Title

Social networks of people with serious mental illness who smoke: potential role in a smoking cessation intervention

Journal

Journal of Mental Health, ahead-of-print(ahead-of-print)

ISSN

0963-8237

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Publication Date

2024-04-08

DOI

10.1080/09638237.2024.2332807

Peer reviewed

Social networks of people with serious mental illness who smoke: potential role in a smoking cessation intervention

Background: Smoking is major contributor to morbidity and mortality among individuals with serious mental illness (SMI) and social networks may play an important role in smoking behaviors.

Aims: Our objectives were to 1) describe the network characteristics of adults with SMI who smoke tobacco 2) explore whether network attributes were associated with nicotine dependence.

Methods: We performed a secondary analysis of baseline data from a tobacco smoking cessation intervention trial among 192 participants with SMI. A subgroup (n=75) completed questions on characteristics of their social network members. The network characteristics included network composition (e.g., proportion who smoke) and network structure (e.g., density of connections between members). We used multilevel models to examine associations with nicotine dependence.

Results: Participant characteristics included: mean age 50 years, 49% women, 48% Black, and 41% primary diagnosis of schizophrenia/schizoaffective disorder. Median personal network proportion of active smokers was 22%, active quitters 0%, and non-smokers 53%. The density of ties between actively smoking network members was greater than between non-smoking members (55% vs 43%, p=0.02). Proportion of network smokers was not associated with nicotine dependence.

Conclusions: We identified potential social network challenges and assets to smoking cessation and implications for network interventions among individuals with SMI.

Keywords: tobacco smoking; smoking cessation, mental disorders; social network analysis

Introduction

People with serious mental illness (SMI) such as schizophrenia and bipolar disorder have higher early mortality rates than those without SMI, and their primary cause of death is cardiovascular disease (CVD) (Colton & Manderscheid, 2006; Druss et al., 2011) (Colton & Manderscheid, 2006; Druss et al., 2011). While multiple behavioral risk factors contribute to their CVD risk, cigarette smoking is particularly notable in this population (Daumit et al., 2005; F. Dickerson et al., 2021; Lasser et al., 2001; McCreadie & Scottish Schizophrenia Lifestyle Group, 2003) (G. L. Daumit et al., 2005; F. Dickerson et al., 2021; Lasser et al., 2001; McCreadie & Scottish Schizophrenia Lifestyle Group, 2003). In a nationally representative sample, people with SMI had 2.7-fold greater odds of smoking than individuals without SMI (Lasser et al., 2001) (Lasser et al., 2001), and in samples of community-dwelling people with SMI, as many as 70% are active smokers (Glasheen et al., 2014, p. 201; McCreadie & Scottish Schizophrenia Lifestyle Group, 2003)(Glasheen et al., 2014; McCreadie & Scottish Schizophrenia Lifestyle Group, 2003). Therefore, promoting smoking cessation among individuals with SMI is critically needed to reduce CVD and overall mortality risk.

Among people with SMI, qualitative studies and surveys have attributed prevailing barriers to quitting smoking to social network characteristics such as a high prevalence of smoking in one's social network, general acceptability of smoking, and lack of social support for quitting (Aschbrenner et al., 2017; Twyman et al., 2014) (Aschbrenner et al., 2017; Twyman et al., 2014). Broadly, social networks – the web of relationships that exist between people – have been postulated to impact health through multiple mechanisms, including social influence, support, engagement, and resource sharing (Berkman et al., 2000)(Berkman et al., 2000). The American Heart Association

identified social networks as an important research gap in understanding and potentially reducing CVD risk (Havranek et al., 2015)(Havranek et al., 2015) and research into cigarette smoking has repeatedly demonstrated the important role of social networks in behavior change (Burgess-Hull et al., 2018; Christakis & Fowler, 2008; Cobb et al., 2010)(Burgess-Hull et al., 2018; Christakis & Fowler, 2008; Cobb et al., 2010). As an example, one of the strongest predictors of sustained cessation for participants randomized into a smoking cessation intervention for a primary care clinic population is spending less time with those members of one's social network who are actively smoking (Richmond et al., 1993)(Richmond et al., 1993). A burgeoning literature seeks to identify social network factors that may be modified to improve smoking cessation efforts among adults with SMI.

Among adults with SMI, prior research has mostly focused on social support rather than formal assessments of social network composition and structure (Corrigan & Phelan, 2004)(Corrigan & Phelan, 2004). Social networks may be unique and critically important in this population, especially for those who participate in organized group settings and rely on network members for advice, support, and instrumental needs (Brunt & Hansson, 2002; Goering et al., 1992; Mueser & Tarrier, 1998; Nelson et al., 1992; Pernice-Duca, 2008)(Brunt & Hansson, 2002; Goering et al., 1992; Mueser & Tarrier, 1998; Nelson et al., 1992; Pernice-Duca, 2008). The limited prior research has found that the social networks of persons with SMI have different composition and structure than other groups. For example, their networks have a higher proportion of mental health staff and are smaller compared to surveys of the general population (Brunt & Hansson, 2002; Mueser & Tarrier, 1998; Pernice-Duca, 2008)(Brunt & Hansson, 2002; Mueser & Tarrier, 1998; Pernice-Duca, 2008); however, a paucity of quantitative

studies to date have specifically characterized the social networks of individuals w

Supplemental Information

Supplemental Tables

Supplemental Table 1. Comparison of demographics, smoking status and health status between subgroup who completed the social network assessment and non-subgroup participants enrolled in a smoking cessation program (N=192)

Supplemental Table 2. Comparison of demographics, smoking status and health status among a subgroup of adults with serious mental illness enrolled in a smoking cessation trial, by baseline nicotine dependence (N=75)

Supplemental Materials

Supplemental Materials 1. Social network assessment from the TRIUMPH trial.

Supplemental Materials 2. Social network questions used to create measures of network composition.

Supplemental Materials 3. Relevant equations for structural social network variables.

Supplemental Materials 4. Index of R packages used in analysis with references.

ith SMI that smoke tobacco and are engaged in smoking cessation. Such information

would aid cessation efforts to mitigate social influences that reinforce smoking behaviors and leverage social supports for abstinence.

In this study, our overall objective was to characterize baseline social network factors that have theoretical importance for the success of a smoking cessation interventions by 1) describing the composition and structure of individuals' social networks among a sample of community-dwelling adults with SMI who smoke tobacco and were enrolled in a smoking cessation trial and 2) exploring whether baseline network attributes, particularly the proportion of network smokers, were associated with baseline level of nicotine dependence.

Materials and Methods

Study Design & Data Source

This study is a secondary cross-sectional analysis of baseline data from the Trial of Integrated Smoking Cessation, Exercise and Weight Management in Serious Mental Illness (TRIUMPH) (NCT02424188), which was a community mental health organization-based, two arm randomized clinical trial of a smoking cessation program integrating exercise and weight counselling in Maryland, USA (Daumit et al., 2019). One hundred ninety-two individuals were enrolled and randomized to treatment as usual or intervention (Daumit et al., 2019). The usual treatment group received referral to a telephone helpline staffed by trained smoking cessation counsellors and capable of providing nicotine replacement therapy, counselling, referrals to in-person classes and limited follow-up by phone. The intervention group received a multi-component smoking cessation intervention including behavioral counselling and pharmacotherapy. The trial recruited adult participants ages 18 and older with SMI who were daily

tobacco smokers, were willing to try to quit within the next six months, and attended community mental health programs. The Johns Hopkins University School of Medicine Institutional Review Board gave ethical approval for this study (IRB 00072510), and all participants signed informed consent to participate.

Trained study staff collected data in-person from 2016 to 2018. Social network data were limited to a convenience sample subgroup of participants at baseline (n=75) due to constraints on study resources including staff trained in social network data collection. This subgroup was similar to study participants who did not undergo social network assessments, as there were no statistically significant differences in baseline demographics (i.e., age, gender, race, marital status), smoking status (i.e., years of smoking, readiness to quit, nicotine dependence), or mental health diagnoses between those who participated in the social network assessment and those who did not (Supplemental Table 1).

Social Network Assessment

Participants completed an egocentric social network inventory at baseline, which characterizes how a person perceives the attributes of members of their social network. The assessment of egocentric networks is a widely used approach (Kessler, 2017; Smith et al., 2013; Waite et al., 2019), which posits that the respondent's perception of the network members' behavior – in contrast to network members' actual behavior – is an important driver of the respondent's behavior (Valente, 2010). Data collection was facilitated by EgoNet software (MD Logix). Each participant began by listing up to 15 people in their personal network with whom they had contact during the past year. The software randomly selected 10 of these network members for additional questions,

including the nature of the relationship, demographics, as well as health status and habits (Supplemental Materials 1). By limiting detailed questioning to 10 network members, we aimed to reduce survey fatigue yet still capture influential network members (McCarty et al., 2007; Valente, 2010). Only 2 participants (2.7%) could not identify at least 10 social network members. We calculated network composition and structural variables as below.

Network Composition

Using a strategy from prior studies (Gudzune et al., 2018; Meza et al., 2020; Pollack et al., 2014), we calculated the proportion of social network members perceived to have certain characteristics. Characteristics included age, gender, race, relationship type, smoking status, mental health, support and contact frequency (Supplemental Materials 2). Race and gender concordance were included as surrogate measures of homophily which is associated with the diversity of information and social models available to an individual (McPherson et al., 2001). Figure 1 displays an example of differences in network composition of smoking behaviors to illustrate these concepts using exemplary participant networks.

Network Structure

We calculated three dimensions of network structure: density, components, and constraint. Equations are available in Supplemental Materials 3.

Network density measures how tight-knit a group of individuals may be (Perry et al., 2018). High density is associated with slower adoption of health behaviors that are perceived as non-normative or taboo (Centola, 2018). Figure 1 displays an example

of differences in network density represented by exemplary participant networks. Participants were asked, “How often have <network member A name> and <network member B name> had contact with each other sometime in the past year or so? (Often, Sometimes, Rarely, Never) (Q17 in Supplemental Materials 1). Density was then calculated as the ratio of participant-reported social ties between network members divided by all possible ties between network members (excluding the participant). We calculated the density of 1) all social ties (Often/Sometimes/Rarely versus Never), 2) close ties (Often versus Sometimes/Rarely/Never), 3) all ties between current smokers, and 4) all ties between non-smokers.

Network components represent the number of independent groups of network members who are connected to one another but not to other groups that the participant knows (Perry et al., 2018). Figure 1 displays an example of differences in components. As compared to connected individuals, unconnected network members are more likely to differ in decision-making, information access, and perspective (Perry et al., 2018). Therefore, the number of components may affect the participant’s diversity of exposure to different opinions or perspectives (Perry et al., 2018). As an example, participants who report no network components that have at least one active quitter may not have ready access to a trusted group who is knowledgeable of the quitting process and how to be supportive. Therefore, for each participant, we calculated 1) the total number of network components, 2) the number of network components that contained at least one active smoker, and 3) the total number of components that contained at least one active quitter.

Constraint estimates the ability of a network member to transmit information and influence across gaps in the network structure (i.e., areas absent of member-member

social ties). We calculated Burt's constraint index (Burt, 2015), which measures how a structural position in the network may constrain members' actions and access to information (range from 0 = maximal potential for transmission to 1 = maximal social constraint).

Nicotine Dependence

To estimate degree of nicotine dependence, we used the Fagerstrom Test of Nicotine Dependence (Heatherton et al., 1991). This validated psychometric measure correlates well with heaviness of smoking and identifies individuals with high consumption of tobacco products (range 0 to 10). A higher total score indicates more intense physical dependence. To aid interpretability of the results, we dichotomized the score into lower (<5) and higher (≥ 5) physical dependence (clinically described as low-to-moderate and moderate-to-high physical dependence, respectively (American Association for Respiratory Care, n.d.; National Institute on Drug Abuse, n.d.)).

Potential Covariates and Recruitment Sites

Participant reported demographics, psychiatric, and medical history: age, gender, race, educational attainment, marital status, primary psychiatric diagnosis, and self-reported medical diagnoses including COPD/emphysema (Supplement Table 2). Primary mental health diagnosis was self-reported by the participant and confirmed via chart review. We also estimated cumulative years of regular smoking by summing the number of years that the participant reported smoking regularly for at least six months, rounded to the nearest half-year. We assessed readiness to quit smoking by asking participants, "Are you thinking about quitting within the next month?" (yes/no) and "Are you thinking about quitting within the next six months?". Participants were recruited from

different types of community mental health programs, which included outpatient clinics and psychiatric rehabilitation programs (PRP). Outpatient clinics focus on provision of ambulatory care, while PRPs provide comprehensive rehabilitation and mental health services, support community integration, and promote use of community resources among their clients. Therefore, we examined mental health organization type, which were grouped as PRP based at academic medical centers, PRP based at community sites, and outpatient clinics.

Analysis

We conducted all analyses in R (R Core Team, 2018) and RStudio (RStudio Team, 2018) (R packages used listed in Supplemental Materials 4). In our first objective describing the social networks attributes of individuals with SMI who smoke, we assembled individual-level and network-level summary statistics including demographics, network composition, and network structure. We used Kruskal-Wallis test to compare the proportion of actively smoking network members who were family versus friends and t-test to compare the density of active smokers versus non-smokers. All estimates have a random effect for recruitment site. Tests were two-tailed with an alpha <0.05 indicating statistical significance.

Our second objective explored the association between baseline network attributes and nicotine dependence. We performed 1) bivariate analyses to identify significant relationships with nicotine dependence and select covariates (Supplement Table 2), followed by 2) dyadic models of the dyadic relationship between participant nicotine dependence score and network member smoking status with an interaction term for daily contact (analyses available upon request), and finally 3) multilevel models of nicotine dependence with participants nested within recruitment sites. Bivariate analysis

identified a significant association only between self-reported COPD/emphysema and nicotine dependence. Therefore, in an attempt to use the most parsimonious model, we did not include other covariates in the final model. The dyadic interaction models uncovered a significant interaction between two network member characteristics: network member smoking status (i.e., active smoker) and frequency of contact between participant and network member (i.e., daily contact). Therefore, we defined the independent variable of our multilevel models as the proportion of social network members who were both active smokers and had daily contact with the participant. We modeled nicotine dependence score as a function of this independent variable with a random effect for recruitment site, adjusting for self-reported COPD/emphysema.

We performed sensitivity analyses of 1) our bivariate models using the Fagerstrom Test of Nicotine Dependence as a continuous variable and 2) our multivariable model adding gender as a potential confounder.

Results

Of the 75 participants, mean age was 50.4 years (SD 11.0), 49.3% were women, and 48.0% Black. Participants carried a diversity of psychiatric diagnoses including: 13.1% schizophrenia, 28.0% schizoaffective disorder, 33.3% bipolar disorder, and 25.3% major depression. They reported a mean of 32.0 (SD 12.4) cumulative years of regular smoking, and mean nicotine dependence score was 4.4 (SD 2.1). Table 1 summarizes individual-level attributes of the sample.

Social network composition

Table 1 shows the network composition of the sample. Given skewness of the data, network compositional variables are presented as median proportion of the personal

network to have attribute. The social networks were comprised almost entirely of adults (median proportion children/young adults 0%), and were mostly age-group concordant with the participant (73%). Networks had a slight preponderance of women (53%), and gender concordant relationships (60%). Race concordance was low (20%). Proportions of friends (50%) and family (40%) were similar. While health providers were infrequently nominated (0%), 30% of network members had been met through a day program or clinic, and 30% also had mental illness.

At the median, active smokers comprised 22% of network members and non-smokers 53% -- few network members (0%) were identified as trying to quit or recently quit smoking ("active quitters"). A greater proportion of active smokers were identified as friends than identified as family (50% vs 40%, t=2.62; df=75, p=0.01).

Social network structure

Table 1 also shows the network structure of the analytic sample. Mean network density was 38%, which is typically considered moderately dense (Valente, 2010). Mean density among smokers was 55%, which indicates a tight-knit group where most know one another. The density of active smokers was greater than non-smokers (t=2.42; df=45; p=0.02). Overall, participants reported a median of 2 components overall and 1 component with at least one smoker. Components that included an active quitter were rare (median 0). On average, participants' social networks had low social constraint (0.28).

Baseline nicotine dependence and social network smoking – exploratory analysis

For our second objective, we modeled participant social networks and nicotine

dependence at baseline. Overall, 45% of participants had nicotine dependence scores greater than or equal to five (i.e., moderate to high dependence). There were no statistically significant differences in individual-level characteristics between participants with lower and higher nicotine dependence, although substantial difference in COPD/emphysema existed (90.2% lower dependence versus 73.5% higher dependence; p=0.07) suggesting the potential for confounding (Supplemental Table 2). The only statistically significant difference in network-level characteristics between participants with lower and higher nicotine dependence was marginally higher median proportion of women network members in latter group (50% vs 58%, p = 0.04) (Table 2). In our final model of baseline nicotine dependence, there was no statistically significant association between participant nicotine dependence and the proportion of network active smokers in daily contact with participants, adjusting for participant COPD/emphysema (β = 0.01; 95%CI -0.19,0.37; p=0.51).

Sensitivity Analyses

We found no qualitative differences in our bivariate results when retaining the Fagerstrom Test of Nicotine Dependence as a continuous variable or when adding gender to our multivariable model as a potential confounder.

Discussion

In this study, we described the composition and structure of participants' social networks among actively smoking adults with SMI enrolled in a smoking cessation trial and tested the association between participant baseline nicotine dependence and the proportion of network members who were active smokers in daily contact with the participant. Most research to date has focused on social support rather than social

networks in this population (Corrigan & Phelan, 2004), and quantitative analyses of the social networks have been limited. Our study adds to this emerging body of quantitative social network analyses among adults with SMI in general and particularly related to smoking. Our cohort is unique for being demographically diverse, inclusive of a breadth of psychiatric diagnoses, and focused on a population of adults residing outside of institutionalized settings.

We were particularly interested in describing social network factors relevant to smoking and smoking cessation. We identified several social network factors that could present challenges to smoking cessation among adults with SMI that smoke. First, the median proportion of actively smoking network members was 22%, with a right skew. To our knowledge, only one other small study has quantitatively analyzed the social networks of adults with SMI enrolled in a smoking cessation program (Aschbrenner et al., 2018), which found a high mean proportion of active smokers in the network (52%). Our quantitative findings align with prior predominantly qualitative work that has identified that the most common barriers to smoking cessation in this population were a high prevalence of smoking among peers and general acceptability of smoking (Aschbrenner et al., 2017; Morgan et al., 1988; Twyman et al., 2014). Future research should examine whether proportion of smokers within the social network influences outcomes of smoking cessation programs among individuals with SMI.

Prior studies have shown that adults with SMI contemplating smoking cessation need social support and positive social influences (Burris et al., 2013; Patten et al., 2016; Rayens et al., 2008; Sorensen et al., 2002; Twyman et al., 2014); therefore, understanding the network structural factors among individuals with SMI may be important in understanding how smoking cessation might be supported. We examined

several network structural factors, including density, components and constraint. We found that network density between network members who actively smoked was high, participants had a limited number of network components, and their networks had low constraint. High density has been associated with slow change of behaviors non-normative to the group (Centola, 2018), which may suggest that promoting cessation among these dense groups of individuals who smoke could be challenging. While limited number of network components may limit exposure to different ideas and behaviors, low social constraint suggests that few individuals in the network are in a position to stifle information flow key to initiating and supporting health behavior changes like smoking cessation. In considering all these structural factors together, our results may imply that if smoking cessation could be promoted in and accepted by these groups, then their low constraint and high density could facilitate behavior change attempts. In this cross-sectional analysis, we did not find any differences in network characteristics between those with lower and higher nicotine dependence at baseline – which gives no indication that future network interventions might need to be altered based on this factor. Overall, our findings support the need for future research describing and testing network approaches to smoking cessation among adults with SMI.

Prior studies have found greater likelihood of cessation success linked to specific characteristics of an individual's social network including the presence of former smokers, active quitters, and other cessation role models as well as strong social support (Aschbrenner et al., 2017, 2018; Christakis & Fowler, 2008). Our findings build on a nascent body of social network research that may help to inform future intervention design. Peer-support interventions have shown great promise, but also great

heterogeneity of effect (F. B. Dickerson et al., 2016; Ford et al., 2013; Malchodi et al., 2003; Park et al., 2004). Per social network theory, quantitatively measuring and monitoring social network within such interventions might help tailor the approach to achieve consistent results (Valente et al., 2015). Alternatively, promising group behavioral interventions (Stead et al., 2017) might be enhanced by measuring and promoting network connections between individuals attempting smoking cessation.

Our descriptive analyses further revealed important contextual results. In general, we found participants' networks to be highly age-group and gender concordant, and participants reported daily contact with 60% of their network members. Participants reported greater percentage of network members were friends rather than family, which differs from prior studies that reported a larger ratio of family to friends for persons with SMI (Brunt & Hansson, 2002; Degnan et al., 2018; Goldberg et al., 2003; Pernice-Duca, 2008). These prior studies also reported small network size and inclusion of healthcare providers within networks, which differs from our findings. The differences between our sample and these prior studies may be related to the fact that our population was recruited, in part, from PRPs, where the opportunity for developing larger networks, particularly of friends met through this setting is likely greater than treatment at an outpatient clinic setting alone. In fact, 30% of our participants' networks were comprised of individuals with mental illness and a similar percentage were known to the participant through a day program or clinic. Prior research has shown that more severe mental illness is associated with smaller social networks (Macdonald et al., 2000), therefore, improvements in pharmacologic therapies for SMI that enable better management may also have contributed to differences in networks between our studies and previous work. Lastly, social networks change with an individual's age and our

analytic sample, which had a mean age of 50 years, was characterized as having personal networks with few children and relatively high age concordance. Evidence from studies of parents suggest that the network dynamics of younger smokers may be substantially different and children themselves can be a potent motivation for smoking cessation (Rosen et al., 2012). Additional research among diverse samples of adults with SMI is needed to understand how setting and treatment may influence social networks.

There are several potential mechanisms that may explain our findings. Clustering of behavioral traits in social networks often occurs due to mutually reinforcing effects of shared environment, homophily, and social influence (Christakis & Fowler, 2013). For example, adults with SMI may find themselves in a neighborhood where tobacco products are readily accessible (shared environment); they may choose their social contacts based upon acceptance of shared behaviors like smoking (homophily); and smoking may become an addiction under the influence of friends and family who also smoke (social influence). As behavioral clustering occurs, we would expect the proportion of actively quitting network members to decrease as these individuals gravitate toward more salubrious environments, seek out relationships that validate their decision to quit, and avoid other smokers who may trigger relapse. The higher density of social ties between smokers compared to non-smokers may be explained by the shared experience of smoking in congregate settings that builds social bonds. The finding that most participants had very few network components may reflect barriers such as stigma, absence of work-related network ties, and the burden of managing psychiatric and medical comorbidities that preclude adults with SMI from exploring new social spaces and forming ties to novel social groups. The finding that

there was no significant association between participant nicotine dependence and the proportion of active smokers in their network suggests that nicotine dependence may be determined by non-network factors, but could also be the result of our small sample size or due to the cross-sectional nature of the analysis.

Our study has several limitations. We examined a small, community-dwelling sample of adults with SMI who demonstrated some interest in quitting smoking. As such, we were unable to model baseline dependent variables such as frequency of smoking or readiness to quit as these were constrained by the clinical trial's eligibility criteria. Similarly, some items on the Fagerstrom Test of Nicotine Dependence may have been constrained by communal living arrangements (e.g., smoking in bed). We used an egocentric network approach that relies on participant perception of attributes and behaviors. Although perceptions of less observable attributes (e.g., readiness to quit smoking) may be less accurate than more observable behaviors (e.g., the act of smoking), perceptions likely influence participants' behaviors regardless of their accuracy. Indeed, when understanding the role of social norms, perceptions may be more valuable than objective measures (Israel, 1982; Valente et al., 1997). Our study design does not allow us to distinguish between shared environment, homophily, and social influence as the mechanism(s) of our social network characteristics findings. Our aim was for this analysis to be descriptive and we were neither designed nor powered to compare participants from different recruitment sites, test whether network characteristics modified the effect of the smoking cessation intervention, or test whether the intervention may have induced changes in social network characteristics. Relatedly, the embedded nature of our study within a randomized trial necessarily lead to selection effects and limits generalizability of our results outside the clinical trial context. For

example, level of nicotine dependence in the sample was low and all participants were ready to quit in the next 6 months, which suggests a level of motivation above the general smoking population. Lastly, while members of the SMI community had significant involvement in the design of the parent study as well as review and approval of this analysis, interpretation of our results would have been enhanced had we employed a formal process for integrating input from study participants and the larger SMI community to inform our inferences with insights of those who have lived experience.

In conclusion, our findings challenge the assumption that adults with SMI have limited social resources from which to draw, and we identified a rich social context that has the potential to reinforce smoking behaviors as well as support smoking cessation. These findings suggest that community treatment site (e.g., PRP) may shape social network formation, posing the question of whether such sites should more intentionally seek to rewire networks to better promote health. Our findings dovetail nicely with prior studies that have found greater likelihood of cessation success linked to having former smokers in one's network, initiating cessation collectively with social network members, having cessation role models, and strong social support (Aschbrenner et al., 2017, 2018; Christakis & Fowler, 2008). Lastly, our findings build on a nascent body of social network research that may help to inform future intervention design. With concurrent measurement of social network characteristics, future clinical trials may ask how networks impact intervention efficacy and how interventions may be customized to an individual's network barriers and assets.

Acknowledgements

The authors would like to thank the trial participants, the Community Advisory Board, and others in the SMI community who made this work possible.

Disclosure Statement

The authors report there are no competing interests to declare.

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