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Examining the effects of stress and psychological distress on smoking abstinence in cancer patients

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ABSTRACT

Introduction: Cancer patients who smoke report more stress and psychological distress than patients who do not smoke. It is unclear how these emotional symptoms may modify smoking behavior in cancer patients. We examined the influence of a smoking cessation intervention for cancer patients on stress and distress, and the effects of these symptoms on smoking abstinence.

Methods: Mixed-methods secondary analysis of data from the Smokefree Support Study, a two-site randomized controlled trial examining the efficacy of Intensive (IT; n = 153) vs. Standard Treatment (ST; n = 150) for smoking cessation in newly diagnosed cancer patients. Stress coping, perceived stress, distress, and anxiety were self-reported at baseline, 3, and 6 months. Abstinence was biochemically-confirmed at 6 months. A subset of patients (n = 72) completed qualitative exit-interviews.

Results: Patients were on average, 58 years old, 56% female, and smoked a median of 10 cigarettes/day. There were no significant treatment group × time interactions or main effects of treatment group on stress or distress measures (p's > 0.05), however there were significant main effects of time suggesting symptom improvements on each measure in both study groups (p's < 0.05). In adjusted logistic regression models, lower levels anxiety at 3 months predicted confirmed smoking abstinence at 6 months (p = .03). Qualitatively, at 6 months, patients reported their stress and smoking were connected and that the cessation counseling was helpful.

Conclusions: Cancer patients enrolled in a smoking cessation trial report decreases in stress, distress and anxiety over time, and anxiety symptoms may impact smoking cessation success at follow-up resulting in an important intervention target.

1. Introduction

Cancer diagnosis and treatment are associated with significant stress and distress among patients (Andrykowski et al., 2008; Schumacher et al., 2013; Zabora et al., 2001). Cancer patients who smoke, including newly diagnosed cancer patients, have higher levels of stress and psychological distress (e.g., anxiety), compared to cancer patients who do not smoke (Choi et al., 2019; Humphris and Rogers, 2004; Novy et al., 2012). Psychological distress may stem from the cognitive and emotional challenges patients confront upon learning of a cancer diagnosis and the perception of stigma and self-blame when the diagnosis is a smoking-related cancer (Else-Quest et al., 2009; Lehto, 2011, 2014;

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Luberto et al., 2016).

Despite the clinical importance of quitting smoking (Fleshner et al., 1999; Joshu et al., 2011; Richardson et al., 1993; Jung et al., 2015; Parsons et al., 2010; Garces et al., 2004), several studies report that psychological distress, generally assessed via depression and anxiety symptoms, predicts poorer cessation outcomes in cancer patients (Blalock et al., 2011; Guimond et al., 2017; Simmons et al., 2013). We were unable to identify literature on stress as a predictor of smoking cessation, despite stress being listed as a perceived barrier to cessation by cancer patients (McBride and Ostroff, 2003; Ark et al., 1997; Wells et al., 2017). Similarly, while in the general population, smoking cessation has been correlated with corresponding reductions in perceived stress and distress (Cohen and Lichtenstein, 1990; Hajek et al., 2010; McDermott et al., 2013; Parrott, 1995), to our knowledge, no prior work has investigated this relationship in cancer patients. Thus, it remains unknown whether a smoking cessation intervention tailored to the psychological needs of cancer patients can effectively reduce stress and psychological distress and whether, correspondingly, improvements in these outcomes may positively influence smoking cessation outcomes.

The current study is a secondary analysis of a randomized clinical trial for recently diagnosed cancer patients which investigated the efficacy of a sustained telephone counseling plus cessation medication treatment (Intensive Treatment; IT) compared to short-term counseling plus medication advice (Standard Treatment; ST) for smoking cessation. This study found 6-month biochemically confirmed cigarette quit rates of 34.5% (IT) vs. 21.5% (ST) ($p < .02$). (Park et al., 2020) In this context, the aims of the present investigation were to: 1) examine the effects of this smoking cessation intervention in cancer care on longitudinal changes in stress coping, perceived stress, psychological distress, and anxiety symptoms; 2) investigate the effects of stress coping, perceived stress, psychological distress and anxiety on biochemically-confirmed smoking abstinence at 6 months; and, 3) qualitatively assess patients' perceptions of the link between stress and distress and changes in smoking behavior.

2. Methods

Data for this investigation come from the Smokefree Support Study (SSS) randomized controlled trial (Park et al., 2020). This study took place in cancer centers at two U.S. hospitals: Massachusetts General Hospital (MGH) Cancer Center in Boston, MA and the Memorial Sloan Kettering Cancer Center (MSKCC) in New York, NY. Study methodology has been previously published (Park et al., 2016). All participants provided written informed consent.

2.1. Participants

Eligible participants were patients with suspected or newly diagnosed cancer (i.e., thoracic, breast, genitourinary, gastrointestinal, head/neck, lymphoma, melanoma, or gynecological), beginning cancer treatment at MGH or MSKCC, at least 18 years of age, English or Spanish speaking, smoked a cigarette in the past 30 days (McBride and Ostroff, 2003) and were willing to consider attempting to quit smoking. We excluded those without telephone access, a limited life expectancy or untreated, unstable psychiatric illness. Eligible patients were recruited by site-specific recruitment mechanisms (Park et al., 2016).

2.2. Study conditions

Eligible participants were randomly assigned to either the Standard Treatment (ST) or Intensive Treatment (IT) group. Participants in both groups received 4 weekly counseling sessions as well as FDA-approved smoking cessation medication referrals and advice. Those in the IT group received an additional 4 biweekly and 3 monthly booster counseling sessions in addition to up to 90 days of free FDA-approved smoking cessation mediation. Most counseling sessions were delivered individually by telephone.

Study counselors were certified tobacco treatment specialists, and the counseling content utilized a treatment protocol informed by Motivational Interviewing (MI) and 5 A's problem solving (ask, advise, assist, arrange, assess) with a focus on cognitive behavioral and stress management strategies (Park et al., 2016). Each counseling session began with an assessment of the patient's level of distress and included content tailored to the patient's readiness to quit smoking, specific cancer treatment, and individual challenges. Those randomized to the IT group received 7 additional counseling sessions, each addressing cancer-related content such as discussions of smoking-associated stigma, social support, and symptom management including mood management (Park et al., 2016). Stress management content included stress awareness (identifying warning signs and triggers and stress relievers), problem-solving, engaging social support, and other emotion-based coping strategies.

2.2.1. Procedures

Participants completed a baseline survey following informed consent and prior to the first counseling session. Follow-up surveys were completed at 3 and 6 months. The 6-month follow-up survey marked a follow-up assessment after the termination of treatment. The 3-and 6-month assessments were completed either by mail, phone, or via web.

3. Measures

3.1. Baseline Measures: Sociodemographic, Smoking, and cancer history

The baseline survey assessed sociodemographic factors including sex, age, race, and educational attainment and smoking history, including average cigarettes smoked per day (in the past 30), time to first cigarette in the morning (Fagerstrom and Schneider, 1989), smoking cessation medication use, and prior quit attempts. Finally, cancer history including cancer tumor clinic type, stage, and comorbid conditions were extracted from patient's electronic medical record.

4. Smoking cessation Measures: 3- and 6-Month Follow-up

We assessed self-reported past 7-day point prevalence tobacco abstinence. Those who reported abstinence were mailed a saliva kit with instructions to return a sample to assess for cotinine to biochemically verify abstinence. Participants who reported using nicotine replacement therapy or nicotine e-cigarettes at follow-up provided an in-person breath carbon monoxide sample.

5. Stress Coping, perceived Stress, and psychological distress

At baseline, 3, and 6 months, we assessed stress coping, perceived stress, psychological distress and anxiety symptoms. Stress coping was measured using a validated, single-item instrument assessing one's ability to cope with stress: "How able have you been to cope with the current stress in your life in the past 2 weeks," with responses ranging from 0 ("not at all able") to 10 ("very much able"). Perceived stress was assessed via the Perceived Stress Scale (PSS-4 Novy et al., 2012; Park et al., 2013) a 4-item assessment of the degree of perceived stress in the past month based on appraisals of stressful situations. Scores on the PSS-4 range from 0 ("never") to 4 ("very often") (Cohen and Williamson, 1998). Whereas perceived stress is how overwhelmed one feels and how high their subjective level of stress is, stress coping is how capable one feels in their ability to manage stress. Psychological distress was assessed using the National Comprehensive Cancer Network (NCCN) Distress Thermometer, a single-item measure of level of distress which asked participants to rate on a scale of 0 to 10, "How much distress have you been experiencing in the past 2 weeks," with responses ranging from 0 ("no distress") to 10 ("extreme distress") (Holland et al., 2007; Piriz et al., 2005). Anxiety symptomatology in the past two weeks was

assessed using the 7-item Generalized Anxiety Disorder Scale with responses on a 4-point scale ranging from 0 to 3 (GAD-740,41,42). Correlations between measures can be viewed in Supplemental Table 1 and internal consistency and scale reliability for each measure in Supplemental Table 2.

6. End of study qualitative exit interviews

At the end of the study (i.e., at 6 months), in-depth semi-structured exit interviews were conducted with a randomly selected subset of participants (N = 72; ST, n = 32 and IT, n = 40) using a priori stratification criteria (i.e., racial/ethnic minority group member, history of serious mental illness, and e-cigarette smoking status) with participants randomly selected after completing the 6 month quantitative survey. Interviews addressed various topics related to smoking and quitting. The present investigation focuses only on the qualitative probes related to stress and distress symptoms described below. The full interviews lasted on average 30–40 min and were audio-recorded and transcribed for analysis.

During the qualitative interview, participants described their stress in the past 6 months. Those who endorsed current stress were asked whether they thought their smoking and stress had any connection, in any direction. We identified overall themes of no connection between smoking and stress, smoking affecting stress, and stress affecting smoking as well as sub-themes among participants who identified stress affecting their smoking behavior.

6.1. Statistical methods

Demographic, smoking and cancer treatment characteristics were compared by treatment group (IT vs. ST) for all randomized participants (N = 303) using chi-square tests for categorical variables and Wilcoxon rank-sum for continuous variables. In all analyses, to account for missing items on the stress and psychological distress scale items, for scales with at least 80% of items completed by participants, we completed responses on the incomplete scales with the average score from available items (Park et al., 2020). Our outcomes analytic dataset included N = 283 participants (N = 20 were removed due to death or medical/psychiatric instability) (Park et al., 2020). Participants who did not complete a follow-up survey or who self-reported abstinence but did not provide biochemical verification were considered smokers (Park et al., 2020).

For the PSS-4 and GAD-7 we constructed composite scores (Spitzer et al., 2006; Schafer, 1997). Mean scores and change scores between timepoints are presented for the all stress and psychological distress measures (i.e., stress coping, PSS-4, NCCN Distress Thermometer and GAD-7). To examine the effects of treatment group on our dependent measures (i.e., stress coping, PSS-4, NCCN Distress Thermometer and GAD-7 scores), we used linear mixed effect models with fixed effects of treatment group, time, and their interaction, and random effects for repeated observations over time within a patient. Study site was also included as a fixed effect in the mixed model predicting GAD-7 scores. All means presented are least square means. We conducted a missing data analysis to examine missingness on stress and distress variables at each timepoint by study treatment group using Fischer's Exact Tests and found no significant differences in the percentage of missing data between study conditions on any variable at any timepoint (ps > 0.10).

To examine the effects of the timing of cessation on stress, distress, and anxiety outcomes, we used participants' biochemically confirmed smoking status at 3 and 6 months and categorized participants as "early quit" (confirmed quit at 3 and 6 months; n = 52, 18%), "late quit" (smoking at 3 months and quit at 6 months; n = 28, 10%), "relapsed" (quit at 3 months and smoking at 6 months; n = 22, 8%), and "never quit" (smoking at both 3 and 6 months; n = 181, 64%). Analysis of covariance was used to examine the effect of quit timing on stress and distress outcomes at 6 months adjusting for study treatment group, baseline score on the stress/distress variable, gender, and education level (for the stress coping model race was also included).

Individual logistic regression models predicting biochemically-confirmed abstinence at 6 months were run for each stress and psychological distress variable reported at the 3 month survey. These models also adjusted for study treatment group, baseline scores on the stress/distress variable, gender, education level and for the stress coping model race was also included. Multiple imputation (N = 10 datasets) was used to impute missing data for patients missing scores on the stress and psychological distress scales (i.e., stress coping, PSS-4, NCCN Distress Thermometer and GAD-7) for the 283 patients in our analytic sample using a 2-step process for each scale. In the first step, we applied Markov chain Monte Carlo method to generate a monotone missing data pattern for values across the 3 timepoints (baseline, 3, 6 months) and in

Table 1
Participant characteristics by study treatment group.

	Total (N = 303)	Intensive Treatment(IT; n = 153)	Standard Treatment(ST; n = 150)	P value
Demographics				
Age, Median (IQR)	59 (52–65)	59 (52–65)	57.0 (52–65)	0.39
Gender				0.79
Female	170 (56)	87 (57)	83 (55)	
Male	133 (44)	66 (43)	67 (45)	
Race				0.45
White	265 (87)	134 (88)	131 (87)	
Black	31 (10)	14 (9)	17 (11)	
Other	7 (2)	5 (3)	2 (1)	
Education[a]				0.46
High school graduate or less	93 (32)	50 (34)	43 (29)	
Some college/voc. School	119 (40)	61 (41)	58 (39)	
College graduate or more	83 (28)	37 (25)	46 (31)	
Smoking Characteristics				
Smoke within 30 m of waking[b]	214 (72)	108 (72)	106 (73)	0.84
Cigarettes/day, Median (IQR)[c]	10 (4–20)	10 (4–18)	10 (4–20)	0.64
Ever tried to quit for 24 h	274 (90)	138 (90)	136 (91)	0.89
Ever used cessation medication to quit (%)	239 (79)	119 (78)	120 (81)	0.63
Cancer Treatment				
Cancer Center Clinic Type				0.97
Thoracic	93 (31)	46 (30)	47 (31)	
Breast	77 (25)	38 (25)	39 (26)	
Genitourinary	51 (17)	25 (16)	26 (17)	
Gastrointestinal	29 (10)	15 (10)	14 (9)	
Head & Neck	31 (10)	18 (12)	13 (9)	
Lymphoma	9 (3)	4 (3)	5 (3)	
Gynecological	7 (2)	3 (2)	4 (3)	
Melanoma	6 (2)	4 (3)	2 (1)	
Smoking-related Tumor	181 (60)	92 (60)	89 (59)	0.89
Stage				0.45
0-II	182 (60)	90 (59)	92 (61)	
III-IV	111 (37)	56 (37)	55 (37)	
Other	10 (3)	7 (5)	3 (2)	

Note. All cells represent n (column %) except for age, cigarettes/day, and age at first cigarette which are displayed as median (interquartile range); Bolded values represent p < .05.

[a] 8 patients did not respond to this question thus data are presented on 148/153 and 147/150 patients for IT and ST, respectively Levenstein et al. (1993).

[b] 6 patients did not respond to this question thus data are presented on 151/153 and 146/150 patients for IT and ST, respectively Levenstein et al. (1993).

[c] 2 patients did not respond to this question thus data are presented on 152/153 and 149/150 patients for IT and ST, respectively Levenstein et al. (1993).

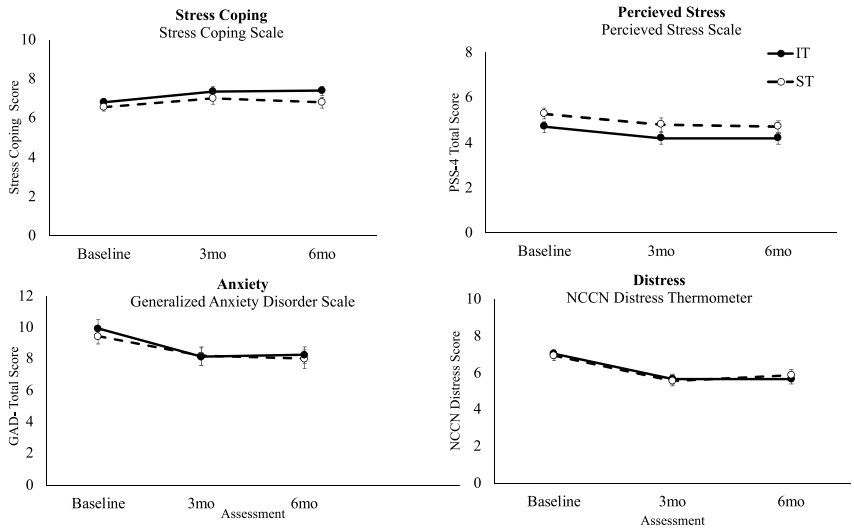

Fig. 1. Stress, Distress and Anxiety Scores Across Time by Treatment Group Note. Means presented are least square means and error bars represent standard error of the mean. IT; Intensive Treatment, ST; Standard Treatment. Upper left and right panels depict Stress Coping single item measure and Perceived Stress Scale (PSS-4) scores, respectively. Lower left and right panels depict Generalized Anxiety Disorder (GAD-7) and NCCN Distress Thermometer single item scores, respectively. Y-axes have been restricted to allow for closer inspection of the data for PSS-4 (full scale of scores ranges from 0 to 16) and GAD-7 (full scale of scores ranges from 0 to 21) scores. Full range of scores are presented on the y-axis for Stress Coping and the NCCN Distress Thermometer. For all outcomes pictured, there were significant main effects of time suggesting symptom improvements on all measures over time (ps < 0.05), but no effects of study treatment group nor interactions between treatment group and time on any outcomes (ps > 0.05).

the second step, a standard monotone regression pattern of observations over time was used to impute all other missing values for each scale. (Park et al., 2020; Schafer, 1997; Gadbury et al., 2003; Zhang et al., 2018; al'Absi et al., 2005) Results for imputed datasets were aggregated and analyzed using the MIANALYZE procedure in SAS. Significance was set at $p < .05$ and all analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC).

For our qualitative aim to investigate patient's perception of the link between stress and smoking behavior, three study staff independently coded qualitative interviews and identified recurrent themes using NVivo 11 software achieving high inter-coder agreement (Kappa=>0.86). Among participants reporting current stress, the following themes were identified relevant to the present secondary analysis: "Stress and smoking connection" with participant responses falling into "No connection" "smoking affects stress" and "stress affects smoking" categories; and "Stress and study connection" (i.e., the relationship between being in the study and changes in stress) with responses falling into "no change," "study decreased stress" and "study increased stress" categories. For this investigation, we also examined differences in responses within themes by study treatment group and by 6-month biochemically-confirmed smoking status.

7. Results

7.1. Participant characteristics

No significant differences were observed by study treatment group on any baseline demographic, smoking, or cancer treatment characteristics (Table 1). While stress coping ability at 6 months differed significantly by study treatment group in the bivariate analysis, this comparison was no longer significant after adjustment for multiple comparisons (Supplemental Table 2).

7.1.1. Changes in stress and psychological distress over time

When examining changes in stress across the study, there was a significant main effect of time on participants' stress coping ($F(2, 467) = 3.3$, $p = .04$) and perceived stress ratings ($F(2, 436) = 5.6$, $p = .0004$), with participants reporting significant increases in stress coping ability over time, and significant decreases in perceived stress across time (Fig. 1). The changes over time were not treatment group specific (ST vs. IT) and there were no main effects of treatment group nor treatment group × time interactions on stress coping ability (Group effect: $F(1, 271) = 3.0$, $p = .08$; Group × time: $F(2, 467) = 0.46$, $p = .63$) or perceived stress (Group effect: $F(1, 279) = 3.1$, $p = .079$; Group × time: $F(2, 436) = 0.09$, $p = .92$) scores. Similarly, for psychological distress, there were main effects of time observed on the NCCN Distress Thermometer ($F(2, 455) = 22.9$, $p < .0001$) and GAD-7 ($F(2, 406) = 13.3$, $p < .0001$) scores, suggesting decreases in scores (i.e., improvements in outcomes) on both measures over time (Fig. 1), but no main effects of treatment group nor group × time interactions (NCCN Distress Thermometer, Group effect: $F(1, 2781) = 0.003$, $p = .96$, Group × time: $F(2, 455) = 0.27$, $p = .77$; GAD-7 Group effect: $F(1, 274) = 0.15$, $p = .70$; Group × time: $F(2, 406) = 0.30$, $p = .74$).

When examining the effects of the timing of smoking cessation on stress, distress and anxiety outcomes at 6 months in adjusted models (Supplemental Table 3), quit timing was significantly associated with GAD-7 scores ($F(3, 199) = 5.64$, $p < .01$) and stress coping ability at 6 months ($F(3, 198) = 4.28$, $p < .01$) such that "early quitters" (biochemically confirmed abstinent at 3 and 6 months) had lower levels of anxiety than those who relapsed or never quit (Bonferroni adjusted p's < 0.001), and higher ability to cope with stress at 6 months compared to those who never quit smoking during the trial (Bonferroni adjusted $p < .001$). The effect of quit timing on distress ($F(3, 198) = 1.42$, $p = 0.24$) and perceived stress scores ($F(3, 195) = 2.03$, $p = 0.11$) at 6 months was not significant.

7.1.2. Effects of stress and psychological distress on smoking abstinence

When examining stress and psychological distress measures at 3 months as predictors of biochemically confirmed abstinence at 6 months in adjusted logistic regression models, anxiety scores at 3 months significantly predicted abstinence (Table 2).

7.1.3. Qualitative findings

Among both biochemically confirmed quitters and smokers at 6 months, most patients endorsed a strong connection between stress and smoking. Specifically, most patients described that greater stress triggered increased smoking and higher stress levels made quitting smoking more challenging ([smoker]:"If I didn't have that [stress], I think I definitely would've quit.").

The most commonly mentioned stressors among all participants were work, cancer diagnosis or treatment ([quitter]: "Plus the cancer-related anxiety…so cigarettes have been a coping mechanism for me"), family concerns (e.g., family member's health issues) and mental health (e.g., anxiety).

Some participants, mostly those who were currently smoking, reported that smoking affected their stress levels. The most common subthemes identified were smoking resulting in decreased stress ([smoker]: "I think smoking is a relief from whatever level of stress I'm under."),

Table 2
Association between stress and distress measures and subsequent biochemically-confirmed abstinence at 6 months.

Model	Covariates	Adjusted odds ratio (Confidence Interval)	P value
Stress Coping (scale 0–10)	Baseline Stress Coping	1.05 (0.92–1.20)	0.47
	3-month Stress Coping	1.05 (0.92–1.21)	0.51
	3-month confirmed abstinence	15.60 (7.75–31.37)	**<0.0001**
	Treatment Group (IT vs. ST)	1.60 (0.84–3.06)	0.15
	Male (vs. Female)	0.64 (0.32–1.26)	0.19
	Age	1.03 (0.99–1.06)	0.13
	White (vs. non White)	0.70 (0.27–1.85)	0.48
	> High school (vs ≤ high school)	0.95 (0.48–1.89)	0.88
Perceived Stress (PSS-4) (scale 0–16)	Baseline Perceived Stress	1.11 (0.95–1.29)	0.18
	3-month Perceived Stress	0.89 (0.78–1.02)	0.09
	3-month confirmed abstinence	15.84 (7.98–31.43)	**<0.0001**
	Treatment Group (IT vs. ST)	1.615 (0.84–3.08)	0.15
	Male (vs. Female)	0.62 (0.31–1.22)	0.16
	Age	1.03 (0.99–1.06)	0.12
	>High school (vs ≤ high school)	0.99 (0.49–1.97)	0.97
Distress (NCCN Thermometer) (scale 0–10)	Baseline Distress	1.04 (0.92–1.18)	0.53
	3-month Distress Score	0.97 (0.87–1.08)	0.55
	3-month confirmed abstinence	15.57 (7.85–30.89)	**<0.0001**
	Treatment Group (IT vs. ST)	1.66 (0.87–3.16)	0.12
	Male (vs. Female)	0.67 (0.34–1.32)	0.24
	Age	1.03 (0.99–1.06)	0.12
	> High school (vs ≤ high school)	0.97 (0.49–1.94)	0.49
Anxiety (GAD-7) (scale 0–21)	Baseline Anxiety	1.07 (0.99–1.15)	0.08
	3-month Anxiety	0.93 (0.87–0.99)	**0.03**
	3-month confirmed abstinence	14.92 (7.47–29.81)	**<0.0001**
	Treatment Group (IT vs. ST)	1.74 (0.91–3.34)	0.09
	Male (vs. Female)	0.61 (0.31–1.21)	0.16
	Age	1.03 (0.99–1.06)	0.11
	> High school (vs ≤ high school)	0.99 (0.49–1.99)	0.98

Note. IT, Intensive Treatment group; ST, Standard Treatment group; PSS-4, Perceived Stress Scale; NCCN, National Comprehensive Cancer Network; GAD-7, Generalized Anxiety Disorder scale. Bolded values represent $p < .05$.

and smoking decreasing anxiety ([smoker]: "…if I'm getting nervous it [smoking] kind of relieves my nerves").

Most participants (both current smokers and quitters) reported that there was a connection between study participation and their stress with the majority of participants reporting that the study decreased their stress (about two thirds of these patients were in the IT group and one third in ST group). The most common sub-theme identified among participants in both groups was that talking to the study counselor decreased stress levels ([smoker]:"A good way to alleviate stress is to put it on somebody else's shoulders."). Participants in both study groups described the counselor listening, empathizing, and providing positive reinforcement as helpful components of the counseling program (e.g., [quitter]: "There was someone calling and congratulating me."). IT participants listed additional techniques and skills that were helpful such as skills related to mood management.

8. Discussion

In this mixed-methods secondary analysis of a smoking cessation trial conducted with cancer patients, we examined the impact of smoking cessation interventions on longitudinal changes in stress coping, perceived stress, and psychological distress including anxiety symptoms, and whether the level of these symptoms at 3 months impacted biochemically confirmed smoking abstinence at 6 months. We also qualitatively examined patient's perception of the link between stress and smoking behavior.

Our quantitative data suggest that among newly diagnosed cancer patients attempting to quit smoking, self-reported perceived stress, psychological distress and anxiety symptoms decreased significantly across a 6-month period, and stress coping ability increased, in both treatment groups. Despite intervention efforts to target these symptoms, there were no differences observed between IT vs ST in reductions in stress or distress outcomes. Additionally, participants who were confirmed quit by 3 months and also quit at 6 months, reported lower levels of anxiety and higher ability to cope with stress at 6 months compared to those who did not quit by 3 months. Anxiety symptoms at 3 months were associated with biochemically-confirmed abstinence at 6 months, with lower anxiety scores predictive of greater smoking abstinence.

In qualitative interviews, most participants reported that their stress and smoking were strongly connected. Many participants reported that stress was a trigger to smoke more, that smoking alleviated stress and distress symptoms, and that stress served as a barrier to quitting smoking, which is consistent with reports in the general population of smokers. (Brown et al., 2005; Gritz et al., 1999) Although we did not find quantitative effects of study treatment group on changes in stress and psychological distress outcomes over time, our qualitative data suggest that this may be because participants in both treatment conditions found the counseling helpful for alleviating stress.

Consistent with smoking cessation research in the general population, (Cohen and Lichtenstein, 1990; Hajek et al., 2010; McDermott et al., 2013; Parrott, 1995) we found that patients attempting to quit smoking reported decreases in stress and distress across the study, with the lowest symptoms generally reported by those who had quit by 3 months and stayed quit at 6 months. We extend these findings specifically to patients newly diagnosed with cancer. Further, our finding that higher levels of anxiety were associated with poorer cessation success is consistent with a growing body of literature on this topic in cancer patients, suggesting that psychological symptoms (e.g., anxiety, depression) may negatively impact the likelihood of smoking cessation. (Guimond et al., 2017; Simmons et al., 2013)

Clinicians working with cancer patients attempting to quit smoking should consider enhancing the psychological support provided, with stress and distress as intervention targets. Our results suggest that even a minimal amount of counseling (i.e., 4 sessions) for smoking cessation occurring within the first month of cancer diagnosis might have helped to reduce stress and distress. Indeed, a central target of our cessation counseling sessions was assessment and delivery of skills surrounding coping with stress and psychological distress symptom management. Existing, validated evidence-based interventions that focus on targeting the stress response and increasing the relaxation response (e.g., Zhang et al. (2018)) in cancer patients could be useful to explore further in the context of smoking cessation interventions. Further, it is promising that patients engaged with our smoking cessation intervention and found the interventions helpful, despite the stigma often associated with smoking in this population (Luberto et al., 2016).

Our study was limited in that we relied on self-reported measures of stress, distress and anxiety using psychiatric screening measures rather than clinical interviews. Further, our study included patients newly

diagnosed with cancer and our findings may not generalize to cancer survivors with a longer history of a cancer diagnosis who may have more stable levels of stress and see less reductions in stress and distress over time. Finally, the parent trial design examined different durations of counseling and availability of pharmacotherapy and did not include a non-intervention control condition to compare our findings to, thus we are limited in our interpretations of the magnitude of reductions in stress and distress symptoms.

These limitations notwithstanding, to our knowledge, this was the first study to investigate the impact of a smoking cessation intervention on stress, anxiety and distress levels in cancer patients, as well as the first examination of stress as a predictor of smoking cessation in cancer patients. We capitalized on clinical trial data from two large academic medical centers with heterogenous representation of primary cancer types (i.e., 8 primary cancer types and cancer stages 0 to IV represented in our sample) and biochemical confirmation of our outcome variable.

In conclusion, our data suggest that cancer patients enrolled in a smoking cessation trial report decreases in stress, distress and anxiety over time and that anxiety symptoms may impact smoking cessation success at follow-up, with higher levels of anxiety resulting in less success in quitting smoking. Anxiety represents an important intervention targets for cancer patients who smoke and want to quit. Smoking cessation and related psychological interventions may be particularly helpful to administer early (within first 3 months) in cancer diagnosis and treatment.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101402.

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