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Contributors to and Correlates of Loneliness in Lung Cancer Patients

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Contributors to and Correlates of Loneliness in Lung Cancer Patients

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background

Loneliness, or the perceived discrepancy between the quantity and quality of ones' actual social relationships and desired level of connectedness, is a potentially important psychosocial factor in lung cancer patients. The purpose of the current study was to investigate the relationship of loneliness to depressive symptoms, quality of life, and social-cognitive variables and to explore the role of loneliness in mediating relationships between social-cognitive variables and depressive symptoms and quality of life. Finally, the study examined whether loneliness predicted change over time in depressive symptoms and quality of life.

Methods

Lung cancer patients were recruited from the Moffitt Cancer Center Thoracic Oncology Clinic to complete two study questionnaires via hard copy or online. Participants completed measures of loneliness (UCLA V3), depressive symptoms, (CES-D) and quality of life (FACT-L) at baseline and 30 days later. Participants also completed measures of demographic characteristics and social-cognitive variables, including cancer-related stigma (CLCSS), cancer-related negative social expectations (CNSES), social constraint (SCS), avoidant coping (CRI – avoidant coping), and beliefs about one's ability to cope with cancer (CBI-B) at baseline. Clinical characteristics were assessed via medical record review.

Results

Participants (n = 109) reported a low to moderate level of loneliness (M = 33.8), and 38% reported clinically significant (CES-D $\geq$ 16) depressive symptoms. Quality of life in the current

study (M = 98.1) was consistent with normative FACT-L data collected from a sample of lung cancer patients. Loneliness was positively correlated with depressive symptoms (r = .44) and negatively correlated with quality of life (r = -.59). In addition, loneliness was positively correlated with social-cognitive variables in the expected directions and social-cognitive variables were related to depressive symptoms and quality of life in the expected directions (p's < .001). Mediation analyses yielded evidence for partial mediation, with loneliness mediating the relationships of social-cognitive variables with depressive symptoms and quality of life for nine of the ten models tested. The exception was findings showing that loneliness did not mediate the relationship between beliefs about one's ability to cope with cancer and depressive symptoms. Loneliness at Time 1 predicted additional variance in depressive symptoms at Time 2 (B = .38, Adj R^2 = .31) after accounting for depressive symptoms at Time 1, but loneliness at Time 1 did not account for additional variance in quality of life at Time 2 after accounting for quality of life at Time 1.

Conclusions

Results suggest that consideration of loneliness is important in order to understand differences in depressive symptoms and quality of life in lung cancer patients. Beyond its direct impact on clinically relevant outcomes, the experience of loneliness may be the mechanism by which social-cognitive factors influence depressive symptoms and quality of life. Investigation of the relationship between stigma and loneliness in the context of lung cancer is particularly novel and warrants further exploration.

INTRODUCTION

Lung cancer is a significant public health problem in the United States, with an estimated 234,000 new cases to be diagnosed in 2018 (American Cancer Society, 2018). Lung cancer is the second most frequently diagnosed cancer in both men and women and is responsible for the most cancer deaths annually, with a projected 154,000 people dying of the disease this year (American Cancer Society, 2018). Unfortunately, the prognosis for lung cancer is poor, with a 5-year survival rate of 56% when diagnosed at a localized stage and 18% overall (American Cancer Society, 2018). Treatment regimens for lung cancer are intensive, often consisting of surgery, systemic therapy, and/or radiotherapy. Symptom burden is high, with primary complaints of fatigue, dyspnea, pain, insomnia, and appetite loss (Braun, Gupta, & Staren, 2011; Buzaglo et al., 2014; Chen, Yu, &Yang, 2008; Cooley, 2000; Tishelman, Lövgren, Broberger, Hamberg, & Sprangers, 2010).

In light of the significant symptom burden, lung cancer patients often suffer from disease- and treatment-related psychosocial morbidity (Graves et al., 2007; Steinberg et al., 2009; Zabora, BrintzenhofeSzoc, Curbow, Hooker, & Piantadosi, 2001). It is well documented that lung cancer patients report elevated rates of depressive symptoms (Chambers et al., 2015; Gonzalez & Jacobsen, 2012; Hopwood & Stephens, 2000; Linden, Vodermaier, Mackenzie, & Greig, 2012a; Muzzatti et al., 2016; Sarna et al., 2005) and diminished overall quality of life (Hulbert-Williams, Neal, Morrison, Hood, & Wilkinson, 2012; Poghosyan, Sheldon, Leveille, & Cooley, 2013; Polanski, Jankowska-Polanska, Rosinczuk, Chabowski, & Szymanska-Chabowska, 2016; Schag, Ganz, Wing, Sim, & Lee, 1994). Beyond symptom burden, there is a limited

understanding of factors associated with depressive symptoms and quality of life in lung cancer patients. Loneliness, or the subjective negative experience of deficits in social relationships, is one such factor that may be associated with these outcomes (De Jong-Gierveld, 2006; Peplau & Perlman, 1979, 1982). The purpose of the current study was to investigate the relationship of loneliness to depressive symptoms and quality of life in a sample of lung cancer patients. The study also sought to identify social-cognitive variables associated with loneliness and to explore the role of loneliness in mediating relationships between these variables and depressive symptoms and quality of life. Finally, the study examined whether loneliness predicted change over time in depressive symptoms and quality of life.

A significant body of research to date has focused on demographic and clinical correlates of depressive symptoms and quality of life outcomes in cancer patients. Lung cancer patients are at increased risk for depressive symptoms, with rates of clinically significant depressive symptoms ranging from 11-50% (Gonzalez & Jacobsen, 2012; Graves et al., 2007; Hopwood & Stephens, 2000; Massie, 2004). Female gender, a diagnosis of small cell (versus non-small cell) lung cancer, and more advanced disease are risk factors for depressive symptoms in lung cancer (Carlsen, Jensen, Jacobsen, Krasnik, & Johansen, 2005; Hopwood & Stephens, 2000; Vodermaier, Linden, MacKenzie, Greig, & Marshall, 2011). Worse overall quality of life has been associated with demographic factors, such as age (worse in younger patients and those $\geq$ 65 years old) (Möller & Sartipy, 2012; Sarna et al., 2005) and lower socioeconomic status (Montazeri, Hole, Milroy, McEwen, & Gillis, 2003), and clinical correlates, such as more advanced disease, disease progression, and treatment intensity (Bernhard et al., 1996; Möller & Sartipy, 2012; Polanski et al., 2016). While informative in determining risk profiles, these factors

2

are not generally amenable to intervention. To date, there is limited understanding of modifiable psychosocial factors that impact depressive symptoms and quality of life related to lung cancer.

Loneliness is a potentially important psychosocial factor in general and in cancer populations. Loneliness is not simply being alone, but rather a perceived discrepancy between the quantity and quality of ones' actual social relationships and desired level of connectedness (Peplau & Perlman, 1979; 1982; Perlman & Peplau, 1981, 1998). Theories of social and evolutionary psychology posit that humans are social creatures who require interaction to survive, and so a perceived deficit in relationships is both negative and distressing (Cacioppo et al., 2006a; Hawkley & Cacioppo, 2010; Perlman & Peplau, 1998). The social-cognitive conceptualization of loneliness states that cognitive, behavioral, and environmental factors (specifically the social environment) influence one another to shape how an individual perceives, experiences, and evaluates their social relationships (Bandura, 1986; De Jong-Gierveld, 1987, 1998; Hawkley & Cacioppo, 2010) As the social-cognitive model suggests, a combination of dispositional and situational factors may precipitate and sustain loneliness (De Jong-Gierveld, 1998; Peplau & Perlman, 1979). Objective characteristics of the social network (e.g., number of friends) poorly predict loneliness, supporting its conceptualization as a subjective experience (Cutrona, 1986). Loneliness in the general population has been associated with female gender, being unpartnered, lesser educational attainment, and lower socioeconomic status (Peplau & Perlman, 1979). Loneliness demonstrates a U-shaped relationship with age, with greater prevalence in young adults (Rokach, 2000b) and older adults (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006b; Cacioppo, Hawkley, & Thisted, 2010; Cohen-Mansfield, Hazan, Lerman, & Shalom, 2016; Hawkley & Cacioppo, 2007; Pinquart & Sorensen, 2001; Steptoe, Shankar, Demakakos, & Wardle, 2013). Persistent loneliness is estimated to be present in 15-

30% of the general population and can have detrimental consequences for physical, mental, and emotional health (Hawkley & Cacioppo, 2010; Heinrich & Gullone, 2006; Peplau & Perlman, 1982). Loneliness has been shown to predict increased morbidity and mortality through a variety of pathways, including diminished engagement in protective health behaviors, poor sleep quality, and physiological, genetic, immunoregulatory, and neuroendocrine processes (Cacioppo, 2002; Cacioppo & Hawkley, 2009; Hawley & Cacioppo, 2003, 2010; Jaremka et al., 2013b; You, Yeh, & Su, 2014).

Loneliness may be precipitated by situational happenings, such as a major life event or stressor. A cancer diagnosis is one such stressor, impacting nearly every aspect of an individuals' life including social relationships (Adams et al, 2016a; Friedman, Florian, & Zernitsky-Shurka, 1989; Jefferies & Clifford, 2011; Karhe & Kaunonen, 2015; Linden &Vodermaier, 2012b; Rokach, 2000a; Rosedale, 2009). A recent meta-analysis of 15 studies of loneliness in cancer patients found a weighted mean loneliness score on the UCLA Loneliness Scale of 38.26 (Range = 20-80, higher = more lonely), which corresponds with a moderate level of loneliness (Deckx, van den Akker, & Buntinx, 2014). It should be noted that none of these studies focused specifically on lung cancer patients and evidence suggests that lung cancer patients may be particularly vulnerable to loneliness. Qualitative explorations consistently show that lung cancer patients identify loneliness as a factor impacting their lives (Buzaglo et al., 2014; Ekfors & Petersson, 2004; Refsgaard, 2013). In a quantitative exploration of social isolation in lung cancer patients, 50% of patients endorsed high levels of social isolation (McGeough, Edwards, Chamberlain, & Nogeire, 1980).

Loneliness and depression are related constructs, and widely used measures of both suggest they are moderately correlated (r = .42 - .68) (Cacioppo et al., 2010; Russell, Cutrona,

Rose, & Yurko, 1984; Russell, 1996). However, multiple studies have established that, while related, loneliness and depression are unique constructs worthy of independent study (Cacioppo et al., 2006b; Russell, 1996; Weeks, Michela, Peplau, & Bragg, 1980). Cacioppo and colleagues have conducted several longitudinal studies in population-based samples of middle-aged and older adults to elucidate the relationship between these two variables. Results suggest that loneliness predicts change in depressive symptoms over time, but depressive symptoms do not predict changes in loneliness (Cacioppo et al., 2006b, 2010).

Quality of life is a multidimensional concept that encompasses functional, emotional, physical, and social well-being. Patient-reported quality of life is frequently used as an outcome measure in lung cancer research in order to document the impact of the disease and its treatment from the patient perspective. Loneliness has been shown to predict worse quality of life, particularly in older adults (Brown, Thompson, Zack, Arnold, & Barile, 2015; Ekwall, Sivberg, & Hallberg, 2004; Musich, Wang, Hawkins, & Yeh, 2015; Steptoe et al., 2013; Theeke, Goins, Moore, & Campbell, 2012). This has importance given that adults over 65 account for 60% of new cancer diagnoses annually (Berger et al., 2006).

Several studies to date have examined the relationship of loneliness to depression and quality of life in cancer patients. Loneliness has been shown to be a risk factor for current and future depressive symptomology in samples of cancer survivors (Jaremka et al., 2013a, 2014). Loneliness has also been associated with worse overall quality of life in cancer patients (Boer, Elving, & Seydel, 1998; Deckx et al., 2013). While relationships of loneliness with depression and quality of life have been described in cancer patients, this has not been fully explored in lung cancer patients.

A number of studies have examined the demographic and clinical correlates of loneliness in people with cancer. A recent systematic review examining risk factors for loneliness in cancer patients identified 15 quantitative studies that used a validated measure of general loneliness. Being unmarried was found to be associated with greater levels of loneliness in patients with cancer (Deckx et al., 2015; Friedman et al., 1989; Perry, 1990; Yildirim & Kocabiyik, 2010), while other demographic factors including age, gender, education, income, and employment status have demonstrated mixed results (Avci & Kumcagiz, 2011; Deckx et al., 2013, 2015; Pehlivan, Ovayolu, Ovayolu, Sevinc, & Camci, 2011; Perry, 1990; Sevil, Ertem, Kavlak, & Coban, 2006; Yildirim & Kocabiyik, 2010). Clinical variables including cancer type, disease stage, and type of treatment were not associated with level of loneliness (Pehlivan et al., 1990; Sevil et al., 2006; Yildirim & Kocabiyik, 2010), but time since diagnosis was positively associated with loneliness, such that individuals more than one year from diagnosis were lonelier than those who were within a year since diagnosis (Deckx et al., 2014).

While there is limited evidence that demographic and clinical variables are related to loneliness, social-cognitive theory and previous research can be used to identify a number of social-cognitive variables that may contribute to loneliness in cancer patients, as well as greater depressive symptomatology and worse quality of life. Moreover, it can be theorized that the relationship of these variables to depression and quality of life is mediated by loneliness (Figure 1).
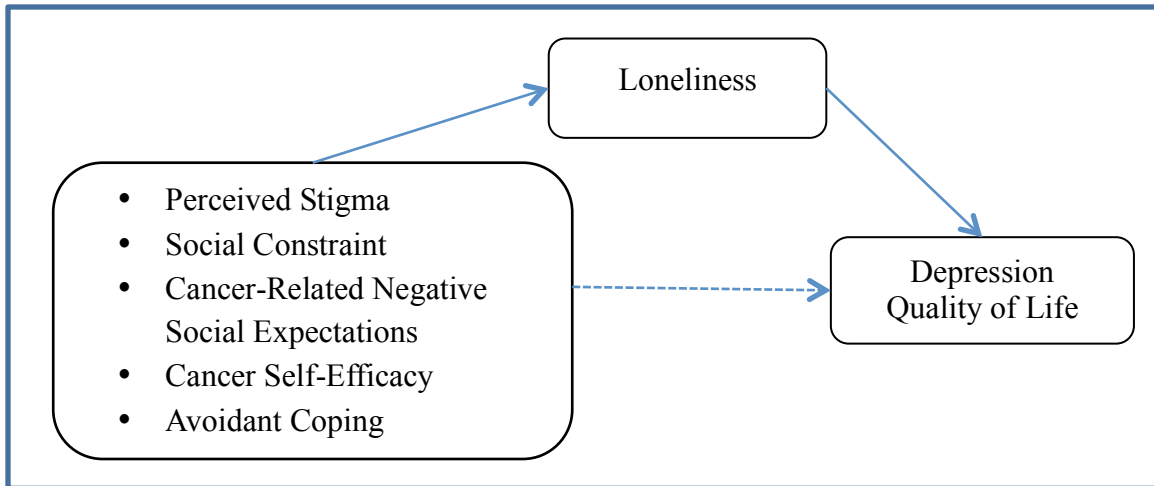
Figure 1. Model of Loneliness Mediating the Relationship Between
Psychosocial Factors with Depression and Quality of Life

Among cancers, health-related stigma is relatively unique to lung cancer in that there is an

established causal relationship between cigarette smoking and lung cancer (Chapple, Ziebland, &

McPherson, 2004; LoConte, Else-Quest, Eickhoff, Hyde, & Schiller, 2008; National Center for

Chronic Disease Prevention and Health Promotion, 2014). Stigmatization occurs when an

individual is considered to be part of a marginalized group due to a personal characteristic

(Goffman, 1963). Lung cancer stigma has been conceptualized as the product of several factors

occurring in tandem, including societal awareness of the connection between lung cancer and

cigarette smoking, the resultant experience of discrimination and isolation that often

accompanies a lung cancer diagnosis, and an individuals' response to these factors (Brown

Johnson, Brodsky, & Cataldo, 2014). Because lung cancer is perceived by many as being self-

inflicted, patients with this disease may experience greater levels of perceived and internalized

stigma (Hamann et al., 2014; Stuber, Galea, & Link, 2008). Perceived stigma causes fear of

rejection and is associated with limited use of social support, which may result in greater feelings

of loneliness (Cataldo, Slaughter, Jahan, Pongquan, & Hwang, 2011). Greater perceived stigma

has been associated with greater depressive symptomology (Brown Johnson et al., 2014; Cataldo et al., 2011, Cataldo, Jahan, & Pongquan, 2012; Else-Quest, LoConte, Schiller, & Hyde, 2009; Gonzalez & Jacobsen, 2012), and worse quality of life in lung cancer patients (Brown Johnson et al., 2014; Cataldo et al., 2011, 2012; Chambers et al., 2012, 2015). Interestingly, lung cancer patients may experience perceived stigma related to their diagnosis regardless of personal smoking history (Brown Johnson et al., 2014; Carter-Harris, 2015; Cataldo et al., 2012; Criswell, Owen, Thornton, & Stanton, 2016).

Social constraint occurs when an individual feels unable to discuss the thoughts and feelings associated with a trauma, such as cancer diagnosis and treatment, with people around them (Lepore & Revenson, 2007). Lung cancer patients may feel socially constrained in discussing their cancer due to personal fears of rejection or feelings of disease-related shame and guilt, or secondary to responses from others in previous attempts at these discussions, including avoidance, criticism, and conflict, discouraging future attempts at discussion (Badr & Taylor, 2006; Dirkse et al., 2014). According to social-cognitive processing theory, this constraint on discussion about the stressor impedes cognitive processing and adjustment, potentially increasing loneliness (Lepore, 2001); indeed, social constraint has been correlated with loneliness in cancer survivors (Mosher et al., 2012). Lung cancer patients may be particularly vulnerable to social constraint due to sensitive issues common to these patients (Badr & Taylor, 2006; Dirkse et al., 2014; Herzer, Zakowski, Flanigan, & Johnson, 2006), including continued tobacco use and poor disease prognosis. In addition, lung cancer patients report more difficulties communicating with their partners as compared to patients with other cancer diagnoses (Schag et al., 1994). Social constraint has been associated with worse mental and physical health outcomes in cancer patients and survivors, including greater symptom burden, cancer-specific distress, more depressive

symptoms, and worse quality of life (Adams et al., 2015, 2016b; Cordova, Cunningham, Carlson, & Andrykowski, 2001; Lepore & Revenson, 2007). While a large body of literature has emphasized the importance of social support in promoting positive psychosocial outcomes, fewer studies have examined the influence of social constraint, despite evidence that negative interactions may have a greater impact on health outcomes (Lepore & Ituarte, 1999; Lepore & Revenson, 2007; Manne, Taylor, Dougherty, & Kemeny, 1997; Manne & Glassman, 2000; Manne, Ostroff, Winkel, Grana, & Fox, 2005).

Cancer-related negative social expectations may precipitate and sustain loneliness (Adams et al., 2017a; Cacioppo & Hawkley, 2009). Cacioppo & Hawkley suggest that loneliness functions as a negative feedback loop whereby lonelier individuals expect more negative social interactions and therefore experience them as such (Cacioppo et al., 2006b; Hawkley & Cacioppo, 2010). Lonely lung cancer patients may experience greater perceived stigma and feel socially constrained in discussing their cancer-related thoughts and emotions, leading these patients to approach future social situations with negative expectations and creating a further divide between the patient and those around them, resulting in greater depressive symptomology (Cacioppo & Hawkley, 2009). Cancer-related negative social expectations have been positively correlated with loneliness and depressive symptoms, and negatively correlated with quality of life (Adams et al., 2017a).

In contrast, greater cancer self-efficacy, or ones belief in their ability to engage in behaviors to manage their cancer diagnosis and treatment, is associated with better physical (lesser symptom burden) and psychosocial (lesser depressive symptoms, better quality of life) health outcomes in mixed cancer samples (Boer et al., 1998; Cleary & Stanton, 2015; Cunningham, Lockwood, & Cunningham, 1991; Heitzmann et al., 2011; Hoffmann, Lent, &

Raque-Bogdan, 2012; Liao et al., 2014; Manne & Glassman, 2000; Merluzzi, Nairn, Hegde, Martinez Sanchez, & Dunn, 2001; Philip, Merluzzi, Zhang, & Heitzmann, 2013). Patients with low cancer self-efficacy may perceive themselves as lacking the capability, support, and resources to navigate their cancer, leading these patients to feel lonelier in their cancer experience (Cleary & Stanton, 2015; Peplau & Perlman, 1982). Low self-efficacy has been associated with loneliness in older adults in the general population (Fry & Debats, 2002; Cohen-Mansfield et al., 2016) and in a sample of breast cancer patients (Cleary & Stanton, 2015).

Coping responses, or the techniques one employs to cope with the cancer experience, can also impact disease processing, adjustment, and outcomes. Lung cancer patients who employ more avoidant coping responses, such as cognitive avoidance and denial, experience worse quality of life and health outcomes and greater depressive symptomology (Gonzalez & Jacobsen, 2012; Nipp et al., 2016). Research also suggests that patients who use avoidant coping strategies when dealing with cancer are lonelier (Cacioppo et al., 2000; Perry, 1990; Rokach, 2000a).

Cancer patients, particularly those diagnosed with lung cancer, may experience loneliness invoked by each of these social-cognitive factors, and there is evidence that each of these factors is associated with depressive symptomology and worse quality of life, suggesting that loneliness may act as a mediator. Loneliness has been identified as an understudied mediator variable in the cancer literature (Cleary & Stanton, 2015; Lepore & Revenson, 2007; Mosher et al., 2012). Studies that have utilized loneliness as a mediator support its inclusion in psychosocial models. For example, loneliness has been shown to mediate the relationship between social constraint and distress in patients who have undergone hematopoietic stem cell transplantation (Mosher et al., 2012). Cancer-related loneliness has also been shown to mediate the relationship between

social constraint and symptoms such as pain, fatigue, sleep disturbance, and cognitive impairment in a mixed cancer sample (Adams, Mosher, Winger, Abonour & Kroenke, 2017b).

Loneliness is a clinically relevant variable and a potential intervention target. As noted above, loneliness is associated with greater depressive symptomology and worse overall quality of life in cancer patients (Boer et al., 1989; Deckx et al., 2014; Jaremka et al., 2013a, 2014). Loneliness has also been identified as a risk factor for decreased survival time and overall mortality in general and cancer samples (Drageset, Eide, Kirkevold, & Ranhoff, 2013; Fox, Harper, Hyner, & Lyle, 1994; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015). A recent meta-analysis of interventions to reduce loneliness identified improving and enhancing social support, increasing opportunities for social contact, and addressing maladaptive social cognitions as primary intervention strategies (Masi, Chen, Hawkley, & Cacioppo, 2011). Masi and colleagues (2011) found that social-cognitive interventions, specifically the provision of cognitive behavioral therapy to change maladaptive social cognitions, were significantly more effective at reducing loneliness than those aimed at bolstering social support, skills, or access. However, there have been no intervention trials to date targeting loneliness in cancer patients and studies that have used social support-based interventions have been unsuccessful (Coleman et al., 2005), unless combined with additional psychosocial and educational components (Fukui, Koike, Ooba, & Uchitomi, 2003; Samarel, Tulman, & Fawcett, 2002). Thus, the current study can help to inform the development of future social-cognitive interventions for loneliness in cancer patients by evaluating novel social-cognitive intervention targets as they relate to loneliness as well as depression and quality of life.

The dynamic nature of the cancer experience justifies the measurement of depressive symptoms and quality of life over time. Depressive symptoms and quality of life may change

frequently in the context of clinical features, such as increased symptom burden and disease progression (Pearman, 2007). Both depressive symptoms (Pinquart & Sorensen, 2010; Satin, 2009) and worse quality of life (Eton et al., 2003; Montazeri, 2009; Sloan et al., 2012) have been associated with worse treatment response and increased risk of mortality in cancer patients. Therefore, it is important to identify whether psychosocial factors like loneliness can predict changes in depressive symptomology and quality of life over time. Accordingly, the present study examined whether loneliness predicted changes in depressive symptomology and quality of life over a 30-day follow-up period.

Aims of the Current Study

With this literature as background and these considerations in mind, the aims of the present study are presented below. Aims 1-4 utilized cross-sectional data collected at the initial assessment point (Time 1), while Aim 5 utilized longitudinal data collected at Time 1 and 30 days later (Time 2).

Aim 1. To examine the relationship of loneliness with depressive symptoms and quality of life in lung cancer patients.

Hypothesis 1: Lonelier lung cancer patients will report more depressive symptoms and worse quality of life.

Aim 2. To investigate the relationship of perceived stigma, social constraint, cancer-related negative social expectations, cancer self-efficacy, and avoidant coping with depressive symptoms and quality of life in lung cancer patients.

12

Hypothesis 2a: Lung cancer patients who endorse greater perceived stigma will report more depressive symptoms and worse quality of life.

Hypothesis 2b: Lung cancer patients who are more socially constrained will report more depressive symptoms and worse quality of life.

Hypothesis 2c: Lung cancer patients who endorse more negative social expectations will report more depressive symptoms and worse quality of life.

Hypothesis 2d: Lung cancer patients with less confidence in their ability to engage in positive cancer management behaviors (cancer self-efficacy) will report more depressive symptoms and worse quality of life.

Hypothesis 2e: Lung cancer patients who engage in more avoidant coping strategies will report more depressive symptoms and worse quality of life.

Aim 3. To investigate the relationship of perceived stigma, social constraint, cancer-related negative social expectations, cancer self-efficacy, and avoidant coping with loneliness in lung cancer patients.

Hypothesis 3a: Lung cancer patients who endorse greater perceived stigma will be lonelier.

Hypothesis 3b: Lung cancer patients who are more socially constrained will be lonelier.

Hypothesis 3c: Lung cancer patients who endorse more negative social expectations will be lonelier.

Hypothesis 3d: Lung cancer patients with less confidence in their ability to engage in positive cancer management behaviors (cancer self-efficacy) will be lonelier.

Hypothesis 3e: Lung cancer patients who engage in more avoidant coping strategies will be lonelier.

Aim 4. To explore whether loneliness mediates the relationship of perceived stigma, social constraint, cancer-related negative social expectations, cancer self-efficacy, and avoidant coping with depressive symptoms and quality of life in lung cancer patients.

Aim 5. To explore whether loneliness at Time 1 predicts changes in depressive symptoms and quality of life between Time 1 and Time 2.

METHODS

Participants

Participants were patients who met the following eligibility criteria: 1) diagnosed with

lung cancer, 2) within three months of beginning systemic therapy or radiotherapy for lung

cancer, 3) had not received treatment for cancer other than lung or non-melanoma skin cancer

within the past five years, 4) able to read and speak English, 5) 18 years of age or older, 6) able

to provide informed consent, and 7) receiving treatment at Moffitt Cancer Center.

Procedure

This study was approved the University of South Florida Institutional Review Board (IRB).

Study eligibility was determined by medical record review and consultation with Moffitt Cancer

Center Thoracic Oncology Program team members. Potentially eligible patients were approached by trained research staff during a scheduled appointment at the Moffitt Cancer Center. The study protocol was explained by research staff.

Table 1. Measures Collected		
Variables	**T1 (Initial)**	**T2 (Day 30)**
Sociodemographics	X	
Clinical Characteristics	X	
Loneliness	X	X
Depression	X	X
Quality of Life	X	X
Perceived Stigma	X	
Social Constraint	X	
Cancer-related Negative Social Expectations	X	
Cancer Self-Efficacy	X	
Avoidant Coping	X	

Eligible patients interested in participation provided written informed consent. Participants were

then given the option to complete the Time 1 study questionnaire in a hard copy form, either in

clinic or at home, or to complete measures online via a unique secure web-based survey link. Patients who opted to complete the hard copy version at home were provided with a postage-paid self-addressed envelope for return mailing. Participants who chose to complete the web-based version were asked for their preferred email address, and provided with instructions for accessing the secure web-based questionnaire. The Time 1 questionnaire took approximately 30 minutes to complete. Thirty days after completion of the Time 1 questionnaire, participants were sent the Time 2 questionnaire in their preferred method of transmission. The hard copy version was sent to participants via FedEx with a postage-paid self-addressed envelope for return mailing, while the online version was sent via secure email link to the participants' preferred email address. The Time 2 questionnaire took approximately 15 minutes to complete. Participants were not compensated for their participation in the study.

Measures

   Sociodemographic Characteristics – Participants completed a standardized self-report form to collect relevant demographic information, including age, sex, marital status, race, ethnicity, education, employment status, and performance status. The abbreviated Lubben Social Network Scale (LSNS-6) assessed size, closeness, and frequency of contact with ones' social network (Gray, Kim, Ciesla, & Yao, 2016; Lubben et al., 2006; Novotny et al., 2010). Additionally, two items from the Social Network Index (SNI) assessed religious affiliation and, if present, frequency of contact with members of the religious network (Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997).

Clinical Characteristics – Relevant clinical information was collected via medical record review, including date of cancer diagnosis, cancer type, disease stage, date(s) of treatment and type(s) of treatment.

Loneliness – Participants completed the 20-item UCLA Loneliness Scale - Version 3 (Russell, 1996) to measure subjective feelings of loneliness. Participants were asked to rate how often each statement is descriptive of them on a four-point Likert scale ranging from 1 (never) to 4 (often). Items were summed to create a total score ranging from 20 to 80, with higher scores indicating greater loneliness. This scale is reliable and valid, with strong internal consistency in samples of cancer patients (α = .89 - .93) (Deckx et al., 2014), construct validity in measuring the adequacy of individuals' interpersonal relationships, and convergent validity with other measures of loneliness (Russell, 1996). In the present study, this scale demonstrated high internal consistency reliability (α = .92).

Perceived Stigma – The Cataldo Lung Cancer Stigma Scale (CLCSS) - Shortened Version was used to assess perceived stigma (Carter-Harris & Hall, 2014; Cataldo et al., 2011). The CLCSS is a 21-item measure composed of three subscales; Shame and Blame, Social Isolation, and Discrimination. Participants were asked to rate the extent to which they agree with statements about lung cancer and perceived stigma on a four-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). The shortened scale has demonstrated excellent psychometric properties, with evidence of strong internal consistency reliability (α = .93) and validity in a sample of lung cancer patients (Carter-Harris & Hall, 2014). In the present study, the CLCSS – Shortened version demonstrated high internal consistency reliability (α = .90).

Social Constraint – The Social Constraint Scale (SCS) - Cancer Version is a 15-item self-report measure assessing perceived barriers to disclosure of cancer-related thoughts or feelings

(Lepore, Silver, Wortman, & Wayment, 1996; Lepore & Ituarte, 1999). Respondents were asked to rate how frequently they felt socially constrained over the previous month on a four-point Likert scale ranging from 1 (never) to 4 (often) (Lepore & Ituarte, 1999; Lepore, 2001). Patients were asked to consider people around them when responding to the items. The SCS has demonstrated adequate psychometric properties, with moderate convergent validity with other validated measures of cancer-related distress and good internal consistency in cancer survivors, with Cronbach's alpha ranging from .88 to .92 (Lepore, 2001). The SCS has also demonstrated discriminant validity as compared with a measure of social support received, and predictive validity of outcomes including mental health and negative affect. In the present study, this scale evidenced high internal consistency reliability (α = .91).

Negative Social Expectations – The five-item Cancer-related Negative Social Expectations Scale was used to measure participants' social cognitions about cancer and its treatment (Adams et al., 2017a). Participants indicated the extent to which they agree with each statement on a 6-point Likert scale from 'strongly disagree' to 'strongly agree'. Preliminary evidence of internal consistency reliability (α = .90) and construct validity has been demonstrated in a mixed cancer sample (Adams et al., 2017a). In the present study, this scale demonstrated adequate internal consistency reliability (α = .77).

Cancer Self-Efficacy – Cancer self-efficacy was assessed using the 12-item Cancer Belief Inventory – Brief Version (CBI-B) (Heitzmann et al., 2011). Participants were asked to rate their confidence in their ability to accomplish cancer-related behaviors now or in the near future. Each item is rated on a nine-point Likert scale ranging from 1 (not at all confident in ability to accomplish behavior) to 9 (totally confident in ability to accomplish behavior). Items were summed to create a total score, with higher scores reflecting greater cancer self-efficacy. This

measure has demonstrated adequate internal consistency (α = .84 - .88) and validity, and is highly correlated with the original scale (CBI-L) (r = .95) (Heitzmann et al., 2011; Merluzzi et al., 2001). In the present study, this scale demonstrated adequate internal consistency reliability (α = .89).

Avoidant Coping – The Coping Response Inventory (CRI-Adult) is a self-report measure of coping responses (Moos, 1993). Participants completed the six-item Cognitive Avoidance subscale to assess avoidant coping. Participants were asked to report the frequency with which they engaged in a particular type of coping on a four-point Likert scale of 'never', 'once or twice', 'sometimes', and 'fairly often'. In the current study, participants indicated how often they engaged in avoidant coping activity in relation to their cancer and its treatment. The CRI has been used with a variety of populations with mental and physical health problems, and the subscale used in the current study has demonstrated adequate internal consistency (α = .60 - .74) and validity in measuring avoidant coping (Moos, 1993). In the present study, this subscale demonstrated adequate internal consistency reliability (α = .80).

Quality of Life – The Functional Assessment of Cancer Therapy (FACT-L) is 37-item lung cancer-specific measure of well-being. The FACT-L is composed of five subscales, including Physical Well-Being, Social/Family Well-Being, Emotional Well-Being, Functional Well-Being, and a Lung Cancer Subscale. Respondents indicated the extent to which quality of life concerns had impacted them over the past week, rating items on a five-point Likert scale ranging from 'not at all' to 'very much'. The five subscale scores were added to compute the FACT-L total score, which was the main quality of life outcome variable in the present study. Use of the FACT-L total score is advantageous in that includes the four general domains of quality of life and incorporates lung cancer-specific information (Cella et al., 2005). The FACT-

19

L has demonstrated adequate psychometric properties (a = .87) in lung cancer patients (Browning 2009). In the present study, internal consistency reliability for the FACT-L was adequate (α = .83).

Depression – Participants completed the 20-item Center for Epidemiological Studies Depression Scale (CES-D) to assess depressive symptoms (Radloff, 1977). Participants denoted the frequency with which they had been bothered by specific depressive symptoms over the previous week on a 4-point Likert scale ranging from 'rarely/none of the time' to 'most/all of the time'. Positively framed items were reverse coded and items were summed to yield a total score ranging from 0 to 60, with higher scores indicating greater depressive symptomology. The CES-D is a valid measure of depressive symptoms in cancer patients with good internal consistency (α = .85), test-retest reliability, and construct validity (Hann, Winter, & Jacobsen, 1999). Item 14 on the CES-D inquires specifically about loneliness ("I felt lonely"). Due to content overlap with the UCLA-V3, CES-D Item 14 was excluded and a total scale score for the 19 remaining items was calculated and used in the analyses. The 20-item total scale score for the CES-D is reported only to facilitate comparison to published norms. The 20-item and 19-item versions of the CES-D demonstrated adequate internal consistency reliability in the current study (both α = .89).

Statistical Analyses

Descriptive statistics (means, standard deviations, frequencies) were computed to characterize the sample. In cases (data points n = 74) where participants missed ≤ 20% of items on an individual scale, available data for that participant were used to calculate an item-level mean value for imputation. Scale scores were subsequently evaluated for normality of their distributions. Skew and kurtosis were evaluated using a value of +/- 2; all scale scores fell within

these bounds. Cronbach's alpha was computed for each scale to estimate internal consistency reliability.

Correlational and chi square analyses were used to examine relationships of sociodemographic and clinical variables with loneliness. Marital status and performance status were significantly ($p < .05$) associated with loneliness. The associations explored in Aims 1-3 were evaluated in a regression framework with and without marital status and performance status to determine whether the pattern of results remained the same with the control variables. The associations tested in Aims 1-3 remained significant (p's $< .05$) with the addition of the control variables. Therefore, the subsequent analyses were run without the control variables.

Accordingly, to address Aims 1-3, a series of Pearson's r correlation coefficients were computed. First, we tested whether loneliness at Time 1 was related to depression and quality of life (Aim 1). Next, we tested whether perceived stigma, social constraint, negative social expectations, cancer self-efficacy, and avoidant coping at Time 1 were related to depression and quality of life at Time 1 (Aim 2). Finally, we tested whether perceived stigma, social constraint, negative social expectations, cancer self-efficacy, and avoidant coping were related to loneliness at Time 1 (Aim 3).

To address Aim 4, separate models were run evaluating whether loneliness mediated the relationships between social-cognitive characteristics (the x variable(s)) and depression and quality of life (the y variable(s)). In order to establish mediation, the following conditions must be met: 1) the x variable must be correlated with the y variable (c pathway), 2) the x variable must be correlated with the mediator, and 3) the mediator must affect the outcome variable (Baron & Kenny, 1986). Therefore, the Pearson's r correlation coefficients calculated in Aims 1-3 were used to determine whether conditions 1 and 2 of mediation were met. Mediation analyses

21

were limited to situations in which conditions 1 and 2 were met. Next, the y variables were entered as the dependent variable in regression equations with each x variable and the mediator to determine whether the mediator affected the outcome variable while controlling for the x variable (condition 3 of mediation) (Baron & Kenny, 1986). The conditions of complete mediation were considered to be met if the relationship between the x and y variable was zero when controlling for the mediator. The conditions of partial mediation were considered to be met if conditions 1-3 were met, but the relationship between the x and the y variable (c' pathway) was not zero when controlling for the mediator. The degree to which the mediator variable accounted for the relationship between the x and y variables was also examined by evaluating the size of the c versus the c' pathway, or the direct effect of x on y (c pathway) versus the effect of x on y while accounting for the indirect effect of the mediator (product of path coefficients a and b), the c' pathway.

First, we examined whether loneliness mediated the relationship between social-cognitive variables and depression. Next, we examined whether loneliness mediated the relationship between social-cognitive variables and quality of life. We used bias-corrected bootstrapping methods (Preacher & Hayes, 2008) with 10,000 bootstrap samples to estimate the indirect effect and 95% confidence interval for the indirect effect. When the 95% confidence interval for the indirect effect did not include zero, the indirect effect was considered statistically significant. Additional reverse mediation models were run evaluating depression and quality of life, respectively, as the mediator variables with loneliness as the outcome variable.

To address Aim 5, hierarchical multiple regression analysis was conducted to explore whether loneliness at Time 1 predicted depressive symptoms and quality of life, respectively, at Time 2 after accounting for depressive symptoms and quality of life at Time 1. With depressive

symptoms at Time 2 serving as the dependent variable, depressive symptoms at Time 1 were entered in step 1, followed by loneliness scores at Time 1 in step 2. The same analysis was then conducted with quality of life at Time 2 serving as the dependent variable, and quality of life at Time 1 entered in step 1, followed by loneliness scores at Time 1 in step 2. Change in R^2 was used to determine whether loneliness at Time 1 accounted for variance in depressive symptoms and quality of life at Time 2 above that accounted for by depressive symptoms and quality of life at Time 1.

A power analysis using G*Power 3.1 indicated that a sample of 84 patients was needed to detect a medium effect (r = 0.30) with a Type I error rate of 0.05 (two-tailed) and power of 0.80 for the univariate correlational analyses addressing Aims 1-3. For the mediational analyses, established methods (Fritz and MacKinnon 2007) indicated that a sample size of 115 patients was needed to detect a small-medium effect in the α pathway (α = .26) and a medium effect in the β pathway (β = .39) with a power of 0.80 when using bias-corrected bootstrapping to test for mediation. Finally, power analysis indicated that a sample of 77 was needed to detect a medium effect (f^2 = 0.15) with a Type I error rate of 0.05 and power of 0.80 in hierarchical multiple regression analyses that included three predictors as might be included in the exploratory analyses for Aim 5. Therefore, the current study sought to obtain complete Time 1 data from 115 participants and complete Time 2 data from 77 participants. Due to difficulties with recruitment, with the committee's consent, recruitment was discontinued once Time 1 data was received from 113 participants and Time 2 data was received from 97 participants.

RESULTS

Participant Characteristics

Participant flow is shown in Figure 2. A total of 1,579 patients were screened for eligibility between December 2016 and December 2017. Of that number, 1,423 patients were ineligible before consent due to: not having a diagnosis of lung cancer (n=75); not being within 3 months of beginning systemic or radiotherapy for lung cancer (n=1033); having a history of cancer other than lung or non-melanoma skin cancer for which they received treatment in the past five years (n=141); not being proficient in English (n=35); not being able to provide consent (n=8); not receiving treatment at Moffitt Cancer Center (n=96); being too sick (n=14); or becoming deceased prior to approach (n=21). Of the 156 patients approached for study participation, 16 refused, and 140 provided written informed consent (90% acceptance rate). Of the 140 participants who consented, 113 completed and returned the Time 1 questionnaire (81% response rate). Seventy-three percent of patients completed the Time 1 survey in hard copy format, while 27% completed the online version. Four patients were deemed to have unusable Time 1 data; one became ineligible after consent, and three were missing >20% of the data on one or more measures. Of the 109 patients with usable Time 1 data, 97 patients (89%) also had usable Time 2 data. Sixty-eight percent of patients who completed the Time 2 survey completed the hard copy, while 32% completed the online version. Analyses for Aims 1-4 were conducted on the 109 patients with evaluable Time 1 data. Analyses for Aim 5 were conducted using data from the 97 patients with evaluable Time 1 and Time 2 data.

Demographic, clinical, and lifestyle characteristics for the 109 patients included in the analyses for Aims 1-4 are shown in Table 2. The majority were non-Hispanic White, with a near equal distribution of males (46%) and females (54%). Most patients were married or living with a partner (72%), and over half had at least some college education (54%). Participant clinical characteristics are shown in Table 3. Participants were diagnosed with either non-small cell (84%) or small cell (16%) lung cancer. The majority were diagnosed with late stage disease (75%), and patients were an average of 102 days since diagnosis. Current treatment regimens included radiation (33%), chemotherapy (74%), immunotherapy (6%), targeted therapy (3%), or participation in a clinical trial (17%). Nearly half (48%) of the participants had a performance status of 1, indicating restriction in physically strenuous self-care activities. Participant lifestyle characteristics are shown in Table 4. Participants reported a moderate level of social engagement on the Lubben Social Network Scale, reporting an average score of 3.6 on a 0 to 5 Likert scale where higher scores reflect greater social engagement in the past month. Participants included never (8%), former (75%), and current (15%) cigarette smokers. A majority reported not consuming an alcoholic beverage in the past month (63%).

Mean scores on the loneliness, depression, quality of life, and social-cognitive measures are presented in Table 5. Participants reported a mean score of 33.8 on the UCLA Loneliness Scale – Version 3 (SD = 10.4), which represents a low to moderate level of loneliness. Participants reported a mean score of 13.7 (SD = 9.4) on the Center for Disease Outcomes – Depression Scale, with 38% of participants endorsing a score of ≥16, indicating significant depressive symptomology. Participants reported an average total score of 98.1 (SD = 20.7, Median = 100, Range: 43 – 144) on the Functional Assessment of Cancer Therapy-Lung, which

is consistent with the median score and range reported in normative data for lung cancer patients (Median = 95, Range: 44 – 135) (Cella et al., 2005).

Participants (n = 140) were compared to non-consenters (n = 16) on demographic characteristics; there were no significant differences between groups (*p*'s > .05). Participants who completed the Time 1 questionnaire (n = 113) were compared to those who did not (n = 27). Completers were more likely to be White than non-White ($\chi 2$ = 3.91, *p* < .05).

Analyses Related to Aims 1, 2, and 3

Correlations of loneliness with depression and quality of life are shown in Table 6. As hypothesized, loneliness was associated with greater depressive symptomology (*r* = .44) and worse quality of life (*r* = -.59) (*p* values < .001).

Correlations between social-cognitive characteristics and depression and quality of life are shown in Table 7. As hypothesized, greater lung cancer-related stigma, social constraint, cancer-related negative social expectations and avoidant coping, and lesser beliefs about one's ability to cope with cancer were associated with greater depressive symptomology and worse quality of life (all *p* values < .001).

Correlations of loneliness with social-cognitive characteristics are shown in Table 8. As hypothesized, greater lung cancer-related stigma, social constraint, cancer-related negative social expectations and avoidant coping, and lesser beliefs about one's ability to cope with cancer were significantly correlated with loneliness (all *p* values < .001).

Analyses Related to Aim 4

Ten mediation models were run to examine loneliness as a mediator of the relationships between social-cognitive variables and depression and quality of life, respectively. The social-cognitive variables were treated as the independent variables, loneliness as the mediator, and depression and quality of life as the dependent variables. Results of analyses for Aims 1, 2, and 3 demonstrated that all social-cognitive variables, loneliness, and depression and quality of life were significantly correlated, so all ten models were run. Bootstrapped estimates and 95% confidence intervals for the indirect effects in the mediation models are shown in Table 9. Loneliness partially mediated the relationship between lung cancer-related stigma, social constraint, cancer-related negative social expectations and avoidant coping with depressive symptoms, as evidenced by 95% confidence intervals for the indirect effect that do not include zero. Loneliness did not mediate the relationship between beliefs about one's ability to cope with cancer and depressive symptoms (95% CI: -.24 to .02). Additionally, loneliness partially mediated the relationship between lung cancer-related stigma, social constraint, cancer-related negative social expectations, avoidant coping, and beliefs about one's ability to cope with cancer with quality of life, as indicated by 95% confidence intervals for the indirect effect that do not include zero.

The mediation models are visually presented in Figures 3a-j, with standardized beta weights for the *a, b, c,* and *c'* pathways shown. Standardized effects sizes for the α pathway were medium in size (Range: $\beta = .35$ to .59) and small-medium in size for the *b* pathway (Range: $\beta = .27$ to .48). The c pathway represents the direct effect of each social-cognitive variable on depressive symptoms or quality of life, respectively. The c' path represents the effect of each social-cognitive variable on depressive symptoms or quality of life when loneliness is added as a

mediator variable. As an example, Figure 3a depicts the model of loneliness as a mediator of the relationship between lung cancer-related stigma and depressive symptoms. The size of the β weight is reduced when loneliness is added as a mediator (*c* pathway = -.40, *p* <.001; *c'* pathway = -.22, *p* <.05), consistent with the significant indirect effect in the bootstrap analyses and evidence of loneliness as a partial mediator of the relationship between lung cancer-related stigma and depressive symptoms. Figure 3e depicts the model of loneliness as a mediator of the relationship between beliefs about ones ability to cope with cancer and depressive symptoms. The size of the β weight is not reduced appreciably (*c* pathway = -.60, *p* <.001; *c'* pathway = -.50, *p* <.001), consistent with the non-significant indirect effect of the bootstrap analyses and evidence that loneliness does not mediate the relationship between beliefs about ones ability to cope with cancer and depressive symptoms.

Additional mediation analyses were performed in which the proposed mediator, loneliness, was entered as the dependent variable, and the dependent variables, depression and quality of life, were entered separately as the mediator variable. The results of these reverse mediation analyses, with bootstrapped estimates and 95% confidence intervals for the indirect effect, are shown in Table 10. Depressive symptoms partially mediated the relationship between lung cancer-related stigma, social constraint, cancer-related negative social expectations and avoidant coping with loneliness. Depressive symptoms did not mediate the relationship between beliefs about one's ability to cope with cancer and loneliness (95% CI: -.29 to .04). Quality of life partially mediated the relationship between lung cancer-related stigma, social constraint, cancer-related negative social expectations, avoidant coping, and beliefs about one's ability to cope with cancer with loneliness.

Analyses Related to Aim 5

Descriptive statistics for loneliness, depression, and quality of life at Time 2 are shown in Table 11. Two hierarchical multiple regression analyses were conducted to determine the relative contribution of loneliness at Time 1 in predicting depressive symptoms and quality of life, respectively, at Time 2 after accounting for depressive symptoms and quality of life at Time 1. Data were evaluated for multicollinearity (variance inflation factor (VIF) of > 4); no variables exceeded this threshold.

The results examining depressive symptoms at Time 2 as the dependent variable are shown in Table 12. Depressive symptoms at Time 1 accounted for 17% of the variance in depressive symptoms at Time 2 (β = .43, t = .98, p < .001). Loneliness at Time 1 accounted for an additional 14% of the variance in depressive symptoms at Time 2 (β = .38, t = 4.4, p < .001) beyond that accounted for by depressive symptoms at Time 1. The results of the model examining quality of life at Time 2 as the dependent variable are presented in Table 13. Quality of life at Time 1 accounted for 46% of the variance in quality of life at Time 2 (β = .68, t = 9.0, p < .001). The addition of loneliness at Time 2 did not significantly change the variance accounted for (ΔR^2 = -.01, R^2 = .45).

DISCUSSION

The purpose of the current study was to investigate the relationship of loneliness to depressive symptoms and quality of life in a sample of lung cancer patients. The study also sought to identify social-cognitive variables associated with loneliness and to explore the role of loneliness in mediating relationships between these variables and depressive symptoms and quality of life. Finally, the study examined whether loneliness predicted change over time in depressive symptoms and quality of life.

The results of the current study confirmed a priori hypotheses. As predicted, loneliness was positively correlated with depressive symptoms and negatively correlated with quality of life. In addition, loneliness was correlated with social-cognitive variables in the expected directions and social-cognitive variables were related to depressive symptoms and quality of life in the expected directions.

Mediation analyses yielded evidence for partial mediation, with loneliness mediating the relationships of social-cognitive variables with depressive symptoms and quality of life for nine of the ten models tested, as evidenced by significant indirect effects of the bootstrap analyses and appreciable drops in size of the c versus the c' pathway, signifying that the addition of loneliness to the equation helped to explain the relationship between the social-cognitive variable of interest and depressive symptoms or quality of life, respectively. The exception was findings showing that loneliness did not mediate the relationship between beliefs about one's ability to cope with cancer and depressive symptoms. It should be noted that reverse mediation analyses also provided support for partial mediation in the same nine models when depressive symptoms and

quality of life were treated as the mediators and loneliness was treated as the dependent variable. Given that the variables of interest were at least moderately correlated with each other as demonstrated in Aims 1-3, evidence in support of both forward and reverse partial mediation is not surprising. Finally, exploratory analyses showed that loneliness at Time 1 predicted additional variance in depressive symptoms at Time 2 after accounting for depressive symptoms at Time 1. However, loneliness at Time 1 did not account for additional variance in quality of life at Time 2 after accounting for quality of life at Time 1.

The mean score on the UCLA Loneliness Scale in the current sample of lung cancer patients (M=33.8) was lower than the weighted mean score reported in a meta-analysis of loneliness in mixed cancer samples (M = 38.26) (Deckx, van den Akker, & Buntinx, 2014). This might be due to patients in the current study being relatively close to the time of diagnosis. Research examining the trajectories of perceived social support in breast and colorectal cancer has demonstrated that patients report an increase in the availability of support around the time of cancer diagnosis, which then declines over time (Haviland et al., 2017; Thompson, Rodebaugh, Perez & Jeffe, 2013). Interestingly, loneliness scores in the current study increased by nearly 2 points from the Time 1 to Time 2 assessment (T2 M = 35.5). This is consistent with the pattern of results observed in the meta-analysis, in which patients who were further from diagnosis endorsed significantly more feelings of loneliness than those who were closer to the time of diagnosis (Deckx, van den Akker, & Buntinx, 2014). Over one third of patients in the current sample reported a score of $\geq$ 16 on the CES-D, a cutoff score which is commonly used to indicate the presence of clinically significant depressive symptoms. This rate is higher than what is found in general cancer samples, where rates of depression range from 8 – 24% depending on clinical characteristics and how symptoms are assessed (Krebber et al., 2014), but consistent with

higher reported rates of depression in lung cancer samples (Gonzalez & Jacobsen, 2012; Cataldo, Jahan, & Pongquan, 2012; Zabora, BrintzenhofeSzoc, Curbow, Hooker, & Piantadosi, 2001). Quality of life in the current study was consistent with normative data collected from a sample of lung cancer patients (Cella et al., 2005), with a median and range of FACT-L values similar to those found in the current study. Quality of life in our sample was higher than baseline values for a sample of lung cancer patients with recently diagnosed metastatic disease (Temel et al., 2010), which may reflect differences in clinical factors between the samples.

The current study extends to lung cancer patients previous findings demonstrating a positive association between loneliness and depression in mixed and breast cancer samples (Jaremka et al., 2014; Adams et al., 2017a). In the current study, loneliness and depressive symptoms were moderately correlated (r = .44), which is consistent with previous work that has established loneliness and depression as distinct constructs worthy of independent investigation (Cacioppo et al., 2006b; Jaremka et al., 2014; Russell, Cutrona, Rose, & Yurko, 1984; Russell, 1996; Weeks, Michela, Peplau, & Bragg, 1980). Additionally, the current study extends findings from a longitudinal study of older adults examining the relationship between loneliness and depression over time (Cacioppo, Hawkley, & Thisted, 2010), in that our study similarly found that loneliness predicts variance in depressive symptoms over time after accounting for depressive symptoms at baseline.

Similarly, loneliness has been correlated with worse quality of life in breast and mixed cancer samples (Adams et al., 2017a; Boer, Elving, & Seydel, 1998; Deckx et al., 2013; Fanakidou et al., 2018), but the relationship between the two has not been examined specifically in lung cancer patients to date. The strong negative correlation between loneliness and quality of life in the current study (r = -.59) is clinically meaningful in that both loneliness and quality of

life have been linked to important outcomes in cancer patients, including overall morbidity and mortality (Hawkley & Cacioppo, 2003, 2010; Vodermaier, Lucas, Linden & Olson, 2017). Unlike findings for depressive symptoms, we did not find that loneliness predicted quality of life over time after accounting for quality of life at baseline. Future research should seek to disentangle the longitudinal relationships between these constructs in lung cancer samples.

The current study addressed an important gap in the literature by examining the relationship of social-cognitive variables with important clinical outcomes in lung cancer patients. Lung cancer patients are an understudied population in psychosocial oncology research and previous studies have focused primarily on the relationship of demographic, disease, and treatment variables with depression and quality of life. The current study extends to lung cancer patients findings on the relationship of social constraint and cancer-related negative social expectations with depression and quality of life from mixed cancer samples (Adams et al., 2015, 2017a, 2017b; Heitzmann et al., 2011). Findings regarding the relationships of cancer-related negative social expectations and beliefs about one's ability to cope with cancer with depressive symptoms and quality of life are generally consistent with those found in general cancer samples (Adams et al., 2017a; Heitzmann et al., 2011; Philip, Merluzzi, Zhang, & Heitzmann, 2013). The relationship between beliefs about ability to cope with cancer and quality of life was particularly strong (r = .72) in the current study whereas it was found to be moderate (r= .43) in mixed cancer samples (Heitzmann et al., 2011). It is possible that this is something unique to lung cancer, whereby patients who are able to maintain cancer-related self-efficacy in the face of a disease with a generally poor prognosis experience better quality of life. Consistent with this view, a recent study of patients with advanced lung cancer within three months of starting therapy found that self-efficacy was the most prominent predictor of quality of life (Liao et al., 2014).

The current study aligns with previous work that has reported a positive correlation between cancer-related stigma and depression (Brown Johnson et al., 2014; Cataldo et al., 2011, Cataldo, Jahan, & Pongquan, 2012; Else-Quest, LoConte, Schiller, & Hyde, 2009; Gonzalez & Jacobsen, 2012), and a negative correlation between cancer-related stigma and quality of life in lung cancer patients (Brown Johnson et al., 2014; Cataldo et al., 2011, Cataldo, Jahan, & Pongquan, 2012; Chambers et al., 2012, 2015) Work by Cataldo and colleagues has posited that cancer-related stigma in lung cancer patients can cause fear of social rejection in patients and negatively influence social relationships by limiting social support, which may be associated with depression and worse quality of life. This conceptualization is also aligned with the Social-Cognitive Processing Model, which suggests that negative health outcomes occur when an individual feels they are unable to express their thoughts and emotions related to a stressor with those around them (Badr & Taylor, 2006; Lepore & Revenson, 2007).

The current study provided further support for the negative impact of social constraint on cancer patient outcomes, specifically depressive symptoms ($r = .41$) and worse quality of life ($r = -.45$) (Adams et al., 2015, 2016b; Cordova, Cunningham, Carlson, & Andrykowski, 2001; Lepore & Revenson, 2007). While avoidant coping was associated with depressive symptoms and quality of life in the anticipated directions (Gonzalez & Jacobsen, 2012; Kershaw, Northouse, Kritpracha, Schafenacker & Mood, 2004; Nipp et al., 2016), we found a stronger correlation between avoidant coping and depressive symptoms ($r = .59$) than has been previously reported in a lung cancer sample ($r = .36$) (Gonzalez & Jacobsen, 2012). This may be attributable to differences in the study samples, as patients in the current study were an average of 3.5 months post-diagnosis while patients in the Gonzalez & Jacobsen study were an average of 18 months post-diagnosis, such that patients the in the current study may still have been processing

receipt of the cancer diagnosis and treatment and utilizing avoidant coping strategies, such as wishing that the problem would go away.

The current study is novel for its examination of relationships between social-cognitive variables and loneliness. While some of these social-cognitive variables have been explored in cancer samples, few have been examined solely in lung cancer patients. In addition, previous research has not looked at these variables together to allow for comparison of the strength of relationships with loneliness. Findings were generally in line with the hypothesized direction based on social-cognitive theory and previous research (Adams et al., 2017a; Lepore, 2001; Mosher et al., 2012). Specifically, findings confirmed a positive association between loneliness and cancer-related negative social expectations in lung cancer patients, as has been reported in a diverse cancer sample (Adams et al., 2017a). This is consistent with the idea that lonelier people may view the world as more socially threatening, expect more negative social interactions and therefore experience them as such (Adams et al., 2017a; Cacioppo et al., 2006b; Hawkley & Cacioppo, 2010). The current study provides initial data on the relationship of lesser beliefs about one's ability to cope with cancer and more avoidant coping with loneliness in lung cancer patients. Social constraint has been correlated with loneliness in cancer survivors (Mosher et al., 2012), a finding this study extends to lung cancer patients. Findings regarding the relationship between lung cancer-related stigma and loneliness are particularly novel. Our study extends beyond the previously reported relationships of perceived stigma with greater depressive symptoms (Brown Johnson et al., 2014; Cataldo et al., 2011, Cataldo, Jahan, & Pongquan, 2012; Else-Quest, LoConte, Schiller, & Hyde, 2009; Gonzalez & Jacobsen, 2012) and worse quality of life (Brown Johnson et al., 2014; Cataldo et al., 2011, Cataldo, Jahan, & Pongquan, 2012; Chambers et al., 2012, 2015) in lung cancer patients to show that stigma is also linked to

loneliness. Additionally, results of mediation analyses indicated that loneliness partially mediates the relationship between stigma and depression and quality of life. Research on HIV-infected individuals has demonstrated this pattern of results, where loneliness mediates the relationship between HIV-related stigma and depressive symptoms (Fekete, Williams & Skinta, 2018). Our findings implicate a reduction in loneliness as the mechanism by which intervening with perceived stigma may help to improve lung cancer patients' psychosocial outcomes, such as lesser depressive symptoms and better quality of life.

Analyses evaluating loneliness as a mediator variable to explain the relationship between other social-cognitive factors with depressive symptoms and quality of life demonstrated evidence of partial mediation, aside from beliefs about ability to cope with cancer. We did not find evidence for loneliness as a mediator between beliefs about one's ability to cope with cancer with depressive symptoms, suggesting that other factors may have more explanatory value than loneliness when looking at this relationship. This may also be a product of the strong independent correlation between self-efficacy and depression. A study of coping self-efficacy and depression in cancer survivors found that cancer self-efficacy was a significant independent predictor of depression, while social support was not a significant predictor (Philip, Merluzzi, Zhang, & Heitzmann, 2013). This suggests that internal perceptions of one's inability to cope with a stressor may be strongly related to depression such that the availability of perceived or actual social resources has a negligible influence. Previous work has demonstrated evidence of loneliness as a partial mediator of the relationship between social constraint and distress as well as between emotional expression and depressive symptoms in cancer samples, consistent with our finding in support of loneliness as a mediator between social constraint and depressive symptoms (Marroquin, Czamanski-Cohen, Weihs & Stanton, 2016; Mosher et al., 2012).

However, the ability to draw definitive conclusions about loneliness as a mediator and the direction of relationships among these variables is precluded by the use of cross-sectional data and the results of reverse mediation analyses, which also suggest that depressive symptoms and quality of life might act as mediator variables between social-cognitive factors and loneliness.

Strengths of the current study include the novel application of a social-cognitive model to understanding factors contributing to depressive symptoms and quality of life in lung cancer patients. In addition, the demographic, clinical, and lifestyle characteristics of the study sample are generally consistent with the population of lung cancer patients seen in major treatment centers. This pattern includes a roughly even division of men and women, a typical distribution of never versus ever smokers, and an approximately 6:1 ratio of patients with NSCLC to SCLC (American Cancer Society, 2018).

The study does, however, possess several limitations. First, the study sample was relatively homogenous with regard to racial and ethnic representation, which may limit the generalizability of findings to more diverse lung cancer populations. Second, shared method variance in the measurement of study variables should be considered based on the use of self-report measures. Third, analyses were performed primarily on cross-sectional data. Mediation analyses conducted on data from a single time point limits the ability to draw conclusions regarding the directionality of relationships in these models. Indeed, reverse mediation analyses also suggested the possibility of depression and quality of life as mediator variables, which precludes the ability to deduce that loneliness acts as the sole mediator variable in these relationships. Longitudinal research designs should be employed to better explore the pattern of relationships among these variables over time. Fourth, even though analyses related to the last study aim were conducted using longitudinal data, the two time points were relatively close

together, which limited the ability to capture change over time. Finally, the timing of study participation may have influenced the pattern of results. All the patients in the current study were within three months of beginning systemic or radiation therapy for lung cancer, and were on average 3.5 months post-diagnosis. Since patients were close to diagnosis and all were on active treatment, it is possible that they may have benefitted from the bolus of support that some patients receive in the period directly after diagnosis.

With regard to future research, study results provide support for expanding the assessment of loneliness in clinical research and practice. Loneliness has received increasing attention as a public health problem in the context of the current age shift in the population. Given that the majority of cancers occur in older adults, continued study of loneliness and potentially modifiable factors related to loneliness in cancer patients and survivors is warranted. Findings also support developing and evaluating interventions targeted at social-cognitive factors as a means of reducing loneliness and thereby reducing depressive symptoms and improving quality of life in people with lung cancer. For example, cognitive-behaviorally based therapies designed to change maladaptive social cognitions and increase patients' self-efficacy to communicate effectively about cancer-related feelings and experiences may help to minimize social constraint, reduce perceptions of being stigmatized, and alter cancer-related negative social expectations (Masi, Chen, Hawkley, & Cacioppo, 2011). Patients may, in turn, engage in more social interactions and feel more satisfied with their interactions, thus reducing feelings of loneliness and improving outcomes.

An additional direction for future research is to focus greater attention on model development and evaluation. Using the social-cognitive model to explain the relationships between these variables and loneliness in the context of lung cancer was supported by prior

research. However, the general structure of the mediation models in the current study may be an oversimplification as suggested by the results of the reverse mediation analyses that were conducted. Other recent studies also suggest that the relationships among social-cognitive variables are complex. For example, in a study of long-term breast cancer survivors, avoidant coping and self-efficacy for symptom management were found to mediate the relationship between social constraint and self-efficacy for symptom management (Adams et al., 2016b). Another recent intervention trial identified multiple mediators of an internet-based psychosocial intervention for women with breast cancer, including loneliness, coping self-confidence, and social support (Cleary & Stanton, 2015). These examples illustrate how variables used in the current mediation models may interact in more complex ways. Use of advanced statistical techniques, such as structural equation modeling and path analysis, with larger samples can assist with the further exploration of the relationships among variables.

In summary, results from the present study suggest that consideration of loneliness is important in order to understand differences in depression and quality of life in cancer populations, particularly in lung cancer patients. Beyond its direct impact on clinically relevant outcomes, the experience of loneliness may be the mechanism by which social-cognitive factors influence depression and quality of life. Investigation of the relationship between stigma and loneliness in the context of lung cancer is particularly novel and warrants further exploration.

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Screened for eligibility
(n = 1,579)

Ineligible for participation (n = 1,423)
- No diagnosis lung cancer (n=75)
- History of treatment for non-lung, non-melanoma skin cancer (n=141)
- Not proficient English (n=35)
- Too sick (N=14)
- Unable to provide consent (n=8)
- Not within 3 months beginning lung cancer treatment (n=1033)
- Deceased prior to approach (n=21)

Approached for consent
(n = 156)

Refused participation
(n = 16)

Consented
(n = 140)

No T1 data (n=25)
- Withdrew (n=4)
- Deceased (n=5)
- Never received (lost in mail, technical difficulties) (n=2)
- Failure to complete T1 (n=14)

Completed T1 survey
(n = 113)

Unusable T1 data (n=4)
- Ineligible after consent (n=2)
- Missing >20% data on at least 1 scale (n=2)

Usable T1 data
(n = 109)

No T2 data (n=12)
- Refused (n=2)
- Never received (lost in mail, technical difficulties) (n=4)
- Failure to complete T2 (n=6)

Usable T2 data
(n = 97)

Figure 2. Participation Consort Diagram

Table 2. *Sociodemographic Characteristics (N=109)*

	M (SD) [Range] or N (%)
Age	65.5 (9.4) [40 – 83]
Gender	
Male	50 (46%)
Female	59 (54%)
Ethnicity	
Spanish/Hispanic/Latino	5 (5%)
Not Spanish/Hispanic/Latino	104 (95%)
Race	
American Indian or Alaska Native	1 (.9%)
Asian	1 (.9%)
Black or African American	4 (4%)
White	103 (94%)
Marital Status	
Married or living with partner	78 (72%)
Single	8 (7%)
Divorced	14 (13%)
Separated	1 (.9%)
Widowed	8 (7%)
Completed Education	
Less than 12 years	16 (15%)
High school graduate	27 (25%)
Trade school	7 (6%)
Some college	33 (30%)
College graduate	16 (15%)
Post-graduate degree	10 (9%)
Current Employment	
Working	
Full time at job	18 (17%)
Part time at job	2 (2%)
On Leave	
With pay	8 (7%)
Without pay	7 (6%)
Not Employed	
Disabled	9 (8%)
Retired	56 (52%)
Homemaker	7 (6%)
Missing	2 (2%)
Religious Affiliation (belong to church, temple other religious group)	
No	60 (55%)
Yes	47 (43%)
Missing	2 (2%)

Table 3. *Clinical Characteristics*

	M (SD) [Range] or N (%)
Lung Cancer Type	
NSCLC	92 (84%)
SCLC	17 (16%)
NSCLC Type	
Adenocarcinoma	63 (68%)
Squamous Cell Carcinoma	22 (24%)
Large Cell Carcinoma	1 (1%)
Large Cell Neuroendocrine Tumor	4 (4%)
Unknown	2 (2%)
AJCC Stage	
I	4 (4%)
II	15 (16%)
III	33 (36%)
IV	40 (44%)
SCLC Stage	
Limited Stage	8 (47%)
Extensive Stage	9 (53%)
Surgery	
Yes	29 (27%)
No	80 (73%)
Type of Procedure	
Wedge Resection	4 (14%)
Segmentectomy	2 (7%)
Lobectomy	19 (66%)
Pneumonectomy	1 (3%)
Unknown	3 (10%)
Time Since Surgery (days)	214 (358) [50 - 1730]
	Median = 96
Current Treatment	
Radiation	36 (33%)
Chemotherapy	81 (74%)
Immunotherapy	7 (6%)
Targeted Therapy	3 (3%)
Clinical Trial	18 (17%)
Previous Treatment	
Radiation	15 (14%)
Chemotherapy	4 (4%)
Immunotherapy	0 (0%)
Targeted Therapy	0 (0%)
Clinical Trial	1 (.9%)
Brain Metastases	
Yes	14 (13%)
No	95 (87%)
Radiation for Brain Metastases	

Yes	9 (64%)
No	5 (36%)
Time Since Diagnosis (days)	102 (58.4) [18 – 370]
	Median = 92
1st Course of Lung Cancer Treatment	
Yes	105 (96%)
No	4 (4%)
Previous Cancer Diagnosis (non-lung, non-melanoma skin)	
Yes	15 (14%)
No	94 (86%)
Performance Status	
(0) Fully Active	27 (25%)
(1) Restricted in physically strenuous self-care	52 (48%)
(2) Ambulatory and capable self-care, but unable to carry out work activities	20 (18%)
(3) Capable only limited self-care	7 (6%)
(4) Completely disabled	1 (.9%)
Missing N=2	2 (2%)

NSCLC= Non-small cell lung cancer, SCLC= Small cell lung cancer, AJCC = American Joint Committee on Cancer

Table 4. *Lifestyle Characteristics*

	M (SD) [Range] or N (%)
Social Network	
Lubben Social Network Scale	19.8 (6.0) [3 – 30]
Average contacts friends/family past month	3.6 (1.0) [0 – 5]
Smoking History	
Smoked >100 cigarettes in lifetime	
Yes	100 (92%)
No	9 (8%)
Average # cigarettes/day	24.9 (14.7) [1-70]
	Median=20
Average number of years smoked	34.0 (13.6) [0-65]
Smoking Status	
Never Smokers	9 (8%)
Former Smokers	82 (75%)
Current Smokers	16 (15%)
Missing	2 (2%)
Average time quit (former smokers) (years)	12.8 (13.7) [1 month – 56 years]
Alcohol	
Consumed alcoholic beverage in past month?	
Yes	40 (37%)
No	69 (63%)
If yes, average number of drinks in past month	
1-3x/month	18 (45%)
1-3x/week	9 (22%)
4-6x/week	7 (18%)
1x/day	2 (5%)
2x/day	4 (10%)

Table 5. *Loneliness, Social-Cognitive Characteristics, Depression, and Quality of Life*

	M (SD) [Range] or N (%)
Loneliness	
UCLA Loneliness Scale (UCLA V3)	33.8 (10.4) [20-64]
Low (20-34)	61 (56%)
Moderate (35-49)	37 (34%)
Moderately High (50-64)	11 (10%)
High (65+)	0 (0%)
Social-Cognitive Characteristics	
Cataldo Lung Cancer Stigma Scale (CLCSS)	70.0 (8.5) [44-84]
Social Constraint Scale (SCS)	24.8 (7.8) [15-52]
Cancer-Related Negative Social Expectations (CNSES)	15.4 (6.1) [5-28]
Cancer Belief Inventory – Brief (CBI-B)	88.1 (14.6) [46–108]
Coping Responses Inventory – Avoidant Coping Subscale (CRI-Avoidant)	5.6 (4.0) [0-18]
Depression	
Center for Epidemiologic Studies Depression Scale (CES-D)	13.7 (9.4) [0-48]
CES-D >16	41 (38%)
Quality of Life	
Functional Assessment of Cancer Therapy – Lung (FACT-L)	98.1 (20.7) [43-134] Median = 100.2
Physical Well-being (PWB)	18.8 (6.1) [1-28]
Social/Family Well-being (SWB)	24.7 (3.9) [8-28]
Emotional Well-being (EWB)	18.6 (4.6) [2-24]
Functional Well-being (FWB)	16.9 (6.6) [4-28]
Lung Cancer Subscale (LCS)	19.2 (5.1) [3-28]
FACT-G	79.0 (17.2) [33-108]
Treatment Outcome Index (TOI)	54.8 (15.4) [23-82]

Table 6. *Correlations of Loneliness with Depression and Quality of Life (QOL)*

	Depression	QOL
Loneliness	.44***	-.59***

* p < .05, **p < .01, *** p < .001

Table 7. *Correlations of Social-Cognitive Characteristics with Depression and Quality of Life (QOL)*

Social-Cognitive Characteristic	Depression	QOL
Lung Cancer-related Stigma	-.40***	.51***
Social Constraints	.41***	-.45***
Cancer-related Negative Social Expectations	.46***	-.44***
Beliefs about Ability to Cope with Cancer	-.60***	.72***
Avoidant Coping	.59***	-.54***

* p < .05, **p < .01, *** p < .001

Table 8. *Correlations of Loneliness with Social-Cognitive Factors*

| Social-Cognitive Characteristic	Loneliness
Lung Cancer-related Stigma	-.59***
Social Constraints	.45***
Cancer-related Negative Social Expectations	.43***
Beliefs about Ability to Cope with Cancer	-.49***
Avoidant Coping	.35***

* p < .05, **p < .01, *** p < .001

Table 9: *Bootstrapped Estimates and Confidence Intervals for Tests of the Indirect Effects of Loneliness as a Mediator Variable*

IV	Path *c* (IV to DV) Total effect B (SE)	Effect of IV on M (*a*) B (SE)	Effect of M on DV (*b*) B (SE)	Direct effects (*c'*) B (SE)	Indirect effect (*a* x *b*)	Indirect effect (*a* x *b*) 95% CI
	DV = Depression (CES-D)					
CLCSS	-.42 (.09)***	-.73 (.10)***	.27 (.09)**	-.23 (.11)*	-.19	-.33 to -.05
SCS	.47 (.10)***	.59 (.12)***	.28 (.08)***	.30 (.11)**	.14	.04 to .28
CNSES	.68 (.13)***	.73 (.15)***	.25 (.08)**	.49 (.13)***	.13	.02 to .27
CRI	1.31 (.17)***	.91 (.24)***	.23 (.07)**	1.10 (.18)***	.09	.02 to .20
CBI-B	-.36 (.05)***	-.35 (.06)***	.17 (.07)*	-.30 (.05)***	-.10	-.24 to .02
	DV = Quality of Life (FACT-L)					
CLCSS	1.24 (.20)***	-.73 (.10)***	-.87 (.19)***	.61 (.23)*	.26	.14 to .39
SCS	-1.20 (.23)***	.59 (.12)***	-.95 (.17)***	-.64 (.23)**	-.21	-.34 to -.11
CNSES	-1.49 (.30)***	.73 (.15)***	-.97 (.17)***	-.79 (.29)**	-.21	-.34 to -.10
CRI	-2.79 (.42)***	.91 (.24)***	-.90 (.15)***	-1.97 (.39)***	-.16	-.27 to -.07
CBI-B	1.01 (.10)***	-.35 (.06)***	-.62 (.14)***	.80 (.10)***	.15	.07 to .26
*Unstandardized regression coefficients reported. IV = independent variable; DV = dependent variable; M = mediator variable; CI = confidence interval; CES-D = Center for Epidemiologic Studies Depression Scale; FACT-L = Functional Assessment of Cancer Therapy – Lung; CLCSS = Cataldo Lung Cancer Stigma Scale; SCS = Social Constraint Scale; CNSES = Cancer-related Negative Social Expectations Scale; CRI = Coping Resources Inventory - Avoidant Coping Subscale; CBI-B = Cancer Beliefs Inventory – Brief *p* < .05, ** *p* < .01, *** *p* < .001						

Table 10. *Bootstrapped Estimates and Confidence Intervals for Tests of Indirect Effects of Depression and Quality of Life as Mediator Variables and Loneliness as the Dependent Variable (Reverse Mediation)*

IV	Path c (IV to DV) Total effect β	Effect of IV on M (*a*) β	Effect of M on DV (*b*) β	Direct effects (c') β	Indirect effect (*a* x *b*)	Indirect effect (*a* x *b*) 95% CI
	DV = Loneliness, Mediator = Depression (CES-D)					
CLCSS	-.59***	-.40***	.24**	-.49***	-.10	-.23 to -.02
SCS	.45***	.41***	.31***	.32***	.13	.04 to .26
CNSES	.43***	.46***	.31**	.28**	.14	.03 to .28
CRI	.35***	.59***	.36**	.14	.21	.06 to .38
CBI-B	-.49***	-.60***	.23*	-.35**	-.14	-.29 to .04
	DV = Loneliness, Mediator = Quality of Life (FACT-L)					
CLCSS	-.59***	.51***	-.38***	-.40***	-.19	-.34 to -.09
SCS	.45***	-.45***	-.48***	.23**	.22	.12 to .34
CNSES	.43***	-.44***	-.49***	.21*	.22	.11 to .34
CRI	.35***	-.54***	-.56***	.05	.30	.19 to .43
CBI-B	-.49***	.72***	-.48***	-.14	-.35	-.54 to -.17

*Unstandardized regression coefficients reported. IV = independent variable; DV = dependent variable; M = mediator variable; CI = confidence interval; CES-D = Center for Epidemiologic Studies Depression Scale; FACT-L = Functional Assessment of Cancer Therapy – Lung; CLCSS = Cataldo Lung Cancer Stigma Scale; SCS = Social Constraint Scale; CNSES = Cancer-related Negative Social Expectations Scale; CRI = Coping Resources Inventory - Avoidant Coping Subscale; CBI-B = Cancer Beliefs Inventory – Brief
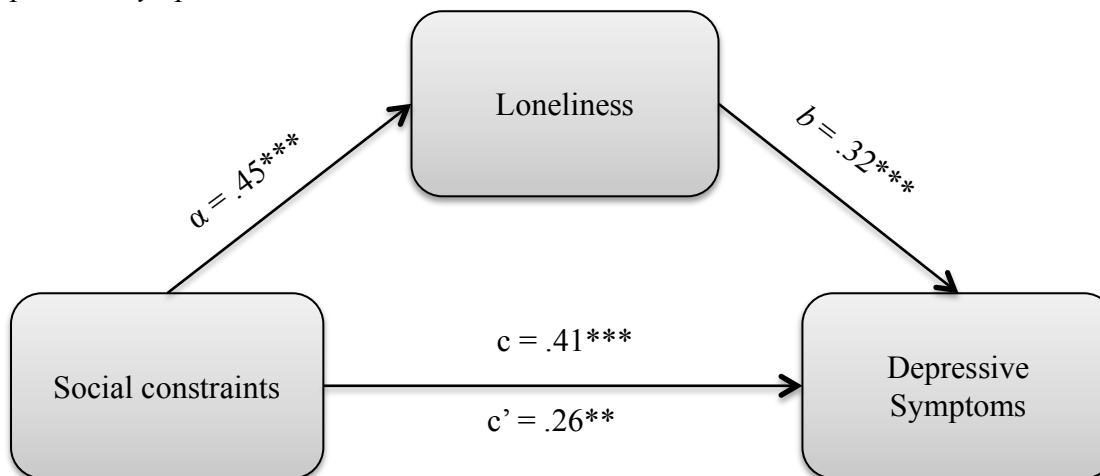* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3a. *Loneliness as a Mediator of the Relationship between Lung Cancer-related Stigma and Depressive Symptoms*
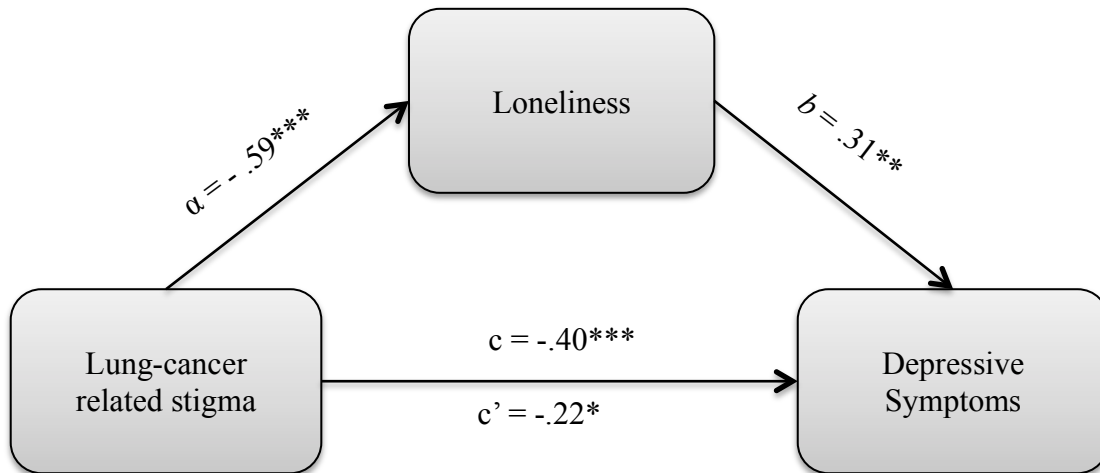
Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
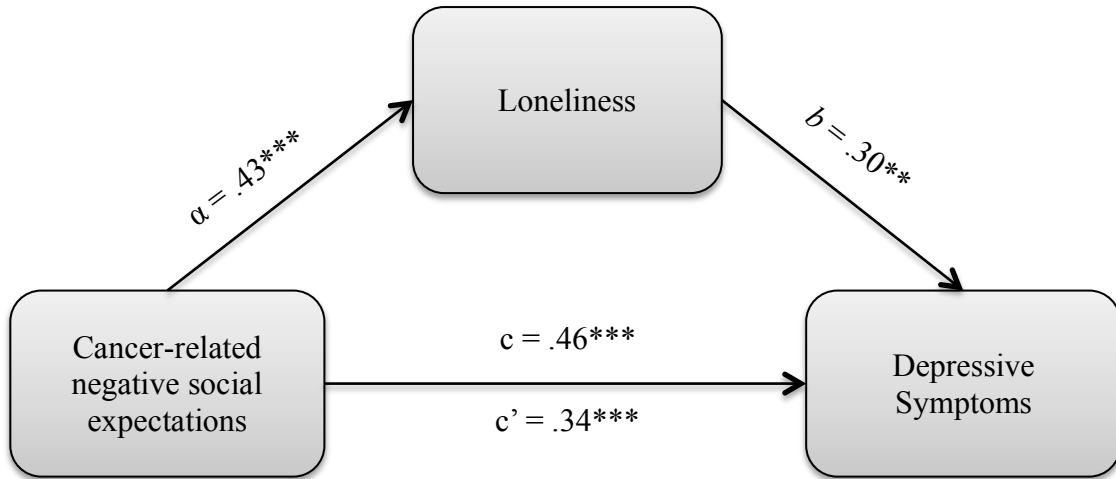* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 3b. *Loneliness as a Mediator of the Relationship between Social Constraints and Depressive Symptoms*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
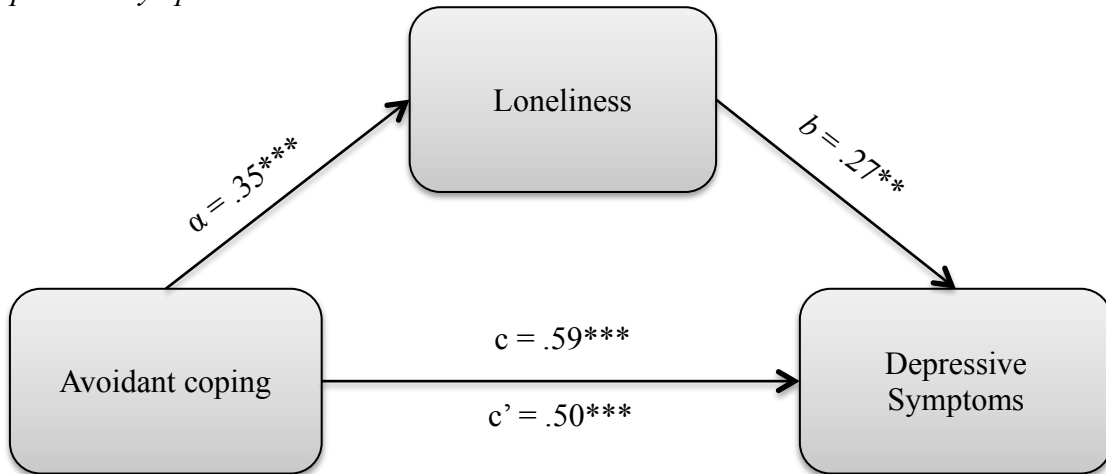* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 3c. *Loneliness as a Mediator of the Relationship between Cancer-related Negative Social Expectations and Depressive Symptoms*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3d. *Loneliness as a Mediator of the Relationship between Avoidant Coping and Depressive Symptoms*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3e. *Loneliness as a Mediator of the Relationship between Beliefs about Ability to Cope with Cancer and Depressive Symptoms*
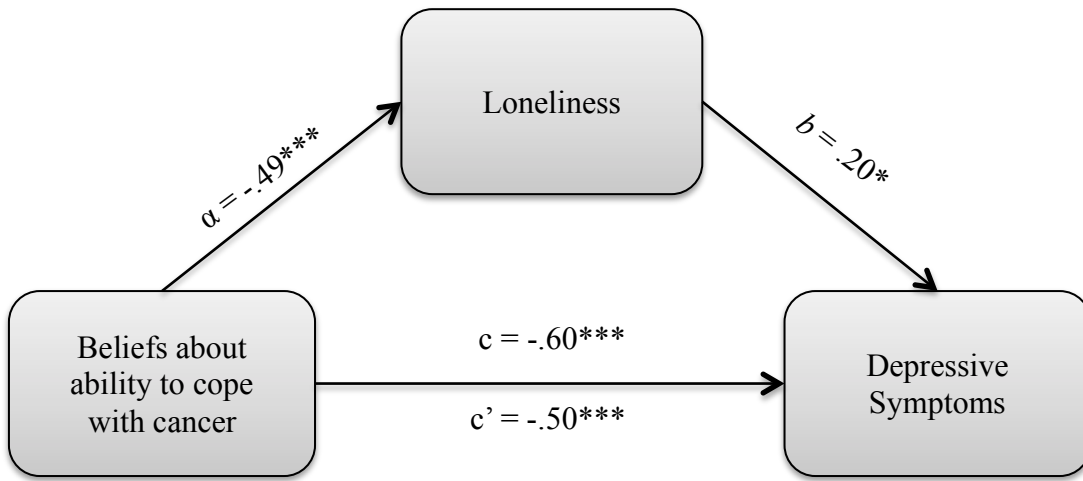
Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
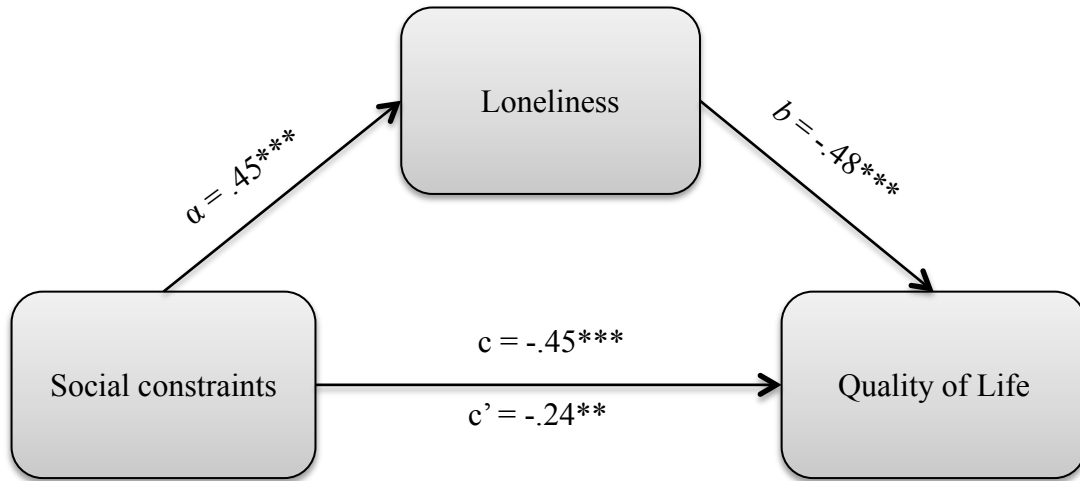* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 3f. *Loneliness as a Mediator of the Relationship between Lung Cancer-related Stigma and Quality of Life*
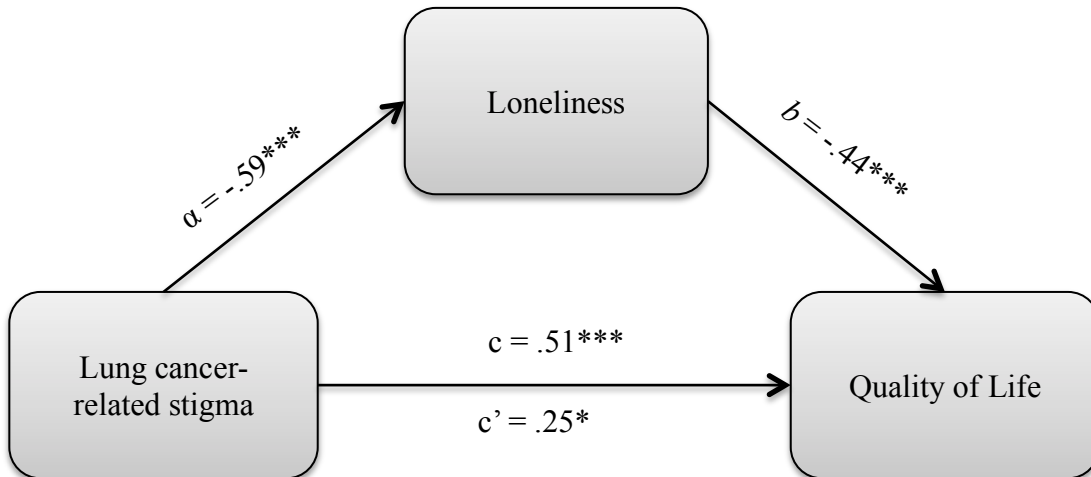
Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
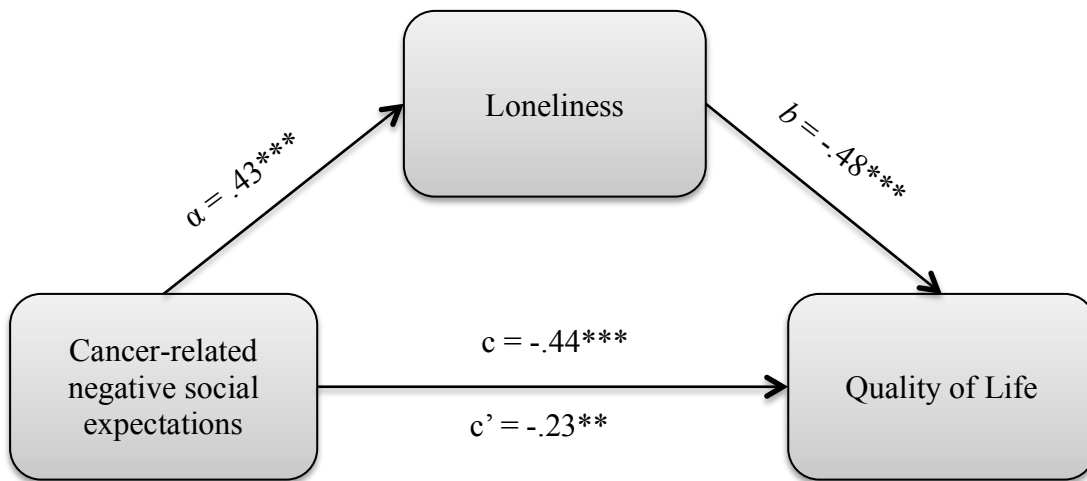* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 3g. *Loneliness as a Mediator of the Relationship between Social Constraints and Quality of Life*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
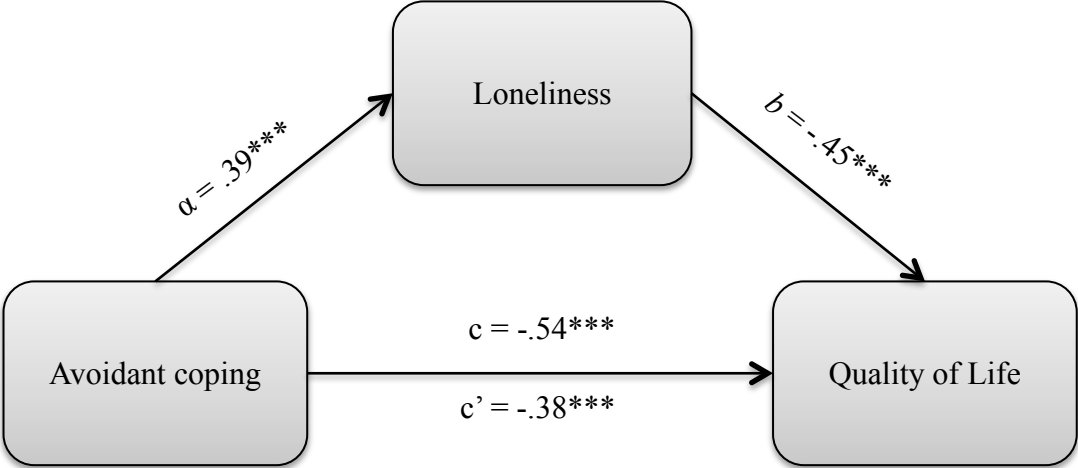* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3h. *Loneliness as a Mediator of the Relationship between Cancer-related Negative Social Expectations and Quality of Life*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3i. *Loneliness as a Mediator of the Relationship between Avoidant Coping and Quality of Life*

Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 3j. *Loneliness as a Mediator of the Relationship between Beliefs about Ability to Cope with Cancer and Quality of Life*
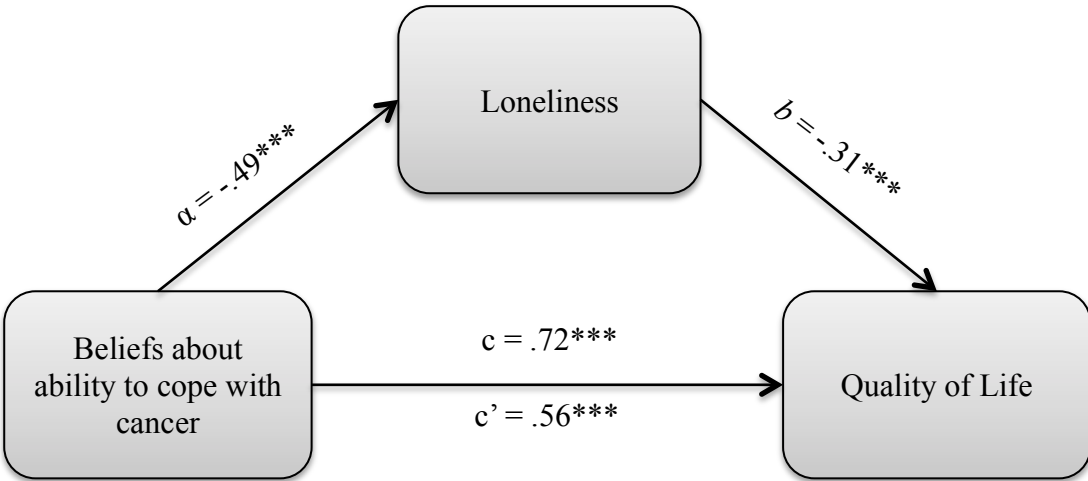
Standardized coefficients shown. c pathway = total effect of the independent variable on the dependent variable; c' pathway = effect of the independent variable on the dependent variable when controlling for the mediator (direct effect).
* *p* < .05, ** *p* < .01, *** *p* < .001

Table 11. *Loneliness, Depression, and Quality of Life at Time 2 (N=97)*

	M (SD) [Range] or N (%)
Loneliness	
UCLA Loneliness Scale (UCLA V3)	35.5 (9.0) [23 – 58]
Low (20-34)	45 (46%)
Moderate (35-49)	44 (45%)
Moderately High (50-64)	8 (8%)
High (65+)	0 (0%)
Depression	
Center for Epidemiologic Studies Depression Scale (CES-D)	13.7 (9.3) [0 – 36]
CES-D >16	34 (35%)
Quality of Life	
Functional Assessment of Cancer Therapy – Lung (FACT-L) Total Score	97.2 (20.9) [40 – 135]
Physical Well-being (PWB)	19.0 (5.5) [1 – 28]
Social/Family Well-being (SWB)	24.6 (3.9) [11 – 28]
Emotional Well-being (EWB)	18.6 (4.5) [5 – 24]
Functional Well-being (FWB)	16.4 (6.5) [3 – 28]
Lung Cancer Subscale (LCS)	18.5 (5.4) [5 – 28]
FACT-G	78.7 (16.9) [31 – 107]
Treatment Outcome Index (TOI)	54.0 (15.8) [14 – 84]

Table 12. *Two-step Hierarchical Linear Regression Treating Depression at Time 2 as the Dependent Variable*

	B	SE	β	t (*p*-value)	Δ R² (*p*-value)	Model Adj R²
Step 1						
Depression T1	5.1	1.1	.43	9.8***		.17
Step 2						
Loneliness T1	.32	.1	.38	4.4***	.14	.31

Note: B = unstandardized regression coefficient; SE = standard error of the estimate for step 1 or step 2; β = standardized regression coefficient

Table 13. *Two-step Hierarchical Linear Regression Treating Quality of Life at Time 2 as the Dependent Variable*

	B	SE	β	t (*p*-value)	Δ R² (*p*-value)	Model Adj R²
Step 1						
Quality of Life T1	.73	.1	.68	9.0***		.46
Step 2						
Loneliness T1	.03	.2	.02	.2	-.01	.45

Note: B = unstandardized regression coefficient; SE = standard error and standard error of the estimate for step 1 or step 2; β = standardized regression coefficient