

Cancer Prevention Among Homeless Smokers

A Dissertation  
SUBMITTED TO THE FACULTY OF THE  
UNIVERSITY OF MINNESOTA  
BY

Erika Ashley Pinsker

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY

Deborah Hennrikus and Jean Forster, Advisors

July 2016

© Copyright by Erika Ashley Pinsker

July 2016

## **Acknowledgements**

I would like to express my sincere gratitude to my advisor Dr. Deb Hennrikus for her support throughout my doctoral studies. Her guidance on my coursework, comprehensive exams, and dissertation has been invaluable. I would like to thank the rest of my dissertation committee Drs. Jean Forster, Darin Erickson, Kathleen Call, and Kolawole Okuyemi for their guidance and feedback on this dissertation. I would also like to give special thanks to Dr. Darin Erickson for all of his advice on my dissertation analyses and Dr. Kolawole Okuyemi for providing me with the data from the Power to Quit Study.

## **Abstract**

There are approximately three million people who experience homelessness in the U.S. each year. Cancer is one of the leading causes of death among the homeless. Many of these cancer deaths could be prevented through promoting age-appropriate cancer screening and smoking cessation.

This dissertation includes three studies focused on breast and cervical cancer screening and smoking cessation among homeless smokers in the Twin Cities, MN. All of the studies were informed by the Behavioral Model for Vulnerable Populations. The three studies were secondary data analyses of the Power to Quit Study, a smoking cessation randomized controlled trial among 430 homeless adults in the Twin Cities, MN. The first study explores breast and cervical cancer screening among homeless female smokers. The second study examines smoking cessation-related weight concern (i.e., concerns about gaining weight after quitting smoking) and the third study explores trends in smoking characteristics over the course of the trial among homeless smokers.

In the first study we found that among homeless female smokers, 56% received a mammogram and 68% received a Pap test in the past year. Females who received a mammogram in the past year had over 9 times greater odds of receiving a Pap test in the past year compared to females who did not. Black race, smoking reduction, greater motivation to quit, and having a case manager to help get and coordinate care were associated with a higher probability of mammography screening, whereas addiction to smoking, overweight/obesity, anxiety, and having more competing needs were associated with a lower probability. Black race was associated with a higher probability of Pap test

screening, whereas addiction to smoking and additional days of cigarette consumption were associated with a lower probability.

In the second study we found that homeless females had higher cessation-related weight concern than homeless males. At follow-up, 8% of males and 5% of females quit smoking. Among males, older age, Black race, higher BMI, depression, and having health insurance were associated with higher cessation-related weight concern. Among females, addiction to smoking, greater cigarette consumption, indicating that quitting is more important, older age of smoking initiation, and less support to quit from family were associated with higher cessation-related weight concern. Cessation-related weight concern was not associated with smoking cessation.

In the third study we found that self-efficacy to refrain from smoking increased linearly over the course of the trial with racial minorities experiencing greater increases. Confidence to quit increased until the midpoint of treatment (week 4) but subsequently decreased. Blacks had higher confidence to quit than Whites. Smoking urges decreased until the midpoint of treatment but subsequently increased. Change in self-efficacy to refrain from smoking, confidence to quit, and smoking urges over time did not predict smoking status at 26-weeks. Individuals with higher self-efficacy to refrain from smoking at baseline were more likely to quit at 26-weeks. Higher levels of self-efficacy to refrain from smoking across all time points was observed among quitters at 26-weeks compared to smokers.

The findings from this dissertation have implications for future cancer prevention programs targeting homeless smokers. Based on the findings from the first study, homeless female-targeted cancer prevention programs could aim to increase both breast

and cervical cancer screening and simultaneously promote age-appropriate cancer screening and smoking cessation. Based on the findings from the second study, it may be beneficial to address cessation-related weight concerns among homeless individuals participating in smoking cessation counseling. Cessation-related weight concern is prevalent among the homeless and may act as a deterrent to making a quit attempt and reason for relapse. Based on the findings from the third study, homeless-targeted tobacco cessation programs could aim to increase self-efficacy to refrain from smoking among participants with lower self-efficacy, particularly White participants. Tobacco cessation programs might also be more effective for this population if they aim to help participants sustain high levels of confidence to quit and low levels of smoking urges throughout the program.

## **Table of Contents**

List of Tables	Page vi
List of Figures	Page viii
Background	Page 1
Research Study 1	Page 14
Research Study 2	Page 44
Research Study 3	Page 74
Conclusion	Page 102
Bibliography	Page 114
Appendix	Page 128

## **List of Tables**

Table 1. Baseline Characteristics of Dropouts Compared to Individuals who Remained in the Study at Week 26 of the Power to Quit Study

Page 12

Table 2. Descriptive Statistics of Homeless Female Smokers in the Power to Quit Study

Page 38

Table 3. Relationship between Breast and Cervical Cancer Screening Among Homeless Female Smokers Aged 40 and Older in the Power to Quit Study

Page 39

Table 4. Predictors of Breast Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 40 and Older

Page 40

Table 5. Predictors of Cervical Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 18 and Older

Page 42

Table 6. Baseline Descriptive Statistics of Homeless Males and Females in the Power to Quit Study

Page 67

Table 7. Cessation-related Weight Concern and Cessation among Homeless Males and Females in the Power to Quit Study

Page 70

Table 8. Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Males in the Power to Quit Study

Page 70

Table 9. Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Females in the Power to Quit Study

Page 72

Table 10. Relationship between Cessation-related Weight Concern and Cessation Controlling for Treatment Group among Participants in the Power to Quit Study

Page 73

Table 11. Smoking Characteristics of Homeless Smokers Over the Course of the Power to Quit Study

Page 96



Table 12. Predictors of Change in Intrinsic Self-efficacy to Refrain from Smoking Over Time among Homeless Smokers in the Power to Quit Study  
Page 97

Table 13. Predictors of Change in Extrinsic Self-efficacy to Refrain from Smoking Over Time among Homeless Smokers in the Power to Quit Study  
Page 98

Table 14. Predictors of Change in Confidence to Quit from Baseline to Week 6 among Homeless Smokers in the Power to Quit Study  
Page 99

Table 15. Predictors of Change in Smoking Urges from Baseline to Week 6 among Homeless Smokers in the Power to Quit Study  
Page 100

Table 16. Relationship Between Change in Smoking Characteristics and Cessation at 26-Weeks Follow-up Controlling for Treatment Group among Participants in the Power to Quit Study  
Page 101

## **List of Figures**

Figure 1. The Behavioral Model for Vulnerable Populations Applied to this Dissertation  
Page 8

Figure 2. Potential Predictors of Breast and Cervical Cancer Screening: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study  
Page 19

Figure 3. Potential Predictors of Cessation-related Weight Concern: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study  
Page 48

Figure 4. Potential Predictors of Change in Smoking Characteristics: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study  
Page 78

Figure 5. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking among Homeless Smokers Over the Course of the Power to Quit Study  
Page 84

Figure 6. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking by Race among Homeless Smokers Over the Course of the Power to Quit Study  
Page 85

Figure 7a. Confidence to Quit among Homeless Smokers from Baseline to Week 26 of the Power to Quit Study  
Page 86

Figure 7b. Confidence to Quit among Homeless Smokers from Baseline to Week 6 of the Power to Quit Study  
Page 86

Figure 8. Confidence to Quit by Race among Homeless Smokers from Baseline to Week 6 of the Power to Quit Study  
Page 87

Figure 9a. Smoking Urges among Homeless Smokers from Baseline to Week 26 of the Power to Quit Study  
Page 88

Figure 9b. Smoking Urges among Homeless Smokers from Baseline to Week 6 of the Power to Quit Study  
Page 88

Figure 10. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking Over the Course of the Power to Quit Study by Smoking Status at 26-weeks Follow-up

Page 89

Figure 11. Confidence to Quit and Smoking Urges from Baseline to Week 6 of the Power to Quit Study by Smoking Status at 26-weeks Follow-up

Page 90

## **Background**

Three million people experience homelessness in the United States each year and over 578,400 are homeless each night.<sup>1,2</sup> In Minnesota, there are an estimated 40,000 individuals who experience homelessness at least once over the course of the year and 14,000 individuals who experience homelessness each night, with the majority of these individuals being in the Twin Cities.<sup>3</sup> Among individuals who experience homelessness in Minnesota, 64% are over 18 years of age. Among adults, 53% are males, 38% are Black, 42% are White, and 50% have been homeless for over one year.<sup>3</sup>

The homeless experience high rates of physical and mental illness, and are at increased risk for premature death.<sup>4,5</sup> In Minnesota, 51% of homeless adults report a chronic health condition and 55% of homeless adults report having a mental illness.<sup>3</sup> Homeless individuals have significantly higher rates of unmet need for care, which further exacerbate their health problems.<sup>6,7</sup> They have difficulty in getting treatment for their health problems due to several reasons, including affordability, lack of health insurance, not knowing where to obtain care, lack of transportation, and competing needs (e.g., obtaining food and shelter).<sup>8,9,10</sup>

Homeless individuals that seek care often do so at emergency departments and federally qualified health centers, clinics that target underserved populations.<sup>11,12</sup> Approximately one third of homeless individuals seek help for primary medical care and psychiatric problems at emergency departments as opposed to outpatient clinics or private offices.<sup>4,11</sup> It is also estimated that approximately 1.1 million homeless individuals visit federally qualified health centers each year.<sup>7,12</sup> Many of these centers are Health Care for the Homeless clinics that receive additional funding that enable them

to meet the needs of homeless patients, including employing on-site case managers, outreach workers, mental health treatment providers, and substance abuse treatment providers.<sup>12</sup> Many of these clinics also offer transportation services and eligibility assistance.<sup>12</sup>

In Minnesota, primary and preventative care is available to homeless individuals. Health Care for the Homeless operates medical clinics at homeless shelters and drop-in centers in Minneapolis (n=11) and St. Paul (n=8) that provide acute and preventative healthcare, and coordinate healthcare services.<sup>13, 14</sup> The most common visit types include wellness check-ups, hypertension, diabetes, upper respiratory infections, and skin and foot problems.<sup>13</sup> Although not specifically targeted to homeless individuals, the Minnesota Department of Health offers the Sage Screening Program, which offers no-cost age-appropriate breast and cervical cancer screening for low-income females in Minnesota who are uninsured or underinsured,<sup>15</sup> and the Sage Scopes Screening Program, which offers no-cost age-appropriate colorectal cancer screening for low-income males and females in Minnesota who are uninsured.<sup>16</sup>

Despite efforts to provide care to homeless individuals, the mortality rate among the homeless is higher than among the general population, with cancer being one of the leading causes of death.<sup>17, 18, 19</sup> Many of these cancer-related deaths could be prevented through early detection by engaging in age-appropriate cancer screening and lifestyle changes, such as smoking cessation.<sup>20</sup> Promotion of smoking cessation is especially important among the homeless since lung cancer is the leading cause of cancer-related deaths among this population,<sup>19</sup> and 73% of homeless adults smoke cigarettes, a rate that is over three times the national rate.<sup>21</sup> The health consequences of smoking may be

especially high among the homeless due to higher incidence of chronic disease and prevalence of substance abuse, which can synergistically increase the risk of cancer.<sup>22, 23,</sup>

<sup>24</sup> However, little information exists about cancer screening and smoking cessation among the homeless and there have been very few interventions targeting cancer screening and smoking cessation among this population.

Only two cancer screening interventions have been conducted among the homeless, with one intervention on breast cancer screening and the other intervention on cervical cancer screening.<sup>25, 26</sup> The intervention targeting breast cancer screening was conducted at a drop-in center in Toronto, Canada in 2002 (n=247). As part of the intervention, a staff member of the center accompanied small groups of homeless and marginally housed women for a luncheon followed by a mammography visit at a weekly pre-arranged time. Prior to the intervention the screening rate among women at the drop-in center was 4.7% and in the year of the intervention, the screening rate was 29%.<sup>25</sup> A 6-part cervical cancer screening intervention targeting homeless females was conducted at Healthcare for the Homeless clinics in Boston that included point-of-care service, multidisciplinary screening, improved health maintenance forms, population management, process improvement, and increased provider and patient education (n=5,434).<sup>26</sup> The clinics observed an increase in the up-to-date cervical cancer screening rate among patients from 19% in 2008 to 50% in 2013. Since these interventions were tested using observational designs rather than randomized controlled trial designs, it is unclear whether the increases in the screening rates are attributable to the interventions; therefore, further research on developing and testing cancer screening interventions targeting the homeless is needed.

There have been several pilot interventions targeting smoking cessation among the homeless. One intervention provided individual motivational interviewing (MI), psychoeducation on psychosocial factors related to smoking, and nicotine replacement therapy (NRT) (i.e., patch or lozenge) or cessation medication to homeless smokers (n=14), and saw a decrease in the number of cigarettes smoked per day (-6) from intake to the final visit and a decrease in breath carbon monoxide (CO) (-5) among homeless participants.<sup>27</sup> An additional pilot study enrolled homeless smokers (n=58) into a program, which provided individual MI, cognitive behavioral therapy, and NRT (i.e., patch, gum, lozenge, or inhaler) or cessation medication and found a 15.5% CO-confirmed 7-day abstinence rate at the end of treatment (12 weeks) and a 13.6% CO-confirmed 7-day abstinence rate at 24-weeks follow-up among participants.<sup>28</sup> Another pilot study provided MI counseling over the phone for six weeks to homeless smokers (n=12), which focused on smoking cessation or reduction, and other healthy behaviors (e.g., fruit and vegetable consumption, alcohol use). Out of those who completed follow-up at week 6, half indicated that the intervention helped them to cut down on the amount of tobacco products that they smoke.<sup>29</sup> However, like the cancer screening studies, none of these studies were randomized or had comparison groups.

A pilot study that informed this current study (i.e., Power to Quit) was also conducted. The pilot study, which was a randomized controlled trial, tested the efficacy of MI individual and group counseling and NRT (i.e., patch or lozenge) for promoting tobacco cessation among homeless smokers (n=46).<sup>30</sup> As part of this study, intervention participants received NRT and MI individual and group counseling focusing on smoking and other addictions or life events that could affect ability to quit, while the control

participants received NRT and MI individual and group counseling focusing only on smoking. This study found a CO-verified abstinence rate of 17.4% among the intervention group versus 8.7% among the control group at 26-weeks follow-up, however these rates were not statistically significantly different ( $p > .05$ ).

Given the paucity of research on interventions targeting cancer screening and smoking cessation among the homeless, further research is needed. Additional research on cancer screening and smoking cessation among the homeless would be useful for developing new cancer screening and smoking cessation interventions that can be tested using randomized controlled trial designs in order to establish their effectiveness. Effective interventions could then be used to reduce cancer morbidity and mortality in the homeless population.

This dissertation features a series of three studies focused on cancer prevention among homeless smokers in the Twin Cities, Minnesota (MN). All three studies are informed by The Behavioral Model for Vulnerable Populations and feature secondary analyses of data from the Power to Quit study, a smoking cessation randomized controlled trial of 430 homeless adult smokers. The first study explores predictors of breast and cervical cancer screening among homeless females. The second study examines predictors of cessation-related weight concern (i.e., concerns about gaining weight after quitting) and the relationship between cessation-related weight concern and cessation among homeless males and females. The third study explores change in smoking characteristics over the course of the study, predictors of change in smoking characteristics, and the relationship between change in smoking characteristics and cessation among homeless males and females. The overall goal of these studies is to



present findings that will influence future cancer prevention interventions targeting breast and cervical cancer screening uptake among homeless females and smoking cessation among homeless males and females.

### Theoretical Framework

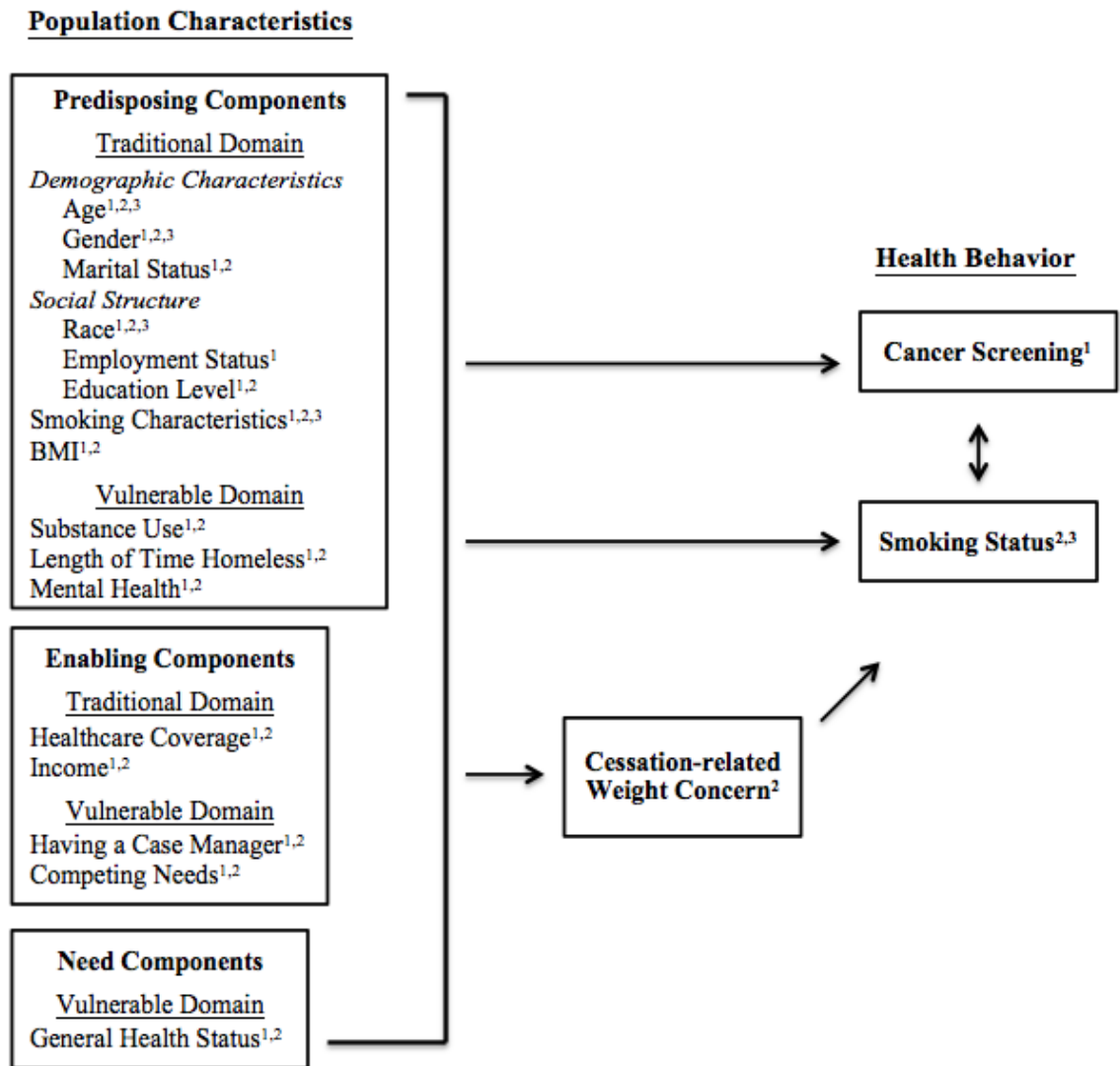
The Behavioral Model for Vulnerable Populations, developed by Gelberg and colleagues, is a revision of the Behavioral Model.<sup>31,32</sup> The Behavioral Model was developed in the late 1960s by Anderson and later updated three times between the 1960s and 1990s.<sup>32</sup> The model was developed in order to explain health behaviors, including the performance of personal health practices and the use of health services. The model suggests that the performance of health behaviors is a function of a predisposition by people to perform the behaviors, factors that enable or impede performance, and people's need for care.<sup>32</sup> In developing the Behavioral Model for Vulnerable Populations, Gelberg and colleagues added characteristics to the Behavioral Model that are important for understanding the health and health seeking behavior of vulnerable populations, including the homeless.<sup>31</sup> A model tailored specifically to vulnerable populations is needed since the factors that make homeless and other populations vulnerable may also affect their performance of health behaviors.<sup>31,33</sup> For instance, homeless individuals often face several problems including mental illness, substance abuse, inadequate housing, and competing needs, which exacerbate the healthcare needs of this population and limit their ability to perform health behaviors.<sup>31,33</sup>

The Behavioral Model for Vulnerable Populations posits that there are three main types of components that predict health behavior such as cancer screening and smoking: predisposing, enabling, and need.<sup>34</sup> Predisposing components are characteristics that

exist prior to the perception of illness, such as race, education, and age. Enabling components are characteristics that facilitate or impede the use of health services and performance of personal health practices, such as having health insurance and an income. Need components pertain to perceptions about health and physical illness, such as perceived health status. Within each component there are two domains, traditional and vulnerable. The traditional domain includes characteristics that are important for predicting health behavior among the general population whereas the vulnerable domain includes additional factors that are important for predicting health behavior among vulnerable populations, such as the homeless. The vulnerable domain was the key addition to the original Behavioral Model that enhanced the relevance of the model for studying homeless and other vulnerable populations.<sup>31</sup> Figure 1 includes the conceptual model guiding this dissertation, which is based on the Behavioral Model for Vulnerable Populations.

In line with the purpose for developing the Behavioral Model for Vulnerable Populations, previous studies that tested the model found that characteristics in the vulnerable domain were important predictors of health behaviors and health outcomes in homeless populations, indicating a strength of the model.<sup>31, 34, 35, 36</sup> Limitations of the model are that it has been predominately tested in non-representative samples of vulnerable populations,<sup>31, 34, 37</sup> and in small samples of vulnerable populations.<sup>31, 35, 36, 37</sup> Another limitation is that studies testing the model have used cross-sectional data and therefore causal relationships between the components and health behaviors cannot be inferred.<sup>34, 35, 36, 37</sup>

Figure 1. The Behavioral Model for Vulnerable Populations Applied to this Dissertation



Note: Variables included in each study are indicated using number superscripts (e.g., <sup>1</sup>= research study 1 on cancer screening). Later sections of this dissertation include the exact model tested in each study.

The version of the Behavioral Model for Vulnerable Populations that is guiding this dissertation includes some differences from the original model. There are several variables in the original model that were not included in this dissertation since they were

not measured in the surveys for the Power to Quit study. Some examples include health beliefs (traditional predisposing components), living conditions and mobility (vulnerable predisposing components), health services resources and barriers to care (traditional enabling components), transportation and social services resources (vulnerable enabling components), and general population health conditions (traditional need components).<sup>31</sup> Another difference is that the model for this dissertation focuses exclusively on the effect of predisposing, enabling, and need components on health behavior. However, the original model also depicts the direction of effect among the predisposing, enabling, and need components (i.e., predisposing → enabling → need), and indicates that health behavior leads to health outcomes (e.g., cancer status) and that health outcomes affect health behavior and predisposing, enabling, and need components. Since the studies in this dissertation focus on health behaviors as the outcomes, health outcomes were not included in the model guiding this dissertation. The model guiding this dissertation is consistent with how previous studies have tested the original Behavioral Model for Vulnerable Populations. Previous studies have focused on a subset of variables included in the original model that are relevant to their outcome and have focused on the relationship between predisposing, enabling, and needs components, and health behavior.<sup>31, 34, 37</sup>

### Power to Quit Study

The Power to Quit study was a randomized controlled trial of 430 homeless adult smokers that assessed the effectiveness of motivational interviewing (MI) for smoking cessation.<sup>38, 39</sup> Participants were randomized to an intervention arm, nicotine patch plus MI, or a control arm, nicotine patch plus standard care (SC), at baseline using pre-

assigned randomization numbers, which were prepared by the study statistician. Treatment assignment was not blinded to participants. Intervention participants received six individual MI counseling sessions each lasting 15-20 minutes, which focused on encouraging smoking cessation and nicotine replacement therapy adherence. Control participants received a one-time advice session on quitting smoking lasting 10-15 minutes. All sessions were delivered by trained counselors. Participants in both conditions received 21mg nicotine patches for eight weeks and a 23-page health educational resource called “The Power to Quit: A Quit Smoking Guide”, which included information on the health risks of smoking, common reasons for smoking, and cognitive exercises to improve self-directed quit attempts.

Participants were recruited from eight homeless shelters in the Twin Cities, MN, from May 2009 to August 2010. Recruitment was conducted at health fairs conducted at Minnesota Homeless Connect, a gathering for homeless individuals to find resources available in the Twin Cities, and via staff information sessions and posted flyers at study sites. Eligibility criteria included being currently homeless and having lived in the Twin Cities for at least six months, having smoked at least one cigarette per day in the past seven days and at least 100 cigarettes in their lifetime, aged 18 years or older, and willing to use nicotine patches for eight weeks and participate in counseling sessions. Exclusion criteria included pregnancy, use of another tobacco cessation aid in the previous 30 days, severe cognitive impairment, suicidal ideation in the last 14 days, a major medical condition within the prior month, or scoring greater than five on items assessing psychotic symptoms from the seven-item Mini International Neuropsychiatric Interview

(MINI), which is included in the appendix.<sup>40</sup> The study sample was found to be demographically representative of the larger homeless population in Minnesota.<sup>3, 38</sup>

Surveys were administered at baseline and weeks 1, 2, 4, 6, 8 (end of treatment), and 26 (follow-up). Measures were taken from surveys and instruments that were previously validated among other populations; however, the measures have not been validated among the homeless. Trained research assistants read all survey items either to or along with participants. The surveys varied in length from 58 to 187 questions. The baseline survey, which was the longest, took between 60 and 90 minutes to complete.

In order to minimize attrition, study staff made reminder calls to participants during the week prior to each appointment, both pending and missed, until the window for completing appointments closed. Calls were made either to each participant's cell phone or to the shelter identified as the most recent nighttime residence in the participant's file. Staff also gave participants appointment reminder slips at the time of setting the appointment. Participants were asked to complete a total of 15 individual visits and received incentives at each visit. Visits at baseline, during treatment (weeks 1, 2, 4, 6, 8), and at follow-up (week 26) were at study sites and included data collection, counseling, distribution of nicotine patches, and/or updates to participants' contact information. Retention visits (weeks 10, 12, 14, 16, 18, 20, 22 and 24) were at a participant's preferred location and included discussion of any difficulties participants had regarding study participation and updates to participants' contact information.

At longer visits that included surveys, participants received \$20 gift cards and two bus tokens (\$3 value). For shorter retention visits, participants received \$10 gift cards, two bus tokens, and a small item of appropriate utility for homeless individuals (e.g.,

playing cards, tote bags, movie passes, water bottles, T-shirts, and personal care items such as soap and a toothbrush). For attending the final visit at 26-weeks, participants received a \$40 gift card and a sweatshirt. For participants who attended all 15 sessions, the monetary incentives totaled \$275 over six months. Shelters were compensated \$25 for each two-hour time period used to conduct the study at their site. Amounts received by each shelter in a calendar year varied depending on the number of hours occupied for the study and ranged from \$3,500 to \$16,425.

At the end of treatment and at follow-up, there wasn't a statistically significant difference in cessation rates between the treatment groups (9.3% (MI) vs. 8.9% (SC),  $p=.89$ , 8 weeks; 9.3% (MI) vs. 5.6% (SC),  $p=.15$ , 26 weeks). There was 75% retention at 26-weeks follow-up. Dropouts and individuals who remained in the study were found to have similar characteristics (Table 1). The following sections of this dissertation include the series of three studies focused on cancer prevention among the homeless that are secondary data analyses of the Power to Quit study.

**Table 1: Baseline Characteristics of Dropouts Compared to Individuals who Remained in the Study at Week 26 of the Power to Quit Study**

Variable	Dropouts		Remained in the Study		P-value
	N	Mean (SD) or N (%)	N	Mean (SD) or N (%)	
Age	106	41.3 (10.5)	324	45.4 (9.5)	<.001
Male gender	106	77 (73%)	324	243 (75%)	.629
Married or living with others	106	5 (5%)	322	16 (5%)	.917
Race	106		324		.060
Black		50 (47%)		193 (59%)	
White		44 (42%)		109 (34%)	
Other		12 (11%)		22 (7%)	
Education $\geq$ high school	106	84 (79%)	324	246 (76%)	.483
Cessation-related weight concern, scale 0-60	106	24.5 (16.9)	324	28.0 (15.8)	.051

<b>Table 1: Baseline Characteristics of Dropouts Compared to Individuals who Remained in the Study at Week 26 of the Power to Quit Study Continued</b>					
	<b>Dropouts</b>		<b>Remained in the Study</b>		<b>P-value</b>
<b>Variable</b>	<b>N</b>	<b>Mean(SD) or N (%)</b>	<b>N</b>	<b>Mean(SD) or N (%)</b>	
Self-efficacy to refrain from smoking					
Intrinsic, scale 6-30	106	17.1 (7.0)	323	16.9 (6.7)	.712
Extrinsic, scale 6-30	105	17.4 (8.6)	321	16.6 (7.6)	.389
Confidence to quit, scale 0-10	106	7.2 (2.5)	324	7.3 (2.4)	.851
Smoking urges, scale 10-70	106	39.5 (18.6)	324	39.9 (17.4)	.843

Note: T-tests were conducted for continuous variables and chi-square tests were conducted for categorical variables



## **Research Study 1: Cancer screening among homeless female smokers**

### Abstract

Cancer is a leading cause of death among homeless females and undergoing regular cancer screening reduces cancer mortality. Breast and cervical cancer screening rates are lower than optimal among homeless females indicating the need to explore factors that impact screening. This study examines predictors of breast and cervical cancer screening among homeless female smokers.

Homeless female smokers (n=110) completed a survey on breast and cervical cancer screening and components from the Behavioral Model for Vulnerable Populations. The relationship between breast and cervical cancer screening was examined and logistic regression was used to identify predictors of up-to-date breast and cervical cancer screening.

Among homeless female smokers, 56% received a mammogram and 68% received a Pap test in the past year. Females who received a mammogram in the past year had over 9 times greater odds of receiving a Pap test in the past year compared to females who did not. Black race, smoking reduction, greater controlled motivation to quit, and having a case manager to help get and coordinate care were associated with a higher probability of mammography screening, whereas addiction to smoking, overweight/obesity, anxiety, and having more competing needs were associated with a lower probability. Black race was associated with a higher probability of Pap test screening, whereas addiction to smoking and additional days of cigarette consumption were associated with a lower probability.

Efforts to promote cancer prevention among homeless female smokers could target both breast and cervical cancer screening, and smoking characteristics given their association with breast and cervical cancer screening uptake among this population.

### Introduction

Approximately 213,500 females experience homelessness each night in the United States.<sup>2</sup> Cancer represents one of the leading causes of death among homeless females.<sup>19</sup> Cancer morbidity and mortality is high among this population due to a high prevalence of cancer risk factors. There are several known risk factors for breast cancer including alcohol consumption and being overweight and obese after menopause.<sup>41</sup> Homeless females have high rates of both alcohol use and overweight and obesity, which put them at high risk of breast cancer.<sup>7, 42, 43, 44, 45</sup> Homeless females have even been found to be at higher risk of breast cancer than low-income housed females.<sup>7, 44</sup> There are also several known risk factors for cervical cancer including smoking, being overweight, HIV infection, having a family history of cervical cancer, and HPV infection.<sup>46</sup> Homeless females have high rates of smoking, overweight and obesity, HIV infection, family history of cervical cancer, and risky sexual behaviors that can lead to HPV infection (e.g., multiple sexual partners and lack of condom use), which increases their risk of cervical cancer.<sup>7, 42, 43, 44, 45, 47</sup> Given the high prevalence of breast and cervical cancer risk factors among homeless females, undergoing regular breast and cervical cancer screening is important for this population. Breast and cervical cancer screening tests detect cancer at an early stage, before symptoms appear.<sup>48</sup> When breast and cervical cancer are detected at an earlier stage, they are easier to treat. Therefore, promoting

breast and cervical cancer screening among homeless females may reduce cancer morbidity and mortality among this population.

Based on statistics from the late 1990s and early 2000s, it is estimated that between 32 and 47% of homeless sheltered females aged 40 and older received yearly breast cancer screening,<sup>42, 43</sup> compared to 51-53% of the general population;<sup>49, 50</sup> and that between 46 and 76% of homeless sheltered females aged 18 and older received yearly cervical cancer screening,<sup>42, 47, 51, 52</sup> compared to 52% of the general population.<sup>50</sup> Although the breast and cervical cancer screening rates among homeless females are similar to the screening rates among the general population, these rates are still lower than optimal. Further, high prevalence of breast and cervical cancer risk factors place homeless females at high risk of breast and cervical cancer morbidity and mortality thus indicating the need to explore factors that influence cancer screening among this population.<sup>53</sup> Several components from the Behavioral Model for Vulnerable Populations, as described in the background section, are associated with breast and cervical cancer screening among homeless females and other disadvantaged females (Figure 2).

Previous research has found that among homeless females traditional predisposing components including older age,<sup>42</sup> twelve or more years of education,<sup>43</sup> employment,<sup>54</sup> and having up-to-date screening for cervical cancer are related to being up-to-date for breast cancer screening.<sup>43</sup> Previous research has also found that traditional enabling components including having health insurance,<sup>54</sup> and money are related to being up-to-date for breast cancer screening.<sup>42, 54</sup> Among disadvantaged females, predisposing components including being married,<sup>55</sup> normal weight,<sup>56</sup> and lack of mental health

problems,<sup>25, 31</sup> vulnerable enabling components including fewer competing needs,<sup>31</sup> and traditional need components including better perceived health status are related to receipt of breast cancer screening.<sup>57</sup>

Previous research has found that among homeless females traditional predisposing components including Black race, twelve or more years of education, and having up-to-date screening for breast cancer,<sup>43</sup> along with vulnerable predisposing components including lack of drug and alcohol use are related to being up-to-date for cervical cancer screening.<sup>53</sup> Previous research has also found that traditional enabling components including having health insurance,<sup>53</sup> and money,<sup>42</sup> and cost of the exam are related to being up-to-date for cervical cancer screening.<sup>53</sup> Among disadvantaged females, traditional need components including better general health status,<sup>57</sup> and vulnerable enabling components including fewer competing needs (e.g., finding food and shelter) are related to receipt of cervical cancer screening.<sup>31</sup>

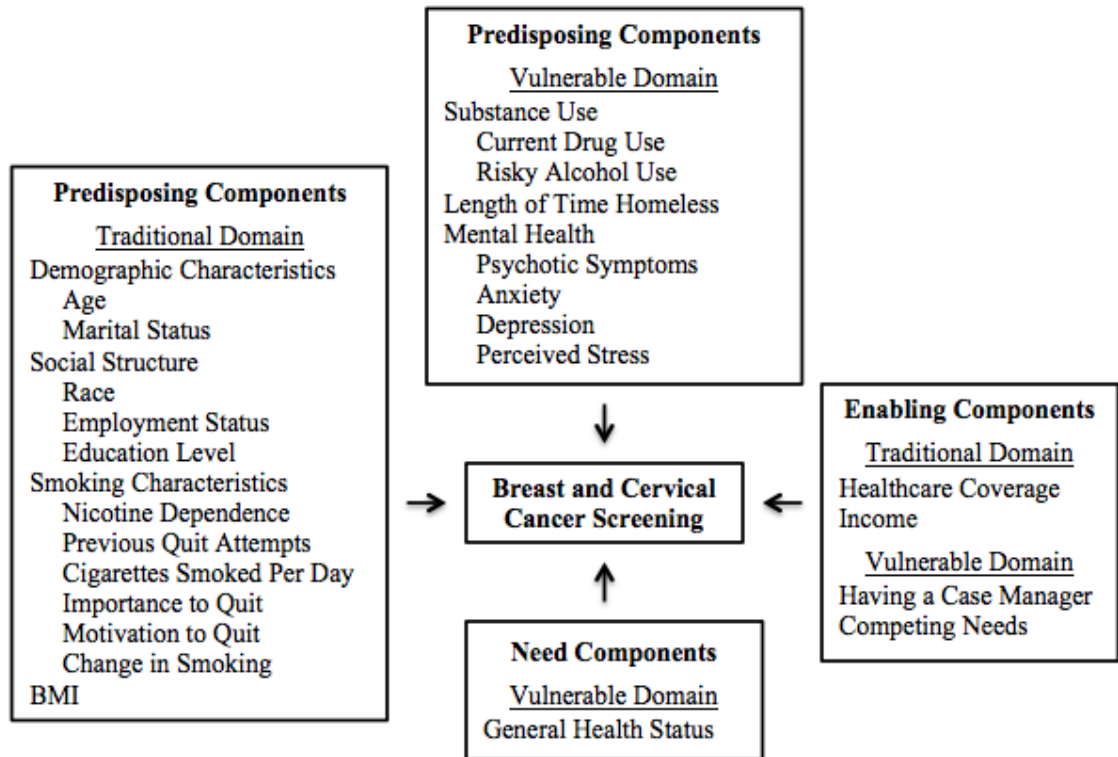
This study explores the relationship between breast and cervical cancer screening and predisposing, enabling, and need components among homeless females who are smokers. This study targets a population of homeless females who are at high risk of cancer due to their smoking status. Smokers are at a higher risk of death from numerous cancers compared to non-smokers.<sup>58</sup> Aside from their smoking status, smokers have less health-promoting lifestyles compared to individuals who have never smoked;<sup>59</sup> and are less likely to comply with breast and cervical cancer screening guidelines.<sup>60, 61, 62, 63, 64</sup> Although several studies have examined the association between smoking status and cancer screening, few studies have examined the association between smoking characteristics (e.g., nicotine dependence, cigarette consumption, and motivation to quit)

and cancer screening behavior, and these associations have not been examined among the homeless.

For instance, one study found that moderately and heavily nicotine-dependent females are less likely to comply with cervical cancer screening recommendations compared with less nicotine-dependent females.<sup>65</sup> The same relationship was found for breast cancer screening; however, the results were not statistically significant. Another study among males found that smokers who are not considering quitting in the next six months have lower adherence to colorectal cancer screening compared to non-smokers and smokers who are considering quitting in one month or 6 months.<sup>66</sup> However, further research is needed to determine whether smoking characteristics are related to breast and cervical cancer screening among homeless females.

This study examines breast and cervical cancer screening among homeless females who are smokers in the Twin Cities, MN. The aims of this study are to 1) describe breast and cervical cancer screening rates, 2) determine if there is a relationship between up-to-date breast and cervical cancer screening, and 3) identify predictors of up-to-date breast and cervical cancer screening among homeless females who are smokers in the Twin Cities, MN. The conceptual model guiding this study, which is informed by the Behavioral Model for Vulnerable Populations is included in 2.

Figure 2. Potential Predictors of Breast and Cervical Cancer Screening: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study



Methods

Power to Quit Study

The Power to Quit study was a randomized controlled trial of 430 homeless adult smokers that assessed the effectiveness of motivational interviewing (MI) for smoking cessation.<sup>38,39</sup> Prior to the start of the trial, a survey was administered at baseline.

Measures

**Health Behavior**

*Cancer Screening.* Participants were asked about their screening history for breast and cervical cancer as follows: “A mammogram is an x-ray of each breast to look for breast cancer. Have you ever had a mammogram?” “A Pap test is a test for cancer of the

cervix. Have you ever had a Pap test?” Answer options included yes, no, and not sure. For each test, participants who answered yes were then asked how long it had been since their last screening, <1 year, 1- <2 years, 2- <3 years, 3- <5 years, or >5 years. A measure of up-to-date cancer screening was developed for each type of screening. Up-to-date cancer screening was determined based on the American Cancer Society (ACS) screening guidelines that were in place when the baseline data were collected (2009-2010) since these are the guidelines that females would have been advised to follow at the time of the study. The ACS guidelines called for yearly mammograms for those 40 years and older and yearly Pap tests starting three years after onset of vaginal intercourse but no later than age 21 (i.e., population generally includes those 18 and older).<sup>67</sup> Guidelines differed for cervical cancer screening among females 70 years of age and older; however, there are no females in our sample in that age range.

### **Traditional Predisposing Components**

*Demographic Characteristics.* Participants were asked their date of birth, which was used to calculate their age at baseline, and their marital status (married, divorced, widowed, separated, never been married, or living with a significant other or partner). Marital status was collapsed into married or living with others vs. divorced, widowed, separated or never married.

*Social Structure.* Participants were asked to report their race/ethnicity (Black, Asian/Pacific Islander, Hispanic, Native American/Alaskan Native, and/or White). Race/ethnicity was included as a social structure variable rather than a demographic variable based on its classification in the Behavioral Model for Vulnerable Populations.<sup>31</sup> Race was collapsed into White, Black, or other. Participants were also asked to report

their employment status (employed, out of work >1 year, out of work <1 year, homemaker, student, retired, or unable to work or disabled) and education level (middle school, some high school, high school graduate or GED, some college or tech school, or college graduate). Employment status was collapsed into employed vs. unemployed. Education level was collapsed into high school graduate/GED or more education vs. some high school or less.

*Smoking Characteristics.* Nicotine dependence was assessed using one item from the Fagerström Test for Nicotine Dependence scale that asked about time to first cigarette of the day.<sup>68</sup> Participants were considered to be nicotine dependent if they smoked within the first 30 minutes of waking. Participants were asked the number of times in the last year they have seriously tried to quit smoking for at least 24 hours and the average number of cigarettes they smoked in a day over the past seven days. Importance to quit was measured by asking participants to report how important it is for them to quit smoking completely on a scale of 0 (not important) to 10 (extremely important).

Motivation to quit was assessed using the Treatment Self Regulation for Smoking Questionnaire (TSRQ), which measures three types of motivation, autonomous (i.e., quitting is positively endorsed and valued by the individual), controlled (i.e., quit in order to obtain a reward, avoid negative consequences, and/or avoid feeling guilty), and amotivation (i.e., the absence of motivation to quit).<sup>69, 70</sup> Participants were asked to indicate how true various reasons for quitting or staying quit are for them. These reasons included autonomous motivation (six items; e.g., because I feel that I want to take responsibility for my own health), controlled motivation (six items; e.g., because I would feel guilty or ashamed of myself if I smoked), and amotivation (three items; e.g., I don't



really know why). Answer options ranged from 1 (not at all true) to 7 (very true) and the items under each category of motivation were summed to develop three subscales. The autonomous and controlled motivation subscales ranged from 6 to 42 while the amotivation subscale ranged from 3 to 21, with higher scores indicating greater motivation. The Cronbach's alpha coefficients for the items in each subscale were 0.75 (autonomous motivation), 0.82 (controlled motivation), and 0.54 (amotivation), indicating acceptable, good, and poor reliability, respectively. Validity of the TSRQ was demonstrated in a general population of smokers in the U.S.<sup>70</sup> The full TSRQ is included in the appendix. All other measures that are not fully described in the text are also included in the appendix.

Change in smoking was assessed by asking participants whether compared to a year ago, they now smoked fewer, the same, or more cigarettes per day and if they now smoked fewer, the same, or more days per week.

*Overweight or Obese.* Weight and height measurements were taken by study staff and were used to calculate BMI. Participants were considered to be overweight or obese if they had a BMI of 25 or greater.

### **Vulnerable Predisposing Components**

*Substance Use.* Participants were asked if they used marijuana, cocaine, heroin, or prescription drugs without prescription in the past 30 days. If participants used at least one of these drugs in the past 30 days, they were considered current drug users.

Participants were asked in the past 30 days, the number of days they drank one or more drinks of an alcoholic beverage. They were then asked how many drinks they usually had on the days that they drank. We calculated the total number of alcoholic drinks per month

and then divided by 30 to generate drinks per day. Individuals who averaged more than one drink per day were considered risky alcohol users.<sup>71</sup>

*Length of Time Homeless.* Participants were asked how long they have been without a regular or permanent place to live (<1 month, 1-3 months, 4-6 months, 7-11 months, 1-3 years, or >3 years). Length of time homeless was collapsed into <1 year, 1-3 years, and >3 years.

*Mental Health* was measured in a number of ways. Psychotic symptoms were measured using the seven-item Mini International Neuropsychiatric Interview (MINI): Psychotic Disorders and Mood Disorder with Psychotic Features Module, which asks participants if they have experienced events such as people spying on them or hearing voices.<sup>40</sup> As is commonly done for this measure, the number of symptoms was summed. Anxiety was measured by asking participants if they have worried excessively or been anxious about several things over the past six months. This item was taken from the MINI: Generalized Anxiety Disorder Module.<sup>40</sup>

Depression was measured using the Patient Health Questionnaire (PHQ-9) for depression.<sup>72</sup> Participants were asked to indicate if they have been bothered with nine problems over the past two weeks, including little interest or pleasure in doing things and feeling tired or having little energy. Answer options ranged from 0 (not at all) to 3 (nearly every day). All items were summed to develop a scale with a possible range of 0 to 27. The Cronbach's alpha for these items was 0.88, indicating good reliability. The scale was found to be valid in a U.S. clinic population.<sup>72</sup> Perceived stress was measured using the four-item Perceived Stress Scale.<sup>73</sup> Participants were asked how often they experienced certain feelings in the past 30 days, including being unable to control important things in

life and feeling that things were going one's way. Answer options ranged from 0 (never) to 4 (very often) and all items were summed (positively worded items were reverse coded) to develop a scale with a possible range of 0 to 16, with higher scores indicating greater stress. The Cronbach's alpha for these items was 0.53, indicating poor reliability. Validity of the scale was demonstrated in the general U.S. population.<sup>74</sup>

### **Traditional Enabling Components**

Participants were asked to report their health care coverage (none, Medicare, Medicaid, state assisted, employer-based, or private) and total monthly family income from food stamps, paychecks, supplemental security income, disability, and other sources. Health care coverage was dichotomized into health insured vs. lack of health insurance. Monthly income was dichotomized into < \$400 vs. ≥ \$400, a cutoff used in previous Power to Quit studies.<sup>38, 75, 76</sup>

### **Vulnerable Enabling Components**

Participants were asked if they have a case manager (e.g., social worker, nurse, service or organization staff manger) who is assigned to help them get and coordinate care. To assess competing needs, participants were asked how often the following were a problem for them: getting a place for the night, getting food to eat, finding a place to wash up, and finding a place to go to the bathroom. Answer options ranged from 0 (never a problem) to 3 (usually a problem). The four items were summed to create a competing needs index that ranged from 0 to 12.

## **Vulnerable Need Components**

General health status was measured using an item from the SF-36 that asks participants to rate their health ranging from poor to excellent.<sup>77</sup> Answer options were collapsed into three categories: excellent or very good, good, and fair or poor.

### Analysis

This study includes baseline data from female smokers in the Power to Quit study. All analyses were conducted using STATA version 13. Descriptive statistics were examined for up-to-date cancer screening and potential predictors of up-to-date cancer screening, including predisposing, enabling, and need components. Reliability was examined for each scale by calculating the Cronbach's alpha. For the two scales with low reliability (amotivation and perceived stress) we examined whether excluding any of the items would increase the reliability of the scales, but it did not. Distributions of all continuous variables were examined. Two variables, previous quit attempts and cigarettes per day, each had 1 extreme outlier, which were replaced by the next highest value for each variable.

Bivariate analyses were conducted. The relationship between up-to-date breast and cervical cancer screening was examined by conducting a chi-square test. Correlations between the potential predictors of up-to-date cancer screening were examined in order to ensure that none of the potential predictors were highly correlated ( $r > 0.7$ ). Continuous, dichotomous, and ordinal variables were included in the correlation matrix.

A series of logistic regression models were conducted to identify predictors of up-to-date breast cancer screening and up-to-date cervical cancer screening. Each model contained one type of screening as the outcome variable and variables from one type of

component as the predictors: traditional predisposing, vulnerable predisposing, traditional enabling, vulnerable enabling, or vulnerable need. Since the outcomes of up-to-date breast and cervical cancer screening are prevalent, risk ratios were reported rather than odds ratios. We obtained the risk ratios using post estimation commands (STATA v13 Margins and nlcom). In order to use this method of calculating the risk ratios all predictors were required to be categorized. Therefore, all continuous variables were dichotomized using a median split before being entered into the regression models.

## Results

Table 2 outlines the prevalence of up-to-date breast and cervical cancer screening and descriptive statistics for the predisposing, enabling, and need components among homeless female smokers 18 years of age and older (n=110). Sixty-eight females were 40 years of age or older and were eligible for breast cancer screening. Fifty-six percent of females 40 and older received a mammogram in the past year and 68% of females 18 and older received a Pap test in the past year. The greatest proportion of participants were Black (49%), addicted to smoking (84% smoke within 30 minutes of waking), and overweight or obese (81%). Sixty-nine percent of participants experienced anxiety in the past 6 months and nearly half (48%) had a case manager that helps them get and coordinate care.

Being up-to-date for breast cancer screening was associated with being up-to-date for cervical cancer screening among females aged 40 and older ( $\chi^2= 16.4$ ,  $df=1$ ,  $p<.001$ ) (Table 3). Compared to females who were not up-to-date for breast cancer screening, females who received a mammogram in the past year had over 9 times greater odds of

receiving a Pap test in the past year (OR: 9.9, CI: 2.7, 40.5). Nearly half of females aged 40 and older (49%) were up-to-date for both breast and cervical cancer screening.

Among females aged 40 and older, several components from the Behavioral Model for Vulnerable Populations were associated with up-to-date breast cancer screening (Table 4). Traditional predisposing components that were associated with a higher probability of receiving a mammogram in the past year included Black race (RR: 2.78, CI: 1.78, 4.37, Ref: White race), greater controlled motivation to quit (RR: 1.64, CI: 1.07, 2.52), and smoking fewer (RR: 2.49, CI: 1.70, 3.66, Ref: more) or the same (RR: 1.60, CI: 1.04, 2.48, Ref: more) number of cigarettes compared to a year ago. Traditional predisposing components that were associated with a lower probability of receiving a mammogram in the past year included addiction to smoking (i.e., smoke within 30 minutes of waking) (RR: 0.63, CI: 0.48, 0.82) and overweight/obesity (RR: 0.71, CI: 0.51, 0.97). Experiencing anxiety in the past six months was the only vulnerable predisposing component that was associated with screening, with those experiencing anxiety having a lower probability of receiving a mammogram in the past year (RR: 0.63, CI: 0.42, 0.93). Both vulnerable enabling components were related to up-to-date breast cancer screening; females who had a case manager that helps them get and coordinate care had a higher probability of receiving a mammogram in the past year (RR: 1.62, CI: 1.04, 2.51), whereas females who had more competing needs had a lower probability of receiving a mammogram in the past year (RR: 0.62, CI: 0.40, 0.98).

Among females aged 18 and older, traditional predisposing components were the only components from the Behavioral Model for Vulnerable Populations that were associated with up-to-date cervical cancer screening (Table 5). Black race (RR: 1.60, CI:

1.19, 2.15, Ref: White race) and smoking the same number of days per week as a year ago (RR: 1.85, CI: 1.22, 2.80, Ref: more) were associated with higher probability of receiving a Pap test in the past year. Addiction to smoking (i.e., smoke within 30 minutes of waking) (RR: 0.75, CI: 0.59, 0.96), greater autonomous motivation to quit (RR: 0.77, CI: 0.59, 0.99), and smoking the same number of cigarettes compared to a year ago (RR: 0.58, CI: 0.43, 0.78, Ref: more) were associated with a lower probability of receiving a Pap test in the past year.

### Discussion

This study examined prevalence of up-to-date breast and cervical cancer screening and predictors of up-to-date breast and cervical cancer screening among homeless female smokers in the Twin Cities, MN. Prevalence of cervical cancer screening in the past year (68%) was comparable to previous findings among sheltered homeless females (46-76%),<sup>42, 47, 51, 52</sup> whereas prevalence of breast cancer screening in the past year (56%) was higher than previous estimates among sheltered homeless females (32-47%).<sup>42, 43</sup> However, these previous estimates of screening in the past year were from the late 1990's and early 2000's and were mostly based on convenience samples of females at shelters.<sup>42, 47, 51, 52</sup> Only one previous study included a random sample of homeless sheltered females.<sup>43</sup> Therefore, these estimates may not be representative of the current screening rate among the larger homeless female population. Consistent with previous literature among homeless sheltered females, being up-to-date for breast cancer screening was associated with being up-to-date for cervical cancer screening.<sup>43</sup> Possible reasons for this association are that females can receive more than one cancer screening exam at an appointment and that females who undergo breast or

cervical cancer screening are more likely to have a health care provider who would recommend other types of cancer screening when needed.<sup>43</sup>

An interesting finding from the analysis of predictors of up-to-date breast and cervical cancer screening was that there were several components from the Behavioral Model for Vulnerable Populations that were predictors of breast cancer screening, but only one type of component was a predictor of cervical cancer screening. Predictors of being up-to-date for breast cancer screening included traditional predisposing components, vulnerable predisposing components, and vulnerable enabling components, whereas only traditional predisposing components predicted cervical cancer screening. This finding was not consistent with previous literature, which found that other components were also related to cervical cancer screening among homeless females, including traditional enabling components (e.g., having health insurance and money) and vulnerable predisposing components (e.g., lack of drug and alcohol use).<sup>53</sup> A possible reason for the discrepancy regarding health insurance and income, which were not predictors of cervical or breast cancer screening in this population, is that no-cost screening for low-income females in Minnesota who are uninsured or underinsured is available.<sup>15</sup>

Another possible reason for these differences is that this study focused on the subset of the homeless female population who are smokers as opposed to the general homeless female population and important predictors of screening among each group may differ. It has been well documented in other populations that smokers are less likely to comply with breast and cervical cancer screening guidelines.<sup>60, 61, 62, 63, 64</sup> However, it is less clear if among smokers there are certain smoking characteristics (e.g., nicotine



dependence, cigarette consumption, and motivation to quit), which are traditional predisposing components that are associated with cancer screening. In this study we found that several of the statistically significant predictors of up-to-date breast cancer screening were smoking characteristics and all but one statistically significant predictor of up-to-date cervical cancer screening were smoking characteristics.

Although greater controlled motivation to quit (i.e., quit in order to obtain a reward, avoid negative consequences, and/or avoid feeling guilty) is typically associated with poorer health and wellbeing,<sup>70</sup> greater controlled motivation to quit was associated with a higher probability of being up-to-date for breast cancer screening. In support of this finding is a colorectal cancer study among males that found that greater general motivation to quit was associated with a higher probability of getting screened for cancer.<sup>66</sup> Individuals with greater controlled motivation to quit smoking may also experience greater controlled motivation to get screened for cancer, which may be sufficient motivation for prompting screening among homeless females.

We also found that addiction to smoking was associated with a lower probability of up-to-date breast cancer screening. This same relationship was found in a previous study among domiciled females; however, the results were not statistically significant in that study.<sup>65</sup> It is worth noting that greater nicotine dependence has been found to be associated with worse health behaviors (e.g., hazardous alcohol drinking, lack of physical activity),<sup>78</sup> including not being up-to-date for cervical cancer screening.<sup>65</sup> Lastly, we found that reducing the number of cigarettes smoked per day or keeping the number the same, as opposed to increasing, was associated with a higher probability of up-to-date breast cancer screening. Individuals who increase their cigarette consumption may have

less health promoting lifestyles and therefore may be less likely to get screened. Consistent in these findings is that individuals who are regarded as having worse smoking characteristics, including less motivation to quit, addiction to smoking, and increased cigarette consumption were less likely to be up-to-date for breast cancer screening. This indicates that having worse smoking characteristics may not only be associated with worse smoking cessation outcomes, but also a less health promoting lifestyle in general.

For up-to-date cervical cancer screening, two correlates were in line with our hypotheses and/or previous literature. Addiction to smoking was associated with a lower probability of up-to-date cervical cancer screening, which is consistent with findings from a previous study among domiciled females;<sup>65</sup> and smoking the same number of days per week as a year ago, as opposed to more, was associated with a higher probability of receiving a Pap test in the past year. As with breast cancer screening, individuals who are regarded as having worse smoking characteristics, including addiction to smoking and additional days of cigarette consumption were less likely to be up-to-date for cervical cancer screening.

However, the direction of effect for two correlates of up-to-date cervical cancer screening was contrary to our hypotheses and/or previous literature. Greater autonomous motivation to quit (i.e., quitting is positively endorsed and valued by the individual) was associated with a lower probability of receiving a Pap test in the past year. Previous literature suggests that greater general motivation to quit is associated with a higher probability of getting screened and that greater autonomous motivation to quit is associated with better health and health behavior outcomes.<sup>66, 70</sup> Since the upper bound of

the 95% confidence interval neared 1 (RR: 0.77, CI: 0.59, 0.99), we examined the bivariate relationship between autonomous motivation to quit as a continuous variable and up-to-date cervical cancer screening. We did not find autonomous motivation to quit to differ by cervical cancer screening status (diff= -2.4, 95% CI: 0, -4.7), which calls into question the findings from the logistic regression. Smoking the same number of cigarettes compared to a year ago, as opposed to more, was also associated with a lower probability of receiving a Pap test in the past year. This is the opposite direction that we would expect based on our other findings and the assumption that females who increase the number of cigarettes that they smoke per day would have less health promoting lifestyles. However, it is possible that individuals who increase their smoking consumption may experience negative health consequences that lead to medical visits and therefore routine screenings.

In regards to non-smoking related characteristics, homeless females who were overweight or obese,<sup>56</sup> and experienced mental health problems (i.e., anxiety),<sup>25</sup> were less likely to be up-to-date on breast cancer screening, which is consistent with previous literature on breast cancer screening among homeless and other disadvantaged populations. Possible reasons for these associations are that obese females are more likely to report that they experience pain from having a mammogram, which serves as a deterrent to future mammograms;<sup>56</sup> and mental health issues may reduce the ability and/or willingness of homeless females to adhere to health promotion activities like cancer screening.<sup>31, 42</sup> Homeless females who had more competing needs were less likely to be up-to-date on breast cancer screening. One possible reason for this association is that homeless females with more competing needs are less likely to have a regular source

of care, which reduces their receipt of preventative care, such as cancer screenings.<sup>10, 31</sup>

An additional reason is that per the Cumulative Complexity Model, many homeless individuals have low patient capacity (i.e., abilities, resources, or readiness to address demands, including physical and mental functioning, socioeconomic resources, social support, and literacy) and homeless individuals who have greater competing needs would have a higher patient workload (i.e., everyday life demands).<sup>79</sup> When patient workload exceeds patient capacity disruptions in accessing care, such as cancer screenings, can occur.

Females who had a case manager that helps them get and coordinate care were more likely to be up-to-date on breast cancer screening. Having case managers help homeless individuals get and coordinate health care reduces barriers to accessing care and has been suggested as an effective strategy for increasing breast cancer screening among the homeless.<sup>80</sup> Black females were more likely to be up-to-date on breast cancer screening compared to White females; however, race was not identified as a correlate of breast cancer screening in a previous study among the homeless.<sup>43</sup> We also found that Black females were more likely to be up-to-date on cervical cancer screening compared to White females. This association was identified as a trend in two previous studies among homeless females.<sup>43, 51</sup>

### Limitations

A large limitation of this study is the small overall sample size (n=110) and the even smaller sample size for the analyses that examine up-to-date breast cancer screening among females aged 40 and older (n=68). However, given that there hasn't been much research on cancer screening among homeless females, especially among the high-risk

group of homeless females who are smokers, this study still makes a valuable contribution to the literature. An additional limitation related to the issue of having a small sample size is that for several categorical variables, there are very small Ns for some of the categories (e.g., married or living with others marital status [n=9] and other race [n=14]). Having small sample sizes for some categories limits our ability to detect statistically significant differences in up-to-date cancer screening between these categories and other categories within the variables.

A third limitation is that some potentially important predictors of up-to-date breast and cervical cancer screening from the Behavioral Model for Vulnerable Populations were not included in this study because they were not measured in the Power to Quit study. Some variables from the model that would have been included in this study if they were measured include health beliefs, barriers to care, transportation, and health services resources. An additional limitation is that for the logistic regression analyses that examined predictors of up-to-date breast and cervical cancer screening, all continuous variables had to be categorized in order to calculate risk ratios using post estimation commands. This is a limitation since categorizing continuous variables results in a loss of power and precision of the estimated risk, and it assumes that everyone in each category has the same risk of getting screened for cancer. Further, for all of our continuous variables except for BMI, there was not a theoretical reason for choosing a particular cutoff point; therefore, we decided to employ a median split. This is a limitation since other studies may choose a different cutoff point, which would make it difficult to compare the findings from each study. Although there are limitations to categorizing the continuous variables, our approach is preferable to reporting results from a logistic

regression model that includes continuous predictors (i.e., odds ratios) since up-to-date breast and cervical cancer screening is common (i.e., >10%) and therefore the odds ratios would overestimate the risk ratios.

Another limitation is that two scales that are included in this study had poor reliability. The Cronbach's alpha for the Perceived Stress Scale was 0.53 and 0.54 for amotivation to quit from the Treatment Self Regulation for Smoking questionnaire. Neither of these variables were predictors of up-to-date breast or cervical cancer screening. The low reliability of the two scales might indicate that the variables were not measuring the same unitary construct in this population, and this poor reliability may be the reason why associations with screening were null.

An additional limitation is that we did not control for shelter in the logistic regression analyses. Although participants were recruited at seven different shelters and attended the same shelter where they enrolled into the study for all of their study visits, it is unlikely that clustering is an issue in this study. Participants in the study did not reside at the particular shelter where they attended study visits; rather they routinely obtained resources and slept at multiple shelters that participated in the study, which reduces the likelihood of a clustering effect. Further, the majority of participants (71%) attended one shelter, the Dorothy Day Center for all study visits, followed by 11% at the shelter, Our Saviors Housing and 10% at the shelter, Union Gospel Mission, with the remaining four shelters having less than 5% of participants, respectively. Therefore, it would be difficult to determine if there are statistically significant differences between the participants at each shelter.

Another limitation is that we utilized American Cancer Society (ACS) screening guidelines from the time that the baseline data was collected (2009-2010) to determine up-to-date cancer screening, as opposed to U.S. Preventive Services Task Force (USPSTF) guidelines. During this time period, the USPSTF recommended biennial breast cancer screening starting at age 50,<sup>81</sup> whereas the ACS recommended annual breast cancer screening for those 40 and older.<sup>67</sup> For cervical cancer screening, the USPSTF recommended Pap tests starting three years after onset of vaginal intercourse but no later than age 21 that occur at least every three years,<sup>82</sup> as opposed to the ACS recommendation of yearly.<sup>67</sup> We decided to utilize ACS guidelines because it has been suggested that shorter screening intervals are more appropriate for the homeless population since the homeless are at high risk for breast and cervical cancer,<sup>7, 42, 43, 44, 45</sup> and there are challenges to engaging the homeless in primary and preventive care.<sup>43, 51</sup> Another limitation is that cancer screening was self-reported and over reporting of both mammography and Pap tests is common.<sup>83</sup>

A final limitation is that our study sample is unlikely to be representative of homeless female smokers. Although the study sample was found to be demographically representative of the larger homeless population in Minnesota, the study sample was self-selected for the tobacco cessation study and motivated to quit and thus may not be representative of homeless female smokers generally.<sup>3, 38</sup> Given these concerns, the prevalence estimates of breast and cervical cancer screening identified in this study may not be representative of the screening prevalence in the larger homeless female smoker population.

### Conclusions

Given the lower than optimal prevalence of breast and cervical cancer screening among homeless female smokers, efforts should be made to increase the screening rates. Smoking characteristics appear to be associated with breast and cervical cancer screening uptake among homeless female smokers and receipt of breast and cervical cancer screening is highly correlated in this population. Programs that aim to increase cancer screening among homeless female smokers could include efforts to increase both breast and cervical cancer screening given their association. Cancer prevention programs could aim to simultaneously promote age-appropriate cancer screening and smoking reduction and cessation given the association between smoking characteristics and cancer screening.



Tables

**Table 2: Descriptive Statistics of Homeless Female Smokers in the Power to Quit Study (n=110)**

Variable	N	Mean (SD) or N (%)
<b>Health Behavior</b>		
Up-to-date cancer screening		
Mammogram, (40 and older, <1 year)	68	38 (56%)
Pap test (18 and older, <1 year)	110	75 (68%)
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age	110	41.7 (11.2)
Marital status	109	
Married or living with others		9 (8%)
Divorced/Widowed/Separated/Never married		100 (92%)
Social Structure		
Race	110	
White		42 (38%)
Black		54 (49%)
Other		14 (13%)
Unemployed	110	104 (95%)
Education $\geq$ high school graduate or GED	110	82 (75%)
Smoking Characteristics		
Time to first cigarette, $\leq$ 30 min	110	92 (84%)
Number of quit attempts, past year	109	2.0 (2.6)
Cigarettes smoked per day	110	18.1 (11.8)
Importance to quit, scale 0-10	110	9.2 (1.6)
Motivation to quit		
Controlled motivation, scale 6-42	110	18.5 (9.3)
Autonomous motivation, scale 6-42	110	37.2 (6.1)
Amotivation, scale 3-21	110	8.1 (4.5)
Cigarettes smoked per day, compared to 1 year ago	110	
Fewer		22 (20%)
Same		41 (37%)
More		47 (43%)
Number of days smoked per week, compared to 1 year ago	110	
Fewer		10 (9%)
Same		66 (60%)
More		34 (31%)
Overweight or obese, BMI $\geq$ 25	109	88 (81%)
<b>Vulnerable Predisposing Components</b>		
Substance Use		
Current drug use in the past 30 days*	109	34 (31%)

<b>Variable</b>	<b>N</b>	<b>Mean (SD) or N (%)</b>
Risky alcohol use, >1 drink a day	110	18 (16%)
Length of time homeless	110	
<1 year		58 (53%)
1-3 years		38 (34%)
>3 years		14 (13%)
<b>Mental Health</b>		
Presence of any psychotic symptoms	110	20 (18%)
Experienced anxiety, past 6 months	110	76 (69%)
Depression, scale 0-27	110	9.8 (6.6)
Perceived stress, scale 0-16	110	7.1 (2.9)
<b>Traditional Enabling Components</b>		
Health insured	110	91 (83%)
Monthly family income < \$400	105	72 (65%)
<b>Vulnerable Enabling Components</b>		
Have a case manager that helps get and coordinate care	106	51 (48%)
Competing needs, scale 0-12	110	4.1 (3.4)
<b>Vulnerable Need Components</b>		
General health status	109	
Excellent/Very good		36 (33%)
Good		41 (38%)
Fair/Poor		32 (29%)

\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription

**Table 3: Relationship between Breast and Cervical Cancer Screening Among Homeless Female Smokers Aged 40 and Older in the Power to Quit Study (n=68)**

	Pap test <1 year	Pap test ≥ 1 year	Total
Mammogram <1 year			
<i>Frequency</i>	33	5	38
<i>Row Percent</i>	87%	13%	
<i>Overall Percent</i>	49%	7%	
Mammogram ≥ 1 year			
<i>Frequency</i>	12	18	30
<i>Row Percent</i>	40%	60%	
<i>Overall Percent</i>	18%	26%	
Total	45	23	68

$\chi^2 = 16.4$ ,  $df=1$ ,  $p < .001$

OR= 9.9, 95% CI: 2.7, 40.5

**Table 4: Predictors of Breast Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 40 and Older (n=68)**

Variable	N	RR	95% CI
<b>Traditional Predisposing Components</b>	65		
Demographic Characteristics			
Age ≥ 48	32	1.36	0.96, 1.91
< 48	33	Ref	
Marital status			
Married or living with others	3	0.40	0.05, 2.87
Divorced/Widowed/Separated/Never married	62	Ref	
Social Structure			
Race			
White	24	Ref	
Black	37	<b>2.78</b>	<b>1.78, 4.37</b>
Other	4	1.51	0.64, 3.55
Unemployed*	64	-	-
Employed	4	Ref	
Education ≥ high school graduate or GED	52	1.55	0.81, 2.96
Some high school or less	13	Ref	
Smoking Characteristics			
Time to first cigarette, ≤ 30 min	57	<b>0.63</b>	<b>0.48, 0.82</b>
> 30 min	8	Ref	
Two or more quit attempts, past year	29	1.10	0.75, 1.60
< 2 quit attempts	36	Ref	
Pack or more per day	36	1.41	0.96, 2.06
< Pack	29	Ref	
Importance to quit, 10 on scale 0-10	45	1.36	0.91, 2.03
< 10	20	Ref	
Controlled motivation to quit, ≥ 17 on scale 6-42	34	<b>1.64</b>	<b>1.07, 2.52</b>
<17	31	Ref	
Autonomous motivation to quit, ≥ 40 on scale 6-42	29	0.92	0.61, 1.38
<40	36	Ref	
Amotivation to quit, ≥ 9 on scale 3-21	31	0.89	0.59, 1.34
< 9	34	Ref	
Cigarettes smoked per day, compared to 1 year ago			
Fewer	12	<b>2.49</b>	<b>1.70, 3.66</b>
Same	27	<b>1.60</b>	<b>1.04, 2.48</b>
More	26	Ref	
Number of days smoked per week, compared to 1 year ago			
Fewer	3	0.39	0.10, 1.50
Same	42	0.68	0.46, 1.00
More	20	Ref	
Overweight or obese, BMI ≥ 25	48	<b>0.71</b>	<b>0.51, 0.97</b>
< 25	17	Ref	

<b>Table 4: Predictors of Breast Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 40 and Older (n=68) Continued</b>			
<b>Variable</b>	<b>N</b>	<b>RR</b>	<b>95% CI</b>
<b>Vulnerable Predisposing Components</b>			
Substance Use			
Current drug use in the past 30 days **	20	1.30	0.88, 1.91
No current drug use	47	Ref	
Risky alcohol use, >1 drink a day	12	0.63	0.32, 1.25
≤ 1 drink	55	Ref	
Length of time homeless			
<1 year	37	3.07	0.95, 9.87
1-3 years	21	2.27	0.67, 7.63
>3 years	9	Ref	
Mental Health			
Presence of any psychotic symptoms	10	1.07	0.63, 1.82
Lack of psychotic symptoms	57	Ref	
Experienced anxiety, past 6 months	46	<b>0.63</b>	<b>0.42, 0.93</b>
Did not experience anxiety	21	Ref	
Depression, ≥ 10 on scale 0-27	34	1.10	0.71, 1.73
< 10	33	Ref	
Perceived stress, ≥ 8 on scale 0-16	30	0.93	0.59, 1.46
< 8	37	Ref	
<b>Traditional Enabling Components</b>			
Health insured	60	2.10	0.65, 6.81
Lack of health insurance	8	Ref	
Monthly family income < \$400	41	0.79	0.52, 1.19
≥ \$400	27	Ref	
<b>Vulnerable Enabling Components</b>			
Have a case manager that helps get and coordinate care	33	<b>1.62</b>	<b>1.04, 2.51</b>
Does not have a case manager	33	Ref	
Competing needs, ≥ 5 on scale 0-12	31	<b>0.62</b>	<b>0.40, 0.98</b>
< 5 competing needs	35	Ref	
<b>Vulnerable Need Components</b>			
General health status			
Excellent/Very good	23	1.23	0.72, 2.11
Good	28	0.94	0.53, 1.69
Fair/Poor	17	Ref	

Note: Continuous variables were dichotomized using a median split. Separate models were examined for each type of component. Statistically significant findings are in bold.

\* Employment status was dropped from the regression model due to limited variability

\*\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription

**Table 5: Predictors of Cervical Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 18 and Older (n=110)**

Variable	N	RR	95% CI
<b>Traditional Predisposing Components</b>	107		
Demographic Characteristics			
Age ≥ 44	49	0.89	0.70, 1.14
< 44	58	Ref	
Marital status			
Married or living with others	9	0.64	0.31, 1.31
Divorced/Widowed/Separated/Never married	98	Ref	
Social Structure			
Race			
White	40	Ref	
Black	53	<b>1.60</b>	<b>1.19, 2.15</b>
Other	14	0.86	0.47, 1.56
Unemployed	102	0.79	0.56, 1.12
Employed	5	Ref	
Education ≥ high school graduate or GED	79	0.93	0.72, 1.21
Some high school or less	28	Ref	
Smoking Characteristics			
Time to first cigarette, ≤ 30 min	90	<b>0.75</b>	<b>0.59, 0.96</b>
> 30 min	17	Ref	
Two or more quit attempts, past year	54	1.07	0.84, 1.37
< 2 quit attempts	53	Ref	
Pack or more per day	52	1.00	0.77, 1.29
< Pack	55	Ref	
Importance to quit, 10 on scale 0-10	73	0.83	0.66, 1.04
< 10	34	Ref	
Controlled motivation to quit, ≥ 17 on scale 6-42	56	0.88	0.70, 1.11
<17	51	Ref	
Autonomous motivation to quit, ≥ 40 on scale 6-42	47	<b>0.77</b>	<b>0.59, 0.99</b>
<40	60	Ref	
Amotivation to quit, ≥ 9 on scale 3-21	50	0.89	0.70, 1.14
< 9	57	Ref	
Cigarettes smoked per day, compared to 1 year ago			
Fewer	21	0.73	0.50, 1.05
Same	40	<b>0.58</b>	<b>0.43, 0.78</b>
More	46	Ref	
Number of days smoked per week, compared to 1 year ago			
Fewer	9	1.61	0.89, 2.92
Same	65	<b>1.85</b>	<b>1.22, 2.80</b>
More	33	Ref	
Overweight or obese, BMI ≥ 25	86	1.12	0.82, 1.54
< 25	21	Ref	

<b>Table 5: Predictors of Cervical Cancer Screening in the Last Year among Homeless Female Smokers in the Power to Quit Study Aged 18 and Older (n=110) Continued</b>			
<b>Variable</b>	<b>N</b>	<b>RR</b>	<b>95% CI</b>
<b>Vulnerable Predisposing Components</b>	109		
Substance Use			
Current drug use in the past 30 days *	34	1.11	0.85, 1.45
No current drug use	75	Ref	
Risky alcohol use, >1 drink a day	18	0.85	0.55, 1.30
≤ 1 drink	91	Ref	
Length of time homeless			
<1 year	58	1.34	0.79, 2.25
1-3 years	38	1.21	0.70, 2.11
>3 years	13	Ref	
Mental Health			
Presence of any psychotic symptoms	19	0.82	0.54, 1.26
Lack of psychotic symptoms	90	Ref	
Experienced anxiety, past 6 months	76	1.00	0.75, 1.34
Did not experience anxiety	33	Ref	
Depression, ≥ 10 on scale 0-27	52	0.96	0.72, 1.28
< 10	57	Ref	
Perceived stress, ≥ 8 on scale 0-16	50	1.10	0.84, 1.45
< 8	59	Ref	
<b>Traditional Enabling Components</b>	110		
Health insured	91	1.27	0.82, 1.96
Lack of health insurance	19	Ref	
Monthly family income < \$400	72	0.88	0.67, 1.14
≥ \$400	38	Ref	
<b>Vulnerable Enabling Components</b>	106		
Have a case manager that helps get and coordinate care	51	1.14	0.88, 1.47
Does not have a case manager	55	Ref	
Competing needs, ≥ 5 on scale 0-12	47	0.85	0.65, 1.12
< 5 competing needs	59	Ref	
<b>Vulnerable Need Components</b>			
General health status			
Excellent/Very good	36	0.93	0.66, 1.30
Good	41	1.06	0.79, 1.43
Fair/Poor	32	Ref	

Note: Continuous variables were dichotomized using a median split. Separate models were examined for each type of component. Statistically significant findings are in bold.

\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription

## **Research Study 2: Cessation-related weight concern among homeless male and female smokers**

### Abstract

Concern about post-cessation weight gain is a barrier to quitting smoking; however, its effect on smoking cessation is unclear. Females have higher cessation-related weight concern than males and predictors of cessation-related weight concern are gender specific.

Homeless males (n=320) and females (n=110) participating in a smoking cessation randomized controlled trial completed surveys on cessation-related weight concern, smoking status, and components from the Behavioral Model for Vulnerable Populations. Generalized estimating equations were used to examine baseline predictors of cessation-related weight concern at baseline, the end of treatment, and 26-weeks follow-up. Logistic regression models were used to examine the relationship between cessation-related weight concern and smoking status at the end of treatment and follow-up.

Homeless females had higher cessation-related weight concern than homeless males. Among males, older age, Black race, higher BMI, depression, and having health insurance were associated with higher cessation-related weight concern. Among females, addiction to smoking, greater cigarette consumption, indicating that quitting is more important, older age of smoking initiation, and less support to quit from family were associated with higher cessation-related weight concern. Cessation-related weight concern wasn't associated with smoking cessation among males or females.

Homeless individuals experienced comparable levels of cessation-related weight concern as other populations. Although several types of characteristics predicted cessation-related weight concern among males, only smoking characteristics predicted cessation-related weight concern among females. Given the small proportion of quitters in this study (8% of males and 5% of females), further research on the impact of cessation-related weight concern on smoking cessation among the homeless is warranted.

### Introduction

Concern about post-cessation weight gain, also referred to as cessation-related weight concern has been identified as a barrier to quitting smoking,<sup>84, 85, 86</sup> and a reason for relapse.<sup>87</sup> It is estimated that a quarter of daily smoking males and half of daily smoking females have concerns about gaining weight after quitting smoking.<sup>84, 88, 89</sup> These concerns may affect smokers' quitting behaviors by decreasing their number of quit attempts.<sup>86, 90</sup> However, the effect that weight concern has on cessation is unclear with some studies finding that smokers with these concerns are less likely to quit,<sup>84, 91, 92, 93, 94</sup> and other studies not finding this association.<sup>95, 96, 97, 98, 99</sup> Some reasons why the findings may be mixed are that weight concern has been assessed using different measures,<sup>96, 100, 101</sup> and studies of weight concern and quitting have focused on different populations.<sup>101</sup> Further, some of the studies that did not find an association between weight concern and cessation only measured general weight concern,<sup>97, 98</sup> as opposed to cessation-specific weight concern, which may be a better predictor of smoking behavior.

96

As concern about post-cessation weight gain has been identified as a barrier to cessation, it is important to understand the characteristics of smokers who experience



these concerns in order to develop targeted smoking cessation interventions. Previous research has found that weight concern differs by gender, with females having greater concerns.<sup>88, 94, 95, 98</sup> Further, predictors of weight concern are gender-specific.<sup>88, 89</sup> Several components from the Behavioral Model for Vulnerable Populations, as described in the background section, are associated with cessation-related weight concern among males and females (Figure 3).

Among males, previous research has found that the following traditional predisposing components are associated with having cessation-related weight concern: older age,<sup>96</sup> being married,<sup>96</sup> greater nicotine dependence,<sup>90, 96</sup> lower self-efficacy to quit,<sup>90, 96</sup> lower motivation to quit,<sup>89</sup> and higher BMI.<sup>90, 96, 100</sup> Among females, previous research has found that the following traditional predisposing components are associated with having cessation-related weight concern: younger age,<sup>88</sup> White race,<sup>86, 88, 96, 102</sup> less education,<sup>86, 96</sup> greater nicotine dependence,<sup>86, 90, 96</sup> greater number of previous quit attempts,<sup>103</sup> greater cigarette consumption,<sup>86, 102, 104</sup> lower self-efficacy to quit,<sup>90, 96</sup> fewer years smoking,<sup>88</sup> less support to quit,<sup>103</sup> and higher BMI.<sup>86, 90, 96, 103, 105</sup> The vulnerable predisposing component depression has also been found to be associated with having cessation-related weight concern among low-income females.<sup>103</sup>

Although there has been research on predictors of cessation-related weight concern and the effect of cessation-related weight concern on cessation, the previous studies focused predominately on white, middle-to-upper socioeconomic status populations and there is little research on cessation-related weight concern among vulnerable populations.<sup>103</sup> Two cessation-related weight concern studies targeted low-income populations,<sup>103, 105</sup> and one targeted a medically ill population;<sup>106</sup> however none

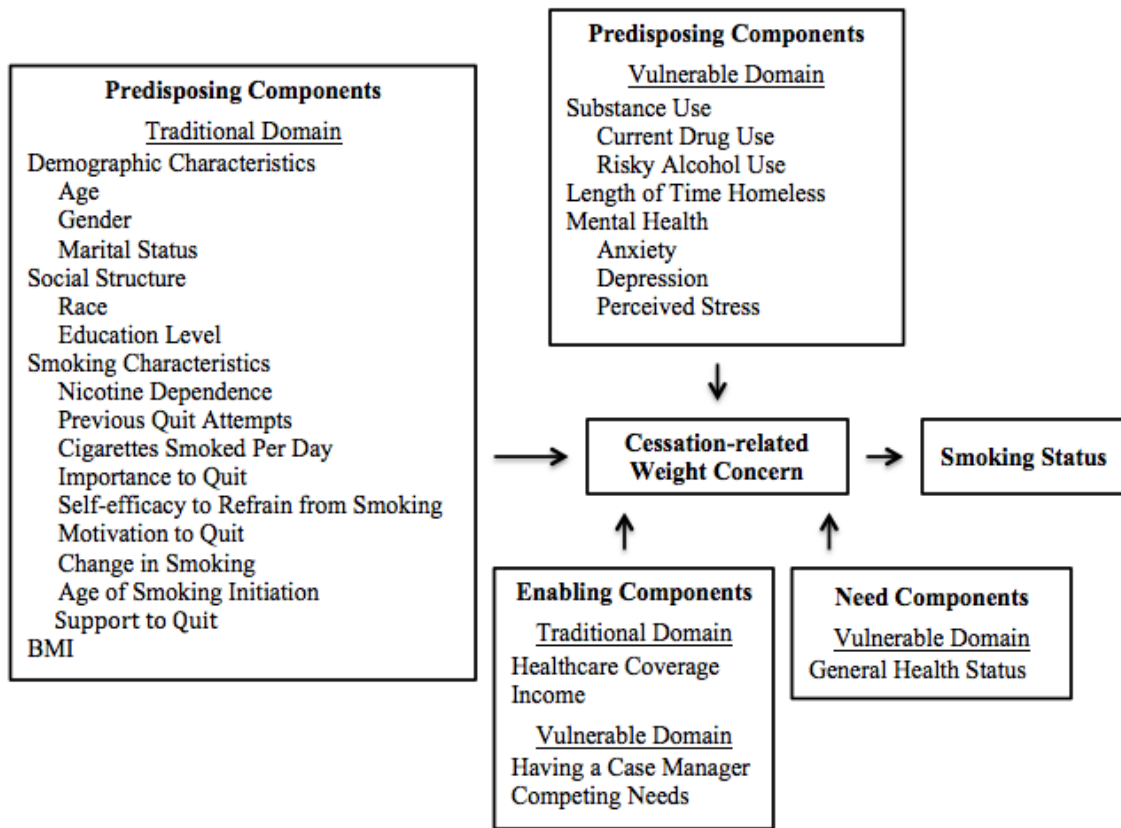
of the previous studies have focused on homeless individuals. It is therefore unclear whether homeless individuals have weight concerns surrounding smoking cessation and whether cessation-related weight concern affects their cessation rates.

Previous research has also largely focused on the relationship between traditional predisposing components and cessation-related weight concern; it is less clear if vulnerable predisposing, enabling, and need components are important predictors of cessation-related weight concern. It is important to determine whether weight concern is a barrier to cessation among the homeless and to identify the individuals who are most likely to experience these concerns given the high smoking prevalence among the homeless (i.e., 73%).<sup>21</sup> If prevalence of weight concern after cessation is high among the homeless, smoking cessation programs may need to consider adding intervention components that address these concerns in order to help homeless smokers successfully quit.

This study examines cessation-related weight concern among homeless male and female smokers in the Twin Cities, MN. The aims of this study are to 1) describe cessation-related weight concern, 2) identify predictors of cessation-related weight concern, and 3) determine if cessation-related weight concern predicts smoking status (i.e., smoker vs. quitter) at the end of treatment and 26-weeks follow-up of the Power to Quit study among homeless male and female smokers. The conceptual model guiding this study, which is informed by the Behavioral Model for Vulnerable Populations, is included in Figure 3. In this study we examine traditional predisposing correlates of cessation-related weight concern that were previously identified among other populations

in addition to components that have not been fully examined, including vulnerable predisposing, traditional and vulnerable enabling, and vulnerable need components.

Figure 3. Potential Predictors of Cessation-related Weight Concern: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study



## Methods

### Power to Quit Study

The Power to Quit study was a randomized controlled trial of 430 homeless adult smokers that assessed the effectiveness of motivational interviewing (MI) for smoking cessation.<sup>38, 39</sup> At baseline participants were randomized to an intervention arm, nicotine patch plus MI, or a control arm, nicotine patch plus standard care (SC). Intervention participants received six individual MI counseling sessions each lasting 15-20 minutes,

which focused on encouraging smoking cessation and nicotine replacement therapy adherence. Control participants received a one-time advice session on quitting smoking lasting 10-15 minutes. Participants in both conditions received 21mg nicotine patches for eight weeks. Surveys were administered at baseline, week 8 (end of treatment), and week 26 (follow-up).

### Measures

All of the variables were measured at baseline, unless otherwise noted.

*Cessation-related Weight Concern* was measured using the Weight Concern Scale.<sup>95</sup> Participants were asked to indicate the importance of six items related to their weight and smoking (e.g., how concerned are you about gaining weight as a result of quitting, how important is losing weight or maintaining your current weight compared with other personal health concerns), with answers ranging from 0 (not at all important) to 10 (extremely important). The six items were summed to create a scale that ranged from 0 to 60, with higher scores indicating greater concern. Cessation-related weight concern was measured at baseline, week 8, and week 26. The Cronbach's alpha coefficients for these items at each time point were 0.80 at baseline, 0.84 at week 8, and 0.85 at week 26, indicating good reliability. Validity of the scale was established among participants in a smoking cessation program in the U.S.<sup>95</sup> Cessation-related weight concern was normally distributed at each time point.

### **Traditional Predisposing Components**

*Demographic Characteristics.* Participants were asked their date of birth, which was used to calculate their age at baseline, whether they self-identify as male, female, or other (specify), and their marital status (married, divorced, widowed, separated, never

been married, or living with a significant other or partner). Marital status was collapsed into married or living with others vs. divorced, widowed, separated or never married.

*Social Structure.* Participants were asked to report their race/ethnicity (Black, Asian/Pacific Islander, Hispanic, Native American/Alaskan Native, and/or White) and education level (middle school, some high school, high school graduate or GED, some college or tech school, or college graduate). Race was collapsed into White, Black, or other. Education level was collapsed into high school graduate/GED or more education vs. some high school or less.

*Smoking Characteristics.* Nicotine dependence was assessed using one item from the Fagerström Test for Nicotine Dependence scale that asked about time to first cigarette of the day.<sup>68</sup> Participants were considered to be nicotine dependent if they smoked within the first 30 minutes of waking. Participants were asked the number of times in the last year they have seriously tried to quit smoking for at least 24 hours and the average number of cigarettes they smoked in a day over the past seven days. Importance to quit was measured by asking participants to report how important it is for them to quit smoking completely on a scale of 0 (not important) to 10 (extremely important).

Self-efficacy to refrain from smoking was measured using the Smoking Self-Efficacy Questionnaire (SEQ-12), which measures both intrinsic and extrinsic self-efficacy.<sup>107</sup> Participants were asked to indicate how sure they are that they could refrain from smoking in a number of situations that are either intrinsic (e.g., when I feel depressed) or extrinsic (e.g., when having drinks with friends) on a scale ranging from 1 (not at all sure) to 5 (absolutely sure). There are six items that measure each type of self-efficacy, which were summed to create two scales that ranged from 6 to 30, with higher

scores indicating greater self-efficacy. The Cronbach's alpha coefficients for the items in each scale were 0.87 (intrinsic self-efficacy to refrain from smoking) and 0.88 (extrinsic self-efficacy to refrain from smoking), indicating good reliability. The SEQ-12 was found to be valid among a general population of smokers.<sup>107</sup>

Motivation to quit was assessed using the Treatment Self Regulation for Smoking Questionnaire (TSRQ), which measures three types of motivation, autonomous (i.e., quitting is positively endorsed and valued by the individual), controlled (i.e., quit in order to obtain a reward, avoid negative consequences, and/or avoid feeling guilty), and amotivation (i.e., the absence of motivation to quit).<sup>69,70</sup> Participants were asked to indicate how true various reasons for quitting or staying quit are for them. These reasons included autonomous motivation (six items; e.g., because I feel that I want to take responsibility for my own health), controlled motivation (six items; e.g., because I would feel guilty or ashamed of myself if I smoked), and amotivation (three items; e.g., I don't really know why). Answer options ranged from 1 (not at all true) to 7 (very true) and the items under each category of motivation were summed to develop three subscales. The autonomous and controlled motivation subscales ranged from 6 to 42 while the amotivation subscale ranged from 3 to 21, with higher scores indicating greater motivation. The Cronbach's alpha coefficients for the items in each subscale were 0.78 (autonomous motivation), 0.83 (controlled motivation), and 0.56 (amotivation), indicating acceptable, good, and poor reliability, respectively. Validity of the TSRQ was demonstrated in a general population of smokers in the U.S.<sup>70</sup>

Change in smoking was assessed by asking participants whether compared to a year ago, they now smoked fewer, the same, or more cigarettes per day and if they now

smoked fewer, the same, or more days per week. Age of smoking initiation was measured by asking participants how old they were when they first started smoking regularly. Support to quit was assessed by asking participants how much encouragement they currently get from family, friends or work colleagues, and case workers to stop smoking, ranging from 0 (none) to 3 (a lot).

*BMI.* Weight and height measurements were taken by study staff and were used to calculate BMI.

### **Vulnerable Predisposing Components**

*Substance Use.* Participants were asked if they used marijuana, cocaine, heroin, or prescription drugs without prescription in the past 30 days. If participants used at least one of these drugs in the past 30 days, they were considered current drug users.

Participants were asked in the past 30 days, the number of days they drank one or more drinks of an alcoholic beverage. They were then asked how many drinks they usually had on the days that they drank. We calculated the total number of alcoholic drinks per month and then divided by 30 to generate drinks per day. Females who averaged more than one drink per day and males who averaged more than two drinks per day were considered risky alcohol users.<sup>71</sup>

*Length of Time Homeless.* Participants were asked how long they have been without a regular or permanent place to live (<1 month, 1-3 months, 4-6 months, 7-11 months, 1-3 years, or >3 years). Length of time homeless was collapsed into <1 year, 1-3 years, and >3 years.

*Mental Health.* Anxiety was measured by asking participants if they have worried excessively or been anxious about several things over the past six months. This item was

taken from the MINI: Generalized Anxiety Disorder Module.<sup>40</sup> Depression was measured using the Patient Health Questionnaire (PHQ-9) for depression.<sup>72</sup> Participants were asked to indicate if they have been bothered with nine problems over the past two weeks, including little interest or pleasure in doing things and feeling tired or having little energy. Answer options ranged from 0 (not at all) to 3 (nearly every day). All items were summed to develop a scale with a possible range of 0 to 27. The Cronbach's alpha for these items was 0.87, indicating good reliability. Perceived stress was measured using the four-item Perceived Stress Scale.<sup>73</sup> Participants were asked how often they experienced certain feelings in the past 30 days, including being unable to control important things in life and feeling that things were going one's way. Answer options ranged from 0 (never) to 4 (very often) and all items were summed (positively worded items were reverse coded) to develop a scale with a possible range of 0 to 16, with higher scores indicating greater stress. The Cronbach's alpha for these items was 0.57, indicating poor reliability. Validity of the scale was demonstrated in the general U.S. population.<sup>74</sup>

### **Traditional Enabling Components**

Participants were asked to report their health care coverage (none, Medicare, Medicaid, state assisted, employer-based, or private) and total monthly family income from food stamps, paychecks, supplemental security income, disability, and other sources. Health care coverage was dichotomized into health insured vs. lack of health insurance. Monthly income was dichotomized into  $< \$400$  vs.  $\geq \$400$ , a cutoff used in previous Power to Quit studies.<sup>38, 75, 76</sup>



### **Vulnerable Enabling Components**

Participants were asked if they have a case manager (e.g., social worker, nurse, service or organization staff manager) who is assigned to help them get and coordinate care. To assess competing needs, participants were asked how often the following were a problem for them: getting a place for the night, getting food to eat, finding a place to wash up, and finding a place to go to the bathroom. Answer options ranged from 0 (never a problem) to 3 (usually a problem). The four items were summed to create a competing needs index that ranged from 0 to 12.

### **Vulnerable Need Components**

General health status was measured using an item from the SF-36 that asks participants to rate their health ranging from poor to excellent.<sup>77</sup> Answer options were collapsed into three categories: excellent or very good, good, and fair or poor.

### **Health Behavior**

*Smoking Status.* Participants were categorized as either smokers or quitters at weeks 8 (end of treatment) and 26 (follow-up) of the Power to Quit study. Participants were determined to be quitters using biochemically verified self-reported seven-day point prevalence abstinence from smoking, defined as having smoked no cigarettes during the previous seven days. Self-reported abstinence was verified using an expired carbon monoxide (CO) test (scores less than 10 p.p.m.). At 26 weeks, if the CO score was greater than 10 p.p.m., salivary cotinine was used to verify abstinence (scores less than 20 ng/ml). Both CO and cotinine testing are well-established methods of validating smoking status that have high sensitivity and specificity.<sup>108, 109</sup> Participants who had missing data

for smoking status were considered to be smokers. Participants who self-reported quitting but whose biochemical results indicated smoking were considered to be smokers.

### Analysis

This study includes baseline, week 8 (end of treatment), and week 26 (follow-up) data from male and female smokers in the Power to Quit study. All analyses were conducted using STATA version 13. Descriptive statistics were examined for potential predictors of cessation-related weight concern, including predisposing, enabling, and need components; cessation-related weight concern; and smoking status among males and females. Reliability was examined for each scale by calculating the Cronbach's alpha. For the two scales with low reliability (amotivation and perceived stress), we examined whether excluding any of the items would increase the reliability of the scales, but it did not. Distributions of all continuous variables were examined. Extreme outliers were replaced by the next highest value. Previous quit attempts had 11 outliers that were replaced and cigarettes per day had 2 outliers that were replaced.

The amount and pattern of missing data at weeks 8 and 26 were also examined. Twenty-five percent of data were missing at weeks 8 and 26. The missing data had an arbitrary pattern with participants either not responding to a particular survey or only missing a couple of items. Dropouts and individuals who remained in the study were found to have similar characteristics (Table 1). Therefore, we did not use any imputation methods and used all of the available data. Correlations between the potential predictors of cessation-related weight concern were examined in order to ensure that none of the potential predictors were highly correlated ( $r > 0.7$ ). Continuous, dichotomous, and ordinal variables were included in the correlation matrix. Intrinsic and extrinsic self-efficacy to

refrain from smoking were correlated ( $r=0.71$ ), which was expected since they are part of the same scale. Therefore, we decided to retain both variables.

A series of generalized estimating equations models (GEE) were conducted to identify baseline predictors of cessation-related weight concern at baseline, week 8, and week 26 among males and females. Each model contained variables from one type of component as the predictors: traditional predisposing, vulnerable predisposing, traditional enabling, vulnerable enabling, or vulnerable need. The outcome variable, cessation-related weight concern included data from all three time points, baseline, week 8, and week 26. All of the models were examined for the full sample and separately by gender. In order to determine which covariance pattern was most appropriate, we examined a correlation matrix with cessation-related weight concern at each of the three time points, variances at each time point, models using several covariance patterns, and model fit (QIC). Across-time correlations for cessation-related weight concern appeared to decay over time and the variances were different at each time point, indicating that an unstructured covariance pattern may be the most appropriate. However, the coefficients and standard errors were similar for models using independent, exchangeable, and unstructured covariance patterns, and the model fit for the independent model was the best. Since independent is the only covariance structure that provides an asymptotically unbiased result, the independent covariance pattern was chosen. A GEE model with all of the components included was examined to determine the effect of time on cessation-related weight concern.

Cessation-related weight concern (baseline, week 8, and week 26) was examined as a predictor of smoking status (week 8 and 26) using a series of logistic regression

models that controlled for treatment group. All of the models were examined for the full sample and separately by gender. Cessation-related weight concern at baseline and week 8 were examined as predictors of smoking status at weeks 8 and 26. Cessation-related weight concern at week 26 was examined as a predictor of smoking status at week 26.

## Results

Table 6 outlines the baseline descriptive statistics for the predisposing, enabling, and need components among homeless male (n=320) and female (n=110) smokers. The average age of participants was 45.3 among males and 41.7 among females. The greatest proportion of participants were Black (59% of males and 49% of females), had at least a high school education (78% of males and 75% of females), and were addicted to smoking (88% of males and 84% of females smoke within 30 minutes of waking). On average, participants smoked 19.1 (males) and 18.1 (females) cigarettes per day and had average BMIs of 29.4 (males) and 32.2 (females).

Table 7 outlines cessation-related weight concern at baseline, week 8, and week 26, and cessation at weeks 8 and 26 among males and females. At baseline, cessation-related weight concern was 25.3 among males and 32.3 among females. At 26-weeks follow-up, 8% of males and 5% of females quit smoking.

Baseline predictors of cessation-related weight concern at baseline, week 8, and week 26 among males and females are described in Tables 8 and 9, respectively. The regression results are presented separately by gender since there were differences in the types of variables that predicted cessation-related weight concern among males and females. Among males, traditional and vulnerable predisposing components and traditional and vulnerable enabling components from the Behavioral Model for

Vulnerable Populations were found to be associated with cessation-related weight concern (Table 8). Traditional predisposing components that were associated with higher cessation-related weight concern included older age ( $B=0.21, p=.009$ ), Black race ( $B=6.09, p=.001$ , Ref: White race), greater controlled motivation to quit ( $B=0.26, p=.016$ ), and higher BMI ( $B=0.42, p<.001$ ). The traditional predisposing component, high school or more education was associated with lower cessation-related weight concern ( $B=-4.22, p=.023$ ). The vulnerable predisposing component, depression was associated with higher cessation-related weight concern ( $B=0.49, p=.001$ ). The traditional enabling component, having health insurance was associated with higher cessation-related weight concern ( $B=4.49, p=.022$ ), whereas having a low monthly family income ( $< \$400$ ) was associated with lower cessation-related weight concern ( $B=-3.53, p=.039$ ). The vulnerable enabling component, having a case manager that helps get and coordinate care was associated with higher cessation-related weight concern ( $B=5.88, p=.002$ ).

Among females, traditional predisposing components from the Behavioral Model for Vulnerable Populations were found to be associated with cessation-related weight concern (Table 9). Traditional predisposing components that were associated with higher cessation-related weight concern included addiction to smoking (i.e., smoke within 30 minutes of waking) ( $B=7.91, p=.010$ ), greater cigarette consumption ( $B=0.22, p=.041$ ), greater importance to quit ( $B=1.47, p=.035$ ), greater controlled motivation to quit ( $B=0.39, p=.002$ ), and older age of smoking initiation ( $B=0.74, p=.003$ ). Traditional predisposing components that were associated with lower cessation-related weight concern included greater autonomous motivation to quit ( $B=-0.36, p=.041$ ) and greater support to quit from family ( $B=-3.29, p=.001$ ). Time was also associated with cessation-

related weight concern, which decreased over the course of the study among females ( $B_{8\text{Weeks}}=-4.53$ ,  $p=.006$ ;  $B_{26\text{Weeks}}=-6.32$ ,  $p=.001$ ).

The relationship between cessation-related weight concern at baseline, week 8, and week 26, and cessation at weeks 8 and 26 is described in Table 10. Cessation-related weight concern was not statistically significantly associated with cessation at any time point. The same results were found among males and females and therefore, findings from the full sample are presented.

### Discussion

This study examined prevalence of cessation-related weight concern and predictors of cessation-related weight concern among homeless male and female smokers in the Twin Cities, MN, who participated in the Power to Quit study. A primary finding was that homeless individuals experienced comparable levels of cessation-related weight concern, measured by the Weight Concern Scale or a variant of the scale, as domiciled populations, including both general and clinic populations.<sup>90, 94, 95, 100, 106</sup> Consistent with previous findings from the literature, we found that homeless females experienced greater levels of cessation-related weight concern than their male counterparts;<sup>90, 94, 95, 100, 106</sup> and predictors of cessation-related weight concern differed by gender.<sup>88, 89</sup> A new finding was that females experienced a decrease in cessation-related weight concern over the course of the study whereas cessation-related weight concern did not change statistically significantly among males. However, even with the decrease, cessation-related weight concern remained higher among females compared to males at 26-weeks follow-up.

As previously identified in the literature, traditional predisposing components were associated with cessation-related weight concern among males. For instance, older

age,<sup>96</sup> and higher BMI,<sup>90, 96, 100</sup> were associated with higher cessation-related weight concern. Black males had higher cessation-related weight concern compared to White males, but previous studies did not identify an association between race and weight concern.<sup>89, 96</sup> Research has found that Black men are at higher risk of weight gain after quitting compared to non-Black individuals,<sup>110</sup> which may indicate why Black men, if they have previously attempted to quit, have higher cessation-related weight concern. High school or more education was associated with lower cessation-related weight concern. Although one study among males did not identify an association between education and weight concern,<sup>96</sup> another study on both males and females found that greater education was associated with higher weight confidence, an item from the Weight Concern Scale that contributes to lower cessation-related weight concern.<sup>94</sup>

Greater controlled motivation to quit (i.e. quit in order to obtain a reward, avoid negative consequences, and/or avoid feeling guilty) was associated with higher cessation-related weight concern among males, which is not surprising since controlled motivation is typically associated with poorer health and wellbeing.<sup>70</sup> However, previous findings on the relationship between motivation to quit and cessation-related weight concern are mixed. A previous study among males found that greater motivation to quit, measured using one item that asked how motivated the participant was to stop smoking, was associated with lower cessation-related weight concern;<sup>89</sup> whereas a study that included both genders found that greater motivation to quit, measured by the stages of change, was associated with higher cessation-related weight concern.<sup>106</sup> These findings suggest that the relationship between motivation to quit and cessation-related weight concern may differ based on how motivation is measured.

An additional finding was that vulnerable predisposing and enabling components were also associated with cessation-related weight concern among males. The vulnerable predisposing component depression was associated with higher cessation-related weight concern, which is consistent with findings among females,<sup>103</sup> and a mixed sample of both males and females.<sup>106</sup> However, this relationship has not been previously found solely among males.<sup>89</sup> The traditional enabling component, having a low monthly family income (< \$400), was associated with lower cessation-related weight concern. Contrary to this finding, one previous study among males and females found that lower income was associated with less weight confidence, which contributes to higher cessation-related weight concern.<sup>94</sup> However, this finding was based on only one item from the Weight Concern Scale, rather than the full scale, and low income corresponded to the bottom third percentile of the population, as opposed to the very low cutoff of \$400 per month used in this study. We also found that the traditional enabling component, having health insurance and the vulnerable enabling component, having a case manager that helps get and coordinate care were associated with greater cessation-related weight concern. It has been documented that homeless individuals who have higher income, health insurance, and help in getting care are more likely to access health care.<sup>7, 42, 44, 51, 111, 112</sup> Homeless smokers who are accessing health care may be more health conscious and therefore more concerned about possible weight gain after quitting smoking.

Although both predisposing and enabling components were found to be associated with cessation-related weight concern among males, only traditional predisposing components were found to be associated with cessation-related weight concern among females. Further, all of the traditional predisposing components that were associated with



cessation-related weight concern among females were smoking characteristics. Consistent with previous literature among females, addiction to smoking,<sup>86,90,96</sup> greater cigarette consumption,<sup>86,102,104</sup> and less support to quit from family,<sup>103</sup> were all found to be associated with higher cessation-related weight concern. It has been hypothesized that since dependent smokers consume more nicotine, they may have experienced greater weight gain during previous quit attempts due to the greater impact of the removal of nicotine, which may help explain the relationship between cessation-related weight concern, and addiction to smoking and greater cigarette consumption.<sup>86</sup> It has also been hypothesized that receipt of social support to quit may influence an individual's perceptions about quitting smoking and possible weight gain after quitting.<sup>103</sup>

A new finding was that greater importance to quit was associated with higher cessation-related weight concern, which has not been previously tested. It is possible that individuals who have placed a greater importance on quitting may have greater intention to quit, which has been found to be associated with higher cessation-related weight concern among females.<sup>103</sup> Individuals who view quitting as important and intend to quit may be more knowledgeable about the possible effects of quitting, including weight gain, leading to higher cessation-related weight concern. Contrary to previous research among females, we found that older age of smoking initiation was associated with higher cessation-related weight concern. Previous research has identified no association between these characteristics and an inverse relationship between the characteristics.<sup>88,96</sup> However, fewer years of smoking has been identified as a correlate of higher cessation-related weight concern,<sup>88</sup> and it is likely that current smokers who initiated smoking at an

older age have smoked for a fewer number of years compared to current smokers who started smoking at a younger age.

As among males, we found that greater controlled motivation to quit was associated with higher cessation-related weight concern. Conversely, we found that greater autonomous motivation to quit (i.e., quitting is positively endorsed and valued by the individual) was associated with lower cessation-related weight concern, which is not surprising since autonomous motivation is typically associated with positive health, behavioral, and psychological outcomes.<sup>70</sup> Previous studies among females either did not find a relationship between motivation to quit and cessation-related weight concern,<sup>90</sup> or found an inverse relationship between the characteristics.<sup>86</sup> However, these studies measured general motivation to quit using either a single item,<sup>90</sup> or the stages of change,<sup>86</sup> further indicating that the relationship between motivation to quit and cessation-related weight concern differs based on how motivation is measured.

Lastly, we did not find cessation-related weight concern to be a predictor of cessation at the end of treatment or at follow-up among homeless males and females. Previous findings regarding the relationship between cessation-related weight concern and cessation have been mixed. Among the studies that measured cessation-related weight concern using the Weight Concern Scale, two studies did not find that cessation-related weight concern was prospectively associated with cessation.<sup>95, 106</sup> However, two other studies found that cessation-related weight concern may play an important role in cessation. One study found that current daily smokers have higher cessation-related weight concern than recent quitters, former smokers, and occasional smokers suggesting that weight concern may be a hindrance to successful quitting.<sup>100</sup> An additional study

found that overweight individuals with higher cessation-related weight concern were less likely to make a quit attempt.<sup>94</sup> Given these findings and the small number of quitters in this study, further research on cessation-related weight concern and its effect on quitting among the homeless is warranted.

### Limitations

One limitation is the relatively small sample size for this study and the large difference in the sample sizes for males (n=320) and females (n=110). The difference in the sample sizes is a limitation since there was more power to detect statistically significant findings in the analyses among males, which may be why we identified a greater number of predictors of cessation-related weight concern among males than among females. However, since this study and previous research has found that predictors of cessation-related weight concern are different among males and females,<sup>88</sup><sup>89</sup> it was important to conduct the analyses separately by gender. An additional limitation related to the issue of having a small sample size is that for several categorical variables, there are very small Ns for some of the categories (e.g., married or living with others marital status [12 males and 9 females], and other race [20 males and 14 females]). Having small sample sizes for some categories limits our ability to detect statistically significant differences in cessation-related weight concern between these categories and other categories within the variables.

A third limitation is that two scales that are included in this study had poor reliability. The Cronbach's alpha for the Perceived Stress Scale was 0.57 and 0.56 for amotivation to quit from the Treatment Self Regulation for Smoking questionnaire. Neither of these variables were predictors of cessation-related weight concern. The low

reliability of the two scales might indicate that the variables were not measuring the same unitary construct in this population, and this poor reliability may be the reason why associations with screening were null.

An additional limitation is that we did not control for shelter in the regression analyses. Although participants were recruited at seven different shelters and attended the same shelter where they enrolled into the study for all of their study visits, it is unlikely that clustering is an issue in this study. Participants in the study did not reside at the particular shelter where they attended study visits; rather they routinely obtained resources and slept at multiple shelters that participated in the study. This reduces the likelihood of a clustering effect.

A fifth limitation is that our measurement of cessation-related weight concern differed from that of other studies, thus limiting our ability to compare findings. For instance, some studies assessed cessation-related weight concern using a measure other than the Weight Concern Scale and studies that used the Weight Concern Scale either measured the scale differently (e.g., used a different likert scale) or reported their results differently (e.g., averaged the scores for items rather than summed or dichotomized the variable).

An additional limitation is that 25% of data were missing at weeks 8 and 26, which affects data on smoking status and cessation-related weight concern at these time points. Individuals who had missing data for smoking status at weeks 8 and 26 were considered to be smokers. For cessation-related weight concern, we decided to use all available data without any imputation methods since missing at random appears to be a reasonable assumption and there was not a statistically significant difference in cessation-

related weight concern at baseline among dropouts and those who remained in the study (Table 1).

A final limitation is that our sample may not be representative of the larger homeless smoker population, which limits the generalizability of our findings about the presence of cessation-related weight concern among homeless smokers. Although the study sample was found to be demographically representative of the larger homeless population in Minnesota, the study sample was self-selected for the tobacco cessation study and motivated to quit and thus may not be representative of homeless smokers generally.<sup>3, 38</sup>

### Conclusions

The amount of cessation-related weight concern that homeless individuals experience is comparable to other populations and higher among females than among males. Several different types of characteristics, including demographic variables, BMI, depression, income, and health insurance status were associated with cessation-related weight concern among males, whereas only smoking characteristics were associated with cessation-related weight concern among females. Although we did not find a statistically significant association between cessation-related weight concern and cessation, this finding should be tested again in a study with a larger number of quitters. Further research on the effect of cessation-related weight concern on quitting would be useful for determining whether tobacco cessation programs that target homeless smokers would benefit from including content on managing cessation-related weight concern.

Tables

**Table 6: Baseline Descriptive Statistics of Homeless Males and Females in the Power to Quit Study (N=430)**

Variable	Homeless Males		Homeless Females	
	N	Mean (SD) or N (%)	N	Mean (SD) or N (%)
<b>Traditional Predisposing Components</b>				
Demographic Characteristics				
Age	320	45.3 (9.3)	110	41.7 (11.2)
Marital status	319		109	
Married or living with others		12 (4%)		9 (8%)
Divorced/Widowed/Separated/Never married		307 (96%)		100 (92%)
Social Structure				
Race	320		110	
White		111 (35%)		42 (38%)
Black		189 (59%)		54 (49%)
Other		20 (6%)		14 (13%)
Education $\geq$ high school graduate or GED	320	248 (78%)	110	82 (75%)
Smoking Characteristics				
Time to first cigarette, $\leq$ 30 min	320	282 (88%)	110	92 (84%)
Number of quit attempts, past year	315	2.2 (3.4)	109	2.0 (2.6)
Cigarettes smoked per day	317	19.1 (10.3)	110	18.1 (11.8)
Importance to quit, scale 0-10	320	9.0 (1.6)	110	9.2 (1.6)
Self-efficacy to refrain from smoking				
Intrinsic, scale 6-30	320	17.2 (6.7)	109	16.2 (6.9)
Extrinsic, scale 6-30	318	16.8 (7.9)	108	16.8 (7.7)
Motivation to quit				
Controlled motivation, scale 6-42	320	18.1 (9.6)	110	18.5 (9.3)
Autonomous motivation, scale 6-42	320	36.6 (6.7)	110	37.2 (6.1)

<b>Table 6: Baseline Descriptive Statistics of Homeless Males and Females in the Power to Quit Study (N=430) Continued</b>					
<b>Variable</b>	<b>Homeless Males</b>		<b>Homeless Females</b>		
	<b>N</b>	<b>Mean (SD) or N (%)</b>	<b>N</b>	<b>Mean (SD) or N (%)</b>	<b>N (SD) or N (%)</b>
Amotivation, scale 3-21	320	8.0 (4.6)	110	8.1 (4.5)	
Cigarettes smoked per day, compared to 1 year ago	320		110		
Fewer		85 (27%)		22 (20%)	
Same		110 (34%)		41 (37%)	
More		125 (39%)		47 (43%)	
Number of days smoked per week, compared to 1 year ago	319		110		
Fewer		35 (11%)		10 (9%)	
Same		213 (67%)		66 (60%)	
More		71 (22%)		34 (31%)	
Age of smoking initiation	319	16.3 (6.0)	110	15.9 (5.4)	
Support to quit (scale 0-3) from:					
Family	319	1.3 (1.3)	110	1.9 (1.3)	
Friends or work colleagues	320	0.8 (1.1)	110	1.3 (1.2)	
Case workers	319	0.6 (1.1)	110	1.2 (1.3)	
BMI	317	29.4 (7.4)	109	32.2 (8.0)	
<b>Vulnerable Predisposing Components</b>					
Substance Use					
Current drug use in the past 30 days*	318	134 (42%)	109	34 (31%)	
Risky alcohol use (>1 drink a day for females, >2 drinks a day for males)	320	36 (11%)	110	18 (16%)	
Length of time homeless	319		110		
<1 year		157 (49%)		58 (53%)	
1-3 years		113 (36%)		38 (34%)	
>3 years		49 (15%)		14 (13%)	

<b>Table 6: Baseline Descriptive Statistics of Homeless Males and Females in the Power to Quit Study (N=430) Continued</b>					
<b>Variable</b>	<b>Homeless Males</b>		<b>Homeless Females</b>		
	<b>N</b>	<b>Mean (SD) or N (%)</b>	<b>N</b>	<b>Mean (SD) or N (%)</b>	<b>N (%)</b>
Mental Health					
Experienced anxiety, past 6 months	318	189 (59%)	110	76 (69%)	
Depression, scale 0-27	318	8.0 (6.3)	110	9.8 (6.6)	
Perceived stress, scale 0-16	318	6.6 (3.1)	110	7.1 (2.9)	
<b>Traditional Enabling Components</b>					
Health insured	320	262 (82%)	110	91 (83%)	
Monthly family income < \$400	320	221 (69%)	110	72 (65%)	
<b>Vulnerable Enabling Components</b>					
Have a case manager that helps get and coordinate care	305	76 (25%)	106	51 (48%)	
Competing needs, scale 0-12	319	4.0 (3.1)	110	4.1 (3.4)	
<b>Vulnerable Need Components</b>					
General health status	319		109		
Excellent/Very good		144 (45%)		36 (33%)	
Good		103 (32%)		41 (38%)	
Fair/Poor		72 (23%)		32 (29%)	

\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription



**Table 7: Cessation-related Weight Concern and Cessation among Homeless Males and Females in the Power to Quit Study (N=430)**

Variable	Homeless Males		Homeless Females	
	N	Mean (SD) or N (%)	N	Mean (SD) or N (%)
Baseline cessation-related weight concern, scale 0-60	320	25.3 (16.6)	110	32.3 (13.8)
Week 8 cessation-related weight concern, scale 0-60	242	25.0 (17.9)	83	29.7 (17.0)
Week 26 cessation-related weight concern, scale 0-60	243	24.5 (17.2)	81	27.9 (17.5)
Week 8 quitters*	320	31 (10%)	110	8 (7%)
Week 26 quitters*	320	27 (8%)	110	5 (5%)

\*Participants with missing data were considered to be smokers

**Table 8: Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Males in the Power to Quit Study (N=320)**

Variable	B	P-Value
Time, 8 weeks	-0.32	.790
Time, 26 weeks	-1.31	.286
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age	<b>0.21</b>	<b>.009</b>
Marital status		
Married or living with others	0.24	.942
Divorced/Widowed/Separated/Never married	Ref	
Social Structure		
Race		
White	Ref	
Black	<b>6.09</b>	<b>.001</b>
Other	4.21	.190
Education $\geq$ high school graduate or GED	<b>-4.22</b>	<b>.023</b>
Smoking Characteristics		
Time to first cigarette, $\leq$ 30 min	-0.68	.769
Number of quit attempts, past year	-0.06	.823
Cigarettes smoked per day	-0.05	.498
Importance to quit, scale 0-10	-0.15	.731
Self-efficacy to refrain from smoking		
Intrinsic, scale 6-30	-0.13	.481
Extrinsic, scale 6-30	0.06	.686
Motivation to quit		
Controlled motivation, scale 6-42	<b>0.26</b>	<b>.016</b>
Autonomous motivation, scale 6-42	-0.12	.325
Amotivation, scale 3-21	0.25	.187

<b>Table 8: Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Males in the Power to Quit Study (N=320) Continued</b>		
<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Cigarettes smoked per day, compared to 1 year ago		
Fewer	2.41	.324
Same	-0.78	.707
More	Ref	
Number of days smoked per week, compared to 1 year ago		
Fewer	-2.45	.462
Same	-3.33	.165
More	Ref	
Age of smoking initiation	-0.01	.918
Support to quit (scale 0-3) from:		
Family	-0.56	.407
Friends or work colleagues	-0.12	.885
Case workers	1.10	.148
<b>BMI</b>	<b>0.42</b>	<b>&lt;.001</b>
<b>Vulnerable Predisposing Components</b>		
<b>Substance Use</b>		
Current drug use in the past 30 days*	-2.21	.175
Risky alcohol use (>1 drink a day for females, >2 drinks a day for males)	-4.03	.129
Length of time homeless		
<1 year	-1.44	.550
1-3 years	2.41	.351
>3 years	Ref	
<b>Mental Health</b>		
Experienced anxiety, past 6 months	0.17	.926
Depression, scale 0-27	<b>0.49</b>	<b>.001</b>
Perceived stress, scale 0-16	0.00	.995
<b>Traditional Enabling Components</b>		
Health insured	<b>4.49</b>	<b>.022</b>
Monthly family income < \$400	<b>-3.53</b>	<b>.039</b>
<b>Vulnerable Enabling Components</b>		
Have a case manager that helps get and coordinate care	<b>5.88</b>	<b>.002</b>
Competing needs, scale 0-12	-0.01	.961
<b>Vulnerable Need Components</b>		
General health status		
Excellent/Very good	-3.78	.057
Good	-2.36	.251
Fair/Poor	Ref	

Note: Separate models were examined for each type of component.

\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription

**Table 9: Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Females in the Power to Quit Study (N=110)**

<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Time, 8 weeks	<b>-4.53</b>	<b>.006</b>
Time, 26 weeks	<b>-6.32</b>	<b>.001</b>
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age	0.17	.156
Marital status		
Married or living with others	0.16	.969
Divorced/Widowed/Separated/Never married	Ref	
Social Structure		
Race		
White	Ref	
Black	-0.39	.885
Other	1.59	.601
Education $\geq$ high school graduate or GED	0.92	.703
Smoking Characteristics		
Time to first cigarette, $\leq$ 30 min	<b>7.91</b>	<b>.010</b>
Number of quit attempts, past year	-0.38	.321
Cigarettes smoked per day	<b>0.22</b>	<b>.041</b>
Importance to quit, scale 0-10	<b>1.47</b>	<b>.035</b>
Self-efficacy to refrain from smoking		
Intrinsic, scale 6-30	0.05	.853
Extrinsic, scale 6-30	-0.02	.922
Motivation to quit		
Controlled motivation, scale 6-42	<b>0.39</b>	<b>.002</b>
Autonomous motivation, scale 6-42	<b>-0.36</b>	<b>.041</b>
Amotivation, scale 3-21	0.25	.494
Cigarettes smoked per day, compared to 1 year ago		
Fewer	0.83	.835
Same	-2.37	.505
More	Ref	
Number of days smoked per week, compared to 1 year ago		
Fewer	4.18	.480
Same	0.64	.850
More	Ref	
Age of smoking initiation	<b>0.74</b>	<b>.003</b>
Support to quit (scale 0-3) from:		
Family	<b>-3.29</b>	<b>.001</b>
Friends or work colleagues	0.08	.956
Case workers	0.48	.660
BMI	0.03	.797

**Table 9: Baseline Predictors of Cessation-related Weight Concern at Baseline, Week 8, and Week 26 among Females in the Power to Quit Study (N=110) Continued**

Variable	B	P-Value
<b>Vulnerable Predisposing Components</b>		
Substance Use		
Current drug use in the past 30 days*	-0.42	.896
Risky alcohol use (>1 drink a day for females, >2 drinks a day for males)	-2.25	.535
Length of time homeless		
<1 year	-0.97	.784
1-3 years	-2.74	.480
>3 years	Ref	
Mental Health		
Experienced anxiety, past 6 months	-1.47	.635
Depression, scale 0-27	0.28	.190
Perceived stress, scale 0-16	0.27	.576
<b>Traditional Enabling Components</b>		
Health insured	2.17	.514
Monthly family income < \$400	-0.45	.879
<b>Vulnerable Enabling Components</b>		
Have a case manager that helps get and coordinate care	-2.18	.407
Competing needs, scale 0-12	-0.38	.380
<b>Vulnerable Need Components</b>		
General health status		
Excellent/Very good	5.22	.104
Good	4.98	.125
Fair/Poor	Ref	

Note: Separate models were examined for each type of component.

\* Marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription

**Table 10: Relationship between Cessation-related Weight Concern and Cessation Controlling for Treatment Group among Participants in the Power to Quit Study (n=430)**

	OR (95% CI) P-value	
	Week 8 cessation	Week 26 cessation
Baseline cessation-related weight concern	0.99 (0.97, 1.02) p=.602	0.99 (0.97, 1.02) p=.587
Week 8 cessation-related weight concern	1.02 (1.00, 1.04) p=.130	1.01 (0.98, 1.03) p=.580
Week 26 cessation-related weight concern	-	1.00 (0.98, 1.03) p=.733

Note: Relationships were examined separately by gender but the effects were the same.

### **Research Study 3: Trends in smoking characteristics among homeless smokers participating in a smoking cessation RCT**

#### Abstract

High self-efficacy to quit facilitates successful smoking cessation and smoking urges represent a barrier to quitting. Self-efficacy to quit and smoking urges are dynamic with changes affecting quitting. This study examines changes in smoking characteristics (i.e., self-efficacy to refrain from smoking, confidence to quit, and smoking urges) over the course of a smoking cessation randomized controlled trial.

Homeless smokers (n=430) completed surveys at baseline, and weeks 1, 2, 4, 6, 8, and 26 on demographics, smoking characteristics, and smoking status. A growth curve analysis was conducted by modeling change in smoking characteristics over time and examining the variability in change in smoking characteristics. We examined the relationship between change in smoking characteristics and smoking status at 26-weeks.

Self-efficacy to refrain from smoking increased linearly over time with racial minorities experiencing greater increases. Confidence to quit increased until the midpoint of treatment but subsequently decreased. Blacks had higher confidence to quit than Whites. Smoking urges decreased until the midpoint of treatment but subsequently increased. Change in the smoking characteristics over time did not predict smoking status at 26-weeks. Individuals with higher self-efficacy to refrain from smoking at baseline were more likely to quit at 26-weeks. Higher levels of self-efficacy to refrain from smoking across all time points was observed among quitters at 26-weeks compared to smokers.

Efforts should be made to increase self-efficacy to refrain from smoking among participants with low self-efficacy given its relationship with quitting. Determining strategies to sustain high confidence to quit and low smoking urges throughout treatment could be the key to promoting cessation among the homeless.

### Introduction

Approximately 75% of homeless smokers indicate a desire to quit smoking.<sup>113, 114</sup> However, homeless smokers face difficulty quitting and maintaining abstinence long-term.<sup>28, 38, 115</sup> Homeless smokers may even have more difficulty with cessation compared to smokers in general due to high rates of comorbidities (e.g., depression, alcohol use, and other substance use), competing challenges (e.g., seeking shelter and food), and high levels of nicotine dependence.<sup>38</sup> Nevertheless, few studies have examined factors that influence cessation among homeless smokers.<sup>116</sup>

In studies among other populations it has been found that high self-efficacy to quit facilitates successful smoking cessation,<sup>117, 118, 119</sup> and that individuals with higher self-efficacy to quit find more success quitting permanently than individuals with lower self-efficacy to quit.<sup>118</sup> Homeless smokers have been found to report lower self-efficacy to quit compared to domiciled socioeconomically disadvantaged smokers, which likely contributes to their difficulty quitting.<sup>120</sup> In addition to self-efficacy to quit, smoking urges have been identified as being related to smoking status. For instance, having smoking urges has been found to be a principal cause of addictive smoking and relapse,<sup>121, 122</sup> and a barrier to smoking cessation.<sup>123</sup> Among homeless smokers, smoking urges have been identified as an important barrier to cessation.<sup>124</sup>

Relying on measurement of self-efficacy to quit and smoking urges at a single time point is likely inadequate for prediction of smoking cessation, as these factors are dynamic, with changes affecting smoking status.<sup>125, 126</sup> Previous research has found that individuals who quit smoking during treatment exhibit increases in self-efficacy to quit during the course of treatment,<sup>127</sup> and high self-efficacy to quit from post-treatment to follow-up.<sup>128</sup> Further, individuals with high self-efficacy to quit at baseline tend to have high self-efficacy to quit from post-treatment to follow-up.<sup>128</sup> However, for most individuals, self-efficacy to quit decreases from post-treatment to follow-up.<sup>128</sup>

Research on trends in smoking urges during treatment has found that individuals who quit smoking exhibit steady drops in smoking urges during the first two weeks after cessation,<sup>126</sup> and that smoking urges increase linearly leading up to relapse.<sup>121, 129</sup> Further, there is a strong negative association over time between smoking urges and self-efficacy to quit,<sup>126</sup> with decreasing self-efficacy to quit during a quit attempt followed by increased smoking urges, which contribute to smoking relapse.<sup>130, 131</sup> A complimentary explanation is that strong smoking urges may undermine self-efficacy to quit.<sup>126, 132</sup>

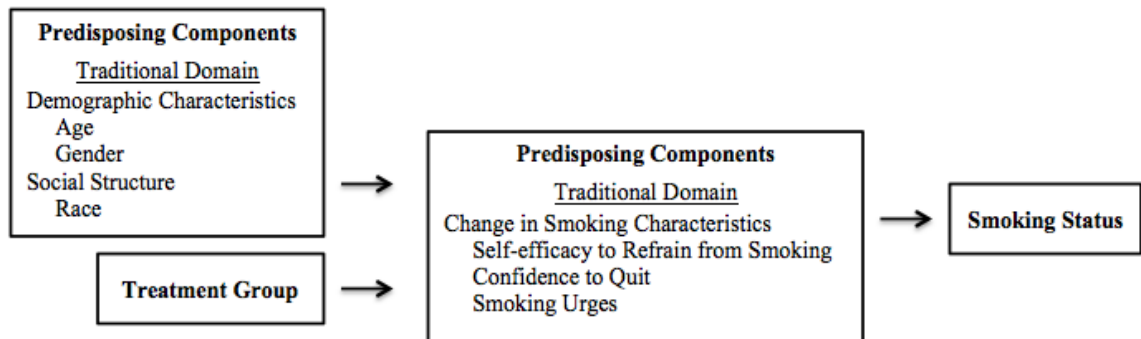
There has been one study that examined trends in self-efficacy to quit and smoking urges among the homeless during treatment, but this study did not find that change in self-efficacy to quit and smoking urges were associated with quitting.<sup>116</sup> However, this study included a small sample size of 57 participants and only included data over one week before the participants' quit date. Exploring changes in self-efficacy to quit and smoking urges over a longer period of time and among a larger sample of homeless individuals will help to uncover trends in these factors and the true relationship between self-efficacy to quit, smoking urges, and cessation among the homeless.

This study examines changes in smoking characteristics, a traditional predisposing component, among homeless individuals in the Twin Cities, MN. The aims of this study are to 1) describe smoking status and traditional predisposing components including age, gender, race, and smoking characteristics (i.e., smoking urges and two measures of self-efficacy to quit, self-efficacy to refrain from smoking and confidence to quit), 2) examine change in smoking characteristics over the course of the smoking cessation intervention, 3) determine whether treatment group, age, gender, and race are predictors of change in smoking characteristics, and 4) evaluate if change in smoking characteristics is a predictor of smoking status at 26-weeks follow-up of the Power to Quit study among homeless smokers.

Although confidence to quit and self-efficacy to refrain from smoking are both measures of self-efficacy to quit, they measure different components of self-efficacy to quit. The former measures general self-efficacy to quit completely and the latter measures self-efficacy to not smoke in particular situations without asking about complete cessation. It has been indicated that self-efficacy is a multidimensional structure where general self-efficacy can be high yet self-efficacy can be low in specific situations.<sup>133</sup> Therefore, we examine both in this study. The conceptual model guiding this study, which includes components from the Behavioral Model for Vulnerable Populations, is included in Figure 4.



Figure 4. Potential Predictors of Change in Smoking Characteristics: Components of the Behavioral Model for Vulnerable Populations Relevant to this Study



## Methods

### Power to Quit Study

The Power to Quit study was a randomized controlled trial of 430 homeless adult smokers that assessed the effectiveness of motivational interviewing (MI) for smoking cessation.<sup>38,39</sup> At baseline participants were randomized to an intervention arm, nicotine patch plus MI, or a control arm, nicotine patch plus standard care (SC). Intervention participants received six individual MI counseling sessions each lasting 15-20 minutes, which focused on encouraging smoking cessation and nicotine replacement therapy adherence. Control participants received a one-time advice session on quitting smoking lasting 10-15 minutes. Participants in both conditions received 21mg nicotine patches for eight weeks. Surveys were administered at baseline and weeks 1, 2, 4, 6, 8 (end of treatment), and 26 (follow-up).

### Measures

#### **Traditional Predisposing Components**

*Smoking Characteristics.* Self-efficacy to refrain from smoking was measured at baseline, week 8, and week 26 using the Smoking Self-Efficacy Questionnaire (SEQ-12),

which measures both intrinsic and extrinsic self-efficacy to refrain from smoking.<sup>107</sup> Participants were asked to indicate how sure they are that they could refrain from smoking in a number of situations that are either intrinsic (e.g., when I feel depressed) or extrinsic (e.g., when having drinks with friends) on a scale ranging from 1 (not at all sure) to 5 (absolutely sure). There are six items that measure each type of self-efficacy, which were summed to create two scales that ranged from 6 to 30, with higher scores indicating greater self-efficacy. The Cronbach's alpha for the intrinsic self-efficacy to refrain from smoking items was 0.87 at baseline, 0.88 at week 8, and 0.89 at week 26, indicating good reliability. The Cronbach's alpha for the extrinsic self-efficacy to refrain from smoking items was 0.88 at baseline, 0.87 at week 8, and 0.89 at week 26, indicating good reliability. The SEQ-12 was found to be valid among a general population of smokers.<sup>107</sup>

Confidence to quit was measured at all time points (i.e., baseline and weeks 1, 2, 4, 6, 8, and 26) by asking participants to report how confident they are that they could quit smoking completely or stay quit if they wanted to on a scale of 0 (not confident) to 10 (extremely confident). Smoking urges was measured at all time points using the Questionnaire of Smoking Urges (QSU-Brief).<sup>134</sup> Participants were asked to indicate the extent that they agree or disagree with 10 statements about their smoking urges (e.g., I have a desire for a cigarette right now; I would do almost anything for a cigarette right now). Answer options ranged from 1 (strongly disagree) to 7 (strongly agree). All 10 items were summed to create a scale, which ranged from 10 to 70, with higher scores indicating greater smoking urges. The Cronbach's alpha for these items at each time point ranged from 0.92 to 0.96, indicating excellent reliability. Validity of the QSU-brief was

demonstrated in a general population of smokers in the U.S. and a group of participants in a smoking cessation program.<sup>134</sup>

*Demographic Characteristics.* Participants were asked their date of birth, which was used to calculate their age at baseline. Age was dichotomized using a median split for the growth curve analysis. Gender was assessed by asking participants if they self-identify as male, female, or other (specify).

*Social Structure.* Participants were asked to report their race/ethnicity (Black, Asian/Pacific Islander, Hispanic, Native American/Alaskan Native, and/or White). Race was collapsed into White, Black, or other.

### **Health Behavior**

*Smoking Status.* Participants were categorized as either smokers or quitters at 26-weeks follow-up of the Power to Quit study. Participants were determined to be quitters using biochemically verified self-reported seven-day point prevalence abstinence from smoking, defined as having smoked no cigarettes during the previous seven days. Self-reported abstinence was verified using an expired carbon monoxide (CO) test (scores less than 10 p.p.m.). If the CO score was greater than 10 p.p.m., salivary cotinine was used to verify abstinence (scores less than 20 ng/ml). Both CO and cotinine testing are well-established methods of validating smoking status that have high sensitivity and specificity.<sup>108, 109</sup> Participants who had missing data for smoking status were considered to be smokers. Participants who self-reported quitting but whose biochemical results indicated smoking were considered to be smokers.

## Analysis

This study includes data from baseline and weeks 1, 2, 4, 6, 8, and 26 from male and female smokers in the Power to Quit study. All analyses were conducted using STATA version 13.

Descriptive statistics were examined for the smoking characteristics at each time point; smoking status at week 26; and age, gender, and race at baseline. Reliability was examined for all scales by calculating the Cronbach's alpha at each time point. Distributions of the continuous variables at all time points were examined. Confidence to quit, smoking urges, and self-efficacy to refrain from smoking were not normally distributed. We examined whether transforming the variables using several types of transformations (e.g., cubic, square, square root, and log) would result in normally distributed variables (STATA v13 Ladder). Transformation did not improve the distributions of confidence to quit and self-efficacy to refrain from smoking. A log transformation did improve the distribution of smoking urges.

The amount and pattern of missing data were also examined. Twenty-five percent of data were missing at weeks 6, 8, and 26. The missing data had an arbitrary pattern with participants either not responding to a particular survey or only missing a couple of items. Dropouts and individuals who remained in the study were found to have similar characteristics (Table 1). Therefore, we did not use any imputation methods and all of the available data were used.

A growth curve analysis was conducted. In the first phase of the analysis, we modeled the change in smoking characteristics over time. Intrinsic and extrinsic self-efficacy to refrain from smoking were measured at three time points (baseline, week 8,

and week 26) and we were therefore limited to estimating a linear trajectory. Confidence to quit and smoking urges were measured at over five time points (baseline and weeks 1, 2, 4, 6, 8, and 26) and we were therefore able to estimate a curving, nonmonotonic trajectory. All of the variables were measured the same at each time point. For each of the variables, we examined plots displaying a sample of participants' trajectories (n=200) in order to examine change in the smoking characteristics over time.

We estimated unconditional models using general linear mixed models and unstructured covariance patterns. For each smoking characteristic, we compared the estimated models by examining model fit criteria (i.e., AIC and -2LL) and the model parameters (i.e., significance of parameters) to select the best fitting model. We plotted the average growth curve using the best fitting model for each smoking characteristic. We conducted the first phase of the growth curve analysis for both smoking urges and log transformed smoking urges and the results were the same. This is likely because growth curve models are robust against non-normality. Therefore, we used the raw data.

In the second phase of the growth curve analysis, we examined the variability in change in smoking characteristics over time by regressing the intercept and slope(s) from the best fitting models on treatment group, age, gender, and race. We plotted the average growth curve for each smoking characteristic by the statistically significant predictors.

Lastly, we examined the relationship between change in smoking characteristics over time and smoking status. The intercept(s) and slope(s) for each smoking characteristic from the best fitting models identified in the growth curve analysis were entered into a logistic regression model as predictors of smoking status at 26-weeks follow-up, controlling for treatment group. For intrinsic and extrinsic self-efficacy to

refrain from smoking, the intercept was the predicted value from baseline and the slope was the difference between the week 26 predicted value and the baseline predicted value. For confidence to quit and smoking urges, there were two intercepts, the predicted value from baseline and the predicted value from week 4. There were also two slopes, the difference between the week 4 predicted value and the baseline predicted value and the difference between the week 6 predicted value and the week 4 predicted value. We examined change from baseline to week 4 and week 4 to week 6 based on the findings from the growth curve analysis. We plotted the average growth curve for each smoking characteristic by smoking status (i.e., smoker vs. quitter). Predicted values of the smoking characteristics at each time point were examined by smoking status using t-tests.

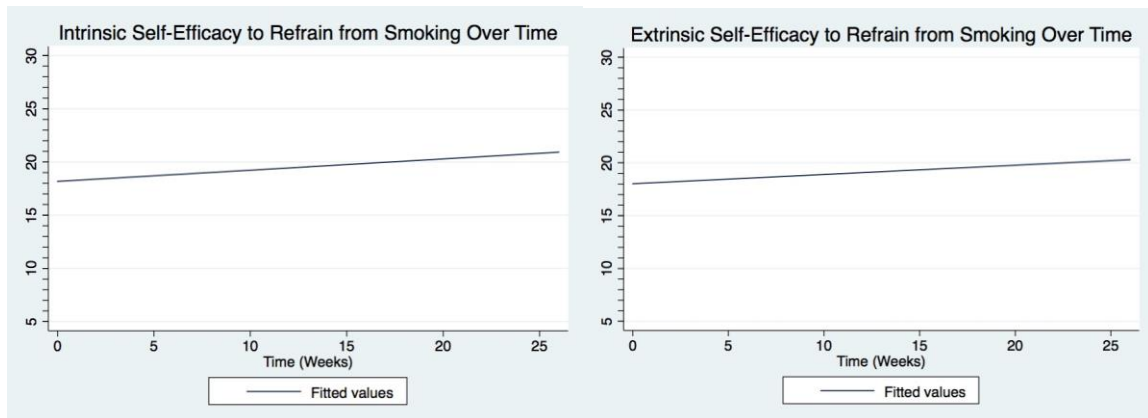
## Results

Participants in the Power to Quit study (n=430) were an average of 44 years of age (mean=44.4, SD=9.9) and 74% were male (n=320). Fifty-six percent of participants were Black (n=243), 36% were White (n=153), and 8% were of another race (n=34). Table 11 outlines the smoking characteristics of homeless smokers over the course of the study. Intrinsic self-efficacy to refrain from smoking was on average 16.9 (scale 6-30) at baseline and 20.2 at 26-weeks follow-up. Extrinsic self-efficacy to refrain from smoking was on average 16.8 (scale 6-30) at baseline and 19.6 at 26-weeks follow-up. Confidence to quit was on average 7.3 (scale 0-10) at baseline and 7.7 at 26-weeks follow-up. Smoking urges was on average 39.8 (scale 10-70) at baseline and 19.7 at 26-weeks follow-up. Only 7% of smokers (n=32) quit at 26-weeks follow-up.

For both intrinsic and extrinsic self-efficacy to refrain from smoking, the random intercept, random linear time models provided the best fit to the data. Figure 5 shows the

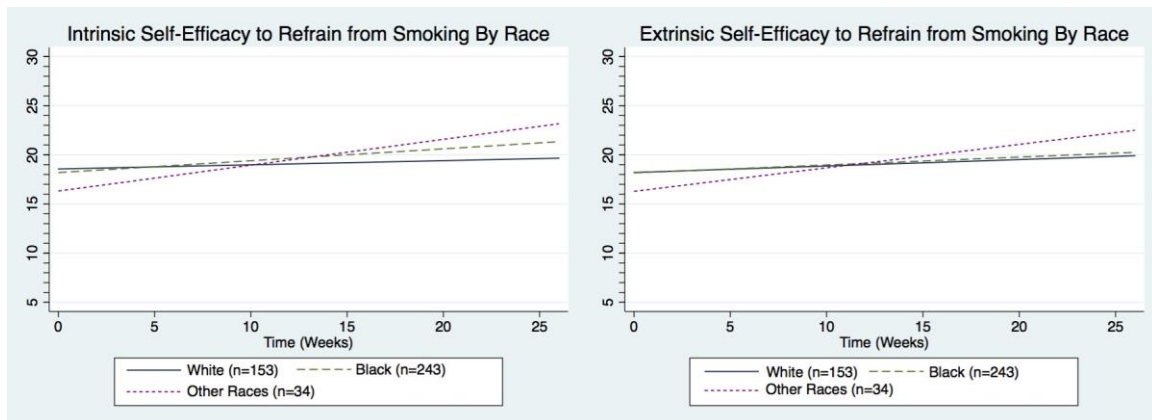
average trajectories of intrinsic and extrinsic self-efficacy to refrain from smoking over the course of the study, which increase linearly over time.

Figure 5. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking among Homeless Smokers Over the Course of the Power to Quit Study (N=430)



Tables 12 and 13 outline predictors of change in intrinsic and extrinsic self-efficacy to refrain from smoking over time. Race was the only predictor that was associated with change in intrinsic ( $B_{\text{Black vs. White}} = 0.08$ ,  $p=.037$ ;  $B_{\text{Other Race vs. White}} = 0.22$ ,  $p=.004$ ) and extrinsic ( $B_{\text{Other Race vs. White}} = 0.17$ ,  $p=.040$ ) self-efficacy to refrain from smoking over time. Figure 6 shows differences in intrinsic and extrinsic self-efficacy to refrain from smoking over time by race.

Figure 6. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking by Race among Homeless Smokers Over the Course of the Power to Quit Study (N=430)



Blacks experienced a greater increase in intrinsic self-efficacy to refrain from smoking over time than Whites. At baseline, Blacks had predicted intrinsic self-efficacy to refrain from smoking that was 0.37 lower than Whites (18.19 vs. 18.56); however, at 26-weeks follow-up Blacks had predicted intrinsic self-efficacy to refrain from smoking that was 1.67 higher than Whites (21.33 vs. 19.66). Individuals of other race experienced the greatest increase in predicted intrinsic self-efficacy to refrain from smoking, from 16.32 at baseline to 23.16 at 26-weeks follow-up. Whites and Blacks did not differ in predicted extrinsic self-efficacy to refrain from smoking over time. Individuals of other race experienced a greater increase in predicted extrinsic self-efficacy to refrain from smoking over time from 16.29 at baseline to 22.49 at 26-weeks follow-up.

For confidence to quit, the random intercept, random cubic time model provided the best fit to the data. Figure 7a shows the trajectory of confidence to quit over the course of the study, which has a cubic trajectory over time, with increases in confidence to quit during the beginning of treatment and decreases in confidence to quit from the end of treatment (week 8) to 26-weeks follow-up. Since the majority of the change in



confidence to quit occurred up until week 6, we examined confidence to quit from baseline to week 6. The random intercept, fixed quadratic time model provided the best fit to the data. Figure 7b shows the trajectory of confidence to quit from baseline to week 6. Confidence to quit increased from baseline to week 4 and decreased from week 4 to week 6.

Figures 7a and 7b. Confidence to Quit among Homeless Smokers from Baseline to Week 26 and Baseline to Week 6 of the Power to Quit Study (N=430)

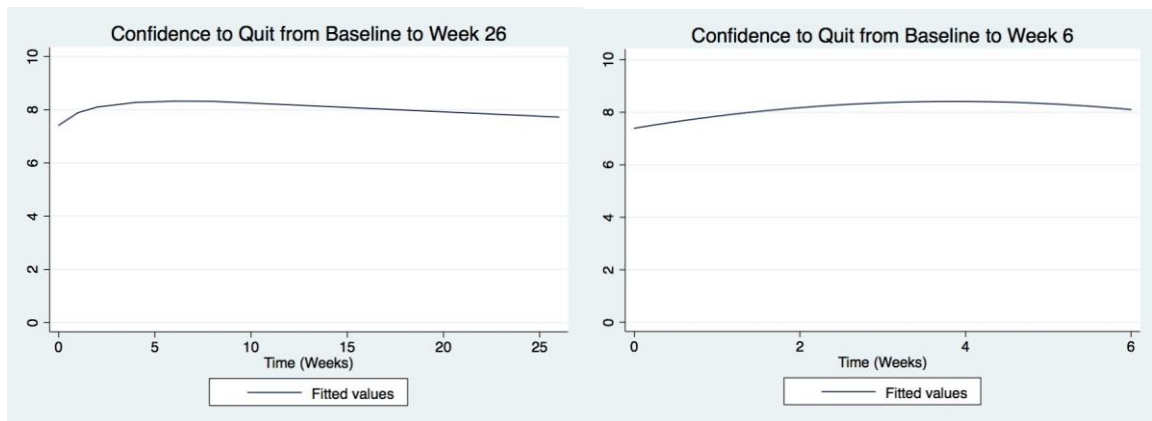
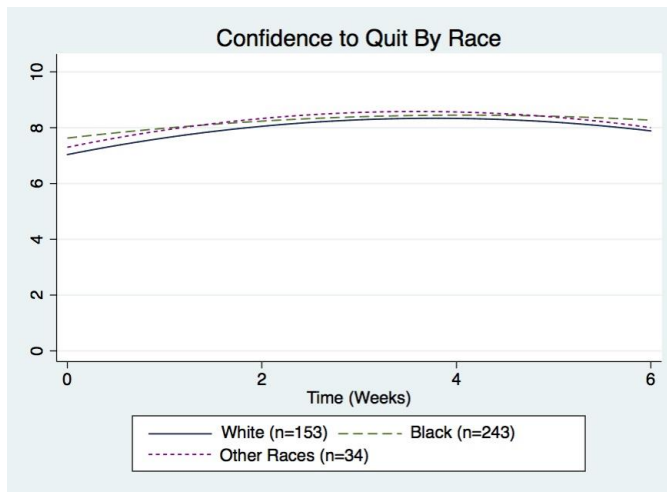


Table 14 outlines predictors of change in confidence to quit from baseline to week 6. Race was the only predictor that was associated with baseline confidence to quit ( $B_{\text{Black vs. White}} = 0.62, p=.002$ ), linear change in confidence to quit over time ( $B_{\text{Black vs. White}} = -0.31, p=.020$ ), and quadratic change in confidence to quit over time ( $B_{\text{Black vs. White}} = 0.04, p=.040$ ). Figure 8 shows differences in confidence to quit from baseline to week 6 by race.

Figure 8. Confidence to Quit by Race among Homeless Smokers from Baseline to Week 6 of the Power to Quit Study (N=430)



Whites and individuals of other race did not differ in predicted confidence to quit from baseline to week 6. However, Blacks experienced less change in predicted confidence to quit than Whites (i.e., their trajectory was ‘flatter’) and consistently had higher confidence to quit. Compared to Whites, Blacks had 0.59 higher predicted confidence to quit at baseline (7.63 vs. 7.04), 0.12 higher predicted confidence to quit at week 4 (8.45 vs. 8.33), and 0.38 higher predicted confidence to quit at week 6 (8.27 vs. 7.89). Whites experienced a greater decrease in predicted confidence to quit from week 4 to 6 than Blacks (-0.44 vs. -0.18).

For smoking urges, the random intercept, fixed cubic time model provided the best fit to the data. Figure 9a shows the trajectory of smoking urges over the course of the study, which has a cubic trajectory over time, with decreases in smoking urges during the beginning of treatment and increases in smoking urges from the end of treatment (week 8) to 26-weeks follow-up. Since the majority of the change in smoking urges occurred up until week 6, we examined smoking urges from baseline to week 6. The random

intercept, fixed quadratic time model provided the best fit to the data. Figure 9b shows the trajectory of smoking urges from baseline to week 6. Smoking urges decreased from baseline to week 4 and increased from week 4 to week 6.

Figures 9a and 9b. Smoking Urges among Homeless Smokers from Baseline to Week 26 and Baseline to Week 6 of the Power to Quit Study (N=430)

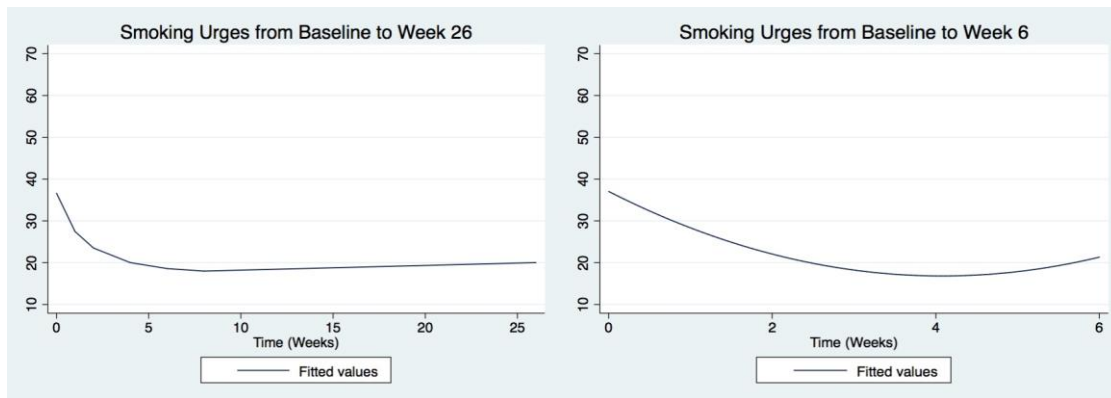
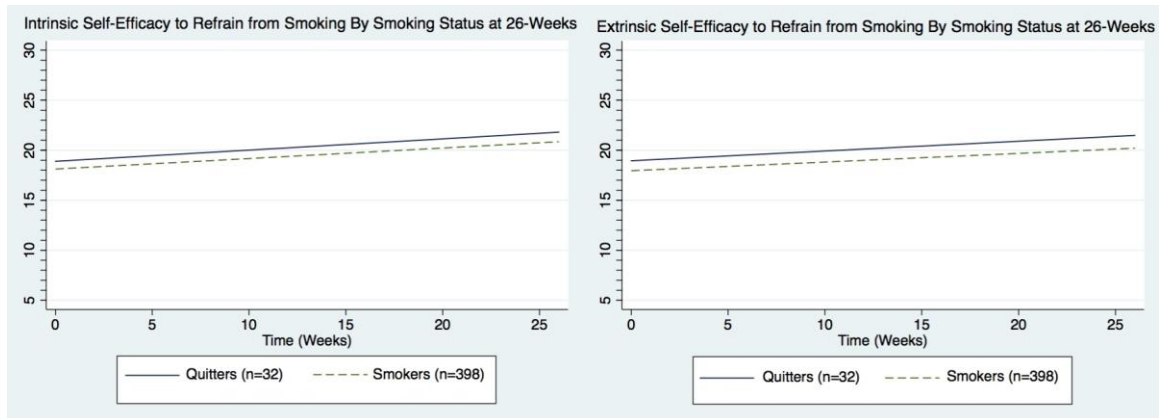


Table 15 outlines predictors of change in smoking urges from baseline to week 6. None of the predictors were associated with change in smoking urges over time.

Table 16 outlines the relationship between change in the smoking characteristics over time and smoking status at 26-weeks follow-up. Change in the smoking characteristics over time and predicted smoking urges and confidence to quit at baseline and week 4 were not associated with smoking status. However, predicted intrinsic and extrinsic self-efficacy to refrain from smoking at baseline were statistically significantly associated with smoking status. For each unit increase in intrinsic self-efficacy to refrain from smoking at baseline, odds of quitting smoking were 1.62 times higher. For each unit increase in extrinsic self-efficacy to refrain from smoking at baseline, odds of quitting smoking were 1.61 times higher. Figure 10 shows differences in intrinsic and extrinsic self-efficacy to refrain from smoking over time by smoking status at 26-weeks follow-up.

Figure 10. Intrinsic and Extrinsic Self-efficacy to Refrain from Smoking Over the Course of the Power to Quit Study by Smoking Status at 26-weeks Follow-up (N=430)

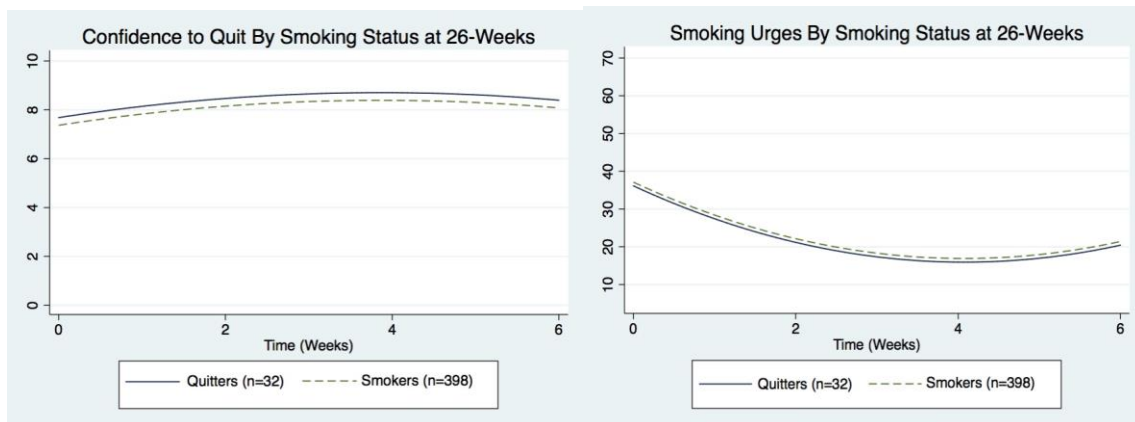


Although the trajectories of intrinsic and extrinsic self-efficacy to refrain from smoking were similar among quitters and smokers at 26-weeks follow-up, quitters had statistically significantly higher predicted intrinsic and extrinsic self-efficacy to refrain from smoking at each time point. At baseline, quitters had predicted intrinsic self-efficacy to refrain from smoking that was 0.78 higher than smokers (18.89 vs. 18.11,  $p < .001$ ) and at 26-weeks follow-up their predicted intrinsic self-efficacy to refrain from smoking was 0.96 higher than smokers (21.85 vs. 20.85,  $p < .001$ ). At baseline, quitters had predicted extrinsic self-efficacy to refrain from smoking that was 0.99 higher than smokers (18.94 vs. 17.95,  $p < .001$ ) and at 26-weeks follow-up their predicted extrinsic self-efficacy to refrain from smoking was 1.29 higher than smokers (21.49 vs. 20.20,  $p < .001$ ).

Figure 11 shows differences in confidence to quit and smoking urges from baseline to week 6 by smoking status at 26-weeks follow-up. The trajectories of confidence to quit and smoking urges were similar among quitters and smokers at 26-weeks follow-up. At all time points, quitters had slightly higher predicted confidence to

quit and slightly lower predicted smoking urges than smokers; however, the values were not statistically significantly different.

Figure 11. Confidence to Quit and Smoking Urges from Baseline to Week 6 of the Power to Quit Study by Smoking Status at 26-weeks Follow-up (N=430)



## Discussion

This study examined change in smoking characteristics over the course of the Power to Quit study, predictors of change in smoking characteristics, and whether change in smoking characteristics is a predictor of smoking status among homeless male and female smokers in the Twin Cities, MN. We found that both intrinsic and extrinsic self-efficacy to refrain from smoking increased linearly over the course of the study, which is consistent with previous research that found that self-efficacy to refrain from smoking increases from pre-treatment to post-treatment.<sup>135, 136, 137</sup> Racial minorities experienced greater increases in intrinsic self-efficacy to refrain from smoking over the course of the study than Whites, and non-White or Black individuals experienced greater increases in extrinsic self-efficacy to refrain from smoking over the course of the study than Whites or Blacks. It was not surprising that racial minorities reported greater increases and

ultimately higher self-efficacy to refrain from smoking at 26-weeks follow-up than Whites, given that previous research has found that racial minorities have higher self-efficacy to quit than Whites.<sup>138, 139, 140, 141</sup> Past studies have found that reasons for the higher self-efficacy to quit among racial minorities include stronger expectancies that behavioral cessation interventions will help them quit smoking,<sup>138</sup> lower likelihood to expect withdrawal effects,<sup>139</sup> and greater likelihood to expect quitting to be unproblematic.<sup>139</sup>

Although self-efficacy to refrain from smoking increased linearly over time, general confidence to quit, for which we had data from additional time points throughout the study, increased at the beginning of the study up until week 4 of treatment and then decreased until follow-up. The overall trajectory of confidence to quit is consistent with a previous study that found that during treatment confidence to quit increased, but subsequently decreased from post-treatment to follow-up.<sup>128</sup> The fact that we see early increases in confidence to quit from baseline to week 4 of treatment is consistent with literature that suggests that confidence increases early on in treatment when participants expect that the treatment will make a positive difference in their lives, in this case help them quit smoking.<sup>142</sup> However, confidence to quit can then decrease if individuals experience difficulty quitting.<sup>139</sup> In line with the findings for intrinsic and extrinsic self-efficacy to refrain from smoking and previous literature, Blacks consistently had higher confidence to quit than Whites.<sup>138, 139, 140, 141</sup>

As previously found in the literature, confidence to quit and smoking urges had opposite trajectories.<sup>126</sup> Smoking urges decreased at the beginning of the study up until week 4 of treatment and then increased until follow-up. Although participants continued

to receive nicotine replacement therapy until week 8, there was a drop-off in adherence to wearing the nicotine patch starting at the week 4 study visit. While 53% of participants had the nicotine patch on at the week 1 and 2 study visits, at weeks 4, 6, and 8 only 45%, 39%, and 34% of participants were wearing the nicotine patch.<sup>38</sup> This decrease in adherence to the nicotine patch over time may be responsible for the increase in smoking urges starting at week 4 and the decrease in confidence to quit, given that strong smoking urges can undermine self-efficacy to quit.<sup>132</sup>

Consistent with previous findings among the homeless, change in intrinsic and extrinsic self-efficacy to refrain from smoking, confidence to quit, and smoking urges did not predict smoking status.<sup>116</sup> In fact quitters and smokers at 26-weeks follow-up had similar trajectories for these smoking characteristics over the course of the trial. However, individuals with higher intrinsic and extrinsic self-efficacy to refrain from smoking at baseline were more likely to quit at 26-weeks follow-up. Furthermore, quitters did have higher intrinsic and extrinsic self-efficacy to refrain from smoking at all time points compared to smokers, which is consistent with previous findings that indicate that individuals with higher intrinsic and extrinsic self-efficacy to refrain from smoking are more likely to quit.<sup>117, 118, 119</sup> Additionally, the quitters exhibited increases in intrinsic and extrinsic self-efficacy to refrain from smoking over the course of treatment, including from post-treatment to follow-up, which has been previously documented in the literature.<sup>127, 128</sup> Although not statistically significantly different, the quitters had slightly higher predicted confidence to quit and slightly lower predicted smoking urges at all time points than smokers.

### Limitations

One limitation is that a single item was used to measure confidence to quit; a multi-item measure with superior psychometric properties is preferable. We addressed this by adding the similar measure, self-efficacy to refrain from smoking. However, this measure also has a limitation in that it was only measured at three time points and, therefore, we were limited to estimating a linear trajectory for the growth curve analysis. Using both of these variables in the growth curve analysis gives us a good idea of how self-efficacy to quit changes over the course of the intervention.

A second limitation is that the smoking characteristics were not normally distributed. Transformation did not improve the distributions of confidence to quit and self-efficacy to refrain from smoking. A log transformation did improve the distribution of smoking urges although it was still not normally distributed and using the transformed variable did not impact the results of the growth curve analysis, therefore we used the raw data. This limitation likely does not have a big impact on the findings from this study given that growth curve models are robust against non-normality.

A third limitation is that there was a very small number of individuals (n=34) who were non-White or Black and these individuals represented several different races/ethnicities including Asian, Hispanic, and Native American. These individuals were all included in one group, which is a limitation since individuals of these races may have different smoking characteristic trajectories.

A fourth limitation is that we did not control for shelter in the regression analyses. Although participants were recruited at seven different shelters and attended the same shelter where they enrolled into the study for all of their study visits, it is unlikely that



clustering is an issue in this study. Participants in the study did not reside at the particular shelter where they attended study visits; rather they routinely obtained resources and slept at multiple shelters that participated in the study. This reduces the likelihood of a clustering effect.

A fifth limitation is that only 7% of participants quit at 26-weeks follow-up (n=32). Therefore, we have very little information about quitters and there was low power to detect differences in the smoking characteristics between smokers and quitters. The findings from this study regarding the relationship between changes in smoking characteristics over the course of a cessation intervention and cessation should be tested again in a study with a larger number of quitters.

A sixth limitation is that 25% of data were missing at weeks 6, 8, and 26, which impacts the data on the smoking characteristics and smoking status. Individuals who had missing data for smoking status at week 26 were considered to be smokers. For the smoking characteristics, we used all of the available data without any imputation methods since missing at random appears to be a reasonable assumption and there weren't statistically significant differences in the smoking characteristics at baseline among dropouts and individuals who remained in the study (Table 1).

### Conclusions

Intrinsic and extrinsic self-efficacy to refrain from smoking increased linearly over the course of the study with greater increases observed among racial minorities and higher self-efficacy to refrain from smoking observed among individuals who quit smoking at 26-weeks follow-up. Although the MI counseling sessions for intervention participants focused primarily on motivating smoking cessation and enhancing adherence

to the nicotine patch, general confidence to quit was also targeted. Given the relationship between higher baseline self-efficacy to refrain from smoking and cessation at 26-weeks, greater efforts to increase self-efficacy to refrain from smoking among participants might increase quit rates. This might be particularly true of White participants who tended to experience a lesser increase in self-efficacy to refrain from smoking.

Confidence to quit increased at the beginning of treatment until week 4 and then subsequently decreased until follow-up in all racial groups, but Blacks consistently had higher confidence to quit than Whites. Confidence to quit and smoking urges had opposite trajectories with smoking urges decreasing at the beginning of treatment and then increasing until follow-up. It is possible that lower adherence to the nicotine patch in the second half of treatment may have prompted the changes in confidence to quit and smoking urges; however, further research is needed to test these relationships. Sustaining high confidence to quit and low smoking urges for the length of treatment could be the key to promoting higher cessation rates among the homeless.

Tables

**Table 11: Smoking Characteristics of Homeless Smokers Over the Course of the Power to Quit Study (N=430)**

<b>Variable</b>	<b>Baseline N</b>	<b>Baseline Mean (SD)</b>	<b>Week 1 N</b>	<b>Week 1 Mean (SD)</b>	<b>Week 2 N</b>	<b>Week 2 Mean (SD)</b>	<b>Week 4 N</b>	<b>Week 4 Mean (SD)</b>
Self-efficacy to refrain from smoking								
Intrinsic, scale 6-30	429	16.9 (6.8)	-	-	-	-	-	-
Extrinsic, scale 6-30	426	16.8 (7.8)	-	-	-	-	-	-
Confidence to quit, scale 0-10	430	7.3 (2.4)	379	8.0 (2.1)	358	8.3 (1.8)	356	8.2 (2.0)
Smoking urges, scale 10-70	430	39.8 (17.7)	374	23.2 (13.5)	357	21.6 (13.5)	354	20.4 (13.5)

<b>Variable</b>	<b>Week 6 N</b>	<b>Week 6 Mean (SD)</b>	<b>Week 8 N</b>	<b>Week 8 Mean (SD)</b>	<b>Week 26 N</b>	<b>Week 26 Mean (SD)</b>
Self-efficacy to refrain from smoking						
Intrinsic, scale 6-30	-	-	322	21.5 (6.5)	324	20.2 (6.9)
Extrinsic, scale 6-30	-	-	327	21.1 (7.1)	323	19.6 (7.7)
Confidence to quit, scale 0-10	328	8.2 (1.9)	327	8.4 (2.0)	323	7.7 (2.4)
Smoking urges, scale 10-70	328	19.9 (13.1)	326	18.4 (12.1)	322	19.7 (13.4)

**Table 12: Predictors of Change in Intrinsic Self-efficacy to Refrain from Smoking Over Time among Homeless Smokers in the Power to Quit Study (N=430)**

<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Intercept	<b>17.56</b>	<b>&lt;.001</b>
Time	0.08	.123
Intervention treatment group	0.63	.283
Intervention treatment group x Time	-0.01	.856
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age $\geq$ 46	0.43	.466
Age $\geq$ 46 x Time	0.02	.627
Male Gender	0.69	.307
Male Gender x Time	-0.06	.184
Social Structure		
Race		
White	Ref	
Black	-0.47	.451
Other	-2.03	.078
Race x Time		
White	Ref	
Black	<b>0.08</b>	<b>.037</b>
Other	<b>0.22</b>	<b>.004</b>

Note: Age was dichotomized using a median split.

**Table 13: Predictors of Change in Extrinsic Self-efficacy to Refrain from Smoking Over Time among Homeless Smokers in the Power to Quit Study (N=430)**

<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Intercept	<b>18.23</b>	<b>&lt;.001</b>
Time	0.09	.119
Intervention treatment group	0.61	.355
Intervention treatment group x Time	-0.01	.863
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age $\geq$ 46	-0.29	.664
Age $\geq$ 46 x Time	0.02	.621
Male Gender	-0.21	.777
Male Gender x Time	-0.04	.398
Social Structure		
Race		
White	Ref	
Black	-0.07	.916
Other	-2.05	.115
Race x Time		
White	Ref	
Black	0.02	.703
Other	<b>0.17</b>	<b>.040</b>

Note: Age was dichotomized using a median split.

**Table 14: Predictors of Change in Confidence to Quit from Baseline to Week 6 among Homeless Smokers in the Power to Quit Study (N=430)**

<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Intercept	<b>7.43</b>	<b>&lt;.001</b>
Time	<b>0.52</b>	<b>.002</b>
Time <sup>2</sup>	<b>-0.07</b>	<b>.006</b>
Intervention treatment group	-0.14	.453
Intervention treatment group x Time	0.19	.130
Intervention treatment group x Time <sup>2</sup>	-0.02	.429
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age ≥ 46	-0.35	.066
Age ≥ 46 x Time	0.02	.879
Age ≥ 46 x Time <sup>2</sup>	0.00	.827
Male Gender	-0.21	.343
Male Gender x Time	0.10	.476
Male Gender x Time <sup>2</sup>	-0.02	.469
Social Structure		
Race		
White	Ref	
Black	<b>0.62</b>	<b>.002</b>
Other	0.13	.730
Race x Time		
White	Ref	
Black	<b>-0.31</b>	<b>.020</b>
Other	0.04	.865
Race x Time <sup>2</sup>		
White	Ref	
Black	<b>0.04</b>	<b>.040</b>
Other	-0.01	.819

Note: Age was dichotomized using a median split.

**Table 15: Predictors of Change in Smoking Urges from Baseline to Week 6 among Homeless Smokers in the Power to Quit Study (N=430)**

<b>Variable</b>	<b>B</b>	<b>P-Value</b>
Intercept	<b>36.98</b>	<b>&lt;.001</b>
Time	<b>-9.98</b>	<b>&lt;.001</b>
Time <sup>2</sup>	<b>1.21</b>	<b>&lt;.001</b>
Intervention treatment group	-2.14	.112
Intervention treatment group x Time	-0.30	.752
Intervention treatment group x Time <sup>2</sup>	0.00	.992
<b>Traditional Predisposing Components</b>		
Demographic Characteristics		
Age ≥ 46	0.17	.901
Age ≥ 46 x Time	0.47	.630
Age ≥ 46 x Time <sup>2</sup>	-0.05	.754
Male Gender	-0.15	.923
Male Gender x Time	0.56	.613
Male Gender x Time <sup>2</sup>	-0.07	.699
Social Structure		
Race		
White	Ref	
Black	1.41	.328
Other	4.53	.090
Race x Time		
White	Ref	
Black	-0.47	.647
Other	-2.25	.229
Race x Time <sup>2</sup>		
White	Ref	
Black	0.09	.606
Other	0.35	.242

Note: Age was dichotomized using a median split.

**Table 16: Relationship Between Change in Smoking Characteristics and Cessation at 26-Weeks Follow-up Controlling for Treatment Group among Participants in the Power to Quit Study (N=430)**

<b>Variable</b>	<b>OR</b>	<b>P-Value</b>
Intrinsic self-efficacy to refrain from smoking Intercept (baseline)	<b>1.62</b>	<b>.001</b>
Intrinsic self-efficacy to refrain from smoking Slope (baseline-W26)	1	-
Extrinsic self-efficacy to refrain from smoking Intercept (baseline)	<b>1.61</b>	<b>.001</b>
Extrinsic self-efficacy to refrain from smoking Slope (baseline-W26)	1	-
Confidence to quit Intercept (baseline)	1.23	.200
Confidence to quit Intercept (W4)	1	-
Confidence to quit Slope (baseline-W4)	1	-
Confidence to quit Slope (W4-W6)	1	-
Smoking urges Intercept (baseline)	0.99	.598
Smoking urges Intercept (W4)	1	-
Smoking urges Slope (baseline-W4)	1	-
Smoking urges Slope (W4-W6)	1	-



## **Conclusion**

### Summary

This dissertation reports the findings from three studies focused on cancer prevention among homeless smokers (n=430) who participated in a smoking cessation randomized controlled trial. All three studies were informed by the Behavioral Model for Vulnerable Populations, which posits that there are three main types of components that predict health behavior: predisposing (i.e., characteristics that exist prior to the perception of illness), enabling (i.e., characteristics that facilitate or impede the use of health services and performance of personal health practices), and need (i.e., perceptions about health and physical illness).<sup>34</sup> Within each component there are two domains, traditional and vulnerable. The traditional domain includes characteristics that are important for predicting health behavior among the general population whereas the vulnerable domain includes additional factors that are important for predicting health behavior among vulnerable populations, such as the homeless. The Behavioral Model for Vulnerable Populations was chosen to guide this dissertation because it provides a framework for understanding health behavior, such as cancer screening and smoking, among vulnerable populations like the homeless.

In the first study we found that prevalence of breast (56%) and cervical (68%) cancer screening in the past year (i.e., the screening interval recommended by the ACS at the time of the study) among homeless female smokers was higher than estimates among the general population (51-53% breast and 52% cervical).<sup>49, 50</sup> However, these screening rates are still lower than optimal given the high prevalence of breast and cervical cancer risk factors among the homeless.<sup>7, 42, 43, 44, 45</sup> Furthermore, it is possible that the yearly

screening rates among the general population were lower because providers may have been following alternate guidelines promoted by the U.S. Preventive Services Task Force that advise breast and cervical cancer screening of the general population less frequently than once per year.<sup>81, 82</sup> We also found that receipt of breast and cervical cancer screening were associated.

Predictors of being up-to-date for breast cancer screening included traditional predisposing components (i.e., Black race, not being addicted to smoking, greater controlled motivation to quit, reducing or maintaining the same number of cigarettes smoked per day, and healthy weight), vulnerable predisposing components (i.e., lack of anxiety), and vulnerable enabling components (i.e., having a case manager that helps get and coordinate care and having fewer competing needs). Only traditional predisposing components (i.e., Black race, not being addicted to smoking, and maintaining the same number of days smoked per week over the past year) predicted up-to-date cervical cancer screening.

In the second study we found that homeless smokers report comparable levels of cessation-related weight concern as domiciled populations.<sup>90, 94, 95, 100, 106</sup> Homeless females experienced greater levels of cessation-related weight concern than homeless males and predictors of cessation-related weight concern were different for the two genders. We also found that cessation-related weight concern decreased over the course of the study among females. However, females still had higher cessation-related weight concern than males at 26-weeks follow-up.

Predictors of higher cessation-related weight concern among males included traditional predisposing components (i.e., older age, Black race, some high school

education or less, greater controlled motivation to quit, and higher BMI), vulnerable predisposing components (i.e., depression), traditional enabling components (i.e., having health insurance and a higher monthly family income) and vulnerable enabling components (i.e., having a case manager that helps get and coordinate care). Only traditional predisposing components, specifically smoking characteristics (i.e., addiction to smoking, greater cigarette consumption, indicating that quitting is more important, greater controlled motivation to quit, lower autonomous motivation to quit, older age of smoking initiation, and less support to quit from family), were predictors of higher cessation-related weight concern among females. Cessation-related weight concern was not a predictor of cessation at the end of treatment or at 26-weeks follow-up among homeless males and females.

In the third study we found that intrinsic and extrinsic self-efficacy to refrain from smoking increased linearly over the course of the study and that racial minorities experienced greater increases in intrinsic and extrinsic self-efficacy to refrain from smoking over the course of the study. Confidence to quit increased until the mid-point of treatment (week 4) and then decreased until 26-weeks follow-up, and Blacks consistently had higher confidence to quit than Whites. Confidence to quit and smoking urges had opposite trajectories. Change in the smoking characteristics over time did not predict cessation at 26-weeks follow-up. However, individuals with higher intrinsic and extrinsic self-efficacy to refrain from smoking at baseline were more likely to quit at 26-weeks follow-up. Furthermore, intrinsic and extrinsic self-efficacy to refrain from smoking were statistically significantly higher at all time points among quitters at 26-weeks follow-up compared to individuals who remained smokers. Although not statistically significantly

different, predicted confidence to quit was slightly higher and predicted smoking urges were slightly lower at all time points among quitters compared to smokers.

In the Power to Quit Study, we found that only 7% of participants quit smoking at 26-weeks follow-up, including 9% of intervention participants and 6% of control participants. The quit rates from this study were lower than rates reported from two previous pilot studies among homeless smokers (17.4% intervention and 8.7% control; <sup>30</sup> 13.6%, no control group<sup>28</sup>). However, these pilot studies featured more intensive counseling and the participants in the Power to Quit study exhibited greater nicotine dependence and a higher prevalence of depression, alcohol abuse, and substance abuse, thus making smoking cessation more challenging. <sup>38</sup>

### Future Research

The findings from these three research studies have uncovered several possible areas of future research among homeless smokers. Based on the findings from the first study a possible area of future research is to qualitatively explore the associations between smoking characteristics and breast and cervical cancer screening in order to better understand why these associations exist. Another area of future research is a qualitative examination of why predisposing and enabling components were predictors of breast cancer screening, whereas only traditional predisposing components predicted cervical cancer screening. Further research in these areas could help inform future breast and cervical cancer screening programs that target the homeless.

Future research should also examine the prevalence of breast and cervical cancer screening and predictors of screening from the full Behavioral Model for Vulnerable Populations among a larger, representative sample of homeless female smokers. In order

to obtain accurate estimates of the prevalence of screening, it would be ideal to collect data from federally qualified health center medical records. Data from these medical records would be more accurate than self-reported screening by homeless individuals since over reporting of both mammography and Pap tests is common.<sup>83</sup> Approximately one-third of homeless individuals frequent federally qualified health centers.<sup>7, 12</sup>

Based on the findings from the second study, possible areas of future research include examining the effect of cessation-related weight concern on cessation in a study with a larger number of quitters and determining whether cessation-related weight concern serves as a deterrent to making a quit attempt or a reason for relapse. Research in these areas would help determine whether tobacco cessation programs that target homeless smokers would benefit from including content on managing cessation-related weight concern.

Qualitative research could aim to explain why predisposing and enabling components, including demographic variables, BMI, depression, income, and health insurance status are associated with cessation-related weight concern among males, whereas only smoking characteristics (traditional predisposing components) are associated with cessation-related weight concern among females. Research in this area could be used to inform targeted efforts on reducing cessation-related weight concern. Lastly, smoking cessation interventions that do include content on managing cessation-related weight concern should be assessed in order to determine whether including this content has an effect on quitting.

Based on the findings from the third study, a possible area of future research is to collect data on self-efficacy to refrain from smoking and confidence to quit over at least 5

time points to determine whether these two types of self-efficacy to quit follow a similar trajectory. Another possible area of research is to examine changes in smoking characteristics over the course of a smoking cessation trial among a larger and more diverse group of racial and ethnic minorities to determine whether different groups have different trajectories. An additional area of research would test the relationship between changes in smoking characteristics and cessation in a study with a larger number of quitters.

Another area of research is to determine why confidence to quit starts to decrease and smoking urges start to increase at the mid-point of treatment. Based on the findings from this study, it is possible that declining adherence to the nicotine patch may have prompted the changes in confidence to quit and smoking urges; however, further research is needed to test these relationships. Research in this area would be useful for determining how to help participants sustain high confidence to quit and low smoking urges for the length of treatment, which could be the key to promoting higher cessation rates among the homeless.

#### Implications for Public Health Practice

There are some key takeaways from these three research studies that public health practitioners could use to inform cancer screening and tobacco cessation programs that target homeless smokers. Based on the findings from the first study, cancer screening programs could aim to increase both breast and cervical cancer screening at one point of contact given their association. Furthermore, cancer prevention programs could aim to simultaneously promote age-appropriate cancer screening and smoking reduction and cessation given the association between smoking characteristics and cancer screening.

Public health practitioners could utilize the findings from this study to identify homeless female smokers who are less likely to be up-to-date for breast and cervical cancer screening and tailor efforts to these individuals.

Based on the findings from the second study, it is apparent that homeless smokers, especially females, experience concerns about gaining weight after quitting. Given that homeless smokers do experience these concerns, it may be beneficial to address the concerns through counseling. Tobacco cessation programs that incorporate counseling could assess whether participants have concerns about gaining weight after quitting and for participants who do have these concerns, the counselors could provide information and resources on how to manage weight after quitting. Previous research among other populations has found that adding weight control to smoking treatment improves abstinence and weight control in the short-term (<3months).<sup>143</sup> Counselors could also utilize the findings from this study in order to identify homeless smokers who are more likely to experience cessation-related weight concern and tailor efforts to these individuals.

Based on the findings from the third study, tobacco cessation programs targeting homeless individuals could aim to increase self-efficacy to refrain from smoking among participants with lower self-efficacy, given the relationship between higher self-efficacy to refrain from smoking and cessation. White individuals appear to experience less increase in self-efficacy to refrain from smoking and, therefore, would be a good target for these efforts. Tobacco cessation programs could also aim to help participants sustain high levels of confidence to quit and low levels of smoking urges throughout the program

and may need to intervene on these smoking characteristics at the mid-point of treatment in order to accomplish this aim.

### Important Considerations

When developing homeless-targeted tobacco cessation and cancer screening interventions, comorbidities and issues that homeless individuals experience need to be considered. Many homeless individuals suffer from mental illness, substance abuse, and competing needs, which limit their ability to obtain screening or quit smoking.<sup>31,33</sup> These factors are included in the Behavioral Model for Vulnerable Populations as part of the vulnerable domain. By highlighting the vulnerable domain, the model provides a solid framework that enables us to better understand which factors are important to target when promoting cancer prevention among the homeless.

In this dissertation we found that several vulnerable components were predictors of cancer screening and cessation-related weight concern, a barrier to cessation, among the homeless. Two mental health issues were associated with study outcomes. Experiencing anxiety was associated with a lower probability of being up-to-date for breast cancer screening among females and depression was associated with higher cessation-related weight concern among males. Two factors related to being homeless were also associated with study outcomes. Having a case manager that helps get and coordinate care was associated with a higher probability of being up-to-date for breast cancer screening among females and higher cessation-related weight concern among males. Having a greater number of competing needs was associated with a lower probability of being up-to-date for breast cancer screening among females.



These findings suggest that addressing vulnerable components as part of cancer prevention efforts is important. Cancer prevention programs that include counseling could aim to reduce anxiety and depression given their association with cancer screening and having cessation-related weight concerns. Cancer prevention programs could involve case managers to help promote screening and reduce concerns surrounding cessation. Lastly, cancer prevention programs could aim to work with shelters to reduce homeless individuals' competing needs, including providing shelter, food, and a place to wash up and go to the bathroom.

Although substance abuse is considered to be an important predictor of health behavior in the Behavioral Model for Vulnerable Populations, substance abuse was not associated with cancer screening or cessation-related weight concern in this dissertation. Prevalence of alcohol abuse was lower than expected with only 13% of participants characterized as exhibiting risky alcohol use (>1 drink a day for females and >2 drinks a day for males). Previous estimates of alcohol dependence among the homeless range from 8% to 58%.<sup>144</sup> A previous analysis of the Power to Quit Study did find alcohol use to be positively associated with smoking at 26-weeks follow-up, which suggests that smoking cessation interventions that target the homeless may be more effective if they include efforts to reduce alcohol consumption.<sup>145</sup>

A sizeable proportion of participants (39%) reported any drug use in the past 30 days (i.e., marijuana, cocaine, heroine, other recreational drug, and/or prescription drug without prescription) and previous estimates of drug dependence among the homeless range from 5% to 54%.<sup>144</sup> However, drug use was not associated with smoking status at 26-weeks follow-up in the Power to Quit study.<sup>145</sup> Given that drug use was not

associated with cancer screening nor smoking cessation in this study, it is unclear whether cancer prevention programs would benefit from including efforts to reduce drug use. It would be good to examine the effect of drug use on smoking cessation in a study with a larger number of quitters before making such a determination.

Although not considered vulnerable components by the model, health insurance and income are important factors to consider when developing interventions targeted towards the homeless as affordability and lack of health insurance are known to impact the ability of homeless individuals to access healthcare.<sup>8,9,10</sup> However, in this study neither income nor health insurance was associated with up-to-date breast or cervical cancer screening. This result was not consistent with the results of a previous study.<sup>53</sup> One reason why there may not have been an association is that even though the participants had very low incomes (68% had monthly family income < \$400), the majority of participants (82%) had health insurance. Another reason is that no-cost breast and cervical screening for low-income females in Minnesota who are uninsured or underinsured is available through the state health department.<sup>15</sup> Unless no-cost screening is available, cancer prevention programs may need to find ways to provide low or no-cost screening to those without insurance.

We did find that having health insurance and a higher monthly family income were associated with higher cessation-related weight concern among males, indicating that males with these characteristics might benefit from intervention to manage concerns about gaining weight after quitting. Lack of health insurance or income are not likely to greatly affect the ability of homeless Minnesotans to quit smoking as the state quitline offers up to four weeks of free nicotine replacement therapy (NRT) per year to any adult

and up to eight weeks of NRT per year and phone coaching to those who are uninsured or whose insurance doesn't cover these services.<sup>146</sup> However, there are challenges that homeless individuals may face when trying to access these services, including access to a phone to sign up for services and a location for the quitline to mail the NRT, that should be considered.

While homeless-targeted cancer prevention efforts are important given the high cancer mortality rates among this population,<sup>17, 18, 19</sup> the homeless have several other pressing needs. Some may argue that these needs should serve as a priority and be addressed prior to cancer prevention efforts. These needs include homelessness, unemployment, financial support, mental health issues, and substance use, which were all prevalent among participants in the Power to Quit Study. Half of participants had been homeless for at least one year, 90% were unemployed, and 68% had a monthly family income that was less than \$400. In terms of mental health issues, 17% experienced any psychotic symptoms, 62% experienced anxiety, and many reported relatively high depression (mean=8.5 on a 0-27 scale) and stress (mean=6.7 on a 0-16 scale) levels. In regards to substance use, 39% reported any drug use in the past 30 days and 13% were characterized as exhibiting risky alcohol use.

A primary solution to these needs is the promotion and expansion of housing assistance programs, such as Housing First, which help homeless individuals identify and secure long-term, affordable housing.<sup>147</sup> Many of these programs also address other pressing needs by offering supportive treatment services in the areas of mental health, general medical health, and substance abuse and help with education and employment. Research has shown that housing assistance programs result in reduced homelessness,

increased housing tenure over time, and fewer emergency room visits and hospitalizations among previously homeless individuals.<sup>147</sup>

It is especially important to address unemployment along with housing given the bidirectional relationship between housing and employment.<sup>148</sup> Individual placement and support is an effective employment model that goes beyond the employment assistance provided through housing assistance programs, which helps individuals with mental illness return to and sustain employment.<sup>149</sup> It has been suggested that this model is most effective among formerly homeless individuals once stable housing has been achieved.

150, 151

Addressing homelessness, unemployment, mental health issues, and substance use through the use of housing assistance programs and individual placement and support has the potential to affect cancer morbidity and mortality among the homeless. Removing these barriers to care and comorbidities would facilitate the completion of cancer screening and tobacco cessation among this population. Addressing homelessness, unemployment, mental health issues, and substance use may eliminate the need for tailored cancer prevention programs, which account for the unique problems faced by vulnerable populations.

## Bibliography

1. The United States Conference of Mayors. Hunger and Homelessness Survey: A Status report on hunger and homelessness in America's cities. A 27-city survey. December 2009. Available at: <https://usmayors.org/pressreleases/uploads/USCMHungercompleteWEB2009.pdf>. Accessed June 2015.
2. Homelessness Research Institute. The state of homelessness in America 2013. 2013. Available at: [http://www.endhomelessness.org/page/-/files/SOH\\_2013.pdf](http://www.endhomelessness.org/page/-/files/SOH_2013.pdf). Accessed July 2015.
3. Wilder Research. *Homelessness in Minnesota: Findings from the 2012 statewide homeless study*. St. Paul, MN 2013.
4. Kushel MB, Vittinghoff E, Haas JS. Factors associated with the health care utilization of homeless persons. *Journal of the American Medical Association*. 2001;285(2):200-206.
5. Khandor E, Mason K, Chambers C, Rossiter K, Cowan L, Hwang SW. Access to primary health care among homeless adults in Toronto, Canada: results from the Street Health survey. *Open Medicine*. 2011;5(2):e94-e103.
6. Baggett TP, O'Connell JJ, Singer DE, Rigotti NA. The unmet health care needs of homeless adults: a national study. *American Journal of Public Health*. 2010;100(7):1326-1333.
7. Lebrun-Harris LA, Baggett TP, Jenkins DM, et al. Health status and health care experiences among homeless patients in federally supported health centers: findings from the 2009 patient survey. *Health Services Research Journal*. 2013;48(3):992-1017.
8. Zlotnick C, Zerger S. Survey findings on characteristics and health status of clients treated by the federally funded (US) Health Care for the Homeless Programs. *Health & Social Care in the Community*. 2009;17(1):18-26.
9. Wood D, Valdez RB. Barriers to medical care for homeless families compared with housed poor families. *American Journal of Diseases of Children*. 1991;145(10):1109-1115.
10. Gelberg L, Gallagher TC, Andersen RM, Koegel P. Competing priorities as a barrier to medical care among homeless adults in Los Angeles. *American Journal of Public Health*. 1997;87(2):217-220.

11. Schanzer B, Dominguez B, Shrout PE, Caton CLM. Homelessness, health status, and health care use. *American Journal of Public Health*. 2007;97(3):464-469.
12. Zur J, Jones E. Unmet need among homeless and non-homeless patients served at Health Care for the Homeless programs. *Journal of Health Care for the Poor and Underserved*. 2014;25(4):2053-2068.
13. West Side Community Health Services. Health Care for the Homeless. Available at: <http://www.westsidechs.org/programs.php?clinic=10>. Accessed January 2015.
14. Hennepin County Human Services and Public Health Department. Health Care for the Homeless. March 2011. Available at: <http://www.hennepin.us/~media/hennepinus/residents/health-medical/documents/health-homeless-brochure-030311.pdf?la=en>. Accessed January 2015.
15. Minnesota Department of Health. Health Screening Programs. *Sage Screening Program Services and Eligibility*. January 2016. Available at: <http://www.health.state.mn.us/divs/hpcd/ccs/screening/sage/services.html>. Accessed March 2016.
16. Minnesota Department of Health. Health Screening Programs. *Colorectal Cancer Screening: Sage Scopes*. April 2015. Available at: <http://www.health.state.mn.us/divs/hpcd/ccs/screening/scopes/index.html>. Accessed March 2016.
17. Hwang SW. Mortality among men using homeless shelters in Toronto, Ontario. *Journal of the American Medical Association*. 2000;283(16):2152-2157.
18. Hwang SW, Orav EJ, O'Connell JJ, Lebow JM, Brennan TA. Causes of death in homeless adults in Boston. *Annals of Internal Medicine*. 1997;126(8):625-628.
19. Baggett TP, Hwang SW, O'Connell JJ, et al. Mortality among homeless adults in Boston: shifts in causes of death over a 15-year period. *JAMA Internal Medicine*. 2013;173(3):189-195.
20. Gelberg L. Health of the Homeless: Definition of the Problem. In: Wood D, ed. *Delivering Health Care to the Homeless Persons: The Diagnosis and Management of Medical and Mental Health Conditions*. New York: Springer Publishing Co.; 1992.
21. Baggett TP, Rigotti NA. Cigarette smoking and advice to quit in a national sample of homeless adults. *American Journal of Preventive Medicine*. 2010;39(2):164-172.
22. Sachs-Ericsson N, Wise E, Debrody CP, Paniucki HB. Health problems and service

- utilization in the homeless. *Journal of Health Care for the Poor and Underserved*. 1999;10:443-452.
23. Ferencick GS. The medical problems of homeless clinic patients: a comparative study. *Journal of General Internal Medicine*. 1992;7(3):294-297.
24. Orleans CT, Hutchinson D. Tailoring nicotine addiction treatments for chemical dependency patients. *Journal of Substance Abuse Treatment*. 1993;10(2):197-208.
25. Heyding RK, Cheung AM, Mocarski EJ, Moineddin R, Hwang SW. A community-based intervention to increase screening mammography among disadvantaged women at an inner-city drop-in center. *Women & Health*. 2005;41(1):21-31.
26. Bharel M, Santiago ER, Nembang Forgione S, León CK, Weinreb L. Eliminating health disparities: innovative methods to improve cervical cancer screening in a medically underserved population. *American Journal of Public Health*. 2015;105(Suppl 3):S438-S442.
27. Connor SE, Scharf DM, Jonkman LJ, Herbert MI. Focusing on the five A's: a comparison of homeless and housed patients' access to and use of pharmacist-provided smoking cessation treatment. *Research in Social and Administrative Pharmacy*. 2014;10:369-377.
28. Shelley D, Cantrell J, Wong S, Warn D. Smoking cessation among sheltered homeless: a pilot. *American Journal of Health Behavior*. 2010;34(5):544-552.
29. Bonevski B, Baker A, Twyman L, Paul C, Bryant J. Addressing smoking and other health risk behaviours using a novel telephone-delivered intervention for homeless people: A proof-of-concept study. *Drug and Alcohol Review*. 2012;31(5):709-713.
30. Okuyemi KS, Thomas JL, Hall S, et al. Smoking cessation in homeless populations: A pilot clinical trial. *Nicotine & Tobacco Research*. 2006;8(5):689-699.
31. Gelberg L, Andersen RM, Leake BD. The Behavioral Model for Vulnerable Populations: application to medical care use and outcomes for homeless people. *Health Services Research Journal*. 2000;34(6):1273-1302.
32. Andersen R. Revisiting the behavioral model and access to medical care: does it matter? *Journal of Health and Social Behavior*. 1995;36(1):1-10.
33. Gelberg L. The Homeless. In: Andersen RM, Rice TH, Kominski GF, eds. *Changing the U.S. health care system: Key issues in health services, policy, and management*. San Francisco: Jossey-Bass Publishers; 1996.

34. Teruya C, Longshore D, Andersen RM, et al. Health and health care disparities among homeless women. *Women & Health*. 2010;50(8):719-736.
35. Stein JA, Andersen R, Gelberg L. Applying the Gelberg-Andersen behavioral model for vulnerable populations to health services utilization in homeless women. *Journal of Health Psychology*. 2007;12(5):791-804.
36. Stein JA, Andersen M, Robertson M, Gelberg L. Impact of hepatitis B and C infection on health services utilization in homeless adults: a test of the Gelberg-Andersen Behavioral Model for Vulnerable Populations. *Health Psychology*. 2012;31(1):20-30.
37. Hogan VK, Amamoo MA, Anderson AD, et al. Barriers to women's participation in inter-conceptual care: a cross-sectional analysis. *BMC Public Health*. 2012;12:93.
38. Okuyemi KS, Goldade K, Whembolua GL, et al. Motivational interviewing to enhance nicotine patch treatment for smoking cessation among homeless smokers: a randomized controlled trial. *Addiction*. 2013;108(6):1136-1144.
39. Goldade K, Whembolua GL, Thomas J, et al. Designing a smoking cessation intervention for the unique needs of homeless persons: a community-based randomized clinical trial. *Clinical Trials*. 2011;8(6):744-754.
40. Sheehan DV, Lecrubier Y, Sheehan KH, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*. 1998;59(Suppl 20):22-33.
41. American Cancer Society. Breast Cancer. *What are the risk factors for breast cancer?* September 2014. Available at: <http://www.cancer.org/cancer/breastcancer/detailedguide/breast-cancer-risk-factors>. Accessed June 2015.
42. Chau S, Chin M, Chang J, et al. Cancer risk behaviors and screening rates among homeless adults in Los Angeles County. *Cancer Epidemiology, Biomarkers & Prevention*. 2002;11(5):431-438.
43. Long HL, Tulskey JP, Chambers DB, et al. Cancer screening in homeless women: attitudes and behaviors. *Journal of Health Care for the Poor and Underserved*. 1998;9(3):276-292.
44. Weinreb L, Goldberg R, Perloff J. Health characteristics and medical service use patterns of sheltered homeless and low-income housed mothers. *Journal of General Internal Medicine*. 1998;13(3):389-397.



45. Wenzel SL, Andersen RM, Gifford DS, Gelberg L. Homeless women's gynecological symptoms and use of medical care. *Journal of Health Care for the Poor and Underserved*. 2001;12(3):323-341.
46. American Cancer Society. Cervical Cancer. *What are the risk factors for cervical cancer?* September 2014. Available at: <http://www.cancer.org/cancer/cervicalcancer/detailedguide/cervical-cancer-risk-factors>. Accessed June 2015.
47. Bharel M, Casey C, Wittenberg E. Disparities in cancer screening: acceptance of Pap smears among homeless women. *Journal of Women's Health*. 2009;18(12):2011-2016.
48. National Cancer Institute. Cancer Screening Overview. July 2014. Available at: <http://www.cancer.gov/about-cancer/screening/patient-screening-overview-pdq>. Accessed July 2015.
49. Pace LE, He Y, Keating NL. Trends in mammography screening rates after publication of the 2009 US Preventive Services Task Force recommendations. *Cancer*. 2013;119(14):2518-2523.
50. Centers for Disease Control and Prevention. 2010 National Health Interview Survey. 2010. Available at: [http://www.cdc.gov/nchs/nhis/quest\\_data\\_related\\_1997\\_forward.htm](http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm). Accessed January 25, 2016.
51. Weinreb L, Goldberg R, Lessard D. Pap smear testing among homeless and very low-income housed mothers. *Journal of Health Care for the Poor and Underserved*. 2002;13(2):141-150.
52. Hogenmiller JR, Atwood JR, Lindsey AM, Johnson DR, Hertzog M, Scott JCJ. Self-efficacy scale for Pap smear screening participation in sheltered women. *Nursing Research*. 2007;56(6):369-377.
53. Wittenberg E, Bharel M, Saada A, Santiago E, Bridges JF, Weinreb L. Measuring the preferences of homeless women for cervical cancer screening interventions: Development of a best-worst scaling survey. *The Patient*. 2015;8(5):455-467.
54. Baldwin DM, Williams-Brown S. Uncovering homeless African-American women's knowledge of breast cancer and their use of breast cancer screening services. *Journal of the National Black Nurses Association*. 2005;16(1):24-30.
55. Hubbell FA, Mishra SI, Chavez LR, Valdez RB. The influence of knowledge and attitudes about breast cancer on mammography use among Latinas and Anglo women. *Journal of General Internal Medicine*. 1997;12(8):505-508.

56. Feldstein AC, Perrin N, Rosales AG, Schneider J, Rix MM, Glasgow RE. Patient barriers to mammography identified during a reminder program. *Journal of Women's Health*. 2011;20(3):421-428.
57. Rimer BK, Conaway MR, Lyna PR, et al. Cancer screening practices among women in a community health center population. *American Journal of Preventive Medicine*. 1996;12(5):351-357.
58. Shafey O, Eriksen M, Ross H, Mackay J. *The tobacco atlas*. 3rd ed. Atlanta, GA: American Cancer Society; 2009.
59. Boyle RG, O'Connor P, Pronk N, Tan A. Health behaviors of smokers, ex-smokers, and never smokers in an HMO. *Preventive Medicine*. 2000;31(2 Pt 1):177-182.
60. Fredman L, Sexton M, Cui Y, et al. Cigarette smoking, alcohol consumption, and screening mammography among women ages 50 and older. *Preventive Medicine*. 1999;28(4):407-417.
61. Rakowski W, Clark MA, Truchil R, Schneider K, Meersman S. Smoking status and mammography among women aged 50-75 in the 2002 behavioral risk factor surveillance system. *Women & Health*. 2005;41(4):1-21.
62. Rakowski W, Meissner H, Vernon SW, Breen N, Rimer B, Clark MA. Correlates of repeat and recent mammography for women ages 45 to 75 in the 2002 to 2003 Health Information National Trends Survey (HINTS 2003). *Cancer Epidemiology, Biomarkers & Prevention*. 2006;15(11):2093-2101.
63. Nelson W, Moser RP, Gaffey A, Waldron W. Adherence to cervical cancer screening guidelines for U.S. women aged 25-64: data from the 2005 Health Information National Trends Survey (HINTS). *Journal of Women's Health*. 2009;18(11):1759-1768.
64. MacLaughlan SD, Lachance JA, Gjelsvik A. Correlation between smoking status and cervical cancer screening: a cross-sectional study. *Journal of Lower Genital Tract Disease*. 2011;15(2):114-119.
65. Byrne MM, Davila EP, Zhao W, et al. Cancer screening behaviors among smokers and non-smokers. *Cancer Epidemiology*. 2010;34(5):611-617.
66. Kim S, Park JS, Oh SW, et al. Association between colorectal cancer screening rate and motivation to quit smoking: the Fourth Korean National Health and Nutrition Examination Survey. *Public Health*. 2014;128(11):1039-1042.
67. Smith RA, Cokkinides V, Brawley OW. Cancer screening in the United States, 2009:

a review of current American Cancer Society guidelines and issues in cancer screening. *A Cancer Journal for Clinicians*. 2009;59(1):27-41.

68. Heatherton TF, Kozlowski LT, Frecker RC, Fagerström KO. The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. *British Journal of Addiction*. 1991;86(9):1119-1127.

69. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology*. 1989;57(5):749-761.

70. Levesque CS, Williams GC, Elliot D, Pickering MA, Bodenhamer B, Finley PJ. Validating the theoretical structure of the Treatment Self-Regulation Questionnaire (TSRQ) across three different health behaviors. *Health Education Research*. 2007;22(5):691-702.

71. National Institute on Alcohol Abuse and Alcoholism. Rethinking Drinking: Alcohol & your health. 2014. Available at: <http://rethinkingdrinking.niaaa.nih.gov/IsYourDrinkingPatternRisky/WhatsAtRiskOrHeavyDrinking.asp>. Accessed January 2014.

72. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*. 2001;16(9):606-613.

73. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behavior*. 1983;24(4):385-396.

74. Cohen S, Williamson G. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, eds. *The social psychology of health: Claremont Symposium on applied social psychology*. Newbury Park: Sage; 1988.

75. Goldade K, Des Jarlais D, Everson-Rose SA, et al. Knowing quitters predicts smoking cessation in a homeless population. *American Journal of Health Behavior*. 2013;37(4):517-524.

76. Okuyemi KS, Goldade K, Whembolua GL, et al. Smoking characteristics and comorbidities in the power to quit randomized clinical trial for homeless smokers. *Nicotine & Tobacco Research*. 2013;15(1):22-28.

77. Ware JEJ, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*. 1992;30(6):473-483.

78. Schumann A, Hapke U, Rumpf HJ, Meyer C, John U. The association between

degree of nicotine dependence and other health behaviours. Findings from a German general population study. *European Journal of Public Health*. 2001;11(4):450-452.

79. Shippee ND, Shah ND, May CR, Mair FS, Montori VM. Cumulative complexity: a functional, patient-centered model of patient complexity can improve research and practice. *Journal of Clinical Epidemiology*. 2012;65(10):1041-1051.

80. Asgary R, Garland V, Sckell B. Breast cancer screening among homeless women of New York City shelter-based clinics. *Women's Health Issues*. 2014;24(5):529-534.

81. U.S. Preventive Services Task Force. Breast Cancer: Screening. *Summary of Recommendations*. November 2009. Available at: <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/breast-cancer-screening>. Accessed December 2015.

82. U.S. Preventive Services Task Force. Screening for cervical cancer: recommendations and rationale. *American Family Physician*. 2003;67(8):1759-1766.

83. Rauscher GH, Johnson TP, Cho YI, Walk JA. Accuracy of self-reported cancer-screening histories: a meta-analysis. *Cancer Epidemiology, Biomarkers & Prevention*. 2008;17(4):748-757.

84. Meyers AW, Klesges RC, Winders SE, Ward KD, Peterson BA, Eck LH. Are weight concerns predictive of smoking cessation? A prospective analysis. *Journal of Consulting and Clinical Psychology*. 1997;65(3):448-452.

85. Rosenthal L, Carroll-Scott A, Earnshaw VA, et al. Targeting cessation: understanding barriers and motivations to quitting among urban adult daily tobacco smokers. *Addictive Behaviors*. 2013;38(3):1639-1642.

86. Pomerleau CS, Zucker AN, Stewart AJ. Characterizing concerns about post-cessation weight gain: results from a national survey of women smokers. *Nicotine & Tobacco Research*. 2001;3(1):51-60.

87. Donny EC, Caggiula AR, Weaver MT, Levin ME, Sved AF. The reinforcement-enhancing effects of nicotine: implications for the relationship between smoking, eating and weight. *Physiology & Behavior*. 2011;104(1):143-148.

88. Clark MM, Hurt RD, Croghan IT, et al. The prevalence of weight concerns in a smoking abstinence clinical trial. *Addictive Behaviors*. 2006;31(7):1144-1152.

89. Clark MM, Decker PA, Offord KP, et al. Weight concerns among male smokers. *Addictive Behaviors*. 2004;29(8):1637-1641.

90. Tuovinen EL, Saarni SE, Kinnunen TH, et al. Associations of weight concerns with self-efficacy and motivation to quit smoking: A population-based study among Finnish daily smokers. *Nicotine & Tobacco Research*. 2015;17(9):1134-1141.
91. Levine MD, Marcus MD, Kalarchian MA, Houck PR, Cheng Y. Weight concerns, mood, and postpartum smoking relapse. *American Journal of Preventive Medicine*. 2010;39(4):345-351.
92. Klesges RC, Brown K, Pascale RW, Murphy M, Williams E, Cigrang JA. Factors associated with participation, attrition, and outcome in a smoking cessation program at the workplace. *Health Psychology*. 1988;7(6):575-589.
93. Schauer GL, Bush T, Cerutti B, Mahoney L, Thompson JR, Zbikowski SM. Use and effectiveness of quitlines for smokers with diabetes: cessation and weight outcomes, Washington State Tobacco Quit Line, 2008. *Preventing Chronic Disease*. 2013;10:E105.
94. Aubin HJ, Berlin I, Smadja E, West R. Factors associated with higher body mass index, weight concern, and weight gain in a multinational cohort study of smokers intending to quit. *International Journal of Environmental Research and Public Health*. 2009;6(3):943-957.
95. Borrelli B, Mermelstein R. The role of weight concern and self-efficacy in smoking cessation and weight gain among smokers in a clinic-based cessation program. *Addictive Behaviors*. 1998;23(5):609-622.
96. Jeffery RW, Hennrikus DJ, Lando HA, Murray DM, Liu JW. Reconciling conflicting findings regarding postcessation weight concerns and success in smoking cessation. *Health Psychology*. 2000;19(3):242-246.
97. French SA, Jeffery RW, Klesges LM, Forster JL. Weight concerns and change in smoking behavior over two years in a working population. *American Journal of Public Health*. 1995;85(5):720-722.
98. Pisinger C, Jorgensen T. Weight concerns and smoking in a general population: the Inter99 study. *Preventive Medicine*. 2007;44(4):283-289.
99. Landrau-Cribbs E, Cabriaes JA, Cooper TV. General and smoking cessation weight concern in a Hispanic sample of light and intermittent smokers. *Addictive Behaviors*. 2015;41:29-33.
100. Luostarinen M, Tuovinen EL, Saarni SE, et al. Weight concerns among Finnish ever-smokers: a population-based study. *Nicotine & Tobacco Research*. 2013;15(10):1696-1704.

101. Veldheer S, Yingst J, Foulds G, et al. Once bitten, twice shy: concern about gaining weight after smoking cessation and its association with seeking treatment. *International Journal of Clinical Practice*. 2014;68(3):388-395.
102. Sánchez-Johnsen LA, Spring BJ, Sommerfeld BK, Fitzgibbon ML. Weight concerns and smoking in Black and White female smokers. *Addictive Behaviors*. 2005;30(3):601-605.
103. Collins BN, Nair U, Hovell MF, Audrain-McGovern J. Smoking-related weight concerns among underserved, black maternal smokers. *American Journal of Health Behavior*. 2009;33(6):699-709.
104. Sorensen G, Goldberg R, Ockene J, Klar J, Tannenbaum T, Lemeshow S. Heavy smoking among a sample of employed women. *American Journal of Preventive Medicine*. 1992;8(4):207-214.
105. Ludman EJ, Curry SJ, Grothaus LC, Graham E, Stout J, Lozano P. Depressive symptoms, stress, and weight concerns among African American and European American low-income female smokers. *Psychology of Addictive Behaviors*. 2002;16(1):68-71.
106. Sepinwall D, Borrelli B. Older, medically ill smokers are concerned about weight gain after quitting smoking. *Addictive Behaviors*. 2004;29(9):1809-1819.
107. Etter JF, Bergman MM, Humair JP, Perneger TV. Development and validation of a scale measuring self-efficacy of current and former smokers. *Addiction*. 2000;95(6):901-913.
108. Jarvis MJ, Russell MA, Saloojee Y. Expired air carbon monoxide: a simple breath test of tobacco smoke intake. *The BMJ*. 1980;281(6238):484-485.
109. Jarvis MJ, Tunstall-Pedoe H, Feyerabend C, Vesey C, Saloojee Y. Comparison of tests used to distinguish smokers from nonsmokers. *American Journal of Public Health*. 1987;77(11):1435-1438.
110. Williamson DF, Madans J, Anda RF, Kleinman JC, Giovino GA, Byers T. Smoking cessation and severity of weight gain in a national cohort. *New England Journal of Medicine*. 1991;324(11):739-745.
111. Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries: descriptive epidemiology, health consequences, and clinical and policy recommendations. *The Lancet*. 2014;384(9953):1529-1540.
112. Muñoz M, Crespo M, Pérez-Santos E. Homelessness effects on men's and women's

health: a comparison between a representative homeless sample and an at-risk group. *International Journal of Mental Health*. 2005;34(2):47-61.

113. Butler J, Okuyemi KS, Jean S, Nazir N, Ahluwalia JS, Resnicow K. Smoking characteristics of a homeless population. *Substance Abuse*. 2002;23(4):223-231.

114. Okuyemi KS, Caldwell AR, Thomas JL, et al. Homelessness and smoking cessation: insights from focus groups. *Nicotine & Tobacco Research*. 2006;8(2):287-296.

115. Businelle MS, Kendzor DE, Kesh A, et al. Small financial incentives increase smoking cessation in homeless smokers: a pilot study. *Addictive Behaviors*. 2012;39(3):717-720.

116. Businelle MS, Ma P, Kendzor DE, et al. Predicting quit attempts among homeless smokers seeking cessation treatment: an ecological momentary assessment study. *Nicotine & Tobacco Research*. 2014;16(10):1371-1378.

117. Curry SJ, Grothaus L, McBride C. Reasons for quitting: intrinsic and extrinsic motivation for smoking cessation in a population-based sample of smokers. *Addictive Behaviors*. 1997;22(6):727-739.

118. Baldwin AS, Rothman AJ, Hertel AW, et al. Specifying the determinants of the initiation and maintenance of behavior change: an examination of self-efficacy, satisfaction, and smoking cessation. *Health Psychology*. 2006;25(5):626-634.

119. Smit ES, Hoving C, Schelleman-Offermans K, West R, de Vries H. Predictors of successful and unsuccessful quit attempts among smokers motivated to quit. *Addictive Behaviors*. 2014;39(9):1318-1324.

120. Businelle MS, Cuate EL, Kesh A, Poonawalla IB, Kendzor DE. Comparing homeless smokers to economically disadvantaged domiciled smokers. *American Journal of Public Health*. 2013;103(Suppl 2):S218-220.

121. Shiffman S, Engberg JB, Paty JA, et al. A day at a time: predicting smoking lapse from daily urge. *Journal of Abnormal Psychology*. 1997;106(1):104-116.

122. McCarthy DE, Piasecki TM, Fiore MC, Baker TB. Life before and after quitting smoking: an electronic diary study. *Journal of Abnormal Psychology*. 2006;115(3):454-466.

123. Orleans CT, Rimer BK, Cristinzio S, Keintz MK, Fleisher L. A national survey of older smokers: treatment needs of a growing population. *Health Psychology*. 1991;10(5):343-351.

124. Connor SE, Cook RL, Herbert MI, Neal SM, Williams JT. Smoking cessation in a homeless population: there is a will, but is there a way? *Journal of General Internal Medicine*. 2002;17(5):369-372.
125. Gwaltney CJ, Shiffman S, Balabanis MH, Paty JA. Dynamic self-efficacy and outcome expectancies: prediction of smoking lapse and relapse. *Journal of Abnormal Psychology*. 2005;114(4):661-675.
126. Shiyko MP, Lanza ST, Tan X, Li R, Shiffman S. Using the time-varying effect model (TVEM) to examine dynamic associations between negative affect and self confidence on smoking urges: differences between successful quitters and relapsers. *Prevention Science*. 2012;13(3):288-299.
127. Condiotte MM, Lichtenstein E. Self-efficacy and relapse in smoking cessation programs. *Journal of Consulting and Clinical Psychology*. 1981;49(5):648-658.
128. Boardman T, Catley D, Mayo MS, Ahluwalia JS. Self-efficacy and motivation to quit during participation in a smoking cessation program. *International Journal of Behavioral Medicine*. 2005;12(4):266-272.
129. Piasecki TM, Niaura R, Shadel WG, et al. Smoking withdrawal dynamics in unaided quitters. *Journal of Abnormal Psychology*. 2000;109(1):74-86.
130. Marlatt GA, Gordon JR. *Relapse prevention: Maintenance strategies in the treatment of addictive behaviors*. 1st Edition ed. New York: Guilford Press; 1985.
131. Berkman ET, Dickenson J, Falk EB, Lieberman MD. Using SMS text messaging to assess moderators of smoking reduction: Validating a new tool for ecological measurement of health behaviors. *Health Psychology*. 2011;30(2):186-194.
132. Gwaltney CJ, Metrik J, Kahler CW, Shiffman S. Self-efficacy and smoking cessation: a meta-analysis. *Psychology of Addictive Behaviors*. 2009;23(1):56-66.
133. Gwaltney CJ, Shiffman S, Norman GJ, et al. Does smoking abstinence self-efficacy vary across situations? Identifying context-specificity within the Relapse Situation Efficacy Questionnaire. *Journal of Consulting and Clinical Psychology*. 2001;69(3):516-527.
134. Cox LS, Tiffany ST, Christen AG. Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. *Nicotine & Tobacco Research*. 2001;3(1):7-16.
135. Alessi SM, Petry NM. Smoking reductions and increased self-efficacy in a



- randomized controlled trial of smoking abstinence-contingent incentives in residential substance abuse treatment patients. *Nicotine & Tobacco Research*. 2014;16(11):1436-1445.
136. Cupertino AP, Berg C, Gajewski B, et al. Change in self-efficacy, autonomous and controlled motivation predicting smoking. *Journal of Health Psychology*. 2012;17(5):640-652.
137. Patten CA, Decker PA, Dornelas EA, et al. Changes in readiness to quit and self-efficacy among adolescents receiving a brief office intervention for smoking cessation. *Psychology, Health & Medicine*. 2008;13(3):326-336.
138. Cropsey KL, Leventhal AM, Stevens EN, et al. Expectancies for the effectiveness of different tobacco interventions account for racial and gender differences in motivation to quit and abstinence self-efficacy. *Nicotine & Tobacco Research*. 2014;16(9):1174-1182.
139. Hendricks PS, Westmaas JL, Ta Park VM, et al. Smoking abstinence-related expectancies among American Indians, African Americans, and women: potential mechanisms of tobacco-related disparities. *Psychology of Addictive Behaviors*. 2014;28(1):193-205.
140. Daza P, Cofta-Woerpel L, Mazas C, et al. Racial and ethnic differences in predictors of smoking cessation. *Substance Use & Misuse*. 2006;41(3):317-339.
141. Martinez E, Tatum KL, Glass M, et al. Correlates of smoking cessation self-efficacy in a community sample of smokers. *Addictive Behaviors*. 2010;35(2):175-178.
142. Irving LM, Snyder CR, Cheavens J, et al. The relationships between hope and outcomes at the pretreatment, beginning, and later phases of psychotherapy. *Journal of Psychotherapy Integration*. 2004;14(4):419-443.
143. Spring B, Howe , Berendsen M, et al. Behavioral intervention to promote smoking cessation and prevent weight gain: a systematic review and meta-analysis. *Addiction*. 2009;104(9):1472-1486.
144. Fazel S, Khosla V, Doll H, Geddes J. The prevalence of mental disorders among the homeless in western countries: systematic review and meta-regression analysis. *PLOS Medicine*. 2008;5(12):e225.
145. Reitzel LR, Nguyen N, Eischen S, Thomas J, Okuyemi KS. Is smoking cessation associated with worse comorbid substance use outcomes among homeless adults? *Addiction*. 2014;109(12):2098-2104.

146. QUITPLAN. Getting free patches, gum or lozenges. 2016. Available at: <https://www.quitplan.com/services-to-help/free-kit.html>. Accessed June 2016.
147. Rog DJ, Marshall T, Dougherty RH, et al. Permanent supportive housing: assessing the evidence. *Psychiatric Services*. 2014;65(3):287-294.
148. Poremski D, Woodhall-Melnik J, Lemieux AJ, Stergiopoulos V. Persisting barriers to employment for recently housed adults with mental illness who were homeless. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. 2015;93(1):96-108.
149. Bond GR, Drake RE. Making the case for IPS supported employment. *Administration and Policy in Mental Health and Mental Health Services Research*. 2014;41(1):69-73.
150. Campbell K, Bond GR, Drake RE. Who benefits from supported employment: a meta-analytic study. *Schizophrenia Bulletin*. 2011;37(2):370-380.
151. Poremski D, Rabouin D, Latimer E. A randomised controlled trial of evidence based supported employment for people who have recently been homeless and have a mental illness. *Administration and Policy in Mental Health and Mental Health Services Research*. 2015;Epub ahead of print.

## **Appendix: Scales and Multi-item Measures**

### Mini International Neuropsychiatric Interview (MINI): Psychotic Disorders and Mood Disorder with Psychotic Features Module

Please answer yes or no to the following questions.

1. In the past 30 days, have you believed that people were spying on you, or that someone was plotting against you or trying to hurt you?
2. In the past 30 days, have you believed that someone was reading your mind or could hear your thoughts, or that you could actually read someone's mind or hear what another person was thinking?
3. In the past 30 days, have you believed that someone or some force outside of yourself put thoughts in your mind that were not your own, or made you act in a way that was not your usual self? Have you ever felt that you were possessed?
4. In the past 30 days, have you believed that you were being sent special messages through the TV, radio, newspaper, or that a person you did not personally know was particularly interested in you?
5. Have your relatives or friends ever considered any of your beliefs strange or unusual?
6. Do you ever hear things other people couldn't hear, such as voices?
7. Do you ever have visions when you are awake or have you ever seen things other people couldn't see?

### Patient Health Questionnaire (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? Not at all, several days, more than half the days, or nearly every day

1. Little interest or pleasure in doing things
2. Feeling down, depressed, or hopeless
3. Trouble falling or staying asleep, or sleeping too much
4. Feeling tired or having little energy
5. Poor appetite or overeating

6. Feeling bad about yourself, or that you are a failure, or have let yourself or family down
7. Trouble concentrating on things, such as reading the newspaper or watching television
8. Moving or speaking so slowly that other people could have noticed, or the opposite, being so fidgety or restless that you have been moving around a lot more than usual
9. Have you had thoughts that you would be better off dead, or of hurting yourself in some way?

### Perceived Stress Scale

In the past 30 days, how often (never, rarely, sometimes, often, or very often)....

1. Have you felt that you were unable to control the important things in your life?
2. Have you felt confident about your ability to handle your personal problems?
3. Have you felt that things were going your way?
4. Have you felt difficulties were piling up so high that you could not overcome them?

### Smoking Self-Efficacy Questionnaire (SEQ-12)

The following are some situations in which certain people might be tempted to smoke. Please indicate how sure you are that you could refrain from smoking in each situation. Not at all sure, not very sure, more or less sure, fairly sure, or absolutely sure

Intrinsic:

1. When I feel nervous
2. When I feel depressed
3. When I am angry
4. When I feel very anxious
5. When I want to think about a difficult problem
6. When I feel the urge to smoke

Extrinsic:

1. When having drinks with friends
2. When celebrating something
3. When drinking beer, wine, or other spirits
4. When I am with smokers
5. After a meal
6. When having coffee or tea

Treatment Self Regulation for Smoking Questionnaire (TSRQ)

The following questions relate to the reasons why you would either quit smoking or stay quit. Different people have different reasons for quitting smoking, and we want to know how true each of the following reasons is for you. 1=not at all true, 2, 3, 4=somewhat true, 5, 6, or 7=very true

Autonomous:

1. Because I feel that I want to take responsibility for my own health.
2. Because I personally believe it is the best thing for my health.
3. Because I have carefully thought about it and believe it is very important for many aspects of my life
4. Because it is an important choice I really want to make.
5. Because it is consistent with my life goals.
6. Because it is very important for being as healthy as possible.

Controlled:

1. Because I would feel guilty or ashamed of myself if I smoked.
2. Because others would be upset with me if I smoked.
3. Because I would feel bad about myself if I smoked.

4. Because I feel pressure from others not to smoke.
5. Because I want others to approve.
6. Because I want others to see I can do it.

Amotivation:

1. I really don't think about it.
2. Because it is easier for me to do what I am told than to think about it.
3. I don't really know why.

Weight Concern Scale

Please rate each question on a scale from 0-10, with 0 being not at all important and 10 being extremely important.

1. How important is losing weight or maintaining your current weight compared with other personal health concerns?
2. People smoke for many reasons. Compared with all of your reasons for smoking, how important is smoking to control your weight?
3. How much do you think cigarettes help you to control your weight?
4. How concerned are you about gaining weight as a result of quitting?
5. How likely do you think it is that you will gain weight as a result of quitting?
6. How likely is it that you would go back to smoking after quitting if you gained too much weight?