Published in final edited form as:

Soc Sci Med. 2012 May ; 74(10): 1602–1609. doi:10.1016/j.socscimed.2011.12.053.

OxyContin® as Currency: OxyContin® Use and Increased Social Capital among Rural Appalachian Drug Users

Adam B. Jonas, MA,

Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine

April M. Young, MPH,

Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine; Department of Behavioral Science and Health Education, Emory University Rollins School of Public Health

Carrie B. Oser, PhD,

Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine

Carl G. Leukefeld, PhD, and

Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine

Jennifer R. Havens, PhD, MPH

Center on Drug and Alcohol Research, Department of Behavioral Science, University of Kentucky College of Medicine

Abstract

Studies have shown that position within networks of social relations can have direct implications on the health behaviors of individuals. The present study examines connections between drug use and individual social capital within social networks of drug users (n=503) from rural Appalachian Kentucky, U.S.A. Respondent driven sampling was used to recruit individuals age 18 and older who had used one of the following drugs to get high: cocaine, crack, heroin, methamphetamine, or prescription opioids. Substance use was measured via self-report and social network analysis of participants' drug use network was used to compute effective size, a measure of social capital. Drug network ties were based on sociometric data on recent (past 6 month) drug co-usage. Multivariate multi-level ordinal regression was used to model the independent effect of sociodemographic and drug use characteristics on social capital. Adjusting for gender, income, and education, daily OxyContin® use was found to be significantly associated with greater social capital, and daily marijuana use was associated with less social capital. These results suggest that in regions with marked economic disparities such as rural Appalachia, OxyContin® may serve as a form of currency that is associated with increased social capital among drug users. Interventions focusing on increasing alternate pathways to acquiring social capital may be one way in which to alleviate the burden of drug use in this high-risk population.

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The authors have no conflicts of interest to disclose.

Keywords

U.S.A.; social capital; Appalachia; OxyContin; nonmedical prescription drug use; marijuana; social networks

Introduction

The definition of social capital has evolved and varied greatly across the research literature since the first direct references in the 1960's (Hannerz, 1969; Jacobs, 1961). The modern concept of social capital can be greatly attributed to seminal works by Pierre Bourdieu (Bourdieu, 1979; 1980; 1985) and James Coleman (Coleman, 1988). Bourdieu maintained that social capital is relative to the size of one's personal social network and the types of capital possessed by social network members (Bourdieu, 1980; 1985). Coleman's works remained largely parallel to Bourdieu's concept, claiming that social capital existed among individuals within tight-knit communities where norms of trust and reciprocity facilitated actions that could lead to individual benefits (Coleman, 1988). He posited that the fear of social exclusion discouraged individuals from breaking community norms of trust, thus maintaining the social system and allowing for benefit among those who were in the community.

An important innovation in the seminal works of Putnam (1993; 1995; 2000) was to establish a definition of social capital as social organization, such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit. Putnam also popularized the distinction between social capital generated from social connections across groups (bridging social capital) and within groups (bonding social capital) (Putnam, 2000). Studies have found connections with bridging and bonding social capital and health both at the individual (Beaudoin, 2009; Mitchell & LaGory, 2002) and community levels (Kim et al., 2006).

Social capital has also been conceptualized more directly within the context of social networks by the "Network Theory of Social Capital" where networks serve not only as an instrument for mobilizing resources, but also as a resource in and of themselves (Lin, 2001). This theory defines social capital as "resources embedded in a social structure which are accessed and/or mobilized in purposive actions" (Lin 2001, p 12). The Network Theory of Social Capital in many ways is a refinement of earlier work (Burt, 1992) postulating that occupying certain network positions called 'structural holes' had effects on individuals obtaining better rewards or promotions within an organization (Lin, 2001). Structural holes theory suggests that the possession of social capital by individuals is associated with occupying 'brokerage positions' within the network (Burt, 1992). These are people who are connected to otherwise unconnected people, allowing them to control what travels through the network. This type of 'open' network is visualized in Figure 1.

In Figure 1, individual A would have access to resources from B, C, and D. However, individuals B, C, and D would be dependent on A. This type of network structure is contrary to earlier concepts of social capital which asserted that dense 'closed' networks were most efficient at producing capital for network members (Coleman, 1988) (for a review of this debate see Burt, 2001).

In the closed network in Figure 2, links between B, C, and D have developed, eliminating individual A's opportunities for brokerage. Now that everybody is connected, A no longer acts as gatekeeper for resources flowing through the network. Metrics such as effective size have been developed for measuring the extent to which individuals span such structural

holes in a network (Borgatti, 1997; Burt, 1992). The literature shows that individuals that span these structural holes are able to access resources within their larger social networks (Burt, 1992; Wellman & Frank, 2001; Woodhouse et al., 1994).

Social capital and illicit drug use

The conceptualization of social capital as the ability to span structural holes is especially applicable to studies of the relationship between social capital and illicit drug use. Though traditionally drug use has been examined from an individual-level paradigm, it has become increasingly recognized that social networks and social capital play a complex role in drug use. According to previous research, a paradoxical relationship exists between social capital and drug use. Some have noted that having a network of drug-using peers can inhibit one's ability to abstain from substance use by facilitating access to drugs (Cloud & Granfield, 2008; Lundborg, 2005) and immersing one in norms supportive of drug use (Kirst, 2009), which may contribute to relapse (Cheung & Cheung, 2003; Radcliffe & Stevens, 2008) and prohibit the development of values supportive of recovery (Cloud & Granfield, 2008). Contrarily, social norms within drug users' networks can also facilitate health-protective drug-related behaviors (e.g. Friedman et al., 2004; Friedman et al., 2007; Latkin et al., 2003; Snead et al., 2003; Wiebel et al., 1996). For example, Kirst (2009) found that within a sample of injection drug users (IDUs) and crack smokers in Toronto, some networks had 'no injection' and 'no equipment sharing' rules that prohibited network members from engaging in risk behavior. Again, however, the seemingly positive influence of these social rules also had an inimical side in that many injection drug users were isolated from their networks and forced to inject alone, placing them at higher risk for fatal overdose. Drug users also reported that isolation from their networks can increase their vulnerability to victimization (Kirst, 2009) and invoked feelings of loneliness from which a return to drug use could offer escape (Weinberg, 2000).

Given the potential of drug users' social networks and accompanying social capital to have a diametric effect on drug use, the implications for intervention are complex. The evidence is clear that social networks of drug users must be taken into account during the development of drug abuse treatment, intervention, and prevention programs. Many studies suggest that drug treatment programs should equip clients with the necessary tools to facilitate new identity development and friendship formation (e.g. Hawkins & Abrams, 2007; McIntosh & McKeganey, 2000; Weinberg, 2000). The mechanisms by which these objectives can be accomplished, however, are less clear; and, the inconsistency of recommendations across studies serves as evidence that the solution may be context and population specific.

Unfortunately, a significant gap exists in the current social capital/drug use literature among rural drug users. Most studies examining social capital and substance use have been conducted in international (Cheung & Cheung, 2003; Cullen, 2010; Johnell et al., 2006; Lindström, 2003, 2004; Lundborg, 2005; McIntosh & McKeganey, 2000; Radcliffe & Stevens, 2008) and/or urban populations (Cheung & Cheung, 2003; Cullen, 2010; Hawkins & Abrams, 2007; Kirst, 2009; Laudet et al., 2000; Radcliffe & Stevens, 2008; Weinberg, 2000); few have examined social capital and drug use in rural America. Appalachia is largely rural; in fact, 42% of the population lives in an area designated as rural. The region, which passes through twelve US states from Northern Mississippi to Southern New York, has been characterized by marked economic distress (ARC, 2011a, 2011b, 2011c, 2011e), and more recently, by a growing problem of nonmedical prescription drug use (Cicero et al., 2005; Havens et al., 2007; Inciardi & Goode, 2003; Shannon et al., 2011; Zhang et al., 2008).

While nonmedical prescription drug use has become problematic nationally (SAMHSA, 2010), Appalachia has been especially hard-hit (Cicero et al., 2005; Havens et al., 2007;

Inciardi & Goode, 2003; Shannon et al., 2011; Zhang et al., 2008). Nonmedical OxyContin[®] use has been a particularly problematic in the region, receiving substantive media attention (e.g. Lipman, 2003; Zacny et al., 2003) and specific mention in government reports that describe nonmedical prescription opioid use as epidemic in Appalachian regions of Kentucky, Virginia, and West Virginia (Drug Enforcement Administration, 2002). A 2006 analysis of Kentucky Medicaid data found that within areas of distressed Appalachia, prescription claims for OxyContin[®] were significantly higher than in other regions of the state (Havens et al., 2006).

According to qualitative research, nonmedical prescription drug use has been well-established in the Appalachian area for decades; in fact, many report that it has become quite normative (Leukefeld et al., 2007). Study findings also suggest that nonmedical prescription drug use has ‘deep roots’ that can be traced back to manual laborers’ (e.g. miners and loggers) use of prescription opioids for pain management. The social networks of drug users have also reportedly contributed, as many participants stated that they had experienced nonmedical prescription drug use first-hand from observing or engaging in drug use with family members and friends (Leukefeld et al., 2007).

Social capital in Appalachia

Recent qualitative research suggests a deterioration of traditional forms of social capital in Central Appalachia resulting from a number of historical and sociopolitical factors (Bell, 2009). In a coal-mining community examined by Bell (2009), residents reported low social capital and extensive mistrust and disconnectedness from their community. Two overriding and interrelated factors were identified as contributing to the decline in social capital: outmigration of the population and de-unionization of the workforce. Bell (2009) asserts that outmigration was primarily due to job loss, which is corroborated by recent reports by the Appalachian Regional Commission (ARC) stating that population outmigration in Appalachia is among the worst in the nation, particularly in the “prime age” workforce (ages of 25 to 55) (ARC, 2011e). More recently, the national recession has exacerbated the job-loss described by Bell (2009); over the course of the recession, Appalachia has lost all of the jobs gained since 2000 (ARC, 2011e).

Job loss and a tradition of industry based on resource extraction have made poverty an acute problem among Appalachian residents. Appalachian Kentucky, according to the ARC, is the most impoverished region of Appalachia (ARC, 2011d) and Kentucky’s counties have the second highest three year average unemployment rate in the region (ARC, 2011d). In particular, the county from which participants were targeted for this study has a poverty rate of 29%, which is 135% greater than the national average (ARC, 2011d).

While it seems that out-migration, job loss, and poverty would have the most notable effects on social capital, respondents (Bell, 2009) cited instead that the de-unionization of the local coal-mining industry played the most significant role. Coal miners in the area had unionized through a long and, at times, violent struggle with the mining industry. The workers’ successful unionization marked a meaningful achievement in light of their longstanding marginalization and exploitation (Bell, 2009; McNeil, 2005). Thus, the de-unionization of the workforce brought about by a non-union company’s take-over of the local industry was especially demoralizing and injurious to community cohesion (Bell, 2009).

While the depletion of social capital in many Appalachian communities is clear, its relationship with nonmedical prescription drug use has yet to be explored. With the degradation of social capital in one realm, it may be possible that alternate forms of social capital have developed. Thus, the objective of this study was to examine the association of drug use and social capital among drug users in rural Appalachian Kentucky. Given the high

prevalence of nonmedical use of controlled-release oxycodone (Oxycontin®) in the region (Cicero et al., 2005; Havens et al., 2006; Inciardi & Goode, 2003; Leukefeld et al., 2007; Rather & Bowers, 2001), the association between OxyContin® use and social capital was specifically examined.

Methods

Research site and data collection

Data are drawn from the Social Networks among Appalachian People (SNAP) study. The overall goal of the SNAP study was to examine risk factors for HIV and other blood-borne infections using a social network approach. Data were collected between November 2008 and August 2010 from a county located in the eastern Appalachian coal field region of Kentucky. Eligible participants were residents of an Appalachian county, 18 years or older, not currently in substance abuse treatment, and had used cocaine, heroin, methamphetamine, or prescription opioids to get high in the 30 days prior to screening. Eligible, consenting participants (N=503) completed an interviewer-administered questionnaire and were compensated \$50 dollars for their time. The study protocol was approved by the University of Kentucky Institutional Review Board.

Respondent driven sampling (RDS) was utilized to recruit the participants. RDS is especially useful in recruiting hidden populations such as drug users (Heckathorn, 1997; 2002). In the current study, RDS was implemented by identifying seeds through outreach workers and community informants, as well as flyers posted at the study's storefront. Those seeds completing the baseline interview were given three coupons to bring in additional network members. The individuals brought in by the initial seeds were then given coupons to recruit additional members; this process continued until the desired sample size was achieved. For each redeemed coupon (i.e., the peer completed the baseline interview), the seed was given \$10. Each participant could therefore earn up to \$30.

Network data

In order to build the drug network, a name-generating questionnaire was utilized to determine drug use among network members. Participants were asked the first name and last initial of anyone they had used drugs with during the past 6 months. Once all of the names were elicited, additional information was gathered for each person named in their network, including demographics and drug use patterns. Ties between network members were then confirmed using four sources of information gathered as part of the SNAP study. First, the first name/last initial was checked against the names of the other participants in the study. If there was a match in the name, the demographic information they provided was matched to that provided by the person naming them. If the demographic information also matched, then this was considered a confirmed linkage. Another way in which linkages were confirmed was to determine whether the participant who was named listed the participant whose linkages we sought to confirm (a *bi-directional tie*). Those linkages not confirmed using the two sources of information were then matched against the screener database. Finally, study staff who are all residents of the county in which the study is being conducted were queried for their knowledge of network linkages. If these techniques did not yield a confirmed linkage, the named network member was not included in the network. The research techniques in this study are similar to those used previously in studies about disease transmission and social networks by Friedman and colleagues in New York City (Friedman et al., 1997) and Rothenberg, Klovadahl, Woodhouse and colleagues in Colorado Springs (Klovadahl et al., 1994; Rothenberg et al., 1994; Woodhouse et al., 1994).

Social capital measure

Social capital has been assessed a number of different ways in previous studies (Fukuyama, 2001). According to Muntaner and Lynch (2002) measures of social capital include community organization membership (clubs, civic, or social organizations), engagement in public affairs (voting, town or school public meeting attendance), volunteering (number of nonprofit organizations), informal sociability (entertaining, visiting friends), and norms of social trust. Although the measures put forth by Putnam have led to important advancements in the discourse, Lin's definition of social capital as both resources mobilized through networks and the network itself (2001) warrants further investigation at the network level of analysis. Network-based social capital studies found predominately in the management/organizational literature have utilized a variety of network measures such as betweenness centrality, constraint, and effective size (Borgatti et al., 1998).

Effective size measures individual access to resources by examining the extent to which individuals span structural holes within a network (Borgatti et al., 1998; Burt, 1992) and has been used as a measure of individual social capital in several other network studies (Burt, 1992, 2001; Cummings & Cross, 2003; Morselli & Tremblay, 2004). Effective size takes into account quantity of ties and also those ties' ability to reach diverse areas of the network; it is calculated by summing the number of people are in one's immediate social network (referred to as ego network size) and then weighting the ties by redundancy, or the amount of overlap participants have to each other's ties (Borgatti, 1997; Borgatti et al., 1998). For example, in Figure 1 individual A who was tied to three other unconnected individuals would have an effective size of three while B, C, and D would all have an effective size of one. In Figure 2 however, the other individuals' mutual connections greatly reduce A's effective size: A's effective size is divided by the number of ties (i.e. three) that exist among its alters ($B \rightarrow C$, $C \rightarrow D$, $D \rightarrow B$). The structure of ties in Figure 2 lessens the effective size score for A and all others in the network to one since A is no longer needed as a gatekeeper and resources can flow freely to all members of the network. Thus, the more unconnected one's alters are from each other, the more social capital one possesses.

Effective size was chosen as the measure of social capital in the current study because it has been subjected to substantial empirical investigation as a correlate of social capital (Borgatti et al., 1998; Burt, 1992, 1997; Cummings & Cross, 2003). Moreover, effective size has a solid grounding in the structural holes theory of the formation of social capital. However, use of effective size as a measure of social capital is also not without its limitations. Structural holes have been shown to play an important role in the generation of social capital within social networks, but have also faced criticism. First, individuals who span these structural holes have been shown in previous studies to be able to access resources within their larger social networks (Burt, 1992; Wellman & Frank, 2001; Woodhouse et al., 1994). It has also proven difficult for structural holes to explain gender differences in how men and women accumulate social capital within organizations (Burt, 1998). Another significant critique of structural holes acknowledged by Burt is that an individual's perceived position within the broader network is critical to their ability to 'capitalize' on the ability to broker in their favor between otherwise unconnected members of the network. However, it has been shown that often individuals' cognitive perceptions of their embeddedness within network structures differ vastly from observed networks (Krackhardt, 1987).

Drug use and socio-demographic variables

Self-reported drug use was obtained by asking "Have you used one or more of the following substances to get high?" for the following substances: alcohol to intoxication, heroin, licit methadone, illicit methadone, OxyContin[®], other oxycodone, hydrocodone, benzodiazepines, cocaine, crack cocaine, methamphetamine and marijuana, with recall

periods of 30 days, 6 months, and lifetime. Drug use variables were further categorized into daily use or non-daily use based upon their reported use in the 6 months prior to the baseline interview. The time period of 6 months was chosen because the timeframe matched the network questions regarding who respondents had used drugs with. Also, given the homogeneity of the sample, race was grouped as “white” or “other” for this analysis. Sources of income included those for employment, unemployment, welfare/AFDC/Social Security, and illicit sources, which were combined to form a total monthly income variable.

Analysis

Based on the extant literature with regard to social capital (Anderson, 2008; Kawachi & Berkman, 2000; Portes, 1998; Putnam, 2000), variables were chosen *a priori* for analysis. Given the non-normality of the outcome variable, bivariate and multivariate analyses were performed using ordinal logistic regression. The outcome variable, effective size, was categorized into quartiles (0= 1, 1= 1.01 – 2.00, 2= 2.01 – 3.00, 3= > 3.01). To assess if the independent variables violated the proportional odds assumption, each independent variable was entered independently into an ordinal regression model. For each model, the proportional odds assumption was checked using a score test in which a $p < .05$ indicated violation of the assumption. Categorical variables with small stratum-specific cell sizes were eliminated from ordinal regression analyses. These variables included daily use of heroin ($n=1$), cocaine ($n=6$), crack ($n=4$), licit methadone use ($n=10$), methamphetamine ($n=2$), acid ($n=0$), oral amphetamines ($n=9$), and inhalants ($n=0$).

Independent variables meeting the proportional odds assumption were evaluated for their bivariate association using multi-level ordinal regression models. Given that individuals were nested within a social network, it was inherent that the observations were correlated. Therefore, two-level random effect ordinal regression models, in which subjects were entered as the random effect, were used to determine the bivariate and multivariate correlates of effective size. The models were estimated using generalized estimating equations (GEE) with PROC GENMOD in SAS v9.3 with empirical standard error estimates. Models were specified to have a multinomial distribution, cumulative logit link function, and an independent correlation structure. Because PROC GENMOD does not currently support multinomial regression analyses (SAS institute Inc., 2008), standard multinomial regression analysis (with the first quartile serving as the referent category) was used for bivariate analyses of variables that violated the proportional odds assumption.

Variables that reached bivariate significance at $p < .10$ were entered into a multivariate multi-level ordinal regression model using PROC GENMOD. To examine if any of the independent variables served as effect modifiers in the association between OxyContin® use and effective size, each independent variable was entered into an interaction term with OxyContin® and evaluated in the model. Collinearity within the model was assessed using the %COLLIN_2011 macro for SAS’s PROC GENMOD procedure (Zack et al., 2011). Condition indexes (CI) of greater than 30 and corresponding variance decomposition proportions (VDPs) of greater than 0.5 are indicative of collinearity (Kleinbaum & Klein, 2010). When collinearity was present, variables were removed from the model sequentially in descending order of their VDPs; collinearity was re-assessed after each removal (Kleinbaum & Klein, 2010). Adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) are reported. Lastly, a diagram of drug co-usage in the SNAP study was created in order to provide a visual representation of the social network using NetDraw 2.098 (Harvard, MA) (Borgatti, 2002). UCInet 6.303 (Harvard, MA) (Borgatti et al., 2002) was utilized to compute all network measures.

Results

Table 1 displays demographic and behavioral characteristics of the sample (n=503). Participants were predominately white (94.2%) and male (56.9%). The median age was 31 years (IQR: 26, 38). Mean monthly income from employment was low (\$349.19, SD: \$817.40) in comparison to the mean income from illicit sources (e.g. selling or manufacturing drugs, robbery, forgery, and prostitution) (\$453.94, SD: \$1484.24). Median educational attainment was 12 years (IQR: 10, 12). Daily use of marijuana (34.4%) was most common, followed by hydrocodone (29.8%) and OxyContin® (28.0%).

In bivariate analyses, gender, educational status, total monthly income, daily marijuana use, and daily OxyContin® use were significantly associated with effective size (Table 2). The proportional odds assumption was assessed for each of the bivariate models. Two models marginally violated the proportional odds assumption, those for education (score test $p=.046$) and benzodiazepine use (score test $p=.044$). In turn, multinomial regression was used to re-evaluate the association of education and benzodiazepine use with effective size, with the first quartile serving as the referent value. Educational status was significant in one of the contrasts, that between the third and first quartiles ($p=.004$), and was therefore retained in the final model. In contrast, benzodiazepine use showed no significant association in any of the contrasts in the multinomial model and was therefore not carried forth in the analysis.

To examine if any of the remaining independent variables served as effect modifiers in the association between OxyContin® use and effective size, each independent variable was entered into an interaction term with OxyContin® and evaluated in the model (e.g. *OxyContin*Income*, *OxyContin*Education*, *OxyContin*Gender*, *OxyContin*Alcohol*, *OxyContin*Marijuana*, and *OxyContin*Hydrocodone*). In the saturated model, which included all interaction terms, collinearity was present (CI: 71.8). Sequential removal of variables in descending order of their VDPs resulted in the removal of two interaction terms, *education*OxyContin* and *marijuana*OxyContin*. The resulting model had borderline collinearity (CI: 31.6), but the removal of additional interaction terms could not be justified given that the highest VDP among them did not exceed 0.5. However, a score test revealed that the remaining interaction terms did not make a meaningful contribution to the model ($\chi^2 = 0.76$, $p=.383$). There was no evidence of collinearity in the resulting no-interaction model (CI: 26.2), nor was there evidence of violation of the proportional odds assumption.

Gender, educational status, total monthly income, and daily use of alcohol to intoxication, marijuana, hydrocodone, and OxyContin® were included in the final multivariate model shown in Table 3. Gender, education, income, nor daily alcohol or hydrocodone use were significantly associated with effective size, controlling for the other variables in the model. Marijuana use had a significant negative association with effective size (AOR: 0.62, 95% CI: 0.44 – 0.87). However, daily OxyContin® users had significantly increased odds of having higher effective size (AOR: 2.31, 95% CI: 1.61 – 3.30), adjusting for gender, education, income, and daily marijuana, alcohol, and hydrocodone use.

Network visualization

The complete drug network is visualized in Figure 1. As shown, many individuals who have high personal social capital as measured by effective size are also daily OxyContin® users (red nodes). The social ‘connectedness’ of the sample should also be noted, as 76.1% (n=383) of participants were contained within the main component (the largest group in which all members can be reached by other members of the group). It is also worth noting that of the 120 participants outside the main component, only 16 (13.3%) had used OxyContin® daily compared to 125 (32.6%) within the main component. This difference was highly significant ($\chi^2=16.877$, $p = <.001$).

Discussion

In this analysis of drug users in rural Appalachia, we found that daily OxyContin[®] users were more likely to hold positions of high social capital among their drug-using peers. Further, among marginalized populations where drug use is fairly normative, certain drugs may elicit enough demand to create brokerage opportunities for the individuals who use drugs the most, allowing them greater social capital and greater access to what ‘flows’ through the network (Burt, 1992), whether that be positive (income, knowledge, trust) or negative (blood-borne infections). Interestingly, marijuana use was associated with decreased social capital. This finding suggests that different classes of drugs may differ in their relationship to social capital.

Over one-third of participants in this study were daily users of marijuana. National data has shown that marijuana use among Appalachian adults is lower than the national average (ARC, 2008). However, marijuana production has been reported to be extremely prevalent in the region (U.S. Department of Justice, 2010). In fact, approximately 10% of all outdoor marijuana plants eradicated nationally comes from the Appalachian portions of Kentucky, Tennessee, and West Virginia (U.S. Department of Justice, 2010). Marijuana production is considered a multigenerational trade in central Appalachia (U.S. Department of Justice, 2010), which would suggest that marijuana might act as a form of capital for otherwise economically disadvantaged families. However, this presupposition should be considered in the context of norms surrounding the actual use of marijuana. Regional data suggests that despite the intensity of marijuana production in Central Appalachia, marijuana use is lower in the region compared to the rest of Appalachia (ARC, 2008). This contrasts sharply with data on OxyContin[®] and prescription opioids, which show that Central Appalachia has a *higher* prevalence of use compared to other Appalachian regions (ARC, 2008). These data suggest that there may be substance-specific social norms. Supportive social norms surrounding OxyContin[®] use may permit the drug to act as a valuable commodity in social exchanges, as OxyContin[®] can have a street value of up to \$100 dollars per pill in rural areas (Estep et al., 2011). This study’s finding of a positive association between OxyContin[®] use and increased social capital can be better understood within this complex milieu. These findings suggest that future interventions in this population must take into account the complex relationship between social capital and frequent drug use, in which some forms of drug use may be destructive to social capital, while use of others can serve as a successful pathway to social capital; or depending on the direction of causality, social capital may facilitate access to some illicit drugs, while limiting access to others.

The large personal networks of the individuals engaging in the most OxyContin[®] use in our study suggest that among drug users, people who use OxyContin[®] regularly are fairly ‘popular’. This may have led to the development of norms in rural Appalachia where OxyContin[®] is important for gaining social stature. It is possible that the high prevalence of OxyContin[®] use among this population is due to a combination of economic and cultural factors, such as the region’s history of prescription drug use for pain resulting from strenuous labor such as coal mining (Leukefeld et al., 2007), the drug’s affordability to those who receive public assistance (Havens et al., 2006) as well as the limited availability of other drugs such as heroin that are more readily available in urban drug markets (Havens et al., 2007). Research in other communities where OxyContin[®] use is not normative, is necessary to understand whether the effects would be similar for a different drug of choice. It would be important to recognize these local norms when designing drug use interventions.

Social capital needs can also be addressed at the community level, increasing the amount of resources ‘available’ to be accessed for rural, Appalachian drug users. However, increasing social capital has been noted to be particularly challenging in rural Appalachia, in part due

to issues surrounding cooperation and trust. Cooperation among the economically-disadvantaged can sometimes be rare due to individuals' tendency to trust only their kin and to be suspicious of other families (Duncan, 2001). Scant resources and unreliable institutions that infuse community life with distrust can also negatively impact the development of social capital in Appalachia (Duncan, 2001). Also, drug interdiction campaigns have served to cycle many rural, Appalachian drug users in and out of the corrections system, further stigmatizing them and diminishing their ability to access capital through traditional means such as employment. There is consensus however, that increasing social capital in rural Appalachia requires investments in educational programs and grassroots civic engagement (Bell, 2009; Duncan, 2001). However, social capital as a concept has been critiqued as ignoring dynamics of class conflict, political power, and inequality and serving to forward conservative political ideologies by shifting the focus away from state intervention to the community and individual level (Friedman et al., 2007; Muntaner & Lynch, 2002; Muntaner et al., 2002; Navarro, 2002).

This study is not without limitations. It is important to note that relationships between actors in this study are based on drug co-usage, not necessarily the exchange of drugs. These social connections, however, present important opportunities for the exchange of resources in the network, whether physical or information. Second, these data are cross-sectional and therefore no inferences can be made about causality. It is unclear whether OxyContin[®] facilitates gains in social capital or if having social capital increases access to OxyContin[®]; only longitudinal research could make this distinction. However, the present study demonstrates that there is a strong association between OxyContin[®] use and social capital, making clear that the topic certainly warrants further research. Third, the data uses the quantity and diversity of self-reported social network connections to represent personal social capital. Therefore, factors commonly associated with social capital such as trust and reciprocity have to be largely assumed as present in the interaction of using drugs with one another. Fourth, because of the homogeneity of the rural Appalachian sample utilized in this study, different forms of social capital such as bridging and bonding social capital could not be properly explored. Lastly, it is unclear if the dynamics observed in this study would differ from those observed in an urban setting where nonmedical prescription drug use is pervasive; thus, further research into how the association between nonmedical prescription drug use and social capital may differ by geographic setting is warranted.

Despite these limitations, this is the first study to examine the role of OxyContin[®] use in social capital in rural Appalachia. This is important knowledge about a geographic area with scarce financial resources. In addition, these data speak to the importance of peer networks in determining social capital and social norms, which has vast implications for intervention research. Future research is necessary to determine whether new patterns will emerge as a result of the reformulation of OxyContin[®]. If so, it will be necessary to examine these changes in drug use patterns in the context of social capital within the larger drug network.

Highlights

- Suggests that certain drugs might elevate frequent users to positions of high social capital within drug use networks
- Identifies daily OxyContin[®] users as highly connected to other drug users in rural Appalachia and in turn, having greater social capital
- Uses social network analysis to examine the relationship of frequent drug use and social capital
- Intervention in such populations must take into account norms of frequent drug usage as a legitimate path to social capital

Provides data on the extent of nonmedical prescription opioid use in networks within rural Appalachia

Acknowledgments

We would like to acknowledge the contributions of the field staff and study participants as well as the National Institute on Drug Abuse (R01DA024598).

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Figure 1.
Example of a 'open' network in which individual fills a structural hole between B, C, and D.

Figure 2.
Example of a 'closed' network in which no structural holes exist.

Figure 3. Network diagram of drug usage in a rural, Appalachian community (n=503). Red nodes are daily OxyContin® users. Nodes are sized by personal social capital indicated by effective size. Links represent use of drugs together.

Table 1

Demographic characteristics and daily drug use among a sample of drug users in rural Appalachia (n=503)

	n	%
<i>Demographic characteristics</i>		
Male	286	56.9
White	474	94.2
Age, median (IQR)	31	26 – 38
Married	132	26.2
Total monthly income ^a , mean (SD)	\$1746.14	\$1130.11
Education, median years (IQR)	12	10 – 12
Access to transportation ^b	182	36.2
Years in region, median (IQR)	29	23 – 35
<i>Daily substance use in past 6 months</i>		
Alcohol to intoxication	37	7.4
Acid	0	0
Benzodiazepines	97	19.3
Cocaine	6	1.2
Crack	4	0.1
Marijuana	173	34.4
Heroin	57	11.3
Hydrocodone	150	29.8
Inhalant	0	0
Illicit Methadone	113	22.5
Licit Methadone	10	2.0
Oral amphetamines	9	1.8
Other Oxycodone	81	16.1
OxyContin®	141	28.0
Methamphetamine	2	0.4
<i>Criminality</i>		
Incarcerated in the past 30 days	36	7.2
Currently involved in legal system ^c	112	22.3
<i>Social capital (i.e. effective size)</i>		
1	226	44.9
1.01 – 2.00	108	21.5
2.01 – 3.00	80	15.9
> 3.01	89	17.7

IQR: interquartile range; SD: standard deviation; AFDC: Aid to Families with Dependent Children; SSI: Supplemental Security Income

^aSources of income included those for employment, unemployment, welfare/AFDC/Social Security, and illicit sources^bDefined as having a valid driver's license and owning an automobile^cCurrent involvement with the legal system was defined as being on probation (with or without a sentence), parole, mandatory release from prison with mandated supervision time, pretrial release, in a diversion program, or incarcerated.

Table 2

Bivariate associations between social capital (e.g. effective size) and demographic and drug use characteristics

Variable	Odds Ratio	95% CI	p-value
Age	1.01	0.99 – 1.03	.288
Gender (male)	0.70	0.50 – 0.97	.030 [*]
Race (white)	1.12	0.53 – 2.35	.776
Total monthly income ^a	1.00	1.00 – 1.00	.040 [*]
Education ^b	1.01	0.99 – 1.01	.101
Years lived in region	1.00	0.98 – 1.01	.684
Married	1.12	0.78 – 1.60	.556
Access to transportation ^c	1.27	0.90 – 1.78	.168
Incarcerated in last 30 days	0.90	0.48 – 1.69	.740
Current legal status	0.94	0.64 – 1.39	.755
Daily use of alcohol to intoxication	0.51	0.25 – 1.05	.066
Daily marijuana use	0.60	0.43 – 0.84	.003 ^{**}
Daily benzodiazepine use ^b	1.16	0.77 – 1.75	.469
Daily OxyContin [®] use	2.31	1.63 – 3.29	<.001 ^{***}
Daily oxycodone use	1.00	0.64 – 1.55	.986
Daily hydrocodone use	0.75	0.53 – 1.05	.096
Daily illegal methadone use	1.10	0.76 – 1.61	.616

*
p<.05;**
p<.01;***
p<.001^aSources of income included those for employment, unemployment, welfare/AFDC/Social Security, and illicit sources^bVariable violated the proportional odds assumption and was therefore evaluated for its bivariate association using standard multinomial logistic regression, with the first quartile of effective size serving as the referent group^cDefined as having a valid driver's license and ownership of an automobile

Table 3

Multivariate associations between social capital (e.g. effective size) and demographic and drug use characteristics

Variable	AOR	95% CI	p-value
Male gender	0.79	0.56 – 1.10	.159
Years of education	1.00	0.99 – 1.01	.260
Total monthly income	1.00	1.00 – 1.00	.212
Daily marijuana use	0.62	0.44 – 0.87	.005
Daily alcohol use to intoxication	0.57	0.26 – 1.25	.158
Daily hydrocodone use	0.80	0.56 – 1.14	.222
Daily OxyContin® use	2.31	1.61 – 3.30	<.0001

AOR: adjusted odds ratio, CI: confidence interval