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Cessation-related weight concern among homeless male and female smokers

Erika Ashley Pinsker [a,b,*], Deborah Jane Hennrikus [c], Darin J. Erickson [c], Kathleen Thiede Call [d], Jean Lois Forster [c], Kolawole Stephen Okuyemi [e]

[a] Minneapolis VA Health Care System, Center for Chronic Disease Outcomes Research, One Veterans Drive Minneapolis, MN 55417, USA
[b] University of Minnesota, Department of Medicine, 401 East River Parkway Suite 131, Minneapolis, MN 55455, USA
[c] University of Minnesota, Division of Epidemiology and Community Health, 1300 S 2nd St., Minneapolis, MN 55455, USA
[d] University of Minnesota, Division of Health Policy & Management, 516 Delaware St. SE Suite 15-223, Minneapolis, MN 55455, USA
[e] University of Minnesota, Program in Health Disparities Research, 717 Delaware St. SE Suite 166, Minneapolis, MN 55414, USA

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ABSTRACT

Concern about post-cessation weight gain is a barrier to making attempts to quit smoking; however, its effect on smoking cessation is unclear. In this study we examine cessation-related weight concern among the homeless, which hasn't been studied.

Homeless males (n = 320) and females (n = 110) participating in a smoking cessation RCT in the Twin Cities, Minnesota from 2009 to 2011 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.

Females had higher cessation-related weight concern than males. Among males, older age, Black race, higher BMI, depression, and having health insurance were associated with higher cessation-related weight concern. Among females, nicotine dependence, greater cigarette consumption, indicating quitting is more important, older age of smoking initiation, and less support to quit from family were associated with higher cessation-related weight concern. In multivariate analyses, cessation-related weight concern decreased over time among females. Cessation-related weight concern wasn't associated with smoking cessation.

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.

1. Introduction

Smoking cessation leads to a 4–5 kg mean increase in body weight at 12 months abstinence, with females gaining more weight than males (Williamson et al., 1991; Pisinger and Jorgensen, 2007; Aubin et al., 2012). Concern about post-cessation weight gain, that is cessation-related weight concern, is a barrier to making attempts to quit smoking (Rosenthal et al., 2013; Pomerleau et al., 2001; Tuovinen et al., 2015), and a reason for relapse (Donny et al., 2011). Approximately one quarter of daily smoking males and half of daily smoking females experience cessation-related weight concern (Meyers et al., 1997; Clark et al., 2006, 2004). However, the effect cessation-related weight concern has on smoking cessation during a quit attempt is unclear with some studies finding smokers with these concerns are less likely to quit (Meyers et al., 1997; Levine et al., 2010; Klesges et al., 1988; Schauer et al., 2013; Aubin et al., 2009), and other studies not finding an association between cessation-related weight concern and cessation (Pisinger and Jorgensen, 2007; Borrelli and Mermelstein, 1998; Jeffery et al., 2000; French et al., 1995; Landrau-Cribbs et al., 2015). Possible reasons for the mixed findings are studies focused on different populations (Veldheer et al., 2014) and cessation-related weight concern has been assessed using different measures (Jeffery et al., 2000; Veldheer et al., 2014; Luostarinen et al., 2013). For instance, some studies measured general weight concern (Pisinger and Jorgensen, 2007; French et al., 1995), as opposed to cessation-specific weight concern, which may be a better predictor of smoking behavior (Jeffery et al., 2000).

As concern about post-cessation weight gain is a barrier to making quit attempts and reason for relapse, it's important to identify

* Corresponding author at: Minneapolis VA Health Care System, One Veterans Drive Building, 9 Mail Code 152, Minneapolis, MN 55417, USA.
E-mail addresses: Erika.Pinsker@va.gov (E.A. Pinsker), hennr001@umn.edu (D.J. Hennrikus), erick232@umn.edu (D.J. Erickson), callx001@umn.edu (K.T. Call), forst001@umn.edu (J.L. Forster), kokuyemi@umn.edu (K.S. Okuyemi).

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characteristics of smokers who experience these concerns in order to develop targeted smoking cessation interventions. Although there's been research on predictors of cessation-related weight concern, previous studies focused predominately on white, middle-to-upper socioeconomic status populations and there are few studies among vulnerable populations (Collins et al., 2009; Ludman et al., 2002; Sepinwall and Borrelli, 2004). None of these studies focused on homeless individuals.

The smoking prevalence among the homeless is 73%, which is over three times the national rate and homeless smokers face difficulty quitting and maintaining abstinence (Baggett and Rigotti, 2010; Shelley et al., 2010; Okuyemi et al., 2013; Businelle et al., 2012). Previous smoking cessation interventions (i.e., pharmacotherapy and counseling) haven't been successful at promoting high cessation rates among the homeless (Shelley et al., 2010; Okuyemi et al., 2013, 2006). Examining potential barriers to quitting and addressing identified barriers as part of homeless-targeted intervention efforts may improve cessation outcomes among the homeless. Cessation-related weight concern may serve as a barrier to quitting among the homeless since there is high prevalence of overweight and obesity in this population (Koh et al., 2012), an established correlate of cessation-related weight concern (Pomerleau et al., 2001; Tuovinen et al., 2015; Aubin et al., 2009; Jeffery et al., 2000; French et al., 1995; Luostarinen et al., 2013; Collins et al., 2009; Sánchez-Johnsen et al., 2005).

This study examines cessation-related weight concern among homeless smokers in the Twin Cities, MN. We examine cessation-related weight concern among males and females separately since weight concern differs by sex, with females having greater concerns and predictors of weight concern being sex-specific (Pisinger and Jorgensen, 2007; Clark et al., 2006, 2004; Aubin et al., 2009; Borrelli and Mermelstein, 1998). 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.

The conceptual model guiding this study (Fig. 1) was informed by the Behavioral Model for Vulnerable Populations, which posits predisposing (i.e., characteristics that exist prior to the perception of illness), enabling (i.e., characteristics that facilitate or impede the performance of health practices), and need components (i.e., perceptions about health and physical illness) predict health behavior (Gelberg et al., 2000). Within each component, the traditional domain includes characteristics that are important for predicting health behavior among the general population and the vulnerable domain includes characteristics that are important for predicting health behavior among vulnerable populations. Previous studies that tested the model found vulnerable domain characteristics were important predictors of health behavior in homeless populations (Gelberg et al., 2000; Teruya et al., 2010; Stein et al., 2007, 2012).

2. Materials and methods

2.1. Study information

Study data were derived from the Power to Quit study, a randomized controlled trial of 430 homeless adult smokers that assessed the effectiveness of motivational interviewing (MI), a counseling approach, for smoking cessation (Okuyemi et al., 2013; Goldade et al., 2011). The design and outcomes of the parent study were previously described (Okuyemi et al., 2013; Goldade et al., 2011). Participants were recruited from eight homeless emergency shelters and transitional housing sites in Minneapolis/St. Paul, Minnesota from May 2009 to August 2010. Eligibility criteria included homelessness, (US Code, 2004) current

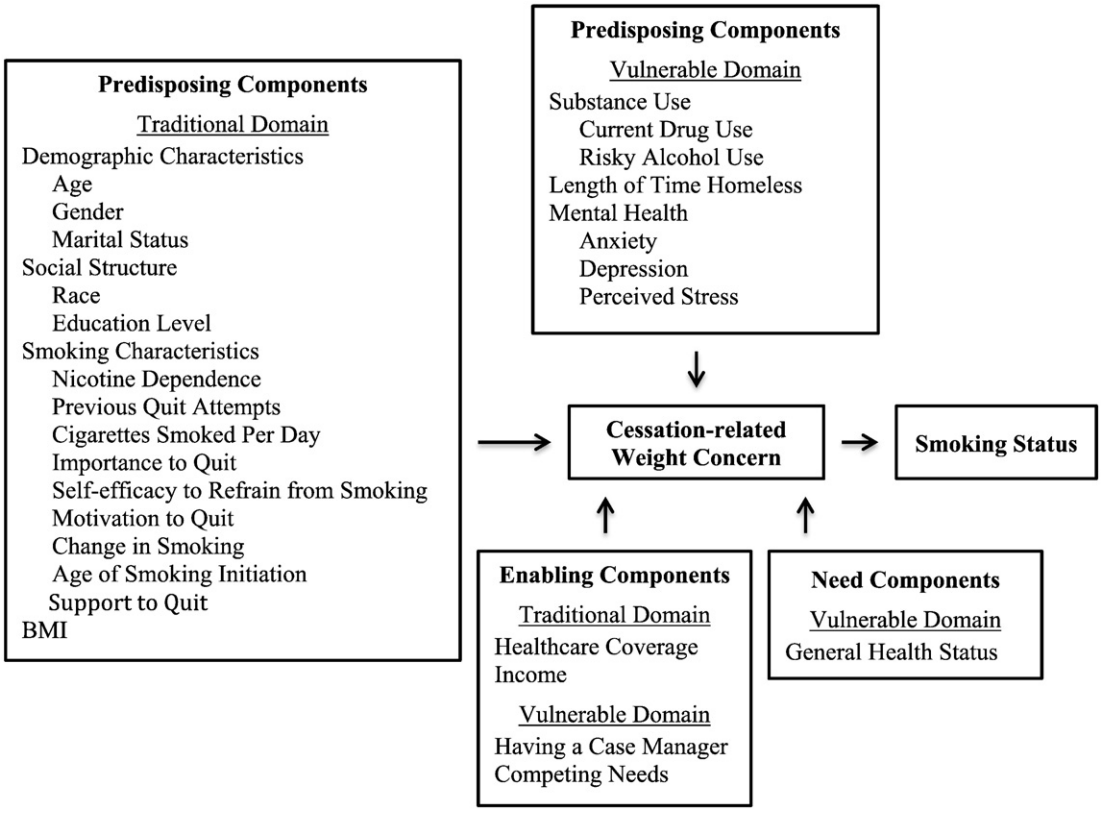

Fig. 1. Potential predictors of cessation-related weight concern: components of the Behavioral Model for Vulnerable Populations relevant to the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011. Description: This figure, which is informed by the Behavioral Model for Vulnerable Populations posits that traditional and vulnerable predisposing, traditional and vulnerable enabling, and vulnerable need components will be associated with cessation-related weight concern in this study. The model also posits that cessation-related weight concern will be associated with smoking status in this study.

cigarette smoker, age 18 years or older, not currently pregnant, willing to use nicotine patches for 8 weeks, and participate in counseling sessions.

At baseline participants were randomized to the nicotine patch plus MI intervention arm or the nicotine patch plus standard care (SC) control arm. Intervention participants received six individual MI counseling sessions each lasting 15–20 min, 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 min. Participants in both conditions received 21 mg nicotine patches for eight weeks.

Surveys were administered at baseline, week 8 (end of treatment), and week 26 (follow-up). Criteria for measure selection included: established reliability and validity, literacy level, prior use among low SES populations, and length. Surveys were pre-tested with 10 homeless individuals and subsequently modified based on feedback. Week 8 and 26 study visit completion rates were 76.1% and 75.4%, respectively. Participants received monetary incentives at each visit totaling $275 over 6 months for attendance at all visits. This study was approved by the University of Minnesota Institutional Review Board. All participants provided informed consent. Consent forms were written at the 5th grade level and participants had the option of having the form read to them.

2.2. Measures

All variables were measured at baseline, unless otherwise noted.

Cessation-related weight concern was measured at baseline, week 8, and week 26 using the Weight Concern Scale (Borrelli and Mermelstein, 1998). Participants indicated 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), ranging from 0 (not at all important) to 10 (extremely important). Items were summed to create a scale ranging from 0 to 60, with higher scores indicating greater concern. The Cronbach's alpha coefficients for these items at each time point ranged from 0.80 to 0.85, indicating good reliability.

2.2.1. Traditional predisposing components

2.2.1.1. Demographic characteristics. Participants reported their date of birth, sex (i.e., male, female, or other (specify)), and marital status.

2.2.1.2. Social structure. Participants reported their race and education level.

2.2.1.3. Smoking characteristics. Nicotine dependence was assessed by asking participants if they smoke within the first 30 min of waking (Heatherton et al., 1991). Participants were asked the number of times in the last year they tried to quit smoking for at least 24 h and the average number of cigarettes they smoked per day over the past seven days.

Participants were asked to report how important it is for them to quit smoking completely on a scale of 0 (not important) to 10 (extremely important). Intrinsic and extrinsic self-efficacy to refrain from smoking were measured using the Smoking Self-Efficacy Questionnaire (SEQ-12) (Etter et al., 2000). Each scale 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) and 0.88 (extrinsic), indicating good reliability.

Motivation to quit was assessed using the Treatment Self-Regulation for Smoking Questionnaire (TSRQ), which measures autonomous motivation, controlled motivation, and amotivation (Ryan and Connell, 1989; Levesque et al., 2007). 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.

Participants were asked whether compared to a year ago, they now smoked fewer, the same, or more cigarettes per day and days per week, and 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).

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

2.2.2. Vulnerable predisposing components

2.2.2.1. 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, 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 and how many drinks they usually had on the days they drank, which were used 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 (National Institute on Alcohol Abuse and Alcoholism, 2014).

2.2.2.2. Length of time homeless. Participants reported how long they have been without a regular or permanent place to live.

2.2.2.3. Mental health. Anxiety was measured by asking participants if they have worried excessively or been anxious about several things the past six months (Sheehan et al., 1998). Depression was measured using the Patient Health Questionnaire (PHQ-9), which ranges from 0 to 27 with higher scores indicating greater depression (Kroenke et al., 2001). The Cronbach's alpha for these items was 0.87, indicating good reliability. Perceived stress was measured using the four-item Perceived Stress Scale, which ranges from 0 to 16, with higher scores indicating greater stress (Cohen et al., 1983). The Cronbach's alpha for these items was 0.57, indicating poor reliability.

2.2.3. Traditional enabling components

Participants reported their health care coverage and total monthly family income.

2.2.4. Vulnerable enabling components

Participants were asked if they have a case manager who helps 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 ranging from 0 (never a problem) to 3 (usually a problem). The four items were summed to create an index ranging from 0 to 12.

2.2.5. Vulnerable need components

General health status was measured by asking participants to rate their health ranging from poor to excellent (Ware and Sherbourne, 1992).

2.2.6. Health behavior

2.2.6.1. Smoking status. Participants were categorized as either smokers or quitters at weeks 8 and 26 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 < 10 p.p.m.). At 26 weeks, if the CO score was >10 p.p.m., salivary cotinine was used to verify abstinence (scores < 20 ng/ml). Both

CO and cotinine testing are well-established methods of validating smoking status that have high sensitivity and specificity (Jarvis et al., 1980; Jarvis et al., 1987).

2.3. Analysis

All analyses were conducted using STATA v13. Descriptive statistics and bivariate relationships (i.e., *t*-tests for continuous variables and x^2 tests for categorical variables) were examined for the components, cessation-related weight concern, and smoking status by sex. We created a plot examining cessation-related weight concern over time by sex. Generalized estimating equations models (GEE), a robust approach for analyzing longitudinal data (Hanley et al., 2003), were conducted to identify baseline predictors of cessation-related weight concern at baseline, week 8, and week 26. Each model contained variables from one type of component as the predictors. A GEE model with all of the

Table 1
Baseline descriptive statistics of homeless male and female participants in the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011 (N = 430).

	Homeless males		Homeless females		t or x^2	p-Value
Variable	N	Mean (SD) or N (%)	N	Mean (SD) or N (%)		
Traditional predisposing components						
Demographic characteristics						
Age	320	45.3 (9.3)	110	41.7 (11.2)	**3.27**	**0.001**
Marital status	319		109		3.52	0.061
Married or living with others		12 (4%)		9 (8%)		
Divorced/widowed/separated/never married		307 (96%)		100 (92%)		
Social structure						
Race	320		110		**6.06**	**0.048**
White		111 (35%)		42 (38%)		
Black		189 (59%)		4 (49%)		
Other		20 (6%)		14 (13%)		
Education ≥ high school graduate or GED	320	248 (78%)	110	82 (75%)	0.40	0.527
Smoking characteristics						
Nicotine dependent (time to first cigarette, ≤30 min)	320	282 (88%)	110	92 (84%)	1.46	0.228
Number of quit attempts, past year	315	2.2 (3.4)	109	2.0 (2.6)	0.68	0.496
Cigarettes smoked per day	317	19.1 (10.3)	110	18.1 (11.8)	0.87	0.384
Importance to quit, scale 0–10	320	9.0 (1.6)	110	9.2 (1.6)	−0.63	0.527
Self-efficacy to refrain from smoking						
Intrinsic, scale 6–30	320	17.2 (6.7)	109	16.2 (6.9)	1.32	0.189
Extrinsic, scale 6–30	318	16.8 (7.9)	108	16.8 (7.7)	0.09	0.930
Motivation to quit						
Controlled motivation, scale 6–42	320	18.1 (9.6)	110	18.5 (9.3)	−0.45	0.656
Autonomous motivation, scale 6–42	320	36.6 (6.7)	110	37.2 (6.1)	−0.71	0.480
Amotivation, scale 3–21	320	8.0 (4.6)	110	8.1 (4.5)	−0.25	0.805
Cigarettes smoked per day, compared to 1 year ago	320		110		1.89	0.389
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		3.35	0.187
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)	0.56	0.574
Support to quit (scale 0–3) from:						
Family	319	1.3 (1.3)	110	1.9 (1.3)	**−4.11**	**<0.001**
Friends or work colleagues	320	0.8 (1.1)	110	1.3 (1.2)	**−4.45**	**<0.001**
Case workers	319	0.6 (1.1)	110	1.2 (1.3)	**−4.20**	**<0.001**
BMI	317	29.4 (7.4)	109	32.2 (8.0)	**−3.39**	**<0.001**
Vulnerable predisposing components						
Substance use						
Current drug use in the past 30 days[a]	318	134 (42%)	109	34 (31%)	**4.08**	**0.044**
Risky alcohol use (>1 drink a day for females, >2 drinks a day for males)	320	36 (11%)	110	18 (16%)	1.95	0.163
Length of time homeless	319		110		0.61	0.739
<1 year		157 (49%)		58 (53%)		
1–3 years		113 (36%)		38 (34%)		
>3 years		49 (15%)		14 (13%)		
Mental health						
Experienced anxiety, past 6 months	318	189 (59%)	110	76 (69%)	3.23	0.072
Depression, scale 0–27	318	8.0 (6.3)	110	9.8 (6.6)	**−2.56**	**0.011**
Perceived stress, scale 0–16	318	6.6 (3.1)	110	7.1 (2.9)	−1.35	0.178
Traditional enabling components						
Health insured	320	262 (82%)	110	91 (83%)	0.04	0.841
Monthly family income < $400	320	221 (69%)	110	72 (65%)	0.49	0.484
Vulnerable enabling components						
Have a case manager that helps get and coordinate care	305	76 (25%)	106	51 (48%)	**19.82**	**<0.001**
Competing needs, scale 0–12	319	4.0 (3.1)	110	4.1 (3.4)	−0.43	0.666
Vulnerable need components						
General health status	319		109		5.06	0.080
Excellent/very good		144 (45%)		36 (33%)		
Good		103 (32%)		41 (38%)		
Fair/poor		72 (23%)		32 (29%)		

[a] Marijuana, cocaine, heroin, other recreational drug, and/or prescription drug without prescription.

Table 2
Cessation-related weight concern and cessation among homeless male and female participants in the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011 (N = 430).

	Homeless males		Homeless females		t or x^2	p-Value
Variable	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)	−3.96	<0.001
Week 8 cessation-related weight concern, scale 0–60	242	25.0 (17.9)	83	29.7 (17.0)	−2.07	0.039
Week 26 cessation-related weight concern, scale 0–60	243	24.5 (17.2)	81	27.9 (17.5)	−1.54	0.124
Week 8 quitters[a]	320	31 (10%)	110	8 (7%)	0.61	0.436
Week 26 quitters[a]	320	27 (8%)	110	5 (5%)	1.44	0.230

[a] Participants with missing data were considered to be smokers.

components included was examined to determine the effect of time on cessation-related weight concern. Cessation-related weight concern was examined as a predictor of smoking status using logistic regression models, controlling for treatment group. 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. All models were examined for the full sample and separately by sex.

3. Results

Table 1 outlines baseline descriptive statistics for homeless male (n = 320) and female (n = 110) smokers. Compared to females, males were older and had a larger proportion of blacks and current drug users. They had lower support to quit, depression, and proportion of individuals with a case manager who helps them get and coordinate care.

Table 2 outlines cessation-related weight concern at baseline, week 8, and week 26, and cessation at weeks 8 and 26 among males and females. Females had higher cessation-related weight concern than males at baseline and week 8. Fig. 2 shows cessation-related weight concern among males and females over time.

Baseline predictors of cessation-related weight concern at baseline, week 8, and week 26 among males and females are described in Table 3. Regression results are presented separately by sex because there were differences in the types of variables that predicted cessation-related weight concern among males and females. Among males, components that were associated with higher cessation-related weight concern included older age (B = 0.21, p = 0.009), Black race (B = 6.09, p = 0.001, Ref: White race), greater controlled motivation to quit (B = 0.26, p = 0.016), higher BMI (B = 0.42, p < 0.001), greater depression (B = 0.49, p = 0.001), having health insurance (B = 4.49, p = 0.022), and having a case manager that helps get and coordinate care (B = 5.88, p = 0.002). Components that were associated with lower cessation-related weight concern included high school or more education (B = −4.22, p = 0.023) and having a low monthly family income (<$400) (B = −3.53, p = 0.039).

Among females, components that were associated with higher cessation-related weight concern included nicotine dependence (B = 7.91, p = 0.010), greater cigarette consumption (B = 0.22, p = 0.041), greater importance to quit (B = 1.47, p = 0.035), greater controlled motivation to quit (B = 0.39, p = 0.002), and older age of smoking initiation (B = 0.74, p = 0.003). Components that were associated with lower cessation-related weight concern included greater autonomous motivation to quit (B = −0.36, p = 0.041) and greater support to quit from family (B = −3.29, p = 0.001). Adjusting for the components, time was associated with cessation-related weight concern, which decreased during the study ($B_{8Weeks} = -4.53$, p = 0.006; $B_{26Weeks} = -6.32$, p = 0.001).

Cessation-related weight concern wasn't statistically significantly associated with cessation at any time point (Table 4). The same results were found among males and females; therefore, findings from the full sample are presented.

4. Discussion

This study examined cessation-related weight concern among homeless smokers in the Twin Cities, MN. We didn't find cessation-related weight concern to be a predictor of cessation at the end of treatment or at follow-up among the homeless. Previous findings regarding the relationship between cessation-related weight concern

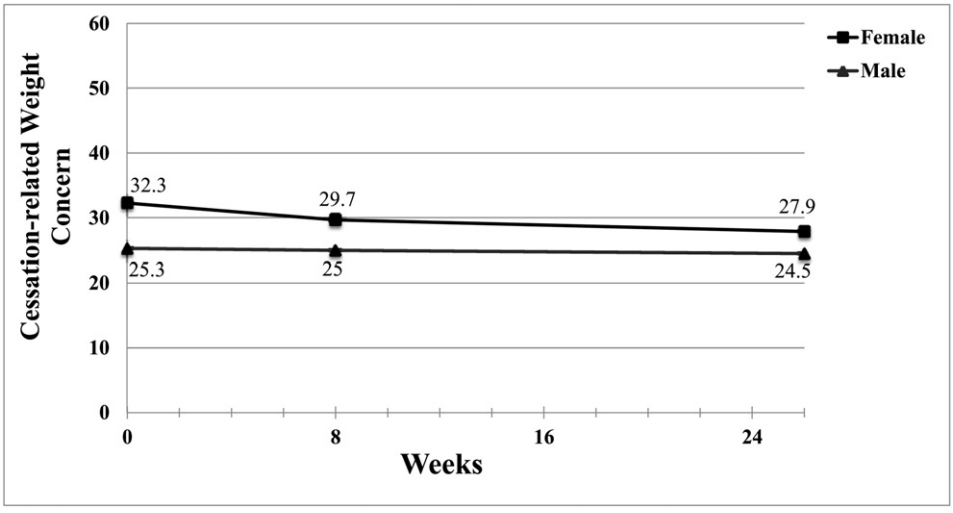

Fig. 2. Cessation-related weight concern over time among homeless male and female participants in the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011 (N = 430). Description: Cessation-related weight concern remained stable over the course of the study among males. Cessation-related weight concern slightly decreased over the course of the study among females; however the differences were not statistically significant. Females had statistically significantly higher cessation-related weight concern than males at baseline and the end of treatment (week 8).

Table 3
Baseline predictors of cessation-related weight concern at baseline, week 8, and week 26 among male and female participants in the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011 (N = 430).

	Males		Females	
Variable	B	p-Value	B	p-Value
Time, 8 weeks	−0.32	0.790	**−4.53**	**0.006**
Time, 26 weeks	−1.31	0.286	**−6.32**	**0.001**
Traditional predisposing components				
Demographic characteristics				
Age	**0.21**	**0.009**	0.17	0.156
Marital status				
Married or living with others	0.24	0.942	0.16	0.969
Divorced/widowed/separated/never married	Ref		Ref	
Social structure				
Race				
White	Ref		Ref	
Black	**6.09**	**0.001**	−0.39	0.885
Other	4.21	0.190	1.59	0.601
Education ≥ high school graduate or GED	**−4.22**	**0.023**	0.92	0.703
Smoking characteristics				
Nicotine dependent (time to first cigarette, ≤30 min)	−0.68	0.769	**7.91**	**0.010**
Number of quit attempts, past year	−0.06	0.823	−0.38	0.321
Cigarettes smoked per day	−0.05	0.498	**0.22**	**0.041**
Importance to quit, scale 0–10	−0.15	0.731	**1.47**	**0.035**
Self-efficacy to refrain from smoking				
Intrinsic, scale 6–30	−0.13	0.481	0.05	0.853
Extrinsic, scale 6–30	0.06	0.686	−0.02	0.922
Motivation to quit				
Controlled motivation, scale 6–42	**0.26**	**0.016**	**0.39**	**0.002**
Autonomous motivation, scale 6–42	−0.12	0.325	**−0.36**	**0.041**
Amotivation, scale 3–21	0.25	0.187	0.25	0.494
Cigarettes smoked per day, compared to 1 year ago				
Fewer	2.41	0.324	0.83	0.835
Same	−0.78	0.707	−2.37	0.505
More	Ref		Ref	
Number of days smoked per week, compared to 1 year ago				
Fewer	−2.45	0.462	4.18	0.480
Same	−3.33	0.165	0.64	0.850
More	Ref		Ref	
Age of smoking initiation	−0.01	0.918	**0.74**	**0.003**
Support to quit (scale 0–3) from:				
Family	−0.56	0.407	**−3.29**	**0.001**
Friends or work colleagues	−0.12	0.885	0.08	0.956
Case workers	1.10	0.148	0.48	0.660
BMI	**0.42**	**<0.001**	0.03	0.797
Vulnerable predisposing components				
Substance use				
Current drug use in the past 30 days[a]	−2.21	0.175	−0.42	0.896
Risky alcohol use (>1 drink a day for females, >2 drinks a day for males)	−4.03	0.129	−2.25	0.535
Length of time homeless				
<1 year	−1.44	0.550	−0.97	0.784
1–3 years	2.41	0.351	−2.74	0.480
>3 years	Ref		Ref	
Mental health				
Experienced anxiety, past 6 months	0.17	0.926	−1.47	0.635
Depression, scale 0–27	**0.49**	**0.001**	0.28	0.190
Perceived stress, scale 0–16	0.00	0.995	0.27	0.576
Traditional enabling components				
Health insured	**4.49**	**0.022**	2.17	0.514
Monthly family income < $400	**−3.53**	**0.039**	−0.45	0.879
Vulnerable enabling components				
Have a case manager that helps get and coordinate care	**5.88**	**0.002**	−2.18	0.407
Competing needs, scale 0–12	−0.01	0.961	−0.38	0.380
Vulnerable need components				
General health status				
Excellent/very good	−3.78	0.057	5.22	0.104
Good	−2.36	0.251	4.98	0.125
Fair/poor	Ref		Ref	

Note: Separate models were examined for each type of component. B is the regression coefficient from the GEE models.
[a] Marijuana, cocaine, heroin, other recreational drug, and/or prescription drug without prescription.

Table 4
Relationship between cessation-related weight concern and cessation controlling for treatment group among participants in the Power to Quit study, which took place in the Twin Cities, Minnesota from 2009 to 2011 (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 = 0.602	0.99 (0.97, 1.02) p = 0.587
Week 8 cessation-related weight concern	1.02 (1.00, 1.04) p = 0.130	1.01 (0.98, 1.03) p = 0.580
Week 26 cessation-related weight concern	–	1.00 (0.98, 1.03) p = 0.733

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

and cessation are mixed. Among the studies using the Weight Concern Scale, two studies didn't find that cessation-related weight concern was prospectively associated with cessation (Borrelli and Mermelstein, 1998; Sepinwall and Borrelli, 2004). However, two other studies found cessation-related weight concern may play an important role in cessation (Aubin et al., 2009; Luostarinen et al., 2013). 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.

Based on qualitative comparison with previous studies using the Weight Concern Scale, homeless individuals experienced similar levels of cessation-related weight concern as domiciled populations (i.e., in the mid-range of the scales) (Table 5) (Tuovinen et al., 2015; Aubin et al., 2009; Borrelli and Mermelstein, 1998; Luostarinen et al., 2013; Sepinwall and Borrelli, 2004; Levine et al., 2013; Correll et al., 2013). However, our ability to compare findings across studies is limited by differential measurement of the Weight Concern Scale. Studies used different Likert scales and some studies summed items rather than averaged. There is need for consensus on the best way to score the Weight Concern Scale in order to standardize measurement and facilitate comparison across studies.

Consistent with the literature, we found homeless females experienced greater cessation-related weight concern than males; (Tuovinen et al., 2015; Aubin et al., 2009; Borrelli and Mermelstein, 1998; Luostarinen et al., 2013; Sepinwall and Borrelli, 2004) and predictors of cessation-related weight concern differed by sex (Clark et al., 2006, 2004). A new finding from the multivariate analysis was that even though the intervention didn't target cessation-related weight concern, homeless females experienced a decrease in cessation-related weight concern over the course of the study whereas cessation-related weight concern didn't change statistically significantly among males.

As identified in the literature, traditional predisposing components were associated with cessation-related weight concern among males. Older age (Jeffery et al., 2000), and higher BMI (Tuovinen et al., 2015; Jeffery et al., 2000; Luostarinen et al., 2013; Levine et al., 2013), were associated with higher cessation-related weight concern. Black males had higher cessation-related weight concern compared to White males. Research has found Black men are at higher risk of weight gain after quitting compared to non-Black individuals (Williamson et al., 1991), which may indicate why Black men, if they 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 (Jeffery et al., 2000), another study on both males and females found greater education was associated with higher weight confidence, an item from the Weight Concern Scale that contributes to lower cessation-related weight concern (Aubin et al., 2009). 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. Controlled motivation is typically associated with poorer health and wellbeing (Levesque et al., 2007).

An additional finding was vulnerable predisposing and enabling components were 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 a mixed sample of both males and females (Sepinwall and Borrelli, 2004). However, this relationship hasn't been identified solely among males (Clark et al., 2004). 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 lower income was associated with less weight confidence, which contributes to higher cessation-related weight concern (Aubin et al., 2009). 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 cutoff of $400 per month used in this study. 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 higher cessation-related weight concern. It's been documented that homeless individuals who have higher income, health insurance, and help in getting care are more likely to access health care (Lebrun-Harris et al., 2013; Chau et al., 2002; Weinreb et al., 1998, 2002; Fazel et al., 2014; Muñoz et al., 2005). Homeless smokers who are accessing health care may be more health conscious and concerned about weight gain after quitting smoking.

Although predisposing and enabling components were associated with cessation-related weight concern among males, only traditional predisposing components, specifically smoking characteristics were associated with cessation-related weight concern among females. Consistent with previous literature among females, nicotine dependence (Pomerleau et al., 2001; Tuovinen et al., 2015; Jeffery et al., 2000), greater cigarette consumption (Pomerleau et al., 2001; Sánchez-Johnsen et al., 2005; Sorensen et al., 1992), and less support to quit from family (Collins et al., 2009), were associated with higher cessation-related weight concern. It's 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 nicotine dependence and greater cigarette consumption (Pomerleau et al., 2001). It's also been hypothesized that support to quit may influence an individual's perceptions about quitting smoking and possible weight gain after quitting (Collins et al., 2009).

A new finding was greater importance to quit was associated with higher cessation-related weight concern. It's possible that individuals who place a greater importance on quitting may have greater intention to quit, which is associated with higher cessation-related weight concern among females (Collins et al., 2009). 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 older age of smoking initiation was associated with higher cessation-related weight concern. Previous research identified no association between these characteristics and an inverse relationship between the characteristics (Clark et al., 2006; Jeffery et al., 2000). However, fewer years of smoking was identified as a correlate of higher cessation-related weight concern (Clark et al., 2006), and it is likely current smokers who initiated smoking at an older age have smoked for fewer number of years compared to current smokers who started smoking at a younger age. As among males, we found greater controlled motivation to quit was associated with higher cessation-related weight concern. Conversely, we found greater autonomous motivation to quit (i.e., quitting is positively endorsed and valued by the individual) was associated with lower cessation-related weight concern. Autonomous motivation is typically associated with positive health, behavioral, and psychological outcomes (Levesque et al., 2007).

4.1. Limitations

A limitation is 25% of data were missing at weeks 8 and 26. However, dropouts and individuals who remained in the study had similar baseline characteristics, including levels of cessation-related weight concern. We used all available cessation-related weight concern data without any imputation methods since missing at random appears to be a reasonable assumption. Individuals who had missing data for smoking status were considered to be smokers.

Another limitation is the Perceived Stress Scale and amotivation to quit from the Treatment Self-Regulation for Smoking questionnaire had poor reliability. We examined whether excluding any items would increase the reliability of the scales, but it didn't. Neither of these variables were predictors of cessation-related weight concern. The low reliability of the scales might indicate the variables were not measuring the same unitary construct in this population, and this poor reliability may explain why associations with cessation-related weight concern were null.

A final limitation is our sample may not be representative of the larger homeless smoker population, which limits the generalizability of our findings. Our study sample was demographically representative of the homeless population in Minnesota, which is demographically similar to the national homeless population, but has a larger proportion of Blacks (Okuyemi et al., 2013; Wilder Research, 2013; U.S. Department

Table 5
Comparison of baseline cessation-related weight concern in this study and previous studies using the Weight Concern Scale.

Author (Year)	Population (N)	Items summed vs. averaged	Scale range	Cessation-related weight concern mean (SD): males	Cessation-related weight concern mean (SD): females	Cessation-related weight concern mean (SD): both genders included
The current study	Homeless daily smokers in Minnesota, USA (N = 430)	Summed	0–60	25.3 (16.6)	32.3 (13.8)	–
Tuovinen et al. (2015)	Daily smokers in Finland (N = 600)	Summed	0–24	7.9 (5.7)	10.0 (6.7)	–
Luostarinen et al. (2013)	Daily smokers in Finland (N = 640)	Summed	0–24	8.0 (5.8)	10.2 (6.7)	–
Levine et al. (2013)	Smokers in USA (N = 595)	Averaged	1–10	–	–	4.2 (2.4)
Correll et al. (2013)	Pregnant female smokers in Appalachia, USA (n = 172)	Averaged	1–10	–	4.3 (2.4)	–
Aubin et al. (2009)	Current smokers in Canada, France, the UK, and USA (N = 2009)	Averaged	1–10	–	–	5.5 (2.3)
Sepinwall and Borrelli (2004)	Older, medically ill smokers in USA (N = 271)	Summed	6–60	25.2 (12.7)	25.8 (14.6)	–
Borrelli and Mermelstein (1998)	Daily smokers in USA (N = 122)	Averaged	1–10	3.9 (2.0)	5.7 (2.1)	–

Note: Tuovinen and Luostarinen modified 1 of the 6 items in the scale.

of Housing and Urban Development Office of Community Planning and Development, 2010). However, our study sample was self-selected for the tobacco cessation study and motivated to quit and thus may not be representative of homeless smokers generally.

4.2. Conclusions

Levels of cessation-related weight concern among the homeless are similar to other populations, higher among females than males, and decrease over time among females. Several types of characteristics, including demographic variables, BMI, depression, and income were associated with cessation-related weight concern among males; 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 in a study with more quitters. Further research on the effect of cessation-related weight concern on quitting would be useful for determining whether homeless-targeted tobacco cessation programs would benefit from including content on managing cessation-related weight concern.

Conflicts of interest

None.

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