Elucidating The Smoking Cessation Process Among Socioeconomically Disadvantaged
Smokers With Serious Mental Illness

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Dedication

This dissertation is dedicated to my family, friends, and canine companions who have supported me through the years.

Abstract

Introduction

The decline in smoking prevalence has been paralleled by widening mental health and socioeconomic disparities in smoking rates.[1] To identify points of intervention, this dissertation presents three studies that elucidate the smoking cessation process among socioeconomically disadvantaged smokers with serious mental illness (SMI).

Methods

The following studies are secondary data analyses of the OPTIN study. ICD-9 codes categorized participants into SMI (n=1044) and non-SMI (n=1277) groups. The first study utilized mediation analysis to examine whether physician cessation treatment advice and physician bias mediate the association between SMI and treatment utilization. The second study utilized logistic regression to examine the intervention effect among smokers with and without SMI, and whether it was more effective for smokers with SMI. Using multinomial and linear regressions, the third study examined how smoking abstinence affects binge drinking and mental health among smokers with and without SMI.

Results

In the first study, smokers with SMI utilized treatments at higher rates than those without SMI. This effect was mediated by physician treatment advice (Proportion Mediated=11.7%), but not bias. In the second study, the intervention increased treatment utilization in the SMI (51.6% vs 38.1%) and the non-SMI group (38.6% vs 25.8%). The

intervention increased abstinence in the non-SMI group (18.1% vs 12.8%) and the SMI

group (14.7% vs 10.8%). There were no significant interactions. In the third study,

smokers who quit had lower odds of binge drinking for more than 3 days per month in

the SMI (OR = 0.26) and the non-SMI group (OR = 0.42). Smokers who quit had lower

depression scores in the SMI (2.37 vs 2.71) and the non-SMI group (1.59 vs 1.75). In the

SMI group, smokers who quit reported lower anxiety scores (55.61 vs. 59.03).

Discussion

These studies highlight the importance of healthcare providers in the cessation process,

demonstrate that proactive outreach is effective for treatment utilization and abstinence,

and provide evidence for beneficial effects of smoking abstinence in the domains of

mental health and alcohol use. These findings underscore the need to facilitate access and

utilization of cessation treatments among smokers with mental illness.

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Background

A Health Disparity Priority

The Health and Economic Burdens of Smoking

There has been a gradual decline in the prevalence of cigarette smoking in the US over the past several decades, with a current estimated prevalence of 17%.[1] Despite this decline, smoking still accounts for approximately 480,000 premature deaths and 300 billion dollars in healthcare costs and lost productivity each year in the US.[2] These figures are made more troubling due to the fact that tobacco-related burdens are borne disproportionately by those of lower socio-economic status (SES), certain racial and ethnic minorities, those who identify as gay, bisexual, or transgender, and those with mental illness.[1]

Smoking, SES, and Mental Illness

The overall decline in smoking prevalence has been paralleled by a widening socioeconomic disparity in smoking rates. Among US adults under the age of 65, 30% of the medically uninsured and Medicaid enrollees are current cigarette smokers, compared to 15% of adults with private health insurance.[3] Socioeconomic disadvantage is also associated with increased rates of mental illness, as the prevalence of many mental health (MH) disorders are far higher among low-income populations,[4,5] those who did not complete high school,[6] and the unemployed.[7]

The co-occurrence of socioeconomic disadvantage and mental illness is especially troubling given evidence suggesting that mental illness is a strong risk factor for smoking

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in its own right. Indeed, rates of smoking among those with a MH disorder are two to three times higher than that of the general US population depending on clinical diagnosis.[8] In addition, those with MH disorders smoke with greater frequency, intensity, and are more nicotine-dependent than smokers without MH disorders.[9] The highest rates of smoking are found among those with diagnoses of schizophrenic disorders, major depressive disorders, and bipolar depression, suggesting that diagnoses consistent with serious mental illness (SMI) confer the greatest smoking risk.[10–12] As a result, cigarette smoking is the primary cause of excess mortality in this population.[13,14] As low SES and mental illness contribute independently to smoking risk,[15] socioeconomically disadvantaged smokers with MH disorders are an exceptionally vulnerable population with respect to smoking-related morbidity and mortality.

Cessation Treatment for Smokers with SMI

Historically, there have been a dearth of studies devoted to evaluating the effectiveness of cessation treatments for smokers with SMI as these smokers are often excluded from participating in cessation trials, particularly those involving novel or high-risk treatments.[16] However, increased attention to this disparity in recent years has helped to demonstrate the effectiveness of multiple cessation treatment modalities for this population.[17]

Effectiveness of Cessation Treatment.

Several studies have demonstrated the effectiveness of nicotine replacement therapy (NRT) among mixed-MH disordered samples,[18–20] and have even demonstrated that the abstinence rates achieved by smokers with MH disorders can be similar to those

experienced by smokers without MH disorders.[20] Varenicline has also been shown to be an effective treatment when used in conjunction with NRT in a mixed-MH disorder sample,[18,20] and Bupropion has been shown to be effective when used in conjunction with NRT and group therapy among smokers with schizophrenia.[21] With respect to non-pharmacological cessation treatments, cognitive behavioral therapy and contingency management techniques have demonstrated effectiveness among mixed-MH disorder samples,[18] as well as among smokers with depression[22,23] and schizophrenia.[24,25] In addition, contingency management techniques are effective for boosting abstinence rates among mixed-MH disorder samples.[19]

Studies further suggest that smokers with SMI are receptive to cessation treatments and take these treatments up at high rates when they are offered.[26–28] Particularly high rates of treatment up-take can be achieved when offered in a proactive and universal manner.[27] In summary, considerable evidence suggests that both pharmacological and counseling-based treatments are effective and well-tolerated among smokers with SMI.

Healthcare Provider Factors and Cessation Treatment Utilization

One potentially important barrier to treatment utilization among smokers with SMI is their interactions with healthcare providers.

SMI and Healthcare Provider Interactions

Individuals with SMI often do not receive the care they need, a problem that is partially attributable to the inherent complexities of the healthcare and insurance systems in the US, factors which make it more difficult for them to initiate and maintain care.[29] Those

with SMI tend to receive lower rates of care from healthcare providers, particularly with respect to care for co-morbid health conditions. Indeed, SMI is associated with a lower probability of being referred for mammography, inpatient services following a diabetic crisis, and cardiac catheterization.[30,31]

Healthcare Provider Barriers: *Advice*.

Evidence suggests that the issue of differential care extends to treatment for smoking cessation. Although the 2008 United States Department of Health and Human Services (USDHHS) clinical practice guideline states that smokers with MH disorders should be offered the same cessation treatment options as smokers without these disorders,[32] in practice this is rarely the case. Smokers with SMI receive low rates of cessation counseling,[33] and smokers with less severe diagnoses like anxiety disorders are more likely to receive cessation care than those with more severe diagnoses like schizophrenia.[34] Several factors may account for this disparity in care. Historically, smoking has been perceived as a normative behavior for smokers with SMI, particularly among staff working in in-patient psychiatric units.[35,36] Furthermore, healthcare professionals may discourage quitting due to a belief that this may exacerbate these patients' depressive symptoms.[37,38] In addition, physicians face competing treatment concerns for these patients, lending to the perception that smoking cessation is not a priority for these individuals.[38,39] This "treatment overshadowing", in which a physician prioritizes treatment of MH symptoms over other health concerns,[40] may contribute to lower rates of cessation-related care for this group.

Healthcare Provider Barriers: *Bias*.

The internalization of mental health stigma and bias on the part of the healthcare provider may also play a role in engendering differential care for those with SMI.[41] Studies have indicated that physicians are less comfortable interacting with patients with MH disorders,[31,42] and that some hold discriminatory beliefs toward these patients.[31] Other research has shown that physicians who have a patient with a history of a MH disorder are less likely to take their medical problems seriously,[43] and that physician endorsement of MH stigma is associated with a lower likelihood of specialist referral and a reduced willingness to refill prescriptions.[44,45] The problem of being unable to obtain prescriptions may be exacerbated for smokers enrolled in publicly-subsidized healthcare programs, as a prescription from a healthcare provider is required in order to receive free or reduced cost cessation treatment. Indeed, Medicaid enrollees are much less likely to utilize pharmacotherapy than the general population.[46]

Barriers to Cessation

Proactive outreach strategies may be useful in helping to address the unique individual, social environment, and healthcare provider barriers to cessation faced by smokers with SMI.

Individual Level Barriers

At the individual level, the "self-medication" hypothesis posits that individuals with mental illness smoke in an attempt to reduce the experience of negative affect and anxiety associated with their condition,[47,48] factors which could reduce the likelihood of engaging in a quit attempt. Smokers with SMI also experience heightened nicotine withdrawal symptoms when trying to quit including depressed mood, anxiety, and generalized

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discomfort.[49,50] With respect to psychosocial profile, evidence suggests that smokers with mental illness have lower self-efficacy for quitting[35,51,52] which contributes to a perceived inability to initiate and maintain abstinence.

Social Environment Barriers

With respect to social environment, smoking is often seen as a normative and socially-acceptable behavior for those with SMI and has even been encouraged among those living in in-patient psychiatric units.[35,36] Indeed, cigarettes have been used as a reward to reinforce acceptable behavior among patients in treatment settings.[53] Individuals with certain MH disorders may also be more susceptible to peer influence regarding smoking. In a study of adolescents, more severe symptoms of depression were associated with greater peer acceptability of smoking.[36]

Healthcare Provider Barriers

Evidence suggests that smokers with SMI receive differential care from their healthcare providers. Physicians face competing treatment demands for these patients, lending to the perception that smoking cessation is not a priority for these individuals.[38,39] The internalization of mental health stigma by physicians may also lead to a different standard of care for smokers with SMI.[41] Several studies have indicated that physicians are less comfortable interacting with patients with MH diagnoses[31,42] and that some hold discriminatory beliefs toward these patients.[31] Finally, research has shown that some physicians expect that the mental health of their patients will deteriorate if they attempt cessation,[37,38] leading to a reluctance to provide cessation advice.

Proactive Outreach: Overcoming Cessation Barriers

Proactive outreach cessation strategies, which promote heightened contact with smokers, facilitate access to free pharmacological cessation treatment, and provide motivational quitting advice as well as promote self-efficacy, may be an effective approach for minimizing psychosocial and healthcare provider barriers to treatment among smokers with SMI. With respect to psychosocial barriers, the motivational interviewing components of the intervention are designed to improve smokers' self-efficacy for quitting as well as address social environmental barriers like permissive social network norms and low social support for quitting. In terms of healthcare provider barriers, proactive outreach may help overcome the issues of competing treatment demands, the perception that smokers with SMI aren't motivated to quit, and the low rates of specialist referral experienced by smokers with SMI by facilitating easy access to evidence-based cessation resources.

Evaluating the Effects of Smoking Cessation

To address the perception that smoking cessation is not a treatment priority, we must critically examining some of the enduring beliefs regarding smoking cessation among those with SMI. Specifically, it is important to evaluate how the smoking cessation process influences the MH of those with SMI and whether it contributes to an increase in other problematic health behaviors.

Mental Health

A key barrier to smoking cessation among those with SMI is the perception that quitting

will exacerbate the MH symptoms associated with their condition. This perception exists at the individual level and at the level of the healthcare provider. Smokers with SMI often use nicotine as a form of self-medication to help reduce the experience of negative affect and anxiety associated with their condition(s),[47,48] while other research suggests that these smokers believe that their MH will deteriorate following a quit attempt.[35] Healthcare providers similarly endorse the belief that quitting may heighten the depressive symptoms of their patients,[37,38] contributing to the belief that smoking cessation is not a treatment priority for these patients.

Binge Drinking

At the individual level, many of those with alcohol use disorder report using tobacco as a way of coping with the urge to drink,[54] making the prospect of quitting smoking seem overwhelming and unattainable. At the level of the healthcare provider, the strong withdrawal symptoms associated with abstinence from both tobacco and alcohol have contributed to a reluctance to treat these conditions simultaneously,[55,56] largely due to the belief that achieving abstinence in one of these behaviors will lead to exacerbation of the other.[57] By exploring how smoking cessation affects the highly co-morbid issue of binge drinking, we can evaluate what impact smoking cessation has on other problematic health behaviors and how physicians should address these issues during the cessation process.

Source of Data

Data for the following studies are taken from the "Improved Effectiveness of Smoking Cessation Programs for Minnesota Priority Populations" (OPTIN) trial.

Study Design

OPTIN is a randomized controlled trial that demonstrated the effectiveness of a proactive outreach intervention for boosting rates of cessation treatment utilization and prolonged abstinence among a sample of socioeconomically disadvantaged smokers enrolled in Minnesota Health Care Programs (MHCP). MHCP is a health insurance program for low-income persons and families that is comprised of two major publicly-subsidized health care assistance programs: Medicaid and MinnesotaCare. The study population sample was stratified by age group (18–24, 25–34, and 35–64), gender, and healthcare program (Medicaid and MinnesotaCare). Institutional Review Board (IRB) approval for the study was obtained from the University of Minnesota and the Minnesota Department of Human Services (DHS).

Sampling Procedure

Prospective participants aged 18 and older were identified using MHCP administrative data from the Minnesota DHS. A random sampling procedure identified 21,181 potential participants out of a total of 630,000 MHCP enrollees. These individuals were mailed a tobacco use survey that served as both an eligibility screen and baseline survey.

Sample

Eligibility criteria included 1) a valid home address, 2) proficiency in English, and 3) current cigarette smoking (having smoked a cigarette in the past 30 days, even a puff). Baseline surveys were mailed to 21,181 prospective participants aged 18 to 64 who were MHCP enrollees. 9,362 baseline surveys were returned. Of these, 6,826 did not meet study inclusion criteria and 130 declined to participate. The remaining smokers (N=2,406) were enrolled in the study and randomized to proactive outreach (n=1200) or usual care (UC) (n=1206).

Participant Characteristics

The majority of the sample was enrolled in Medicaid (73%) at the time of the baseline survey Most of the sample was female (70%), and the racial composition was majority White (78%) with large groups of African American (11%) and American Indian (7%) participants. A significant proportion of participants had completed at least some college (42%), and most of the sample (69%) earned less than $20,000 annually. Slightly less than half of the sample (43.4%) had at least one SMI diagnosis, defined as: Schizophrenia spectrum disorder, psychotic disorder, major depressive disorder, and/or bipolar I or II disorder (see Table 1).

With respect to smoking characteristics, the majority of participants (70%) smoked a cigarette within 30 minutes of waking. Most participants (54%) reported having made a quit attempt within the past year at baseline. Only 31% of participants reported having used any form of cessation treatment within the past year, with the vast majority reporting that they had used some form of pharmacotherapy (NRT, prescription medication).

Table 1. Baseline Characteristics of the OPTIN Sample.

Characteristic	N=2406 No. (%) or Mean
Demographics	
Insurance type	
Medicaid	1,749 (72.7)
MnCare	657 (27.3)
Male	707 (29.4)
Race/Ethnicity	
White	1,885 (78.4)
Black or African American	256 (10.6)
Amer Indian or Alaskan Native	167 (6.9)
Hispanic or Latino	42 (1.8)
Asian or Pacific Islander	56 (2.3)
SMI Diagnosis	
Major depression	835 (34.7)
Bipolar	440 (18.3)
Schizophrenia	146 (6.1)
Psychotic	164 (6.8)
Any	1044 (43.4)
Education	
Grade 11/lower	322 (13.7)
HS grad/GED	781 (33.2)
Some college	977 (41.5)
College grad/higher	274 (11.6)
Employment	
Employed/self-employed	1,206 (51.1)
Student	162 (6.9)
Out of work	307 (13.0)
Unable to work/disabled	553 (23.4)
Homemaker	133 (5.6)
Yearly income	
Less than $10k	857 (37.3)
$10,001-$20k	720 (31.4)
$20,001-$40k	492 (21.4)
More than $40k	228 (9.9)
Smoking History	
Cigs/day	13.6
Time until 1st cig (mins)	
≤ 5	617 (26.0)
6 – 30	1045 (44.0)
> 30	715 (30.0)
Past year quit attempt	1287 (54.3)
Any treatment used	752 (31.3)

Data were collected from MHCP administrative and claims data obtained from the

Minnesota DHS for a 2-year period prior to study initiation, and using mailed surveys at

baseline (i.e. at time of randomization) and at 12 months post-randomization. A modified

Dillman sequential mixed mode protocol (mailed questionnaire plus telephone follow-up)

was used, including a $10.00 incentive that was included with the first mailing of the

follow-up survey. 944 participants (78%) in UC and 826 participants (69%) in proactive

outreach returned their 12-month follow-up survey (see Table 2).

Table 2. Measures and Data Collection Schedule

MEASURES	Pre	Baseline	12-M	Source
Demographics				
Insurance	x	x		DHS Admin
Sex		x	x	
Age		x	x	
Race/ethnicity		x	x	Survey
Employment status		x	x	
Educational level		x	x	
Household income		x	x	
Smoking history				
Age began to smoke regularly		x		
Quit attempt in past 12 months		x	x	Survey
Number of days smoked in past 30 (Youth Tobacco Survey-CDC)		x	x	
Smoking outcomes				
6 month prolonged abs			x	Survey
Nicotine dependence				
CPD (cigarettes per day) (Partial Cigarette Dependence Scale)		x	x	Survey
Time of first cigarette in the morning (Partial Cigarette Dependence Scale)		x	x	
Treatment utilization				
Use of smoking cessation services in past 12 months		x	x	
Use of meds/NRT past 12 months		x	x	Survey
Use a tele stop smoking program in past 12 months		x	x	
Healthcare provider				
Have a regular healthcare provider		x	x	
Saw a healthcare provider in the past 12 months		x	x	
Doctor advise to quit		x	x	
Doctor discuss ways to quit (other than meds)		x	x	Survey
Doctor discuss medications		x	x	
Satisfaction with help received about quitting smoking		x	x	
Provider bias and cultural competence		x	x	
Cessation beliefs				
Readiness to quit ladder (RQL) (contemplation ladder)		x	x	Survey
Global self-efficacy (SEG)		x	x	
Social environment				
Other people in household		x		
Other household smoker		x	x	
Smoking rules in home		x	x	Survey
Friends that smoke		x		
Important peoples' attitudes toward your smoking		x		
Social undermining/social support		x		
Mental health				
Alcohol use (BRFSS and DoD)		x	x	
Depression symptoms PROMIS Anxiety Scale)		x	x	Survey
Anxiety symptoms				
Mental health disorder	x			DHS Admin

Research Study 1

Title: <u>Serious mental illness and cessation treatment utilization:</u>

<u>The mediating role of healthcare provider interactions</u>

Specific Aims

<u>Aim 1:</u> To explore the effect of SMI on cessation treatment utilization.

> *Hypothesis 1*: SMI will be negatively associated with cessation treatment
> utilization.

<u>Aim 2:</u> To explore the roles of 1) physician-delivered cessation advice, and 2)
perceptions of physician bias as potential mediators of the effect of SMI on cessation
treatment utilization.

> *Hypothesis 2(i):* A significant amount of the total effect of SMI on change in
> cessation treatment utilization rates will be mediated by its indirect effect on
> physician-delivered cessation advice.

> *Hypothesis 2(ii):* A significant amount of the total effect of SMI on change in
> cessation treatment utilization rates will be mediated by its indirect effect on
> perceptions of physician bias.

Abstract

Introduction

Evidence suggests that patients with SMI receive differential care from their healthcare providers for co-morbid health conditions, and that physicians may be reluctant to treat smoking cessation as a healthcare priority for those with SMI. The purpose of the present study is to elucidate the role that healthcare provider interactions play in the cessation process for smokers with SMI, in an effort to identify points of intervention that may be effective for this population.

Methods

Data for this secondary data analysis were taken from the OPTIN study. ICD-9 codes consistent with diagnoses of schizophrenic disorders, psychotic disorder, bipolar disorders, and/or major depressive disorder were used to categorize participants in SMI (n=1044) or non-SMI (n=1277) groups. Mediation analyses assessed whether the effect of SMI on cessation treatment utilization at 12-month follow-up was mediated by baseline measures of physician-delivered cessation advice and perceptions of physician bias, respectively.

Results

Contrary to expectation, smokers with SMI utilized cessation treatments at higher rates than those without SMI. Smokers with SMI reported higher rates of physician-delivered advice to use cessation treatments, effects that were associated with higher rates of cessation treatment utilization. In minimally adjusted models, the effect of SMI on any

form of cessation treatment utilization was partially mediated by advice to use

medications (Proportion Mediated=11.7%) and by advice to use other forms of treatment

(Proportion Mediated=6.0%). Mediation by physician bias was not present.

Discussion

The association between physician advice to use cessation treatment and cessation

treatment utilization highlights the important role that healthcare providers play in the

cessation process. These results suggest that the patient/physician relationship is an

important point of intervention for low-income smokers, and that continued effort is

needed to minimize barriers to cessation-related care. This is particularly important for

smokers with SMI, who tend to be interested in quitting but may need more help from

healthcare professionals in order to achieve prolonged smoking abstinence.

Introduction

The overall decline in smoking prevalence has been paralleled by widening socioeconomic and mental health disparities in smoking rates. Among adults under the age of 65, 30% of the medically uninsured and Medicaid enrollees are current cigarette smokers, compared to 15% of those with private health insurance.[3] Socioeconomic disadvantage is also associated with heightened rates of mental illness, as the prevalence of MH disorders are higher among low income populations,[4,5] those who did not complete high school,[6] and the unemployed.[7] As low socioeconomic standing and mental illness are independently associated with smoking,[15] socioeconomically disadvantaged smokers with SMI are an exceptionally vulnerable population with respect to smoking-related morbidity and mortality.

Increased attention to these disparities has helped to demonstrate the effectiveness of multiple forms of treatment for this population. NRT has been shown to be effective in mixed-MH disordered samples,[18–20] leading to abstinence rates similar to those experienced by non-MH smokers.[20] Studies have also shown that Varenicline and Bupropion, used in conjunction with NRT, are effective for smokers with MH disorders.[18,20,21] Cognitive behavioral therapy has been shown to be effective in mixed-MH disorder samples,[18] as well as among smokers with depression[22,23] and schizophrenia.[24,25] In addition, research has demonstrated that motivational interviewing is an effective cessation treatment for smokers with major depression.[58]

Considerable evidence suggests that pharmacological and counseling-based treatments are effective and well-tolerated by smokers with SMI, but reducing smoking disparities

requires a thorough examination of the barriers and facilitators to their use. One important factor is these smokers' interactions with their healthcare providers. Although the 2008 USDHHS clinical practice guideline states that smokers with MH disorders should be offered the same cessation treatment options as smokers without these disorders,[32] evidence suggests that they do not receive that same level of cessation-related treatment and advice from their healthcare providers.[33,34,59]

Several factors may account for this potential disparity in care. Physicians face competing treatment demands for these patients, lending to the perception that smoking cessation is not a priority for these individuals[38,39] and potentially contributing to lower rates of cessation-related care for this group. The internalization of mental health stigma on the part of physicians can also play a role in engendering differential care for those with SMI.[41] Several studies have indicated that physicians are less comfortable interacting with patients with MH diagnoses[31,42] and that some hold discriminatory beliefs toward these patients.[31] Physician endorsement of MH stigma is associated with a lower likelihood of specialist referral and a reduced willingness to refill prescriptions.[44,45] The problem of being unable to obtain prescriptions may be exacerbated for smokers with SMI who are enrolled in Minnesota Health Care Programs (MHCP), as a prescription from a healthcare provider is required in order to receive free or reduced cost cessation treatment.

Despite evidence suggesting that both pharmacological and counseling cessation treatments are effective for smokers with SMI, little is known about their rates of cessation treatment utilization. As such, an initial aim of this study is the explore rates of

cessation treatment utilization among smokers with and without SMI.

Furthermore, while smokers with SMI who are enrolled in MHCP have access to free and reduced cost cessation treatments, a lack of adequate cessation-related care from healthcare providers may act as a barrier to cessation treatment utilization. Given the heightened rates of smoking-related morbidity and mortality among smokers with SMI, it is critically important that we better understand the effect that these interactions have on the cessation process. As such, our primary aim is to elucidate the mechanisms that contribute to cessation treatment utilization among smokers with SMI relative to those without SMI, with a focus on healthcare provider interactions. Specifically, we will explore the roles of physician advice to use medications and advice to use other cessation treatment options, as well as perceptions of physician bias, as potential mediators of the effect of SMI on cessation treatment utilization. As eliminating smoking would prevent a large amount of the excess morbidity and mortality experienced by this population,[60,61] it is imperative that we continue to identify points of intervention that can be used to help eliminate this health disparity.

Methods

Study Design

Data were obtained from the OPTIN study. The study population sample was stratified by age group (18–24, 25–34, 35–64), gender, and MHCP insurance program (Medicaid or MinnesotaCare). Medicaid is reserved for very low-income residents, whereas MinnesotaCare serves people at higher incomes that are still near the poverty threshold. Using data obtained from MHCP insurance claims during a 2-year period prior to study

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initiation, ICD-9 codes consistent with diagnoses of schizophrenic disorders, psychotic

disorder, bipolar I and II disorder, and/or major depressive disorder were used to

categorize participants as having SMI (n=1044) or not having SMI (n=1277).

<u>Measures</u>

Measures were obtained from OPTIN baseline and follow-up survey data, as well as from

MHCP administrative and claims data.

Demographics

Insurance program, age, sex, education, employment status, income, and race/ethnicity

were assessed.

Mental Health Diagnoses

Participants with at least one ICD-9 code in the range of 1) 295.00 to 295.94 were

considered to have a schizophrenic disorder, 2) 297.00 to 298.9 were considered to have

a psychotic disorder, 3) 296.2 to 296.36 were considered to have a major depressive

disorder, 4) 296.00 to 296.13 and/or 296.4 to 296.9 were considered to have a bipolar

disorder.

Smoking History

Questions from the California Tobacco Survey[62] and the Behavioral Risk Factor

Surveillance System (BRFSS)[63] were used to assess lifetime duration of smoking, time

until first cigarette after waking, cigarettes smoked per day (CPD), and past year quit

attempts.

Social Environment

A composite variable was created to measure participants' perceived social support for cessation by taking the mean of two support-related variables that assessed perceived support for quitting and others' desire for quitting, respectively.[28] These items were assessed on a 5-point scale, with higher scores indicating greater levels of support. Participants reported the proportion of their close friends and family who were smokers. Participants also indicated whether they lived with a child under the age of 18, whether they lived with another smoker, and the smoking rules within their home.

Healthcare Provider Factors

Healthcare Effectiveness Data and Information Set (HEDIS) tobacco performance measures were used to assess participants' past year healthcare experiences.[26] Items assessed whether participants received physician-delivered advice to quit, advice to use cessation medications, and advice to use ways (besides products) to help with quitting. A composite variable of perceptions of healthcare provider bias was created by summing 3 items from the Physician Bias and Interpersonal Cultural Competence Measures Scale[27] (see Appendix). Each item was assessed on a 5-point scale, with higher values indicating greater perceptions of physician bias. Analyses run on the summary measure created for these items yielded an unadjusted Cronbach's alpha reliability score of 0.74.

Cessation Beliefs

Self-efficacy for quitting was measured on a scale from 1 to 10, with higher values indicating greater confidence in quitting.[28] The Contemplation Ladder assessed readiness to quit on a scale from 1 to 10, with higher values indicating greater readiness to quit.[29]

Cessation Treatment Utilization

Several items assessed whether participants used NRT products, prescription cessation medications, and behavioral counselling in the past year.

Statistical Analysis

Bivariate Analyses

Bivariate analyses, using t-tests and Pearson's chi-square tests, were used to compare participants with SMI to those without SMI across a series of socio-demographic, smoking history, cessation treatment utilization, healthcare provider, social environment, and cessation beliefs measures.

Mediation Approach

Mediation analyses adhered to the counterfactual approach, which asserts that the total effect of the exposure (SMI) on the outcome (cessation treatment utilization) can be decomposed into natural direct effects and natural indirect effects, or meditational effects.[64] The direct effect is the amount of change that would occur in cessation treatment utilization in the presence vs. the absence of SMI, provided that for each individual the mediator (physician advice or physician bias, respectively) was kept at the level that it would have if each individual did not have SMI. The indirect effect expresses

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how much the outcome would change on average if SMI was present, but the mediator was changed from the level it would have in the presence compared to the absence of SMI.

This approach to effect decomposition was preferred over the conventional regression adjustment approach,[65] which may produce biased effect estimates.[64] A SAS macro developed by Valeri and VanderWheele utilizes the G-estimation approach and produces reliable effect estimates when using continuous, dichotomous, and/or count data.[66] Furthermore, these models produce reliable estimates even in the presence of an exposure/mediator interaction.

Mediation Analyses

Analyses will assess whether baseline measures of 1) physician-delivered advice to use medications (NRT and/or prescription) 2) physician-delivered advice to use other cessation treatments (not medications), and 3) participants' perceptions of physician bias, separately, mediate the effect of SMI diagnosis on cessation treatment utilization at 12-month follow-up (see Figure 1). The physician-delivered advice to use medications mediator was paired with 1) utilization of medications, and 2) utilization of any cessation treatment. The physician-delivered advice to use other cessation treatments mediator was paired with 1) utilization of counseling, and 2) utilization of any cessation treatment. The perceptions of physician bias mediator was paired with utilization of any cessation treatment.

Figure 1. Mediation Models and Timeline of Measures.

| 2-Yrs Pre-Baseline | Baseline | 12-M Follow-Up |
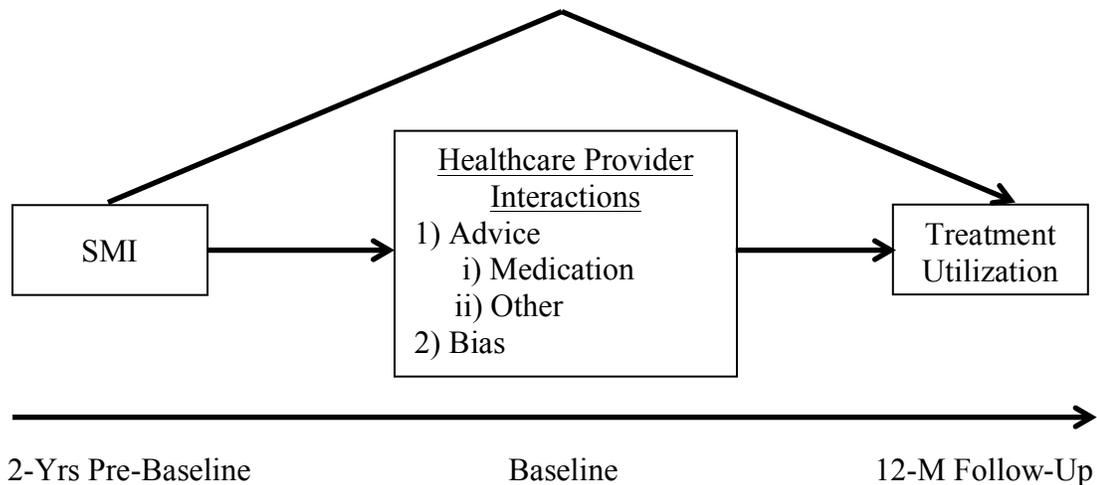
Five hundred bootstrap samples were produced for each set of regression analyses from which effect estimates and their associated confidence intervals were derived. In modeling the dichotomous outcome variables (cessation treatment use vs. none), Poisson regressions were fit to the data in order to produce relative risk (RR) estimates. Poisson regression was chosen due to the well-documented problems with utilizing logistic regression with common dichotomous outcomes (over 10% prevalence),[66,67] and due to its superiority for model convergence relative to binomial models. Logistic regressions modeled the physician advice mediators (medications and other) and linear regressions modeled the perceptions of physician bias mediator.

Model Building

Prior to model building, each exposure/mediator pairing was evaluated for statistical interaction in their effects on a given outcome. None of the pairings produced statistically

significant interactions; thus, interaction terms were not included in any of the following analyses.

In order to produce valid effect estimates, counterfactual mediation models assume no unmeasured or uncontrolled confounding between the 1) exposure and outcome, 2) exposure and the mediator, and 3) mediator and the outcome.

For each mediator/outcome pairing, a series of mediation analyses were conducted beginning with a minimally-adjusted model controlling only for intervention condition (proactive outreach vs. usual care). Sequential adjustments for blocks of socio-demographic (insurance program, age, gender, race/ethnicity, employment, education, income), smoking history (time until first cigarette after waking, CPD), and social environment (proportion of close friends/family that smoke, social support for quitting, and home smoking rules) variables were then performed.

Sensitivity Analyses

In order to elucidate the association between SMI and cessation treatment utilization, Poisson regressions were used to examine the effect of SMI on cessation treatment utilization (medication, counseling, any form) while statistically adjusting for clinical encounter frequency.

Results

<u>Baseline Comparison of Smokers with SMI vs without SMI</u>

Compared to non-SMI smokers (n=1277), those with SMI (n=1044) were more likely to be enrolled in Medicaid, were older, and were more likely to be female. Few differences emerged across race and ethnicity, although there were slightly greater proportions of Black and American Indian participants among those with SMI. Smokers with SMI also had lower educational attainment, were much more likely to report being unable to work or disabled, and earned less than their non-SMI counterparts; factors that are consistent with heightened rates of enrollment in Medicaid rather than MinnesotaCare (see Table 3).

Participants with SMI smoked more cigarettes per day, had smoked for a greater number of years, and were more likely to report smoking within 5 minutes of waking. Smokers with and without SMI had similar rates of past year quit attempts, but those with SMI utilized cessation treatments at much higher rates.

Smokers with SMI had greater proportions of family/friends that were current smokers, had less restrictive home smoking rules, but had similar levels of social support for quitting compared to smokers without SMI.

Although smokers with SMI had significantly lower self-efficacy for quitting, they did not differ from smokers without SMI with respect to readiness to quit.

Table 3. Baseline Demographic, Smoking History, Social Environment, Healthcare Provider, and Cessation Belief Characteristics of SMI vs Non-SMI Smokers

Characteristic	SMI N=1044	Non-SMI N=1277	p Value
	No. (%) or Mean±SD		
Demographics			
Insurance Program			
Medicaid	861 (82.5)	813 (63.7)	**<0.001**
MnCare	183 (17.5)	464 (36.3)	.
Age			
18-24	172 (16.5)	279 (21.9)	**<0.001**
25-34	344 (33.0)	459 (35.9)	.
35-64	528 (50.6)	539 (42.2)	.
Male	274 (26.3)	412 (32.3)	**0.002**
Race/Ethnicity			
White	801 (76.7)	1012 (79.3)	**0.078**
Black or African American	130 (12.5)	122 (9.6)	.
Amer Indian or Alaskan Native	79 (7.6)	84 (6.6)	.
Hispanic or Latino	15 (1.4)	27 (2.1)	.
Asian or Pacific Islander	19 (1.8)	32 (2.5)	.
Education			
Grade 11/lower	161 (15.8)	157 (12.6)	**0.001**
HS grad/GED	344 (33.8)	418 (33.4)	.
Some college	428 (42.0)	513 (41.0)	.
College grad/higher	85 (8.4)	163 (13.0)	.
Employment			
Employed/self-employed	352 (34.4)	789 (63.0)	**<0.001**
Student	86 (8.4)	72 (5.8)	.
Out of work	161 (15.7)	138 (11.0)	.
Unable to work/disabled	370 (67.6)	177 (14.1)	.
Homemaker	54 (5.3)	77 (6.2)	.
Yearly income			
Less than $10k	488 (48.8)	350 (28.8)	**<0.001**
$10,001-$20k	295 (29.5)	403 (33.2)	.
$20,001-$40k	157 (15.7)	312 (25.7)	.
More than $40k	61 (6.1)	150 (12.4)	.
Smoking History			
Cigs/day	14.7±9.6	13.0±8.8	**<0.001**[1]
Duration (yrs)	21.7±12.9	19.7±13.0	**<0.001**
Time until 1st cig (mins)			
≤ 5	321 (31.1)	285 (22.6)	**<0.001**
6 – 15	332 (32.1)	348 (27.6)	.
16 – 30	157 (15.2)	185 (14.7)	.
31 – 60	100 (9.7)	169 (13.4)	.
> 60	123 (11.9)	274 (21.7)	.

Past year quit attempt	565 (55.1)	677 (53.8)	0.536
Any treatment used	411 (39.4)	328 (25.7)	**<0.001**
Social Support			
Support of others for quitting	4.4±0.8	4.4±0.7	0.102[1]
Social Norms			
Friends/family who smoke			
Almost all	258 (24.9)	221 (17.4)	**<0.001**
Over half	230 (22.2)	267 (21.1)	.
About half	235 (22.7)	363 (28.7)	.
Less than half	139 (13.4)	199 (15.7)	.
Very few	151 (14.6)	193 (15.2)	.
None	23 (2.2)	24 (1.9)	
Home smoking rules			
Smoking is not allowed	471 (45.4)	681 (53.8)	**<0.001**
Smoking is allowed at times	276 (26.6)	333 (26.3)	.
Smoking is allowed	291 (28.0)	253 (20.0)	.
Healthcare Provider			
Regular physician	857 (83.6)	900 (71.6)	**<0.001**
Physician advised to quit	748 (79.0)	811 (74.5)	**0.017**
Physician discussed medications	428 (45.5)	438 (40.4)	**0.022**
Physician discussed other	494 (52.5)	466 (42.9)	**<0.001**
Physician bias	5.9±2.9	5.8±2.8	0.475
Clinical transactions	252.5±304.1	78.8.9±126.2	**<0.001**
Cessation Beliefs			
Quitting self-efficacy	4.7±3.0	5.3±3.1	**<0.001**
Contemplation Ladder	6.3±2.9	6.3±2.9	0.495

[1]Satterthwaite test

SMI and Cessation Treatment Utilization

In unadjusted analyses, SMI was positively associated with cessation treatment utilization
(medications, counseling, and any form) at 12-month follow-up (Table 4).

Table 4. Cessation Treatment Utilization of SMI vs Non-SMI Smokers at 12-Month Follow-up

Outcome	SMI N=761	Non-SMI N=947	p Value
	No. (%)		
Treatment Utilization			
Medications	319 (41.9)	282 (29.8)	**<0.001**
Counseling	109 (14.3)	105 (11.1)	**0.045**
Any	340 (44.7)	299 (31.6)	**<0.001**

Associations Between Mediators

Advice to use cessation medications was positively associated with advice to use other forms of cessation treatments (p<0.001) (see Table 5). Both treatment advice mediators were negatively associated with perceptions of physician bias (all p<0.001).

Table 5. Correlation Across Mediators

Mediator	Medication Advice	Other Advice	Physician Bias
Medication Advice	-	-	-
Other Advice	0.640*	-	-
Physician Bias	-0.171*	-0.165*	-

  * = p<0.001

Summary of Regression Effects

Physician Advice to Use Medications

In a logistic regression controlling for intervention condition, SMI was positively associated with physician advice to use cessation medications (β^1=0.49, OR=1.63, p<0.001). In a Poisson regression controlling for intervention condition, physician advice to use cessation medications was positively associated with use of cessation medications

$(\beta^2=0.42$, RR=1.53, p<0.001) (Figure 2) and any form of cessation treatment $(\beta^3=0.38$,

RR=1.45, p<0.001) (Figure 3).

Figure 2. Summary of Effects for Physician Advice to Use Medication Mediator and
Medication Use Outcome

$\beta^1=0.49*$ · SMI → Physician Advice to use Meds · $\beta^2=0.42*$ → Medication Use

* = p<0.001
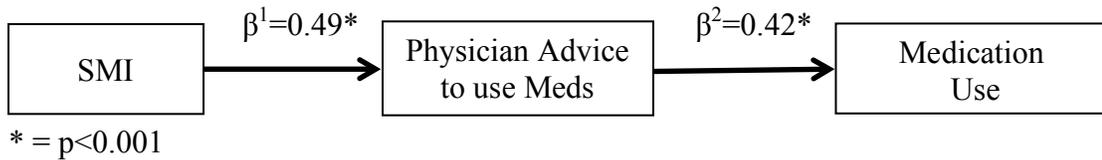
Figure 3. Summary of Effects for Physician Advice to Use Medication Mediator and
Any Treatment Use Outcome

$\beta^1=0.49*$ · SMI → Physician Advice to use Meds · $\beta^3=0.38*$ → Any Treatment Use
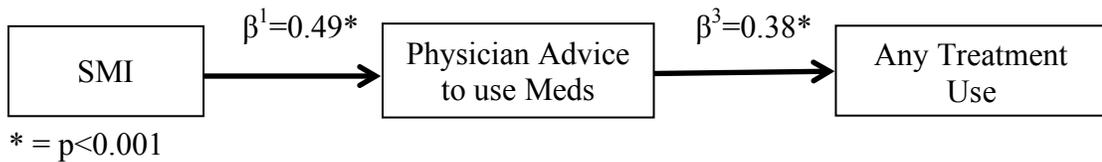
* = p<0.001

Physician Advice to Use Other

In a logistic regression controlling for intervention condition, SMI was positively

associated with physician advice to use cessation treatments other than medications

$(\beta^1=0.31$, OR=1.37, p<0.001). In a Poisson regression controlling for intervention

condition, physician advice to use treatments other than medications was positively

associated with use of cessation counseling $(\beta^2=0.24$, RR=1.27, p=0.087) (Figure 4) and

any form of cessation treatment $(\beta^3=0.29$, RR=1.34, p<0.001) (Figure 5).

Figure 4. Summary of Effects for Physician Advice to Use Other Treatments Mediator and Counseling Use Outcome

```
                    β¹=0.31*                          β²=0.24
  ┌─────────┐                ┌──────────────┐                ┌──────────────┐
  │   SMI   │───────────────▶│Physician Advice│──────────────▶│  Counseling  │
  │         │                │ to use Other  │                │     Use      │
  └─────────┘                └──────────────┘                └──────────────┘
```
$\beta^1=0.31*$ $\beta^2=0.24$

* = p<0.001
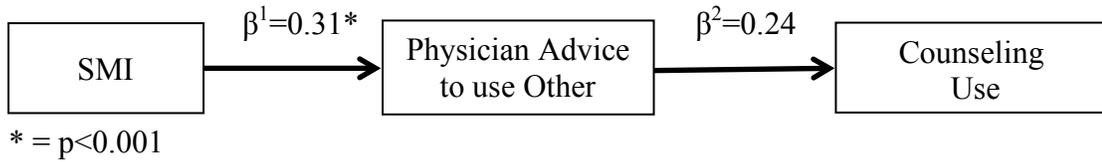
Figure 5. Summary of Effects for Physician Advice to Use Other Treatments Mediator and Any Treatment Use Outcome

```
                    β¹=0.31*                          β³=0.29*
  ┌─────────┐                ┌──────────────┐                ┌──────────────┐
  │   SMI   │───────────────▶│Physician Advice│──────────────▶│Any Treatment │
  │         │                │ to use Other  │                │     Use      │
  └─────────┘                └──────────────┘                └──────────────┘
```
$\beta^1=0.31*$ $\beta^3=0.29*$

* = p<0.001
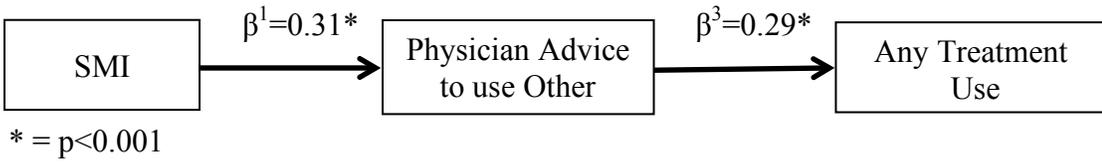
Perceptions of Physician Bias

In a linear regression controlling for intervention condition, SMI was not associated with perceptions of physician bias advice ($\beta^1=0.09$, p=0.454). In a Poisson regression controlling for intervention condition, physician bias was not associated with the use of any form of cessation treatment ($\beta^2=-0.004$, p=0.798) (Figure 6).

Figure 6. Summary of Effects for Perception of Physician Bias Advice Mediator and Any Treatment Use Outcome

```
                    β¹=0.09                           β²=-0.004
  ┌─────────┐                ┌──────────────┐                ┌──────────────┐
  │   SMI   │───────────────▶│Physician Bias │──────────────▶│Any Treatment │
  │         │                │              │                │     Use      │
  └─────────┘                └──────────────┘                └──────────────┘
```
$\beta^1=0.09$ $\beta^2=-0.004$
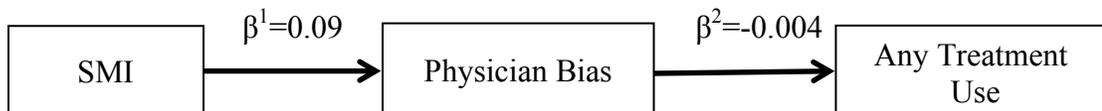
<u>Meditation Effects</u>

There was a significant total effect of SMI on cessation treatment utilization (medications and any treatment use) at 12-month follow-up across all models (see Table 6).

Physician Advice to Use Medications

Across all the models predicting utilization of medications and utilization of any form of cessation treatment, the indirect effects were small but statistically significant. In the models controlling only for intervention condition, the proportion of the total effect of SMI on smoking cessation treatment utilization that was mediated by the effect of SMI on physician advice to use medications was 13.4% for medication utilization and 11.7% for any treatment utilization. The directions of these effects were positive and indicate partial mediation. Mediation effects were attenuated in subsequent models controlling for blocks of demographic, smoking history, and social environment covariates, but remained statistically significant (see Table 6).

Physician Advice to Use Other Treatments

SMI was positively associated with utilization of cessation counseling at 12-month follow-up, although the total effects did not reach statistical significance (see Table 6).

The indirect effect was statistically significant in the model predicting utilization of cessation counseling, controlling only for intervention condition. The indirect effects did not reach statistical significance in the more fully adjusted models. Across the first three models predicting any cessation treatment utilization, the indirect effects were small but statistically significant. In the model controlling only for intervention condition, the

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proportion of the total effect of SMI on any cessation treatment utilization that was

mediated by the effect of SMI on physician advice to use other treatments was 6.0%. The

directions of these effects were positive and indicate partial mediation. Mediation effects

were attenuated in more fully adjusted models, but remained statistically significant.

Perceptions of Physician Bias

The indirect effects were not statistically significant in any of the models predicting any

treatment use, indicating no mediation by perceptions of physician bias (see Table 6)

Table 6. Mediation Effects for Physician Advice and Physician Bias Mediators and Treatment Utilization Outcomes

Mediator	Outcome	Model	Total Effect RR (95% CI)	Direct Effect RR (95% CI)	Indirect Effect RR (95% CI)	Proportion Mediated (%)
Physician Advice to Use Medication	Medication use	Model 1	1.41 (1.24-1.60)	1.34 (1.19-1.53)	1.05 (1.03-1.07)	13.4
		Model 2	1.30 (1.14-1.50)	1.26 (1.10-1.45)	1.03 (1.02-1.06)	12.6
		Model 3	1.23 (1.07-1.43)	1.20 (1.05-1.39)	1.02 (1.01-1.05)	11.1
		Model 4	1.23 (1.07-1.40)	1.20 (1.05-1.36)	1.02 (1.01-1.04)	10.3
	Any treatment use	Model 1	1.41 (1.26-1.57)	1.35 (1.21-1.51)	1.04 (1.02-1.06)	11.7
		Model 2	1.28 (1.12-1.46)	1.24 (1.09-1.42)	1.03 (1.01-1.05)	11.4
		Model 3	1.23 (1.06-1.41)	1.20 (1.05-1.38)	1.02 (1.01-1.04)	9.5
		Model 4	1.21 (1.06-1.39)	1.19 (1.04-1.37)	1.02 (1.01-1.03)	8.6
Physician Advice to Use Other	Counseling use	Model 1	1.26 (0.95-1.62)	1.24 (0.94-1.60)	1.02 (1.00-1.05)	7.9
		Model 2	1.16 (0.85-1.50)	1.15 (0.85-1.48)	1.01 (0.99-1.03)	8.8
		Model 3	1.07 (0.81-1.42)	1.06 (0.81-1.41)	1.01 (0.99-1.03)	11.4
		Model 4	1.10 (0.83-1.41)	1.09 (0.82-1.41)	1.01 (0.99-1.03)	6.9
	Any treatment use	Model 1	1.41 (1.24-1.60)	1.38 (1.22-1.57)	1.02 (1.01-1.04)	6.0
		Model 2	1.29 (1.14-1.47)	1.27 (1.12-1.44)	1.02 (1.00-1.03)	6.0
		Model 3	1.23 (1.08-1.38)	1.22 (1.06-1.37)	1.01 (1.00-1.02)	4.8
		Model 4	1.22 (1.06-1.41)	1.21 (1.05-1.40)	1.01 (0.99-1.02)	4.1
Perceived Physician Bias	Any treatment use	Model 1	1.43 (1.26-1.60)	1.42 (1.26-1.60)	0.99 (0.99-1.00)	0.1
		Model 2	1.30 (1.14-1.49)	1.30 (1.14-1.49)	0.99 (0.99-1.00)	0.0
		Model 3	1.25 (1.08-1.43)	1.25 (1.08-1.43)	1.00 (0.99-1.00)	0.0
		Model 4	1.23 (1.09-1.40)	1.23 (1.09-1.40)	0.99 (0.99-1.00)	0.0

Model 1 is adjusted for intervention condition
Model 2 is adjusted for intervention condition and demographics
Model 3 is adjusted for intervention condition, demographics, and smoking history
Model 4 is adjusted for intervention condition, demographics, smoking history, and social environment

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Sensitivity Analysis

SMI, Cessation Treatment Utilization, and Clinical Encounter Frequency

Compared to unadjusted models, regression models adjusting for clinical encounter
frequency resulted in attenuated effects of SMI on cessation treatment utilization
(medication, counseling, and any form) (see Table 7).

Table 7. Cessation Treatment Utilization of SMI vs Non-SMI Smokers at 12-Month
Follow-up Adjusting for Clinical Encounters

Outcome	SMI N=761	Non-SMI N=947	Relative Risk (95% CI)	p Value
	(No.) %			
Medication Use				
Min adjusted	319 (41.9)	282 (29.8)	1.39 (1.19-1.64)	**<0.001**
Fully adjusted	-	-	1.26 (1.05-1.51)	**0.013**
Fully adjusted+			1.23 (1.02-1.48)	**0.030**
Counseling Use				
Min adjusted	109 (14.3)	105 (11.1)	1.24 (0.94-1.62)	0.112
Fully adjusted	-	-	1.07 (0.79-1.45)	0.644
Fully adjusted+			0.98 (0.71-1.34)	0.890
Any Treatment Use				
Min adjusted	340 (44.7)	299 (31.6)	1.40 (1.20-1.63)	**<0.001**
Fully adjusted	-	-	1.25 (1.05-1.49)	**0.013**
Fully adjusted+			1.21 (1.01-1.45)	**0.037**

+ Adjusted for clinical encounter frequency

Discussion

This is one of the first studies to explore rates of cessation treatment utilization among
smokers with MH disorders, and is the first to examine cessation treatment utilization
within a sample of socioeconomically disadvantaged smokers with recent diagnoses that
are consistent with SMI. Contrary to our hypothesis, smokers with SMI utilized cessation
treatments at higher rates than smokers without SMI. These results were partially

explained by socio-demographic, smoking history, and social environment confounders, as well as a heightened frequency of clinical contact among smokers with SMI.

The primary goal of the present study was to elucidate the smoking cessation process among smokers with SMI by exploring how healthcare provider interactions influence cessation treatment utilization within this population. Past literature indicated that smokers with SMI would be less likely to report receiving physician-delivered advice to use cessation treatments and would be more likely to perceive physician bias. However, our results show that smokers with SMI received higher rates of physician-delivered advice to use cessation treatments, effects which were associated with higher rates of cessation treatment utilization. Smokers with SMI also reported approximately equivalent levels of physician bias compared to smokers without SMI, and physician bias was not significantly associated with cessation treatment utilization.

The meditational effects of physician advice to use cessation treatments were small, but they highlight the role that healthcare providers play in the cessation process. Physician advice to use medications was positively associated with both medication utilization and any form of cessation treatment utilization. These results indicate that baseline advice to use a specific type of cessation product was associated with the use of that product 12 months later, suggesting that physician explanations regarding the benefits of cessation medications and how to properly use them may spur action on the part of the patient. These results also suggest a sort of carry-over effect of providing advice to use a specific cessation product, as advice to use medications had a similarly large effect on the use of any form of cessation treatment. It may be the case that discussing specific cessation

strategies with a patient may act as a sort of primer for the use of other cessation treatments, as participants who utilize one form of treatment may be more willing to try other treatments in the future.

Physician advice to use other forms of cessation treatment besides medications (including counseling) was not significantly associated with the use of counseling at 12-month follow-up, although these effects did trend in a positive direction. It is possible that a lack of an effect was due to the more broad nature of this physician advice measure, which could refer to forms of treatment other than just counseling (e.g. peer support groups, internet cessation resources, etc.). However, advice to use other forms of treatment was significantly associated with the use of any form of cessation treatment, again providing evidence for a carry-over effect of more specific cessation advice on an increased willingness to use any cessation treatment.

Smokers with SMI were not more likely to perceive physician bias than those without SMI. It is possible that, because the vast majority of participants with SMI (nearly 84%) reported having a regular physician, these patients may have felt more comfortable with their healthcare providers due to increased frequency of contact. In addition, this measure focused on patients' perceptions of physician bias. As such, even if some physicians' hold more discriminatory beliefs toward patients with SMI, this may not be expressed in an overt way that is perceived by the patient.

Our results also indicate a lack of an association between baseline perceptions of physician bias and cessation treatment utilization at 12-months. However, it is important to note that there was a negative correlation between perceptions of physician bias and

physician-delivered advice to use medications and to use other forms of treatment. Thus, although patients' perceptions of physician bias do not appear to influence patients' use of cessation treatments, these perceptions are associated with differential cessation care.

In light of the strong positive association between SMI and treatment utilization, sensitivity analyses were performed to explore whether these finding were influenced by frequency of clinical contact. Indeed, our results indicate that smokers with SMI had far more clinical encounters in the 2-year period prior to study initiation than smokers without SMI. Furthermore, when the frequency of clinical encounters was added as a potential confounder in regression models predicting treatment utilization, the positive association between SMI and treatment utilization was attenuated. This suggests that SMI smokers' comparatively high rates of cessation treatment utilization are at least partially explained by the heightened frequency with which they interact with their healthcare providers.

Limitations

Although the timeline of assessments establishes temporality across the measures, a key assumption of our analytic plan is that of causal effects between the exposure, mediator, and outcome. There is a case to be made for casualty given the body of literature supporting strong links between these factors, even though the investigators did not assign the exposure variable. Because these data were analyzed as observational there is also the potential for unmeasured confounding to bias our effect estimates. We were also unable to obtain measures of functional impairment to pair with the MH diagnoses obtained from the DHS claims data. Functional assessments would increase the

likelihood that the smokers included in our SMI category were experiencing a high degree of current life impairment; an important diagnostic criterion for assessing SMI.

Conclusion

The strong positive association between physician-delivered advice to use cessation treatments and cessation treatment utilization, among smokers with and without SMI, highlights the important role that healthcare providers play in the cessation process. Because our sample of smokers were enrolled in MHCP and had access to free or reduced cost healthcare, it is difficult to extend these findings to the broader population of smokers who may have more variable access to healthcare. However, the high rates of physician-delivered cessation advice reported by this sample suggest that the expansion of publicly-subsidized insurance programs may result in greater rates of treatment utilization among low-income smokers. Smokers with SMI were more likely to use cessation treatments than those without SMI, but this group still experiences heightened rates of smoking relative to the general population. Indeed, evidence suggests that smokers with SMI require a greater number of quit attempts and may need to utilize a greater number of treatment strategies before achieving cessation. As such, findings ways to bolster rates of physician contact and engagement is particularly important for this group.[68] Given the time limitations faced by physicians, strategies to address this issue may involve having systems in place to efficiently provide these smokers with referrals for external cessation resources. Going forward, it is critical that we provide smokers with MH disorders with the professional support they need in order to achieve long-term abstinence, and ultimately eliminate this health disparity.

Title: <u>Effectiveness of a proactive outreach smoking cessation intervention among</u>

<u>socioeconomically disadvantaged smokers:</u>

<u>The role of serious mental illness</u>

Specific Aims

<u>Aim 1:</u> To examine the effect of a proactive outreach intervention on cessation treatment utilization and prolonged abstinence among smokers with SMI and without SMI.

> *Hypothesis 1(i):* The proactive outreach intervention will be effective for promoting cessation treatment utilization among smokers with SMI and without SMI.

> *Hypothesis 1(ii):* The proactive outreach intervention will be effective for promoting prolonged abstinence among smokers with SMI and without SMI.

<u>Exploratory Aim:</u> To examine whether a proactive outreach intervention is significantly more effective, with respective to cessation treatment utilization and prolonged abstinence, for smokers with SMI compared to those without SMI.

> *Hypothesis(i):* The proactive outreach intervention will be significantly more effective for increasing cessation treatment utilization for smokers with SMI relative to those without SMI.

Hypothesis(ii): The proactive cessation intervention will be significantly more effective for promoting smoking abstinence among smokers with SMI relative to those without SMI.

Abstract

Introduction

Despite overall declines in smoking prevalence, significant socioeconomic and mental health disparities remain. The purpose of the present study is to examine whether a proactive outreach intervention that facilitated access to cessation treatments and addressed smokers' psychosocial needs was effective for promoting cessation treatment utilization and prolonged abstinence among low-income smokers with SMI.

Methods

Data were taken from the OPTIN study. The intervention included mailings, telephone outreach, counseling, and access to free cessation treatments. ICD-9 codes indicating diagnoses of schizophrenic disorders, psychotic disorder, bipolar disorders, and major depressive disorder were used to categorize participants in SMI (n=1044) or non-SMI (n=1277) groups. Logistic regressions modelled the effect of the intervention on cessation treatment utilization (medication, counseling, any form) and 6-month prolonged abstinence at 12-month follow-up in the SMI and non-SMI groups, respectively. Logistic regressions then tested for the presence of intervention x SMI interactions on all outcomes.

Results

Relative to usual care, the intervention increased any form of treatment utilization in the SMI group (51.6% vs 38.1%, p<0.001) and the non-SMI group (38.6% vs 25.8%, p<0.001). The intervention also increased prolonged abstinence in the SMI group (14.7%

vs 10.8%, p=0.070) and the non-SMI group (18.1% vs 12.8%, p=0.019). There were no interactions between the intervention and SMI on any of the outcomes tested.

Discussion

Results suggest that proactive outreach is a promising strategy for boosting cessation treatment utilization and abstinence rates among smokers enrolled in publicly-subsidized state insurance programs. This is particularly important for smokers with SMI, who tend to engage in a greater number of quit attempts and utilize more treatments before achieving cessation.

Introduction

Population-level declines in the prevalence of smoking have given rise to significant socioeconomic and mental health disparities in smoking rates. While the prevalence of smoking among those with private insurance is 15%,[3] close to 30% of the medically uninsured and Medicaid enrollees are current smokers. The prevalence of smoking among those with mental health disorders is also exceedingly high, ranging from two to three times higher than that of the general US population depending on clinical diagnosis.[8] As socioeconomic disadvantage is associated with an increased likelihood of having a mental health disorder, socioeconomically disadvantaged smokers with SMI need to be a focal point of cessation efforts going forward.

Smokers with SMI face barriers to cessation at multiple levels of influence, contributing to the persistent high rates of smoking experienced by this population. At the individual level, the "self-medication" hypothesis posits that individuals with mental illness smoke to reduce the experience of negative affect and anxiety associated with their condition,[47,48] factors which could reduce the likelihood of engaging in a quit attempt. Smokers with SMI also experience heightened nicotine withdrawal symptoms when trying to quit, including depressed mood, generalized discomfort, and anxiety.[49,50] With respect to cessation beliefs, smokers with SMI have low self-efficacy for quitting[35,51,52] but tend to be highly motivated to quit.[69]

At the interpersonal level, smokers with SMI are more likely to have peers that are accepting of smoking and view tobacco use as a normative behavior.[35] In addition, individuals with SMI may be more susceptible to peer influence regarding smoking

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behavior, as a study of adolescents demonstrated that more severe symptoms of depression were associated with greater peer acceptability of smoking.[36] The social acceptability of smoking is especially pervasive in in-patient mental health settings. Indeed, smoking has historically been encouraged within psychiatric units[35,36] and has been used as a reward to reinforce certain behaviors among these patients.[53]

At the healthcare provider level, evidence suggests that smokers with SMI may receive differential cessation-related care from their physicians. Healthcare professionals may discourage quitting for these patients due to a belief that this may exacerbate their depressive symptoms.[37,38] Physicians also face many competing treatment demands for those with SMI.[38,39] This "treatment overshadowing", in which a physician prioritizes the treatment of MH symptoms over other health concerns,[40] may contribute to lower rates of cessation-related care for this group.

The OPTIN trial organized these barriers in a conceptual framework that was informed by elements of Social Cognitive Theory (SCT),[5,6] the Transtheoretical (Stages of Change) Model,[7] and the Biopsychosocial Model of Perceived Discrimination.[8] While the original framework was tailored to the low-income OPTIN sample, the present study adapts this framework to reflect the barriers experienced by low-income smokers with co-occurring SMI. The SCT component helps elucidate the roles that social acceptance of smoking and low self-efficacy for quitting may have on cessation treatment utilization among low-income smokers with SMI. The Transtheoretical Model, which asserts 5 distinct phases of behavior change, provides a framework for smokers' progression through the phases of treatment utilization, cessation initiation, and prolonged abstinence, and how

individual, interpersonal, and healthcare provider barriers can interfere with this progression. The Biopsychosocial Model of Perceived Discrimination helps delineate the influence of discrimination in social or healthcare settings on the utilization of cessation treatments and prolonged abstinence; barriers that may be exacerbated for smokers with SMI.

The OPTIN trial sought to address these barriers to cessation treatment utilization and abstinence by implementing a proactive outreach cessation intervention. Proactive outreach strategies, which promote heightened contact with smokers, facilitate access to cessation treatments, and provide motivational quit advice while promoting self-efficacy, may be an effective approach for minimizing barriers to treatment utilization and abstinence among smokers with SMI. With respect to psychosocial barriers, the outreach and motivational interviewing components of the intervention are designed to improve smokers' self-efficacy for quitting and address social environmental barriers like permissive social norms and low social support for quitting. By facilitating access to evidence-based cessation resources, proactive outreach can address the healthcare provider barriers of competing treatment demands, the perception that smokers with SMI are not motivated to quit, and low rates of referral for cessation services.

The aim of the present study is to examine the effectiveness of a proactive outreach intervention among socioeconomically disadvantaged smokers with SMI and without SMI, with respect to rates of cessation treatment utilization and 6-month prolonged abstinence at 12-month follow-up. Because components of proactive outreach are hypothesized to overcome cessation treatment utilization barriers that may be exacerbated

for smokers with SMI, an exploratory aim is to examine whether the intervention is significantly more effective for smokers with SMI relative to those without SMI.

Methods

Study Design

Data were obtained from the OPTIN study (N=2406); a two-arm RCT which evaluated the effect of proactive outreach on rates of 6-month prolonged abstinence in a sample of smokers enrolled in MHCP.[70] The study sample was stratified by age group (18–24, 25–34, 35–64), gender (male or female), and insurance program (Medicaid or MinnesotaCare). Using MHCP insurance claims drawn from a 2-year period prior to study initiation, ICD-9 codes indicative of schizophrenic disorders, psychotic disorder, bipolar I and II disorder, and/or major depressive disorder were used to categorize participants as having SMI (n=1044) or not having SMI (n=1277).

Measures

Measures were obtained from OPTIN baseline and follow-up survey data, as well as from MHCP administrative and claims data.

Demographics

Insurance program, age, sex, race/ethnicity, education, employment status, and income were assessed.

Mental Health Diagnoses

Participants with at least one diagnostic code in the range of 1) 295.00 to 295.94 were

considered to have a schizophrenic disorder, 2) 297.00 to 298.9 were considered to have a psychotic disorder, 3) 296.2 to 296.36 were considered to have a major depressive disorder, 4) 296.00 to 296.13 and/or 296.4 to 296.9 were considered to have a bipolar disorder.

Smoking History

Questions from the California Tobacco Survey [62] and the BRFSS[63] were used to assess lifetime duration of smoking, time until first cigarette after waking, cigarettes smoked per day, and past year quit attempts.

Social Environment

A composite variable measured participants' perceived social support for cessation by taking the mean of two support-related variables that assessed perceived support for quitting and others' desire for quitting, respectively.[28] All items were assessed on a 5-point scale, with higher scores indicative of greater levels of social support. Participants reported the proportion of their close friends and family who were smokers. Participants then reported whether they lived with a child under the age of 18, whether they lived with another smoker, and the smoking rules within their home.

Healthcare Provider Factors

HEDIS tobacco performance measures were used to assess participants' past year healthcare experiences.[26] Items assessed whether participants received physician-delivered advice to quit, advice to use cessation medications, and advice to use ways (besides products) to help with quitting. A composite variable of perceptions of

healthcare provider bias was created by summing 3 items from the Physician Bias and Interpersonal Cultural Competence Measures Scale.[27] Each item was assessed on a 5-point scale, with higher values indicating greater perceptions of physician bias.

Cessation Beliefs

Self-efficacy for quitting was measured on a 1 to 10 scale, with higher values indicating greater confidence in quitting.[28] The Contemplation Ladder assessed readiness to quit on a 1 to 10 scale, with higher values indicating a greater readiness to quit.[29]

Outcomes

Cessation Treatment Utilization

Items assessed whether participants used NRT products, prescription cessation medications, and behavioral counselling in the past year at 12-month follow-up. These items were used to create dichotomized measures indicating the use of any medication, any counselling, and any form of treatment use.

Smoking Abstinence

A self-report measure was used to assess 6-month prolonged abstinence at 12-month follow-up.[71] Participants who reported smoking at least once on 7 consecutive days or at least once on 2 consecutive weekends in the 6-month period prior to the follow-up survey were considered continuing smokers.

Conceptual Framework

The conceptual framework guiding the proactive outreach intervention was informed by SCT,[5,6] the Transtheoretical Model,[7] and the Biopsychosocial Model of Perceived Discrimination.[8] SCT asserts that a complex interplay of individual (cognitive), social environment, and behavioral forces influence each other throughout the process of behavior change. In the context of smoking cessation among the socioeconomically disadvantaged, SCT emphasizes the roles that permissive social norms and low self-efficacy for quitting may have on cessation treatment utilization. The Transtheoretical Model stipulates that as an individual undergoes a behavior change they pass through a series of cognitive stages including precontemplation, contemplation, preparation, action, and maintenance. With respect to smoking cessation, progression from the initiation of treatment utilization, adherence to cessation care, and maintenance of abstinence can be thought of as guided by these stages. The Biopsychosocial Model of Perceived Discrimination asserts that perceptions of discrimination, which socioeconomically disadvantaged smokers may experience in social or healthcare provider settings, influence their likelihood of engaging in a quit attempt and utilizing cessation treatments.

Although the original conceptual framework was tailored to the low-income OPTIN sample, it can be argued that many of the barriers to cessation treatment experienced by these smokers are exacerbated for those with SMI. These smokers are likely to have peer networks that are more conducive to smoking, lower self-efficacy for quitting, and heightened perceptions of physician bias relative to their non-SMI counterparts. These

theorized links are reflected in the revised version of the original OPTIN conceptual

framework (see Figure 7).

Figure 7. Conceptual Framework Describing a Proactive Outreach Intervention for Smoking Cessation.
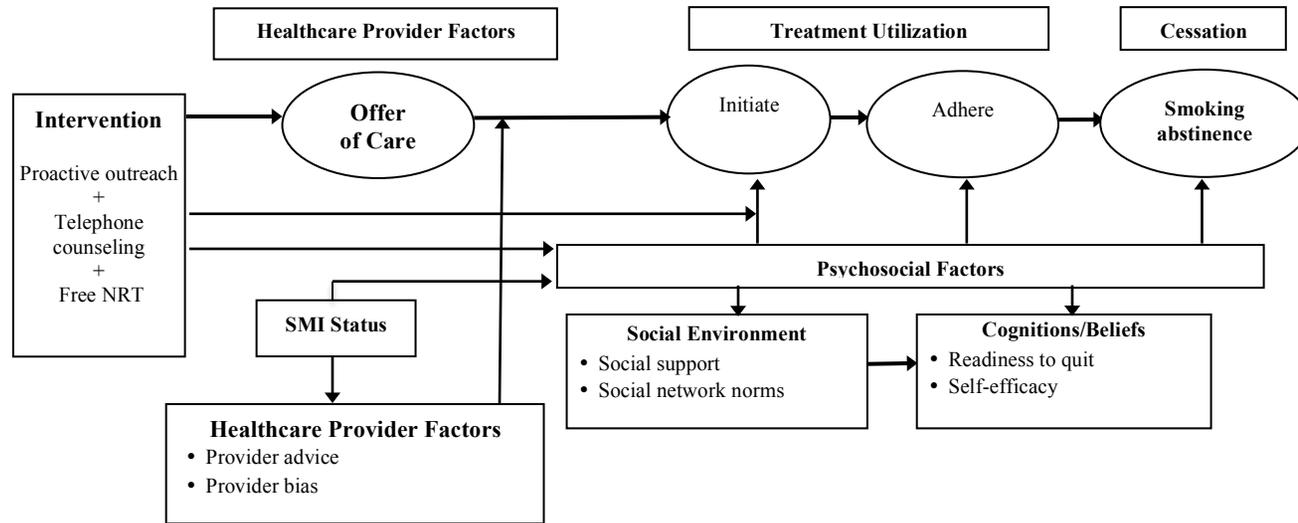
<u>Proactive Outreach Intervention</u>

The intervention was designed to minimize psychosocial and healthcare provider barriers to cessation treatment utilization and abstinence, and contained two primary components.

Outreach

In the outreach component of the intervention, participants received "targeted" motivation materials in the form of mailed invitation materials and telephone contacts. The messaging was informed by focus groups and was designed to appeal to a low-income population, as such messaging is more effective for stimulating interest in an intervention than generic messaging.[72] The mailings provided motivational encouragement for smokers to seek out and use cessation treatments, as well as information regarding the safety and efficacy of the NRT products that would be provided to the participants. Several weeks after the outreach materials were mailed, participants were contacted via telephone. The outreach calls were meant to 1) provide motivational advice for quitting, 2) promote quitting self-efficacy, 3) encourage participants to utilize the provided cessation treatments, and 4) give information about how to properly use NRT.

Access to Evidence-Based Cessation Treatment

The intervention also facilitated access to free, comprehensive cessation treatments. An 8-week course of NRT (patch, gum or lozenge) was mailed to participants prior to their target quit date. In addition, participants were offered intensive, telephone-based behavioral counseling. This counseling employed a motivational interviewing (MI) and

cognitive-behavioral approach to smoking cessation. MI techniques are appropriate for smokers at all levels of readiness to quit,[73] and stress collaboration between the counselor and the participant..[74] An adaptation of the California Helpline protocol was used to deliver the counseling,[75] which consisted of 7 calls that were initiated by the counselor.

Usual Care

Participants in usual care had access to the existing care structure provided by MHCP. All MHCP enrollees have a primary care provider and may consult with this provider to receive cessation treatment. In this way, participants assigned to UC had access to similar treatment options as the intervention group, but they were not specifically invited to receive cessation treatment or provided with facilitated access to these treatments.

Statistical Analysis

Bivariate Analyses

Using t-tests and Pearson's chi-square we compared participants with SMI and without SMI participants across socio-demographic, smoking history, healthcare provider, social environment, cessation beliefs, cessation treatment utilization, and smoking abstinence measures.

Main Effect of Intervention

Logistic regressions modeled the effect of intervention condition (outreach vs. usual care) on cessation treatment utilization (medications, counseling, any form) and 6-month

prolonged abstinence at 12-month follow-up, controlling for the stratification variables of age, sex, and insurance program.

Intervention Effect Stratified by SMI Group

Logistic regressions, stratified by SMI group, modelled the effect of intervention condition on cessation treatment utilization and prolonged abstinence while controlling for the stratification variables.

SMI x Intervention Interaction

Primary Outcomes

Logistic regressions modelled cessation treatment utilization and prolonged abstinence using intervention condition, SMI group, and an intervention by SMI interaction term as predictors. These models also controlled for the stratification variables.

Missing Data

In the regression models there was approximately 28% missing data for the SMI group and 27% missing data for the non-SMI group.

Analyses were conducted to assess baseline differences between 12-month follow-up survey responders and non-responders. Regressions were run modeling the primary and secondary outcomes adjusting for variables that were associated with non-response to the 12-month follow-up survey.

An iterative regression model process was then employed to impute 10 complete imputed versions of the baseline and 12-month follow-up survey data,[76] which is considered sufficient for analyses of missing data.[77] Regressions modeling the primary and secondary outcomes were run on the resulting datasets. Both minimally and fully adjusted models were included in these analyses.

Results

Missing Data

With respect to demographic characteristics, survey non-responders were younger, were more likely to be non-White, were more poorly educated, and had lower annual income. In terms of smoking history, non-responders smoked for a shorter mean duration of time than responders and were more likely to report smoking their first cigarette more than one hour after waking. The groups were similar with respect to CPD, past year quit attempts, and use of cessation treatment at baseline (see Table 8).

Non-responders had more smokers in their peer networks but were similar to responders in terms of home smoking rules. The groups had similar self-efficacy for quitting and readiness to quit.

To control for these baseline differences, fully adjusted models adjusted for the variables of race/ethnicity, education, employment, income, duration of smoking, and time until first cigarette after waking.

Table 8. Characteristics of Follow-Up Survey Responders Vs. Non-Responders

Characteristic	Responder N=1770	Non-Responder N=636	p Value
	No. (%) or Mean		
Intervention			
Proactive outreach	826 (46.7)	374 (58.8)	**<0.001**
Usual care	944 (53.3)	262 (41.2)	.
Demographics			
Age			
18-24	316 (17.9)	180 (28.3)	**<0.001**
25-34	576 (32.5)	248 (39.0)	.
35-64	878 (49.6)	208 (32.7)	.
Male	511 (28.9)	195 (30.7)	0.395
Race/Ethnicity			
White	1403 (79.3)	482 (75.8)	**0.025**
Black or African American	188 (10.6)	68 (10.7)	.
Amer Indian or Alaskan Native	119 (6.7)	48 (7.6)	.
Hispanic or Latino	29 (1.6)	13 (2.0)	.
Asian or Pacific Islander	31 (1.8)	25 (3.9)	.
Education			
Grade 11/lower	197 (11.4)	125 (20.1)	**0.003**
HS grad/GED	563 (32.5)	218 (35.1)	.
Some college	755 (43.6)	22 (35.8)	.
College grad/higher	218 (12.6)	56 (9.0)	.
Employment			
Employed/self-employed	880 (50.5)	326 (52.7)	**0.033**
Student	118 (6.8)	44 (7.1)	.
Out of work	211 (12.1)	96 (15.5)	.
Unable to work/disabled	433 (24.9)	120 (19.4)	.
Homemaker	100 (5.7)	33 (5.3)	.
Yearly income			
Less than $10k	611 (36.1)	437 (40.7)	**0.034**
$10,001-$20k	556 (32.8)	164 (27.2)	.
$20,001-$40k	353 (20.9)	139 (23.0)	.
More than $40k	173 (10.2)	55 (9.1)	.
Mental Health			
SMI	761 (44.6)	283 (46.2)	0.492
Smoking History			
Cigs/day	13.6	13.6	0.494
Duration (yrs)	21.4	17.0	**0.002**
Time until 1st cig (mins)			
≤ 5	344 (32.0)	273 (30.0)	**<0.001**
6 – 15	360 (33.5)	329 (25.3)	.

16 – 30	166 (15.5)	190 (14.6)	.
31 – 60	90 (8.4)	195 (15.0)	.
> 60	955 (10.6)	316 (24.3)	.
Past year quit attempt	522 (54.70)	332 (53.3)	0.545
Any treatment used	558 (31.5)	194 (30.5)	0.633
Social Support			
Support of others for quitting	4.4	4.4	0.123
Social Norms			
Friends/family who smoke			
Almost all	337 (19.1)	151 (23.9)	**0.001**
Over half	347 (19.8)	166 (26.3)	.
About half	470 (26.8)	148 (23.4)	.
Less than half	285 (16.2)	82 (12.9)	.
Very few	38 (2.2)	76 (1.4)	.
Home smoking rules			
Smoking is not allowed	891 (50.7)	315 (49.8	0.904
Smoking is allowed at times	460 (26.2)	167 (26.4)	.
Smoking is allowed	406 (23.1)	151 (23.9)	.
Self-Efficacy			
Quitting self-efficacy	5.09	4.96	0.824
Readiness to Quit			
Contemplation Ladder	6.39	6.02	0.368

Baseline Comparison of Smokers with SMI vs. without SMI

Compared to non-SMI smokers (n=1277), those with SMI (n=1044) were more likely to

be enrolled in Medicaid, tended to be older, and were more likely to be female. With

respect to race and ethnicity, there were greater proportions of Black and American

Indian participants in the SMI group. Smokers with SMI also tended to have lower

educational attainment, were much more likely to report being unable to work or

disabled, and earned significantly less than their non-SMI counterparts (see Table 9).

In terms of smoking history, participants with SMI smoked significantly more cigarettes

per day, had smoked for a greater number of years, and were more likely to report

smoking within 5 minutes of waking. Although smokers with SMI and those without SMI

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reported similarly high rates of past year quit attempts, smokers with SMI were much more likely to have used a cessation treatment during the past year.

In general, smokers with SMI had social environments that were more conducive to smoking. Smokers with SMI had greater proportions of family/friends that were current smokers, had less restrictive home smoking rules, but had similar levels of social support for quitting compared to smokers without SMI.

Although smokers with SMI had significantly lower self-efficacy for quitting, they did not differ from non-SMI smokers in terms of readiness to quit.

Table 9. Baseline Demographic, Smoking History, Social Environment, Healthcare Provider, and Cessation Belief Characteristics of SMI vs Non-SMI Smokers

Characteristic	SMI N=1044	Non-SMI N=1277	p Value
	No. (%) or Mean±SD		
Demographics			
Insurance Program			
Medicaid	861 (82.5)	813 (63.7)	**<0.001**
MnCare	183 (17.5)	464 (36.3)	.
Age			
18-24	172 (16.5)	279 (21.9)	**<0.001**
25-34	344 (33.0)	459 (35.9)	.
35-64	528 (50.6)	539 (42.2)	.
Male	274 (26.3)	412 (32.3)	**0.002**
Race/Ethnicity			
White	801 (76.7)	1012 (79.3)	0.078
Black or African American	130 (12.5)	122 (9.6)	.
Amer Indian or Alaskan Native	79 (7.6)	84 (6.6)	.
Hispanic or Latino	15 (1.4)	27 (2.1)	.
Asian or Pacific Islander	19 (1.8)	32 (2.5)	.
Education			
Grade 11/lower	161 (15.8)	157 (12.6)	**0.001**
HS grad/GED	344 (33.8)	418 (33.4)	.
Some college	428 (42.0)	513 (41.0)	.
College grad/higher	85 (8.4)	163 (13.0)	.
Employment			
Employed/self-employed	352 (34.4)	789 (63.0)	**<0.001**
Student	86 (8.4)	72 (5.8)	.
Out of work	161 (15.7)	138 (11.0)	.
Unable to work/disabled	370 (67.6)	177 (14.1)	.
Homemaker	54 (5.3)	77 (6.2)	.
Yearly income			
Less than $10k	488 (48.8)	350 (28.8)	**<0.001**
$10,001-$20k	295 (29.5)	403 (33.2)	.
$20,001-$40k	157 (15.7)	312 (25.7)	.
More than $40k	61 (6.1)	150 (12.4)	.
Smoking History			
Cigs/day	14.7±9.6	13.0±8.8	**<0.001**[1]
Duration (yrs)	21.7±12.9	19.7±13.0	**<0.001**
Time until 1st cig (mins)			
≤ 5	321 (31.1)	285 (22.6)	**<0.001**
6 – 15	332 (32.1)	348 (27.6)	.
16 – 30	157 (15.2)	185 (14.7)	.
31 – 60	100 (9.7)	169 (13.4)	.
> 60	123 (11.9)	274 (21.7)	.

Past year quit attempt	565 (55.1)	677 (53.8)	0.536
Any treatment used	411 (39.4)	328 (25.7)	**<0.001**
Social Support			
Support of others for quitting	4.4±0.8	4.4±0.7	0.102[1]
Social Norms			
Friends/family who smoke			
Almost all	258 (24.9)	221 (17.4)	**<0.001**
Over half	230 (22.2)	267 (21.1)	.
About half	235 (22.7)	363 (28.7)	.
Less than half	139 (13.4)	199 (15.7)	.
Very few	151 (14.6)	193 (15.2)	.
None	23 (2.2)	24 (1.9)	
Home Environment			
Home smoking rules			
Smoking is not allowed	471 (45.4)	681 (53.8)	**<0.001**
Smoking is allowed at times	276 (26.6)	333 (26.3)	.
Smoking is allowed	291 (28.0)	253 (20.0)	.
Healthcare Provider			
Regular physician	857 (83.6)	900 (71.6)	**<0.001**
Physician advised to quit	748 (79.0)	811 (74.5)	**0.017**
Physician discussed medications	428 (45.5)	438 (40.4)	**0.022**
Physician discussed other	494 (52.5)	466 (42.9)	**<0.001**
Physician bias	5.9±2.9	5.8±2.8	0.475
Cessation Beliefs			
Quitting self-efficacy	4.7±3.0	5.3±3.1	**<0.001**
Contemplation Ladder	6.3±2.9	6.3±2.9	0.495

[1]Satterthwaite test

Main Effect of Intervention

As described in our prior work,[78] participants in the proactive outreach condition had

higher odds of medication, counselling, and any form of treatment utilization than

participants in UC (all p<0.001). In addition, participants in the proactive outreach

condition had higher odds of prolonged abstinence than participants in UC (p=0.006) (see

Table 10).

Table 10. Effect of Proactive Outreach on Cessation Treatment Utilization and Prolonged Abstinence

Outcome	Usual Care	Outreach	Odds Ratio (95% CI)	p Value
	(No.) %			
Treatment				
Medication use				
Observed*	(278/944) 29.5	(335/826) 40.6	1.63 (1.34-2.00)	**<0.001**
Counseling use				
Observed*	(45/944) 4.8	(174/826) 21.1	5.42 (3.83-7.66)	**<0.001**
Any trt use				
Observed*	(289/944) 30.6	(365/826) 44.2	1.81 (1.48-2.21)	**<0.001**
Abstinence				
6m prolonged abs				
Observed*	(113/937) 12.1	(135/820) 16.5	1.47 (1.12-1.93)	**0.006**

* Adjusted for stratification variables of sex, age, and insurance program

Cessation Treatment Utilization and Prolonged Abstinence in SMI Group

In analyses of observed data, SMI participants in the proactive outreach condition had higher odds of any form of cessation treatment utilization than participants in UC (51.6% vs. 38.1%, OR=1.76, 95% CI: 1.31-2.37, p<0.001). Similar effects were obtained when adjusting for variables associated with survey non-response (see Table 11).

SMI participants in the proactive outreach condition also had higher odds of prolonged abstinence than participants in UC, although this effect did not reach significance (14.7% vs. 10.8%, OR=1.50, 95% CI: 0.97-2.31, p=0.070). Similar effects were obtained in models adjusting for variables associated with survey non-response (see Table 11).

In analyses of imputed data, the effect of proactive outreach on prolonged abstinence was attenuated in both minimally adjusted and fully adjusted models. The effect of proactive outreach was strengthened in the analyses of the treatment utilization outcomes and all effects remained statistically significant (see Table 11).

Table 11. Cessation Treatment Utilization and Prolonged Abstinence in SMI Group

Outcome	Usual Care	Outreach	Odds Ratio (95% CI)	p Value
<u>Treatment</u>				
Medication use				
Observed*	(143/391) 36.6	(176/370) 47.6	1.58 (1.18-2.12)	**0.002**
Observed†	36.8	47.3	1.67 (1.22-2.30)	**0.002**
Imputed*	-	-	1.78 (1.34-2.37)	**<0.001**
Imputed†	-	-	1.90 (1.41-2.55)	**<0.001**
Counseling use				
Observed*	(25/391) 6.4	(84/370) 22.7	4.43 (2.75-7.15)	**<0.001**
Observed†	6.3	21.6	4.63 (2.77-7.75)	**<0.001**
Imputed*	-	-	6.12 (3.78-9.91)	**<0.001**
Imputed†	-	-	6.58(4.01-10.80	**<0.001**
Any trt use				
Observed*	(149/391) 38.1	(191/370) 51.6	1.76 (1.31-2.37)	**<0.001**
Observed†	38.3	51.6	1.89 (1.37-2.60)	**<0.001**
Imputed*	-	-	2.06 (1.55-2.74)	**<0.001**
Imputed†	-	-	2.22 (1.65-3.00)	**<0.001**
<u>Abstinence</u>				
6m prolonged abs				
Observed*	(42/389) 10.8	(54/367) 14.7	1.50 (0.97-2.31)	0.070
Observed†	9.9	14.5	1.48 (0.90-2.46)	0.126
Imputed*	-	-	1.35 (0.90-2.05)	0.115
Imputed†	-	-	1.22 (0.79-1.90)	0.370

* Adjusted for stratification variables of sex, age, and insurance program
† Adjusted for stratification variables, race/ethnicity, education, employment, income, time until 1st cigarette, and duration of smoking

<u>Cessation Treatment Utilization and Prolonged Abstinence in non-SMI Group</u>

In analyses of observed data, non-SMI participants in the proactive outreach condition had higher odds of any form of cessation treatment utilization than participants in UC (38.6% vs. 25.8%, OR=1.79, 95% CI: 1.35-2.37, p<0.001). Similar effects were obtained in models adjusting for variables associated with follow-up survey non-response (see Table 12).

Non-SMI participants in the proactive outreach condition had higher odds of prolonged abstinence than participants in UC (18.1% vs. 12.8%, OR=1.55, 95% CI: 1.08-2.23, p=0.017). Similar effects were obtained in models adjusting for variables associated with follow-up survey non-response (see Table 12).

In analyses of imputed data, the effect of proactive outreach on prolonged abstinence was slightly attenuated, but remained statistically significant across minimally and fully adjusted models. The effect of proactive outreach was strengthened in the analyses of the treatment utilization outcomes and all effects remained statistically significant (see Table 12).

Table 12. Cessation Treatment Utilization and Prolonged Abstinence in Non-SMI Group

Outcome	Usual Care	Outreach	Odds Ratio (95% CI)	p Value
Treatment				
Medication use				
Observed*	(130/519) 25.1	(152/428) 35.5	1.63 (1.22-2.17)	**<0.001**
Observed†	24.8	35.2	1.67 (1.23-2.27)	**0.001**
Imputed*	-	-	1.98 (1.47-2.66)	**<0.001**
Imputed†	-	-	2.02 (1.50-2.74)	**<0.001**
Counseling use				
Observed*	(19/519) 3.7	(86/428) 20.1	6.81(4.04-11.48	**<0.001**
Observed†	3.5	20.5	7.54(4.33-13.11	**<0.001**
Imputed*	-	-	8.92(5.48-14.52	**<0.001**
Imputed†	-	-	9.13(5.56-14.99	**<0.001**
Any trt use				
Observed*	(134/519) 25.8	(165/428) 38.6	1.79 (1.35-2.37)	**<0.001**
Observed†	25.5	38.6	1.86 (1.38-2.51)	**<0.001**
Imputed*	-	-	2.42 (1.82-3.22)	**<0.001**
Imputed†	-	-	2.49 (1.86-3.33)	**<0.001**
Abstinence				
6m prolonged abs				
Observed*	(66/514) 12.8	(77/425) 18.1	1.55 (1.08-2.23)	**0.017**
Observed†	11.9	17.3	1.61 (1.08-2.41)	**0.020**
Imputed*	-	-	1.52 (1.08-2.16)	**0.018**
Imputed†	-	-	1.52 (1.07-2.18)	**0.021**

* Adjusted for stratification variables of sex, age, and insurance program
† Adjusted for stratification variables, race/ethnicity, education, employment, income, time until 1st cigarette, and duration of smoking

Tests of Interaction

The SMI x intervention condition interaction terms in the regressions modeling

medication use, counseling use, any treatment use, and 6-month prolonged abstinence at

12-month follow-up were not significant in the analyses of observed data and imputed

data.

Discussion

In concordance with our hypothesis, the proactive outreach intervention was effective for promoting all forms of cessation treatment utilization (medication, counseling, and any form) for smokers with SMI and those without SMI. In addition, there was a significant effect of the intervention on prolonged abstinence in the non-SMI group. Although the magnitude of the intervention effect was similar in the SMI group, it did not reach statistical significance. Taken in conjunction with the significant main effects of the intervention, these results suggest that the proactive outreach strategy was largely effective for helping smokers in our low-income sample, regardless of SMI status, overcome healthcare provider and psychosocial barriers to treatment utilization and abstinence.

The existing literature suggests that smokers with SMI tend to have more problems accessing healthcare, heightened perceptions of physician bias, permissive social attitudes toward smoking, and low self-efficacy for quitting. Our baseline analyses replicated several of these findings, demonstrating that the SMI smokers in our sample lived in social environments that were more conducive to smoking and had lower self-efficacy for quitting than their non-SMI counterparts. As the OPTIN intervention was designed to minimize these barriers through proactive outreach, facilitated access to cessation medication, and motivational interviewing, we hypothesized that the intervention would be significantly more effective for smokers with SMI. However, it was instead found that the effects of the intervention were very similar for smokers with and without SMI.

The lack of any significant interactions between the intervention and SMI status may be better explained in the context of the healthcare characteristics of our study sample. All participants in the OPTIN study were enrolled in the publicly-subsidized MHCP which provided them with access to free or reduced cost healthcare. This facilitated access to care seems to have been of particular benefit for the SMI smokers in our sample, as baseline analyses indicated that these smokers were more likely to report having a regular physician, had much more frequent interactions with their healthcare providers, and were more likely to receive physician-delivered cessation advice than non-SMI smokers. In contrast, a significant proportion of the broader population of those with MH disorders do not have health insurance, and those with MH disorders tend to be uninsured at higher rates than the general population.[79] These differing rates of coverage may contribute to the disparity in healthcare service utilization observed in previous studies. Thus, the increased quality of healthcare experienced by SMI smokers in our sample compared to those in the general population may have resulted in a smaller intervention "boost" relative to that which was initially hypothesized.

In addition to reporting frequent quit attempts, smokers with SMI also had much higher rates of cessation treatment utilization than non-SMI smokers at baseline. Again, these results may in part be explained by the nature of the MHCP healthcare system, which appears to provide a comparatively supportive environment for smokers with SMI with respect to access and utilization of cessation resources. Despite these high underlying rates of treatment use for smokers with SMI, the proactive outreach intervention produced similarly sized treatment utilization effects in both groups, and resulted in a past year treatment utilization rate of greater than 50% in the SMI group. This suggests

that proactive outreach strategies are an effective means of providing a boost in treatment utilization rates among smokers who are already in frequent contact with the healthcare system and who receive high levels of physician-delivered cessation advice. This result is particularly important for smokers with SMI, given evidence which indicates that this population may require a greater number of quit attempts and may need to utilize a greater number of treatment strategies before achieving cessation.[68]

It should be noted that, while the intervention resulted in heightened rates of medication use across both groups, it had an even larger effect on the use of counseling. Past year use of counseling at baseline was very low in both groups, a finding which is problematic given the considerable body of evidence which demonstrates the effectiveness of motivational interviewing techniques for boosting quit rates among smokers with and without MH disorders. The low underlying rates of counseling use, in combination with the high uptake seen in the intervention group, suggests that there may be an unmet demand for counseling resources among socioeconomically disadvantaged smokers enrolled in publicly-subsidized insurance programs. This result is also an indication that cessation counseling that is delivered in a proactive fashion via telephone outreach can effectively reduce access barriers.

Although smokers in the SMI group reported comparatively high rates of treatment utilization at follow-up, they achieved lower rates of prolonged abstinence than the non-SMI group. This finding is consistent with evidence which shows that smokers with MH disorders have difficulty quitting[80,81] despite engaging in frequent quit attempts, and as the present study demonstrates, utilizing cessation treatment at high rates. The

intervention produced a moderately sized effect on prolonged abstinence in the SMI

group, one that was only slightly smaller than that observed in the non-SMI group. This

finding, although exploratory and not statistically significant, provides preliminary

evidence that proactive outreach cessation strategies may be effective for smokers with

SMI. Again, although smokers in our sample accessed cessation treatment at high levels

at baseline, these results suggest that proactive outreach strategies can provide a

significant boost in treatment utilization and in abstinence rates.

Limitations

Although it is plausible that the proactive outreach intervention would be more effective

for smokers with SMI given the significant healthcare provider and psychosocial barriers

experienced by this group, we were unpowered for a formal statistical test of interaction

by SMI diagnosis. Our study also experienced considerable loss to follow-up, which we

attempted to account for using imputation methods. In addition, we do not have measures

of functional impairment to help validate the SMI categorizations. When paired with the

MH diagnoses, these assessments would help ensure that the smokers in the SMI

category were experiencing a high degree of life impairment.

Conclusion

The present study adds to the body of evidence demonstrating that smokers with SMI are

interested in quitting and take up treatment at high rates when it is offered.[26–28]

Examination of baseline rates of physician-delivered cessation advice and treatment

utilization among SMI smokers in this sample also shows that MHCP is providing a

relatively supportive cessation environment for smokers with SMI, particularly in light of

past evidence demonstrating the disparity in cessation-related care experienced by these smokers in the broader US population. Our results suggest that proactive outreach strategies are effective for boosting rates of treatment utilization among smokers with SMI, even among those already receiving high rates of quality cessation care from their healthcare providers. These interventions may be particularly useful for boosting rates of counseling use, which were discouragingly low at baseline. Furthermore, this study provides evidence that proactive outreach may be effective for boosting abstinence rates among smokers with SMI, although further research is needed to replicate these findings. It is critically important that public health experts continue to develop and evaluate strategies for increasing rates of smoking cessation and reducing the disparity in smoking-related morbidity and mortality experienced by those with MH disorders.

Research Study 3

Title: The effect of prolonged smoking cessation on binge drinking and mental health among smokers with serious mental illness

Specific Aims

Aim 1: To examine the effect of 6-month prolonged smoking cessation on binge drinking among smokers with SMI and smokers without SMI.

Hypothesis 1: Smoking cessation will be associated with a reduction in binge drinking among smokers with SMI and smokers without SMI.

Aim 2: To examine the effect of 6-month prolonged smoking cessation on depression and anxiety symptoms among smokers with SMI and smokers without SMI.

Hypothesis 2: Smoking cessation will be associated with improvement in depression and anxiety symptoms among smokers with SMI and smokers without SMI.

Abstract

Introduction

The overall prevalence of smoking is declining, but rates of smoking remain high for those with alcoholism and SMI. The challenges inherent in quitting smoking may seem particularly daunting for these smokers given the common perceptions that quitting smoking will exacerbate MH symptoms and lead to increases in alcohol abuse behaviors. The aims of the present study are to address these longstanding perceptions by exploring the effect of incident smoking cessation on binge drinking and symptoms of depression and anxiety.

Methods

We present data from secondary analyses of the OPTIN study. ICD-9 codes obtained from insurance claims data were used to identify participants with schizophrenic disorders, psychotic disorder, bipolar disorders, and/or major depressive disorder. These diagnoses were used to categorize participants into SMI (n=1044) and non-SMI (n=1277) groups. Multivariable linear regressions modeled the effects of 6-month prolonged cessation (yes vs.no) on PHQ-2 depression scores, PROMIS anxiety scores, and binge drinking at 12-month follow-up in the SMI and non-SMI groups, respectively.

Results

In the minimally adjusted models, smokers who quit had far lower odds of binge drinking more than 3 days per month than those who did not quit in both the SMI (OR=0.26, 95% CI: 0.09-0.76) and the non-SMI group (OR=0.42, 95% CI: 0.21-0.87), although the

overall effects of quitting smoking did not reach statistical significance. Smokers who quit also had lower PHQ-2 scores in both the SMI (2.37 vs 2.71, p=0.042) and the non-SMI group (1.59 vs 1.75, p=0.065). Smokers who quit reported lower PROMIS anxiety scores in the SMI group (55.61 vs. 59.03, p<0.001), but this effect did not reach significance in the non-SMI group.

Conclusion

Smoking cessation was associated with reductions in binge drinking as well as symptoms of depression and anxiety in both the SMI and non-SMI groups. These findings counter the narrative that quitting smoking is detrimental for those with MH disorders and bolster the case for promoting cessation among these smokers and helping facilitate access to cessation resources.

Introduction

The prevalence of smoking among those with MH disorders is two to three times higher than that of the general US population, depending on clinical diagnosis.[8] Those with diagnoses consistent with SMI like major depressive disorder[82,83] and schizophrenia[84] are also more likely to engage in alcohol abuse behaviors. Furthermore, evidence suggests that smoking and alcoholism tend to co-occur as the prevalence of alcohol dependence among current smokers is nearly 10 times that of non-smokers.[85] The high co-occurrence of smoking and alcohol dependence among those with SMI is a grave public health concern. In addition to the well-established cardiovascular and hepatic risks associated with these behaviors,[86,87] the combined use of cigarettes and alcohol is associated with a multiplicative increase in the risk for certain head and neck cancers.[88]

Many smokers with alcohol use disorder report using smoking as a way to cope with urges to drink,[54] making the prospect of quitting seem overwhelming and unattainable. Furthermore, the strong withdrawal symptoms associated with smoking cessation and abstinence from alcohol have contributed to a reluctance to treat these conditions simultaneously,[55,56] largely due to the belief that achieving abstinence in one of these behaviors will lead to exacerbation of the other.[57] Smokers with alcohol use disorder often echo these concerns with many of them espousing the belief that quitting smoking would harm their sobriety.[54] Some early research partially validates these concerns, as several studies have demonstrated that smoking cessation is associated with increased alcohol use.[89,90] However, more recent studies have shown that alcohol use does not substantially change following smoking cessation[91,92] or is actually reduced.[57,93] It has

been suggested that methodological variability, recall bias, and an inability to establish temporal ordering may account for the inconsistent findings across these studies.[57]

A key barrier to smoking cessation among those with SMI is the perception that engaging in a quit attempt may exacerbate their MH symptoms. This perception exists at both the individual level and at the level of the healthcare provider. Evidence suggests that smokers with SMI may use nicotine as a form of self-medication to help reduce the experience of negative affect and anxiety associated with their condition(s),[47,48] and qualitative work has shown that these smokers expect that their MH will deteriorate following a quit attempt.[35] Healthcare providers similarly endorse the belief that quitting may heighten the depressive symptoms of their patients.[37,38]

Despite the concerns of both smokers and healthcare providers regarding the potentially deleterious consequences associated with smoking cessation, a growing body of evidence suggests that quitting smoking leads to improved MH among the general population.[94–96] Other research has shown similarly beneficial effects of smoking cessation on MH symptoms among smokers with diagnoses of mood and anxiety disorders.[97]

The inconsistent findings regarding the effects of smoking cessation on alcohol use highlight the need for continued research exploring this issue. As such, the first aim of the present study is to assess the effect of smoking cessation on behaviors consistent with alcohol abuse. We will specifically focus on binge drinking behaviors given the pronounced deleterious health risks associated with drinking to excess[98–100] and because binge drinking is a predictor of alcohol dependence.[101] There is also a lack of research exploring whether the effects of smoking cessation on alcohol use differ by SMI status;

an important clinical consideration when approaching the treatment of smoking for those with MH disorders due to the high co-morbidity of these conditions.[82,102] We will address this gap in the literature by examining the effect of smoking cessation on binge drinking among those with SMI and without SMI, respectively.

The second aim of this study is to explore the effects of smoking cessation on MH symptoms. Continued research in this area is essential in order to better inform both smokers and physicians on what to expect when approaching cessation, an issue of particular importance for smokers with SMI. On the part of the smoker, this information may allay fears regarding MH symptom exacerbation and boost motivation to quit and enhance self-efficacy. For healthcare providers, this information may be useful when providing clinical care for cessation and when considering treatment options. Developing individually-tailored treatment plans may be particularly useful if the effects of smoking cessation on MH differs for smokers with and without SMI. In light of evidence which suggests that tobacco use can reduce the effectiveness of common antipsychotic and antidperessant medications,[53] it is also plausabile that prolonged cessation may be particularly beneficial for smokers with SMI. As such, we will examine the effects of prolonged smoking cessation on MH symptoms among smokers with and without SMI.

Methods

Study Design

Data were obtained from the OPTIN study (N=2406). This study was a two-arm RCT that demonstrated the effectiveness of proactive outreach on 6-month prolonged abstinence in a sample of smokers enrolled in MHCP.[70] The study population sample was

stratified by age group (18–24, 25–34, 35–64), gender (male or female), and insurance program (Medicaid or MinnesotaCare). Using MHCP insurance claims drawn from a 2-year period prior to study initiation, ICD-9 codes indicative of schizophrenic disorders, psychotic disorder, bipolar I and II disorder, and/or major depressive disorder were used to categorize participants as having SMI (n=1044) or not having SMI (n=1277).

Measures

Measures were obtained from OPTIN baseline and follow-up survey data, as well as from MHCP administrative and claims data.

Demographics

Age, sex, insurance program, education, employment status, income, and race/ethnicity were assessed. The "Hispanic" and "Asian/Pacific Islander" categories were collapsed into one category due to the small sizes of these groups.

Smoking History

Standard questions from the California Tobacco Survey[62] and the BRFSS[63] assessed smoking history, including lifetime duration of smoking, time until first cigarette, cigarettes smoked per day, and past year quit attempts.

Smoking Abstinence

A self-report measure was used to assess 6-month prolonged abstinence at 12-month follow-up.[71] Participants who reported smoking at least once on 7 consecutive days or at least once on 2 consecutive weekends in the 6-month period prior to the follow-up survey

were considered continuing smokers.

Social Environment

A composite variable measured participants' perceived social support for cessation by taking the mean of two support-related variables that assessed perceived support for quitting and others' desire for quitting, respectively.[28] All items were assessed on a 5-point scale, with higher scores indicative of greater levels of social support. Participants reported the proportion of their close friends and family who were smokers. Participants then reported whether they lived with a child under the age of 18, whether they lived with another smoker, and the smoking rules within their home.

Healthcare Provider Factors

HEDIS tobacco performance measures were used to assess participants' past year healthcare experiences.[26] Items assessed whether participants received physician-delivered advice to quit, advice to use cessation medications, and advice to use ways (besides products) to help with quitting. A composite variable of perceptions of healthcare provider bias was created by summing 3 items from the Physician Bias and Interpersonal Cultural Competence Measures Scale.[27] Each item was assessed on a 5-point scale, with higher values indicating greater perceptions of physician bias.

Mental Health Diagnoses

Participants with at least one ICD-9 code in the range of 1) 295.00 to 295.94 were considered to have a schizophrenic disorder, 2) 297.00 to 298.9 were considered to have a psychotic disorder, 3) 296.2 to 296.36 were considered to have a major depressive

disorder, 4) 296.00 to 296.13 and/or 296.4 to 296.9 were considered to have a bipolar disorder.

Mental Health Symptoms

Measures taken from the PROMIS instrument were used to assess mental health symptoms.[103] The anxiety measure was created by taking the sum of 7 items assessed on a scale from 1-5, with higher scores indicating greater anxiety. A T-score was then calculated by multiplying the summed score by 7 and dividing by the number of items that the participant answered (see Appendix). The depression measure was created by taking the sum of 2 items assessed on a scale from 1-4, with higher scores indicating greater depressive thoughts (see Appendix).

Alcohol

An item from the BRFSS was used to assess binge drinking by asking on how many days in the past 30 the participant had consumed 5 or more drinks (4 or more for women). Participants were placed into "0 days", "1 day", "2-3 days", or "more than 3 days" categories (see Appendix).

<u>Statistical Analysis</u>

Bivariate Analyses

Bivariate analyses, performed using t-tests and Person's chi-square, were used to compare participants with and without SMI across demographic, smoking history,

cessation treatment utilization, healthcare provider, social environment, and psychosocial measures.

Regression Analyses

Multivariable multinomial regression was used to model the effect of 6-month prolonged smoking cessation (yes vs. no) on the 4-level binge drinking outcome variable at 12-month follow-up, stratified by SMI category (SMI vs. non-SMI). A baseline measure of binge drinking was included in these models.

Log transformations of the depression and anxiety outcome variables and their respective baseline measures were performed to address right skewing. All means reported in these outcomes analyses are geometric means that have been exponentiated from the log form.

Multivariable linear regressions were used to model the effect of prolonged cessation on PHQ-2 depression score and PROMIS anxiety score at follow-up, stratified by SMI category. Baseline measures of each outcome variable were included in their respective models.

Post-Hoc Multinomial Regression Analyses

In order to account for the low statistical power of the binge drinking outcome, and due to the similarity of effects observed across the SMI and non-SMI groups, a post-hoc analysis was conducted to examine the main effect of smoking cessation on binge drinking in the combined SMI and non-SMI sample.

Confounder Adjustment

A series of bivariate analyses were conducted comparing those who quit smoking vs. continuing smokers across a series of potential demographic, smoking history, social environment, and smoking beliefs confounders (see Table 13). The analyses indicate that quitters tended to score lower on indicators of nicotine dependence, but were less likely to have engaged in a quit attempt at baseline. In addition, quitters were less likely to report having received advice to quit or to use cessation medication from their healthcare provider. Quitters also reported social environments that were less conducive to smoking, particularly with respect to home smoking rules. Quitters reported much higher self-efficacy for quitting and readiness to quit at baseline.

In addition to the unadjusted regression models, hierarchical models were used to incrementally adjust for the effects of the 1) intervention 2) demographic 3) social environment, and 4) smoking history/cessation beliefs variables.

Table 13. Intervention, Demographic, Social Environment, and Smoking
History/Cessation Beliefs Characteristics of Smoking Quitters Vs. Non-Quitters

Characteristic	Smoking Quitter N=248	Smoking Non-Quitter N=1509	p Value
	No. (%) or Mean		
Intervention			
Proactive outreach	135 (54.4)	685 (45.4)	**0.008**
Usual care	113 (45.6)	824 (54.6)	.
Demographics			
Age			
18-24	51 (20.6)	263 (17.4)	0.323
25-34	84 (33.9)	488 (32.3)	.
35-64	113 (45.6)	758 (50.2)	.
Male	77 (31.1)	430 (28.5)	0.411
Race/Ethnicity			
White	186 (75.0)	1206 (79.9)	0.112
Black or African American	30 (12.1)	158 (10.5)	.
Amer Ind or Alaskan Native	17 (6.9)	101 (6.7)	.
Hispanic or Latino	7 (2.8)	22 (1.5)	.
Asian or Pacific Islander	8 (3.2)	22 (1.5)	.
Education			
Grade 11/lower	32 (13.2)	163 (11.0)	0.504
HS grad/GED	72 (29.6)	486 (32.9)	.
Some college	204 (42.8)	647 (43.8)	.
College grad/higher	35 (14.4)	181 (12.3)	.
Employment			
Employed/self-employed	128 (52.9)	746 (50.2)	0.189
Student	15 (6.2)	102 (6.9)	.
Out of work	18 (7.4)	189 (12.7)	.
Unable to work/disabled	67 (27.7)	362 (24.5)	.
Homemaker	14 (5.8)	86 (5.8)	.
Yearly income			
Less than $10k	76 (32.5)	531 (36.7)	0.117
$10,001-$20k	93 (39.7)	459 (31.7)	.
$20,001-$40k	44 (18.8)	306 (21.2)	.
More than $40k	21 (8.9)	151 (10.4)	.
Social Norms			
Friends/family who smoke			
Almost all	38 (15.5)	297 (19.8)	**<0.001**
Over half	34 (13.9)	308 (20.6)	.
About half	65 (26.5)	403 (26.9)	.
Less than half	39 (15.9)	242 (16.2)	.

Very few	58 (23.7)	221 (14.8)	.
None	11 (4.5)	27 (1.8)	
Home smoking rules			
Smoking is not allowed	155 (63.5)	730 (48.7)	**<0.001**
Smoking is allowed at times	54 (22.1)	402 (26.8)	.
Smoking is allowed	35 (14.3)	368 (24.5)	.
Smoking History			
Cigs/day	9.8±10.8	14.2±8.8	**<0.001**[1]
Duration (yrs)	19.7±13.8	21.7±13.2	**0.034**
Time until 1st cig (mins)			
≤ 5	33 (14.0)	401 (26.7)	**<0.001**
6 – 15	50 (21.3)	450 (30.0)	.
16 – 30	27 (11.5)	240 (16.0)	.
31 – 60	35 (14.9)	174 (11.6)	.
> 60	90 (38.3)	235 (15.7)	.
Cessation Beliefs			
Quitting self-efficacy	7.0±2.9	4.8±3.0	**<0.001**
Contemplation Ladder	7.4±2.9	6.2±2.8	**<0.001**

[1]Satterthwaite test
[2]Geometric means are reported

Results

Baseline Comparison of Smokers with SMI vs without SMI

Compared to non-SMI smokers (n=1277), those with SMI (n=1044) were more likely to be enrolled in Medicaid, were older, and more likely to be female. Smokers with SMI also tended to be less educated, less likely to be currently employed, and earned significantly less (see Table 14).

With respect to mental health and alcohol use characteristics, smokers with SMI had significantly more symptoms of depression and anxiety at baseline, were more likely to have a diagnosis of alcohol dependence disorder, but had lower levels of binge drinking (see Table 14).

Smokers with SMI had more indicators of nicotine dependence, including less time until

smoking their first cigarette after waking. They also tended to be heavier smokers and

had smoked for a longer duration of time than those without SMI. Smokers with SMI had

lower quitting self-efficacy but reported similar readiness to quit as those without SMI.

Smokers in the SMI group also had more smokers in their peer groups and had less

restrictive home smoking rules (see Table 14).

Smokers with SMI were more likely to report having a regular doctor, and received more

advice to quit and to use cessation treatments than non-SMI smokers (see Table 14).

Table 14. Baseline Demographic, Mental Health/Alcohol, Smoking History, Social Environment, Healthcare Provider, and Cessation Belief Characteristics of SMI vs. Non-SMI Smokers

Characteristic	SMI N=1044	Non-SMI N=1277	p Value
	No. (%) or Mean±SD		
Demographics			
Insurance Program			
Medicaid	861 (82.5)	813 (63.7)	**<0.001**
MnCare	183 (17.5)	464 (36.3)	.
Age			
18-24	172 (16.5)	279 (21.9)	**<0.001**
25-34	344 (33.0)	459 (35.9)	.
35-64	528 (50.6)	539 (42.2)	.
Male	274 (26.3)	412 (32.3)	**0.002**
Race/Ethnicity			
White	801 (76.7)	1012 (79.3)	0.078
Black or African American	130 (12.5)	122 (9.6)	.
Amer Indian or Alaskan Native	79 (7.6)	84 (6.6)	.
Hispanic or Latino	15 (1.4)	27 (2.1)	.
Asian or Pacific Islander	19 (1.8)	32 (2.5)	.
Education			
Grade 11/lower	161 (15.8)	157 (12.6)	**0.001**
HS grad/GED	344 (33.8)	418 (33.4)	.
Some college	428 (42.0)	513 (41.0)	.
College grad/higher	85 (8.4)	163 (13.0)	.
Employment			
Employed/self-employed	352 (34.4)	789 (63.0)	**<0.001**
Student	86 (8.4)	72 (5.8)	.
Out of work	161 (15.7)	138 (11.0)	.
Unable to work/disabled	370 (67.6)	177 (14.1)	.
Homemaker	54 (5.3)	77 (6.2)	.
Yearly income			
Less than $10k	488 (48.8)	350 (28.8)	**<0.001**
$10,001-$20k	295 (29.5)	403 (33.2)	.
$20,001-$40k	157 (15.7)	312 (25.7)	.
More than $40k	61 (6.1)	150 (12.4)	.
Mental Health			
Depression[2]	2.8±1.9	1.9±1.9	**<0.001**
Anxiety[2]	58.6±1.2	51.0±1.2	**<0.001**
Alcohol			
Alcohol dependence disorder	355 (34.0)	100 (7.8)	**<0.001**
Binge drinking (past month)			**<0.001**
0 days	641 (65.5)	658 (54.0)	.

85

1 day	91 (9.3)	148 (12.1)	.
2-3 days	99 (10.1)	200 (16.4)	.
> 2-3 days	147 (15.0)	213 (17.5)	.
Smoking History			
Cigs/day	14.7±9.6	13.0±8.8	**<0.001**[1]
Duration (yrs)	21.7±12.9	19.7±13.0	**<0.001**
Time until 1st cig (mins)			
≤ 5	321 (31.1)	285 (22.6)	**<0.001**
6 – 15	332 (32.1)	348 (27.6)	.
16 – 30	157 (15.2)	185 (14.7)	.
31 – 60	100 (9.7)	169 (13.4)	.
> 60	123 (11.9)	274 (21.7)	.
Smoking Abstinence			
6-month prolonged	96 (12.7)	143 (15.2)	0.137
Social Norms			
Friends/family who smoke			
Almost all	258 (24.9)	221 (17.4)	**<0.001**
Over half	230 (22.2)	267 (21.1)	.
About half	235 (22.7)	363 (28.7)	.
Less than half	139 (13.4)	199 (15.7)	.
Very few	151 (14.6)	193 (15.2)	.
None	23 (2.2)	24 (1.9)	
Home smoking rules			
Smoking is not allowed	471 (45.4)	681 (53.8)	**<0.001**
Smoking is allowed at times	276 (26.6)	333 (26.3)	.
Smoking is allowed	291 (28.0)	253 (20.0)	.
Healthcare Provider			
Regular physician	857 (83.6)	900 (71.6)	**<0.001**
Physician advised to quit	748 (79.0)	811 (74.5)	**0.017**
Physician discussed medications	428 (45.5)	438 (40.4)	**0.022**
Physician discussed other	494 (52.5)	466 (42.9)	**<0.001**
Physician bias	5.9±2.9	5.8±2.8	0.475
Cessation Beliefs			
Quitting self-efficacy	4.7±3.0	5.3±3.1	**<0.001**
Contemplation Ladder	6.3±2.9	6.3±2.9	0.495

[1]Satterthwaite test

[2]Geometric means are reported

Binge Drinking at Follow-up in Smoking Quitters vs. Non-Quitters

SMI Group

In the minimally adjusted model (model 2), smokers who quit had lower odds of binge drinking for 2-3 days (OR=0.68, 95% CI: 0.28-1.63) and more than 3 days (OR=0.26, 95% CI: 0.09-0.76) compared to no days of binge drinking than those who did not quit. The overall effect was marginally significant (p<0.1) in model 2, but did not reach significance in the more fully adjusted models (see Table 15).

Non-SMI Group

In the minimally adjusted model, smokers who quit had lower odds of binge drinking for 2-3 days (OR=0.58, 95% CI: 0.30-1.13) and more than 3 days (OR=0.42, 95% CI: 0.21-0.87) compared to no days of binge drinking than those who did not quit (see Table 15). The overall effects were marginally significant (p<0.1) in models 2 through 4.

Table 15. Binge Drinking at Follow-Up in Smoking Quitters vs Non-Quitters by SMI Group

			SMI (N=667)					Non-SMI (N=865)	
Model	Smoking Quitter	Binge Drink	OR (95% CI)	p Value	Model	Smoking Quitter	Binge Drink	OR (95% CI)	p Value
1	Yes vs No	0 days	-	-	1	Yes vs No	0 days	-	-
		1 day	0.89 (0.39-2.05)	0.152			1 day	1.08 (0.63-1.87)	0.100
		2-3 day	0.78 (0.36-1.69)	-			2-3 day	0.72 (0.41-1.28)	-
		> 3 days	0.34 (0.13-0.87)	-			> 3 days	0.51 (0.28-0.92)	-
2	Yes vs No	0 days	-	-	2	Yes vs No	0 days	-	-
		1 day	0.99 (0.42-2.34)	0.096			1 day	0.91 (0.49-1.70)	0.087
		2-3 day	0.68 (0.28-1.63)	-			2-3 day	0.58 (0.30-1.13)	-
		> 3 days	0.26 (0.09-0.76)	-			> 3 days	0.42 (0.21-0.87)	-
3	Yes vs No	0 days	-	-	3	Yes vs No	0 days	-	-
		1 day	1.11 (0.46-2.71)	0.213			1 day	0.92 (0.47-1.78)	0.080
		2-3 day	0.79 (0.32-1.95)	-			2-3 day	0.58 (0.29-1.18)	-
		> 3 days	0.30 (0.09-0.94)	-			> 3 days	0.30 (0.17-0.83)	-
4	Yes vs No	0 days	-	-	4	Yes vs No	0 days	-	-
		1 day	0.98 (0.39-2.45)	0.441			1 day	1.04 (0.53-2.06)	0.074
		2-3 day	0.80 (0.32-2.01)	-			2-3 day	0.61 (0.29-1.24)	-
		> 3 days	0.38 (0.12-1.22)	-			> 3 days	0.38 (0.17-0.84)	-
5	Yes vs No	0 days	-	-	5	Yes vs No	0 days	-	-
		1 day	0.88 (0.33-2.39)	0.310			1 day	1.13 (0.53-2.38)	0.191
		2-3 day	0.71 (0.27-1.88)	-			2-3 day	0.66 (0.30-1.46)	-
		> 3 days	0.30 (0.08-1.06)	-			> 3 days	0.42 (0.17-1.03)	-

Model 1 is unadjusted
Model 2 is adjusted for baseline binge drinking and intervention
Model 3 is adjusted for baseline binge drinking, intervention, and socio-demographics
Model 4 is adjusted for baseline binge drinking, intervention, socio-demographics, and social environment

Model 5 is adjusted for baseline binge drinking, intervention, socio-demographics, social environment, and smoking characteristics

Post-Hoc Binge Drinking at Follow-up in Smoking Quitters vs. Non-Quitters

Combined SMI and Non-SMI sample

In the minimally adjusted model (model 2), smokers who quit had lower odds of binge drinking for 2-3 days (OR=0.61, 95% CI: 0.36-1.03) and more than 3 days (OR=0.37, 95% CI: 0.21-0.67) compared to no days of binge drinking than those who did not quit (see Table 16). These effects were largely consistent across all levels of adjustment.

Table 16. Binge Drinking at Follow-Up in Smoking Quitters vs Non-Quitters in Combined Sample

Model	Smoking Quitter	Binge Drink	OR (95% CI)	p Value
1	Yes vs No	0 days	-	-
		1 day	1.05 (0.67-1.66)	0.014
		2-3 day	0.76 (0.48-1.20)	-
		> 3 days	0.46 (0.28-0.75)	-
2	Yes vs No	0 days	-	-
		1 day	0.97 (0.59-1.59)	0.006
		2-3 day	0.61 (0.36-1.03)	-
		> 3 days	0.37 (0.21-0.67)	-
3	Yes vs No	0 days	-	-
		1 day	1.00 (0.60-1.69)	0.011
		2-3 day	0.64 (0.37-1.11)	-
		> 3 days	0.36 (0.19-0.67)	-
4	Yes vs No	0 days	-	-
		1 day	1.05 (0.62-1.78)	0.019
		2-3 day	0.68 (0.39-1.18)	-
		> 3 days	0.37 (0.19-0.72)	-
5	Yes vs No	0 days	-	-
		1 day	0.98 (0.55-1.74)	0.034
		2-3 day	0.65 (0.36-1.12)	-
		> 3 days	0.36 (0.18-0.73)	-

Model 1 is unadjusted
Model 2 is adjusted for baseline binge drinking and intervention
Model 3 is adjusted for baseline binge drinking, intervention, and socio-demographics
Model 4 is adjusted for baseline binge drinking, intervention, socio-demographics, and social environment
Model 5 is adjusted for baseline binge drinking, intervention, socio-demographics, social environment, and smoking characteristics

PHQ-2 Scores at Follow-up in Smoking Quitters vs. Non-Quitters

SMI Group

In the minimally adjusted model (model 2), smokers who quit reported lower depression scores than those who did not quit (2.37 vs. 2.71, p = 0.042). This effect was attenuated in the most fully adjusted model (see Table 17).

Non-SMI Group

In the minimally adjusted model, smokers who quit reported lower depression scores than those who did not quit (1.59 vs. 1.75, p = 0.065). This effect was slightly strengthened in more fully adjusted models, reaching significance in models two and three (see Table 17).

Table 17. PHQ-2 Depression Scores at Follow-Up in Smoking Quitters vs Non-Quitters by SMI Group

SMI (N=650)					Non-SMI (N=817)				
Model	Smoking Quitter	T2 Mean*	Mean Diff	p Value	Model	Smoking Quitter	T2 Mean*	Mean Diff	p Value
1	Yes	2.34	0.38	**0.048**	1	Yes	1.41	0.26	0.064
	No	2.72	-	-		No	1.67	-	-
2	Yes	2.37	0.34	**0.042**	2	Yes	1.59	0.16	0.065
	No	2.71	-	-		No	1.75	-	-
3	Yes	2.37	0.30	0.087	3	Yes	1.46	0.16	**0.047**
	No	2.67	-	-		No	1.62	-	-
4	Yes	2.20	0.31	0.060	4	Yes	1.48	0.22	**0.033**
	No	2.51	-	-		No	1.66	-	-
5	Yes	2.52	0.16	0.427	5	Yes	1.49	0.18	0.071
	No	2.68	-	-		No	1.67	-	-

Model 1 is unadjusted
Model 2 is adjusted for baseline PHQ-2 score and intervention
Model 3 is adjusted for baseline PHQ-2 score, intervention, and socio-demographics
Model 4 is adjusted for baseline PHQ-2 score, intervention, socio-demographics, and social environment
Model 5 is adjusted for baseline PHQ-2 score, intervention, socio-demographics, social environment, and smoking characteristics
*Least squares geometric mean

PROMIS Anxiety Scores at Follow-up in Smoking Quitter vs. Non-Quitters

SMI Group

In the minimally adjusted model (model 2), smokers who quit reported lower anxiety scores than those who did not quit (55.61 vs. 59.03, p <0.001). This effect was attenuated in subsequent models but remained significant (see Table 18).

Non-SMI Group

In the minimally adjusted model (model 2), smokers who quit reported lower anxiety scores than those who did not quit (48.96 vs. 50.21, p <0.001), but this effect was not significant (p=0.131). The effect of abstinence on anxiety scores was strengthened in the most fully adjusted model (46.47 vs. 48.22, p=0.062) (see Table 18).

Table 18. PROMIS Anxiety Scores at Follow-Up in Smoking Quitters vs Non-Quitters by SMI Group

	SMI (N=738)					Non-SMI (N=906)			
Model	**Smoking Quitter**	**T2 Mean***	**Mean Diff**	**p Value**	**Model**	**Smoking Quitter**	**T2 Mean***	**Mean Diff**	**p Value**
1	Yes	54.62	4.53	**<0.001**	1	Yes	49.23	0.91	0.327
	No	59.15	-	-		No	50.14	-	-
2	Yes	55.63	3.40	**<0.001**	2	Yes	48.96	1.25	0.131
	No	59.03	-	-		No	50.21	-	-
3	Yes	56.67	2.36	**0.004**	3	Yes	47.51	1.34	0.107
	No	59.61	-	-		No	48.85	-	-
4	Yes	55.94	2.78	**0.007**	4	Yes	47.18	1.25	0.138
	No	58.72	-	-		No	48.43	-	-
5	Yes	56.41	2.40	**0.035**	5	Yes	46.47	1.75	0.062
	No	58.81	-	-		No	48.22	-	-

Model 1 is unadjusted
Model 2 is adjusted for baseline PROMIS anxiety score and intervention
Model 3 is adjusted for baseline PROMIS anxiety score, intervention, and socio-demographics
Model 4 is adjusted for baseline PROMIS anxiety score, intervention, socio-demographics, and social environment
Model 5 is adjusted for baseline PROMIS anxiety score, intervention, socio-demographics, social environment, and smoking characteristics
*Least squares geometric mean

Discussion

The overall effect of quitting smoking on binge drinking was not significant in either the SMI or non-SMI group. However, a trend did exist such that those who quit had lower odds of binge drinking for 2-3 days or more than 3 days compared to those who did not quit. This trend remained consistent in analyses of the combined SMI and non-SMI sample. Regardless of SMI status, smokers who quit reported lower levels of depression and anxiety at 12-month follow-up than those who did not quit. The direction of these effects remained consistent across all levels of adjustment, although there was some attenuation in the SMI group. When examined in parallel, the association between smoking cessation and reductions in MH symptoms was slightly stronger among those with SMI compared to those without SMI.

The finding that smoking cessation did not appear to exacerbate binge drinking, and may be associated with reductions in this behavior, has important implications for our low-income sample. Foremost, it contradicts a long-held assumption that the challenges inherent in quitting smoking, particularly coping with withdrawal symptoms, may be compensated for by increasing other substance use behaviors.[55,104] Given the reductions in binge drinking noted among those who quit smoking, it appears that any uptick in problematic alcohol use following cessation, if present at all, does not persist once an individual has been quit for a prolonged period of time. This result can also be viewed as promising given evidence showing that smoking can be used as a means of coping with the urge to drink among those with alcohol use disorders.[54] These beliefs and coping strategies can have the effect of reducing the motivation and perceived ability to quit

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among those with co-morbid alcohol dependence.[104] Despite these negative expectations about quitting smoking, there was a relatively high rate of cessation in our sample (14.1% overall) and on the whole those who quit did not experience an increase in binge drinking.

These results have particular relevance for smokers with SMI. First, while only a subset of the smokers in the SMI group had a diagnosis of alcohol dependence disorder (34%), this rate was far higher than that seen in the non-SMI group (8%) and in the general US population (3.5%).[105] As such, the perception that attempting cessation will exacerbate alcohol abuse behaviors likely plays a more significant role in discouraging cessation among this group of smokers. Despite the high rate of alcohol dependence, cessation was not associated with heightened rates of binge drinking. These results suggest that cessation should be encouraged among smokers with SMI, and that the benefits of providing a counter-narrative to the "quitting smoking is dangerous" argument may carry greater weight within this population. In addition, it should be noted that the SMI smokers in our sample tended to have lower self-efficacy for quitting than the non-SMI smokers, a finding which is consistent with past research.[35,51,52] Providing these smokers with accurate information regarding the consequences of smoking cessation may help to boost self-efficacy for quitting by providing them with a more complete picture of how cessation could affect their propensity to drink.

In assessing our secondary aim, we were able to replicate the finding that cessation is associated with improvements in MH for those without SMI, providing further evidence for more wide-ranging beneficial effects of cessation aside from the obvious

cardiovascular benefits. Our study was also one of the first to demonstrate the beneficial

effects of cessation on MH symptoms among those with SMI; a finding that runs counter

to the prevailing narrative that quitting smoking can be detrimental to the MH of this

group. This information may be useful in helping to dispel the notion that quitting

smoking is not a treatment priority for smokers with SMI. By demonstrating that the act

of quitting smoking may in itself provide modest relief of MH symptoms, it is easier to

prioritize offering these smokers advice to quit and access to cessation resources.

Although baseline analyses indicate that smokers with SMI were provided with relatively

high rates of cessation and treatment utilization advice from their healthcare providers,

the use of individualized feedback to address cessation barriers may help to maximize the

effectiveness of this advice. The recently validated Barriers to Quitting Smoking in

Substance Abuse Treatment (BQS-SAT) scale can be used to assess perceived barriers to

quitting,[106] including concerns regarding the potential effects of cessation on MH.

Physicians can assess these concerns and then provide smokers with more accurate

information on the quitting process, thereby increasing motivation and self-efficacy for

quitting.

Quitting smoking is a daunting prospect for any smoker, but it can be particularly

challenging for those with a history of alcoholism who are attempting to remain sober.

The high prevalence of smoking among those involved in alcohol recovery organizations

like Alcoholics Anonymous (AA) may actually have a detrimental impact on these

individuals' motivation to quit. While AA no doubt provides an important support

network for those living with alcoholism, smoking remains highly prevalent among those

attending AA meetings[107] and may be used as a means of coping with the urge to drink. By providing organizations such as AA with data showing that quitting smoking is not associated with higher rates of alcohol use relapse and that continued smoking actually reduces the likelihood of achieving long-term sobriety,[108] we can perhaps help to lessen its role as a perceived "crutch" for those with alcohol dependence.

Limitations

Because we are analyzing these data as observational, there is the potential for unmeasured confounding to bias our effect estimates. It is possible that those who were able to quit smoking may differ from non-quitters in ways that are difficult to control for using standard covariate adjustment. In addition, we merged the "Hispanic" and "Asian/Pacific Islander" categories into a single category to account for the small sizes of these groups. This may have hampered our ability to adequately control for the confounding influence of race/ethnicity for these analyses. It is important that future work examining the influence of smoking cessation on MH symptoms and binge drinking incorporates larger numbers of racial and ethnic minorities. It is also challenging to establish the direction of effects between smoking cessation and MH symptoms and binge drinking behavior. We attempted to address this issue by controlling for baseline levels of the outcome variables. Another limitation is that the OPTIN trial was not sufficiently powered to examine whether the proactive outreach intervention itself had an effect on binge drinking, depression, or anxiety. This is an important area of research to pursue if we are to demonstrate that efforts to promote smoking cessation, including population-level interventions like OPTIN, are effective for improving the MH of

smokers with SMI. In addition, while rates of smoking cessation were comparatively high in our study relative to similar trials, only 14.1% (n=248) of the sample achieved cessation. The small size of the smoking quitter group limited the power of our analyses and increased the likelihood of Type 2 errors. This was particularly problematic in our analysis of the binge drinking outcome, which had small numbers of participants in the "1 day", 2-3 days", and the "more than 3 days" categories. To address this limitation, post-hoc analyses were performed on the combined SMI and non-SMI sample in order to examine the main effect of prolonged smoking cessation on binge drinking. The timeline of our measures also precluded us from assessing any effects that smoking cessation may have on MH symptoms and alcohol use immediately following a quit attempt. This is valuable information to have in order to build a more complete picture of how cessation impacts these outcomes in both the short term and the long term. In addition, we do not have measures of functional impairment to help validate the SMI categorizations which would help ensure that the smokers in the SMI category were experiencing a high degree of life impairment. There is also a potential for selection bias as it is plausible that losses to follow-up were associated with the exposure (smoking cessation) and the outcomes (MH symptoms, binge drinking).

Conclusion

It is important that we actively work to counter the narrative that smoking cessation is not a treatment priority for smokers with SMI. Given the reductions in problematic MH symptoms and binge drinking experienced by smokers who quit, our findings bolster the case for providing all smokers with advice to quit and access to cessation resources,

particularly those with co-morbid MH and alcohol use disorders. As smoking is

responsible for much of the excess mortality experienced by those with SMI,[13] it is vital

to shape an alternative narrative which stresses that smoking cessation is in fact one of

the most pressing treatment priorities for this population. Going forward we must work to

disseminate this information to healthcare providers, organizations like AA, and to

smokers themselves in order to eliminate this health disparity.

Overview

It is clear that socioeconomically disadvantaged smokers with SMI are a uniquely

vulnerable population with respect to smoking-related morbidity and mortality. As such,

it is imperative that we work to better understand the barriers and facilitators to treatment

utilization and cessation among these smokers. This dissertation involves secondary data

analyses of OPTIN trial data. OPTIN trial participants were a sample of

socioeconomically disadvantaged smokers enrolled in Minnesota Health Care Programs;

a publicly-subsidized state health insurance program comprised of Medicaid and

MinnesotaCare. Using DHS data drawn from a 2-year period prior to study initiation,

ICD-9 codes indicating diagnoses of schizophrenic disorders, psychotic disorder, bipolar

disorders, and major depressive disorder were used to categorize participants in SMI

(n=1044) or non-SMI (n=1277) groups.

Summary of Research

The three research studies that comprise this dissertation sought to elucidate the factors

that influence the cessation process among socioeconomically disadvantaged smokers

with SMI.

Research Study 1

As it is increasingly acknowledged that healthcare providers play a key role in the

cessation process, the first study explored whether SMI affects the nature of smokers'

interactions with their healthcare providers, and whether these interactions affect the

propensity with which they utilize cessation treatments. The bulk of the existing literature suggested that patients with SMI were likely to experience heightened levels of physician bias and lower rates of care for co-morbid conditions like tobacco use. As such, it was hypothesized that there would be a strong negative association between SMI and cessation treatment utilization at 12-month follow-up.

Contrary to expectations, smokers with SMI actually had significantly higher rates of cessation treatment utilization at follow-up including medication use (41.9% vs. 29.8%, p<0.001), counseling use (14.3% vs. 11.1%, p=0.045), and use of any form of cessation treatment (44.7% vs. 31.6%, p<0.001). It was further noted that smokers with SMI reported higher baseline rates of physician-delivered advice to use medications and advice to use treatments other than medications than smokers without SMI. These physician advice variables were in turn associated with higher rates of cessation treatment utilization at follow-up. Analyses of the indirect effects of SMI on cessation treatment utilization through physician-delivered cessation advice indicated partial mediation by these variables. The proportion of the total effect of SMI on treatment utilization that was mediated by these physician advice variables ranged from 4.1% to 13.4%, depending on the mediator and outcome in question. With respect to the third proposed mediator, analyses revealed no evidence of associations between SMI and levels of perceived physician bias, or between perceived physician bias and cessation treatment utilization.

Given the well-documented associations between SMI and lower rates of cessation-related care and heightened levels of physician bias noted in previous studies, we conducted post-hoc sensitivity analyses to help elucidate these seemingly counterintuitive

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findings. Using a measure of clinical encounter frequency derived from DHS data, analyses revealed comparatively high rates of physician contact in the SMI group relative to the non-SMI group. It was also found that adding clinical encounter frequency as a covariate to our regression models resulted in a large attenuation of the effect of SMI on treatment utilization.

These findings suggest that SMI smokers' comparatively high rates of cessation treatment utilization are at least partially explained by the heightened frequency with which they interact with their healthcare providers, likely due to the fact that these smokers were enrolled in MHCP and had access to free or reduced cost healthcare. The heightened rate of physician contact may help to explain the disparity in cessation care observed between the SMI participants in the present study and those in past studies, where these individuals may have had more variable access to healthcare. Furthermore, the finding that smokers in the SMI group had higher rates of clinical encounters and were more likely to report having a "regular" doctor may have resulted in these patients feeling more comfortable with their healthcare providers and being less likely to perceive bias.

It is difficult to generalize these findings to the broader population of low-income smokers due to variations in access to healthcare. However, the relatively high rates of physician-delivered cessation advice reported by smokers with and without SMI seem to suggest that expanding publicly-subsidized insurance programs like Medicaid may bolster rates of treatment utilization among low-income smokers. This may be particularly important for smokers with SMI as they often require a greater number of

quit attempts and need to utilize more treatment strategies before achieving cessation. This suggests that finding ways to maximize contact with their healthcare providers is a crucial step toward reducing smoking rates in this population.

Research Study 2

The second study examined whether proactive outreach strategies are an effective approach for minimizing healthcare provider and psychosocial barriers to treatment utilization and prolonged smoking abstinence among smokers with and without SMI. The proactive outreach intervention was meant to minimize individual-level barriers to cessation like low self-efficacy for quitting, address social environmental barriers including permissive social norms and low social support for quitting, and circumvent healthcare provider barriers by facilitating direct access to evidence-based cessation resources. Subsequent exploratory analyses investigated whether the intervention was significantly more effective for smokers with SMI compared to those without SMI for both the treatment utilization and the prolonged abstinence outcomes.

As hypothesized, it was found that the intervention significantly increased rates of any form of treatment utilization in both the SMI group (51.6% vs 38.1%, p<0.001) and the non-SMI group (38.6% vs 25.8%, p<0.001). The intervention also increased rates of prolonged abstinence in the SMI group (14.7% vs 10.8%, p=0.070) and the non-SMI group (18.1% vs 12.8%, p=0.019).

With respect to the exploratory aim, it was hypothesized that the intervention would be significantly more effective for smokers with SMI compared to those without SMI. Baseline analyses demonstrated that smokers with SMI in our sample lived in social

environments that were more conducive to smoking and had lower self-efficacy for quitting than those without SMI; barriers that the OPTIN intervention was designed to minimize through proactive outreach and motivational interviewing. However, there were no interactions between the intervention and SMI status on any of the outcomes tested. When examined in parallel, the effects observed in the SMI and non-SMI groups were similar in magnitude for the both the cessation treatment utilization and the prolonged abstinence outcomes.

The similarity of effects for the treatment utilization outcomes observed in the SMI and non-SMI groups can be put in context by more thoroughly examining the healthcare characteristics of our sample. Through their enrollment in MHCP, all participants in the OPTIN study had access to free or reduced cost healthcare. This facilitated access to care seems to have been of particular benefit for the SMI smokers in our sample, as baseline analyses indicated that these smokers were more likely to report having a regular physician, had much more frequent interactions with their healthcare providers, were more likely to receive physician-delivered cessation advice, and had much higher rates of cessation treatment utilization than non-SMI smokers. The increased access to healthcare experienced by SMI smokers in our sample compared to those in the general population may have dampened the effectiveness of the intervention relative to that which was initially hypothesized.

Despite the relatively supportive cessation environment that MHCP seems to be providing for smokers with SMI, our study suggests that proactive outreach is still effective for boosting rates of treatment utilization and provides preliminary evidence for

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its effectiveness in boosting prolonged abstinence rates as well. These interventions may be especially useful for bolstering rates of counseling use among these smokers, which were lower than 5% at baseline among the smokers in our sample. When used in conjunction with cessation care provided through healthcare programs like MHCP, proactive outreach strategies may play an important role in reducing smoking rates among socioeconomically disadvantaged smokers with SMI.

Research Study 3

The third study examined the enduring conception that smoking cessation is deleterious for smokers with SMI, specifically with respect to MH symptom exacerbation and problematic alcohol use behaviors. Evidence suggests that these perceptions exist at both the individual level and at the level of the healthcare provider, and may contribute to a reluctance to recommend and/or engage in smoking cessation. Regressions modeled the effect of prolonged cessation on PHQ-9 depression scores, PROMIS anxiety scores, and past month binge drinking behaviors at 12-month follow-up among smokers with and without SMI while controlling for baseline levels of these variables. Given the lack of past research in these areas conducted among samples of smokers with SMI, these analyses were largely exploratory.

Analyses revealed that smokers who achieved prolonged smoking cessation had far lower odds of binge drinking for 3 days per month than those who did not achieve cessation in both the SMI (OR=0.26, 95% CI: 0.09-0.76) and the non-SMI groups (OR=0.42, 95% CI: 0.21-0.87). With respect to the MH outcomes, smokers who achieved cessation had lower PHQ-2 scores in both the SMI (2.37 vs 2.71, p = 0.042) and the non-SMI group (1.59 vs

1.75, p = 0.065). Smokers who achieved cessation also reported lower PROMIS anxiety scores in the SMI group (55.61 vs. 59.03, p <0.001), but this effect was not significant in the non-SMI group.

Given the high rates of alcohol dependence disorder observed among smokers with SMI (34% in our sample), it is critically important to examine how problematic drinking behaviors are affected in the wake of smoking cessation. Despite this high rate of alcohol dependence, prolonged smoking abstinence was not associated with heightened rates of binge drinking. Indeed, a trend appeared such that smokers who quit had lower odds of past month binge drinking than those who remained smokers, although further research is needed to replicate this association. Our study also demonstrated that prolonged cessation was associated with lower levels of depression and anxiety among those with SMI. Taken together, these results counter the narrative that smoking cessation is not a treatment priority for smokers with SMI. Providing these smokers with more accurate information about the long-term effects of smoking cessation on MH symptoms and problematic substance use behaviors may help boost motivation to quit, and heighten these smoker's perceiving ability to engage in quit attempts and successfully achieve cessation.

Final Thoughts

The aim of this dissertation was to identify how our healthcare apparatus can better serve socioeconomically disadvantaged smokers with SMI. The results of these studies suggest that, in general, the SMI smokers enrolled in MHCP are being provided with a comparatively supportive healthcare environment relative to what has been observed in past studies of smokers with mental illness. This resulted in unexpectedly high rates of

physician interaction, higher rates of cessation-related care, and ultimately higher rates of

cessation treatment utilization. However, there is room for improvement. The promising

results of the proactive outreach intervention with respect rates of cessation treatment

utilization and prolonged abstinence suggest that these smokers still face barriers to

cessation care. Given the time limitations imposed on many physicians, it may be useful

to more widely implement systems that provide these smokers with referrals for external

cessation resources and to increase coordination across healthcare providers. It is also

plausible that more widespread implementation of proactive outreach strategies can help

to supplement the care environment provided by MHCP. Our results helped counter the

notion that smoking cessation is problematic for those with SMI by establishing that

quitting is not associated with increases in deleterious MH symptoms or harmful drinking

behaviors. It is vital that we actively distribute this information to healthcare providers

and to smokers themselves to provide a more accurate depiction of how smoking

cessation affects well-being. Given the centrality of social support organizations like AA

in the lives of many smokers coping with alcoholism, it is also important to disseminate

this information to resources that fall outside the scope of the traditional healthcare

environment. We must treat the persistent high rates of smoking among

socioeconomically disadvantaged smokers with mental illness as a public health priority,

and continue working to reduce the smoking-related health and economic burdens borne

by this population.

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Appendix: Scale Measures

Perceptions of Healthcare Provider Bias

When considering your overall experience with your doctor or primary healthcare provider(s), whether or not they spoke to you about quitting smoking…

Strongly Agree	Somewhat Agree	Neither Agree/ Diasgree	Somewhat Disagree	Strongly Disagree

a) I felt I was treated with respect and dignity.
b) I felt my background and values were understood.
c) I felt I was looked down on for the way I live my life.

Binge Drinking Behavior

During the past 30 days, on how many days did you have 5 or more drinks of alcohol (4 or more drinks if you are a woman)?

   1) 28 – 30 days (about every day)*
   2) 20 – 27 days (5 – 6 days a week, average)*
   3) 11 – 19 days (3 – 4 days a week, average)*
   4) 4 – 10 days (1 – 2 days a week, average)*
   5) 2 – 3 days in the past 30 days
   6) Once in the past 30 days
   7) I drank during the past 30 days, but I never drank 5 or more drinks on the same occasion†
   8) Didn't drink any alcohol in the past 30 days†

   * Items merged into single category
   † Items merged into single category

Patient Health Questionnaire (PHQ-2)

1) During the past 2 weeks, how often have you been bothered by having little interest or little pleasure in doing things? Would you say…

     1) Not at all
     2) Several days
     3) More than half the days
     4) Nearly every day

2) During the past 2 weeks, how often have you been bothered by feeling down, depressed, or hopeless? Would you say…

     1) Not at all
     2) Several days
     3) More than half the days
     4) Nearly every day

PROMIS Anxiety

In the past 7 days…

Never   Rarely   Sometimes   Usually   Almost   Always

a) I felt fearful.
b) I felt anxious.
c) I felt worried.
d) I found it hard to focus on anything other than my anxiety.
e) I felt nervous.
f) I felt uneasy.
g) I felt tense.