classes and indicative of both groups having notable risks and unmet needs, the two profiles are substantively different based upon history of sex exchange and the injection and incarceration histories of their main partners. The HRW+HRP class, which over half of the sample falls into, has male partners with histories of injection drug use and incarceration that further elevate their risk levels, while the HRW class had male partners who did not, placing them at a somewhat lower level of risk. This illustrates the prevalence and the severity of risk that partners add to the profiles of the majority of women in the sample. In addition, members of the HRW+HRP class were more likely to endorse getting high and forgetting as a reason for no condom use, which suggests elevated risk for unintended pregnancy, sexually transmitted infections, and a more pressing need for targeted, strengths-based reproductive health interventions for this group.

These results are not surprising, given the body of research suggesting a low use of protective health services and high involvement of drug using women with risky partners. For example, previous analyses using these data indicate that women's recent drug injection practices were correlated with having more male sex partners and having partners that inject drugs (Staton et al, 2017). The current findings are also consistent with previous studies suggesting that women with substance use problems in Appalachia frequently use opiates as their drug of choice (Shannon et al., 2009; Young, Havens, & Leukefeld, 2012) and infrequently access healthcare (Cole & Logan, 2010), and that partner drug use is associated with increased risk of violence and forced sexual activity, and women's fear of partner violence is associated with giving in to unwanted sexual activity (El-Bassel, Gilbert, White, Wu & Chang, 2011). Additionally, others found that intimate partner violence and potential for victimization from a partner was elevated in a sample of rural, pregnant Appalachian women who used drugs (Shannon, Nash & Jackson, 2016). Moreover, women with drug injecting partners have been found to be more likely to be recent drug injectors themselves, compared with women who do not have injecting partners (Staton et al, 2017). These examples point to the need to design comprehensive social work responses that address the risks identified in this sample, based on which class the person falls into. Moreover, given that the preponderance of the sample fell into the HRW+HRP class, attempts to design intervention strategies must take the impact of involvement with risky partners into consideration.

Implications for Social Work Practice

In light of these similarities between the two classes in terms of their personal levels of risk, interventions that are targeted towards improving health and social service use for

Appalachian women who use drugs are recommended. Targeted interventions could include educational programs that promote condom and other contraceptive use to reduce risk of unintended pregnancy and sexually transmitted infections in this population even when drug use is ongoing. These programs would need to be designed to assure substance using women that they will not be turned over to authorities for illegal substance use in the context of seeking health and social services, as fear of the criminal justice system, distrust of the health system, and internalized stigma about their illicit drug use likely discourages preventive health and social service seeking behavior (Ahern, Stuber & Galea, 2007; Staton, Leukefeld & Logan, 2001). Moreover, women in prison or jails may not trust those health providers within the criminal justice system (Staton, Leukefeld & Logan, 2001), providing a further challenge to the provision of services.

In light of these findings, targeting or personalizing interventions may be especially important in a resource-constrained geographic area like Appalachia where distrust of medical and health workers may be common (Behringer & Friedell, 2006), and therefore those designing interventions must consider challenges while capitalizing on the strengths of women in Appalachia in the social, economic, and cultural context of the geographic region, and match women with interventions that are most beneficial to them (Hamburg & Collins, 2010; Moody, Satterwhite, & Bickel, 2017; Redekop & Mladsi, 2013; Shannon et al., 2014; Shannon et al., 2009). For instance, educational messaging that communicates the gains that can be achieved through improving personal health behaviors, such the benefits of increased condom use, as has been suggested by others (Garcia-Retamero & Cokely, 2011), and would likely also be beneficial for this population, if tailored to them culturally, and in the context of their substance use. Programs that build trust with health and social service providers in the region may help further reduce risks ensure that rural women who use drugs feel safe enough to seek preventive care and accurate health related information when needed, even when they continue to engage in substance use.

These goals might be accomplished by using community health workers to connect this population to available mental health and health services, in order to increase their service awareness of available services even in the context of active substance use. This approach has been previously suggested for rural youth, and the use of community health workers has been successful in Appalachia in other health contexts (Angold et al, 2002; Feltner, Ely, Whitler, Gross & Dignan, 2012; Snell-Rood, Feltner & Schoenberg, 2018). Provider competence is also going to be important when working with this population. Providers in the area will need to be culturally sensitive to the nuances of the Appalachian culture, and well versed in understanding the stigma experienced by women involved in substance use and other elements of a risky lifestyle, as interactions with providers who lack cultural competence has been associated with treatment noncompliance in other settings (Hooper et al, 2018).

However, for those in the HRW+HRP class, efforts to address their health and social service needs will have to target partner risks as well, it seems, if their risks are to be reduced. Any effort to improve health and social service use may be thwarted by risky partners if this is not taken into consideration. One such intervention that has been proposed elsewhere includes the Community Reinforcement Approach (Moody et al., 2017), which involves

skills training and relationship counseling. The Community Reinforcement Approach has a strong body of evidence behind it (Abbott et al., 1998; Pantalon, Chawarski, Falcioni, Pakes, & Schottenfeld, 2004; Roozen et al., 2003), and may be useful for adapting to high risk Appalachian populations.

Targeted interventions could also include couples-based approaches aimed at those in the higher risk profile that focus on improving consistent condom and other contraceptive use in the context of the partner's drug injection behaviors, for example. Success with such approaches has been found by others, including in one study focused on a couples-based intervention shown to reduce risk of HIV exposure for Latina and African American women with drug-injecting male partners (McMahon et al, 2015). Research also supports the success of individual interventions targeted towards those with higher levels of sexual risk behaviors, as brief interventions have demonstrated success at reducing sexually transmitted infections in at-risk patients in a sexually transmitted disease clinic (Carey, Senn, Venable, Coury-Doniger & Urban, 2010).

Limitations

The results of this analysis should be viewed in the context of its limitations. Data are self-reported and thus may incorporate some social desirability bias. Participants were also recruited from jails in one Appalachian state and may not represent all women from Appalachia, including those who may still use drugs but have not drawn attention from law enforcement. Lastly, although we were guided by the literature in selection of variables, there may be important dimensions of risk and protective factors that we inadvertently left out.

Conclusion

This study used person-centered analysis to examine profiles of health and sexual risk in Appalachian women. Women in both profiles reported infrequent condom use, low levels of reproductive and physical health screens. Most women also reported no lifetime history of STDs. However, many women reported risky romantic partnerships with men who had histories of incarceration and injection drug use and were more likely to have exchanged sex for drugs or other resources, which coincided with a high number of drugs used in the past six months and more intense reasons for no condom use. The presence of two distinct risk profiles suggests that risk is more heterogeneous than has been traditionally conceptualized and, for Appalachian women, is part of a context that includes partner risk and drug use. Creating meaningful change will require culturally sensitive and targeted interventions that addresses access to health care, reliable contraceptive and STD prevention methods, and drug prevention and interventions that focus on both women and their partners.

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Table 1.

Model Fit statistics for 1- through 4-class solution

Number of classes	Log Likelihood	AIC	BIC	aBIC	VLMR-LRT
1	1912.447	3848.893	3896.791	3858.714	n/a
2	1852.347	3754.695	3854.481	3775.155	$p < .0001$
3	1834.958	3745.916	3897.592	3777.016	$p = .0592$
4	1817.798	3737.595	3941.16	3779.334	$p = .2218$

AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; aBIC = adjusted Bayesian Information Criterion; VLMR-LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio test. The two-class solution, shown in bold, was retained for further analysis based on these fit statistics and the substantive interpretation.

Table 2.

Proportions and sample frequencies for variables used in the latent class analysis

	High Risk Women	High Risk Women with High Risk Partner	Full sample
Protective factors			
Past year mammogram or pap smear			
No	72%	75%	295 (73.8%)
Yes	28%	25%	105 (26.3%)
Past year general health screens			
No	56%	58%	203 (57.3%)
Yes	44%	42%	151 (37.8%)
Frequency of condom use			
Never	73%	68%	277 (69.4%)
Sometimes	16%	25%	88 (22.1%)
Quite a bit	9.0%	5.0%	26 (6.5%)
All the time	2.0%	2.0%	8 (2.0%)
Risk factors			
Number of STDs ever reported			
0	67%	56%	239 (59.8%)
1	21%	30%	108 (27.0%)
2	10%	10%	40 (10.0%)
3	3.0%	2%	10 (2.5%)
4	0%	1.0%	3 (0.8%)
Sex exchange			
No	71%	49%	226 (56.5%)
Yes	29%	51%	174 (43.5%)
Main partner injects drugs			
No	100%	13%	147 (36.8%)
Yes	0%	87%	203 (50.8%)
Main partner ever incarcerated			
No	57%	3.0%	76 (21.5%)
Yes	43%	97%	278 (78.5%)

Table 3.

Auxiliary variables by class

	High Risk Women	High Risk Women with High Risk Partner
Opiate and other drug use		
Crack	8.1%	23.1%
Cocaine	10.0%	3.18%
Inhalants	1.6%	5.6%
Heroin	14.7%	25.8%
Methadone	16.8%	28.9%
Oxycontin	9.5%	10.6%
Percocet	42.5%	47.4%
Morphine	12.1%	25.1%
Buprenorphine	46.6%	72.7%
Opana	8.3%	21.0%
Neurontin	80.2%	86.8%
Anti-anxiety medications	63.1%	65.5%
Methamphetamines	28.7%	59.8%
Bath salts	0.3%	3.3%
Reasons for not using condoms		
Having sex with only one partner	72.8%	52.8%
Using another form of birth control	11.9%	3.6%
Do not think about it	20.7%	48.6%
Get high and forget	3.2%	34.9%