ORIGINAL INVESTIGATION

A Qualitative Study of Lung Cancer Risk Perceptions and Smoking Beliefs Among National Lung Screening Trial Participants

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Received March 25, 2013; accepted July 22, 2013

ABSTRACT

Introduction: The National Comprehensive Cancer Network and the American Cancer Society recently released lung screening guidelines that include smoking cessation counseling for smokers undergoing screening. Previous work indicates that smoking behaviors and risk perceptions of the National Lung Screening Trial (NLST) participants were relatively unchanged. We explored American College of Radiology Imaging Network (ACRIN)/NLST former and current smokers' risk perceptions specifically to (a) determine whether lung screening is a cue for behavior change, (b) elucidate risk perceptions for lung cancer and smoking-related diseases, and (c) explore postscreening behavioral intentions and changes.

Methods: A random sample of 35 participants from 4 ACRIN sites were qualitatively interviewed 1–2 years postscreen. We used a structured interview guide based on Health Belief Model and Self-Regulation Model constructs. Content analyses were conducted with NVivo 8.

Results: Most participants endorsed high-risk perceptions for lung cancer and smoking-related diseases, but heightened concern about these risks did not appear to motivate participants to seek screening. Risk perceptions were mostly attributed to participants' heavy smoking histories; former smokers expressed greatly reduced risk. Lung cancer and smoking-related diseases were perceived as very severe although participants endorsed low worry. Current smokers had low confidence in their ability to quit, and none reported quitting following their initial screen.

Conclusions: Lung screening did not appear to be a behavior change cue to action, and high-risk perceptions did not translate into quitting behaviors. Cognitive and emotional dissonance and avoidance strategies may deter engagement in smoking behavior change. Smoking cessation and prevention interventions during lung screening should explore risk perceptions, emotions, and quit confidence.

INTRODUCTION

Tobacco use accounts for 87% of lung cancer deaths in the United States (American Cancer Society, 2013). In 2010, the National Lung Screening Trial (NLST) reported that screening older current and former smokers, with a minimum history of 30 pack-years, with low-dose computed tomography (LDCT) could reduce lung cancer mortality by 20% compared with chest X-ray (National Lung Screening Trial Research Team et al., 2011). The National Comprehensive Cancer Network (NCCN) and the American Cancer Society (ACS) released lung screening guideline recommendations for individuals who meet the NLST

age and smoking characteristics in 2013. The NCCN explicitly recommends smoking cessation counseling as an integral component of LDCT screening (NCCN, 2012), and the ACS recommends that clinicians initiate discussions about LDCT screening (Wender et al., 2013). With these newly released guidelines and expected widespread use of LDCT, lung screening will likely become a critical opportunity to communicate risks of smoking, as well as promote smoking cessation and relapse prevention. However, prior studies have been inconclusive as to whether lung screening promotes cessation in current smokers or continued abstinence in former smokers (Anderson et al., 2009; Sinicropo et al., 2010; Taylor et al., 2007; Townsend et al., 2005;

doi:10.1093/ntr/ntt133

Advance Access publication September 2, 2013

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van der Aalst, van den Bergh, Willemsen, de Koning, & van Klaveren, 2010; Vierikko et al., 2009).

The effects of lung screening, on risk perceptions and motivation to quit, are largely unknown. In the general population, smokers who perceive greater risks have greater intention to quit (Weinstein, Slovic, & Gibson, 2005), which may lead to quitting smoking (Armor & Taylor, 1998; Romer & Jamieson, 2001; Taylor et al., 2007). Although hypothesized as a potential “cue to action,” few studies have examined the impact of lung cancer screening on risk perceptions underlying smoking behavior change (Byrne, Weissfeld, & Roberts, 2008; Sinicrope et al., 2010). Understanding patients’ smoking-related risk perceptions is important for guiding the development of smoking cessation interventions effectively targeted to the needs of patients undergoing lung cancer screening.

Park et al. (2009) surveyed a subset of 630 NLST participants prior to their initial lung screen and concluded that smokers overestimated their own risk and the population-based risk for lung cancer but attenuated their risk compared with others of similar smoking status. Former smokers were more likely to have lower risk perceptions for lung cancer and other smoking-related diseases compared with current smokers. Moreover, at the initial screen, risk perceptions were associated with current smokers’ intentions to quit smoking and former smokers’ intentions to remain abstinent. However, at 1-year follow-up, risk perceptions for lung cancer and smoking-related diseases had not significantly changed or were not associated with smoking behavior changes (Park et al., 2012).

The objectives of the current study are to qualitatively explore NLST participants’ risk perceptions, specifically to (a) determine whether lung screening is a “cue to action” for smoking behavior change, (b) elucidate risk perceptions and underlying behavior change determinants for lung cancer and smoking-related diseases, and (c) explore postscreening behavioral intentions and changes.

METHODS

Study Design

We conducted a qualitative substudy to explore lung cancer and other smoking-related disease risk perceptions among a subset of participants of the NLST. The NLST is a collaboration between the American College of Radiology Imaging Network (ACRIN) and the National Cancer Institute Lung Screening Study (LSS). NLST methods and the risk perception substudy methods have previously been described (National Lung Screening Trial Research Team et al., 2011; Park et al., 2009). At the time of recruitment into the trial, participants were 55–74 years of age, current or former (quit within the past 15 years) smokers with a history of 30 pack-years or more, and had no history of lung cancer. At each screening appointment, current smokers were offered referrals to smoking cessation programs if desired.

Participant Recruitment and Data Collection

From December 2003 to March 2004, all trial enrollees at eight ACRIN substudy sites were invited to complete the risk perception substudy questionnaire as part of the trial prescreening and 1-year follow-up screen (Park et al., 2009). The current study

sample was randomly selected among four risk perception substudy sites; selection was stratified by gender, smoking status, and baseline screening result. The Brown University Center for Statistical Sciences, the coordinating statistical center for the NLST trial, conducted the random selection of participants. Brown transferred information on selected participants, with gender and smoking status characteristics, to Massachusetts General Hospital (MGH). During the data collection period, MGH investigators and staff were blinded to the initial screen results. Data were collected until it was determined that thematic saturation (the point at which no new data emerge) was reached (Guest, Bunce, & Johnson, 2006). Of the 61 NLST participants randomly selected, 14 refused, 9 had disconnected phones/wrong numbers, 2 were deemed ineligible (1 due to hearing loss and 1 due to weakness associated with chemotherapy treatment), and 1 died. Thus, of the 49 participants contacted and eligible, 35 agreed to be interviewed (71% participation rate; 35/49). Participants were remunerated \$20 for their time.

Based on the geographic dispersion of participants, we conducted in-depth interviews via phone. This data collection format and modality allow for participant privacy while discussing a potentially sensitive topic, which was relevant given the nature of the questions. A structured interview guide was developed to explore risk perceptions and cognitive and emotional determinants of behavior change, based on the Health Belief Model (Rosenstock, 1974), Precaution Adoption Process Model (Weinstein, 1988), and the Self-Regulation Model (Leventhal, Safer, & Panagis, 1983) (Supplementary Appendix 1). Questions included (a) impressions of the lung cancer screening experience; (b) personal and comparative risk and other cognitive determinants of behavior change (e.g., perceived severity, quit confidence); (c) objective risk (e.g., prevalence of lung cancer); (d) emotional determinants of behavior change (e.g., worry about lung cancer and smoking-related diseases); and (e) behavioral change intentions and outcomes.

In accordance with Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines, we describe our research team, study design, data analysis, and findings (Tong, Sainsbury, & Craig, 2007). Study procedures were approved by the Institutional Review boards of the participating ACRIN sites and the MGH/Partners HealthCare.

Data Analyses

Interviews were conducted by a trained research assistant, using a structured interview guide. Interviews were audio taped, transcribed, and reviewed for accuracy. Two members of the research team coded all data independently using NVivo 8. Data were analyzed using content analysis to identify major concepts and axial coding to group and connect data into meaningful categories (Bradley, Curry, & Devers, 2007; Byrne, 2001). At each analysis phase, the coders and the principal investigator compared their results to confirm consistency, resolving discrepancies through discussion and comparison of the raw data. Themes within each content area were identified, and responses were categorized into codes. The coders then refined their definitions and the content of the codes and compared their coding lists. Analyses were conducted by smoking status and initial screening result. MGH investigators and staff were unblinded to screen results once the NLST trial results were published (National Lung Screening Trial Research Team et al., 2011).

RESULTS

Participants

Thirty-five participants completed qualitative telephone interviews. Characteristics of participants at trial enrollment are shown in Table 1. The majority of participants were White (91%), reflective of the NLST participant population. The average age was 61.0 years. About 50% were male, and 50% were current smokers. Twenty-four participants had negative screens, 10 participants had an abnormal finding determined not to be lung cancer (false positives), and 1 participant had a positive lung screen diagnosed as lung cancer. Telephone interviews were conducted 1–2 years following initial screen. Current smokers had smoked an average of 43.6 years. Former smokers had smoked for an average of 46.5 years and had quit an average of 5.9 years ago. Of the current smokers, 76.5% smoked within 30 minutes of waking. Of note, overall, findings did not vary by test result (primarily negative vs. false positive); therefore, findings are presented by smoking status only.

Lung Screening as a Cue for Smoking Behavior Change

Reasons for Seeking Screening

Most participants cited their heavy smoking history as the reason for seeking screening and were self-motivated to get screened. Personal experiences, such as familiarity with lung

cancer and smoking-related diseases in friends or family members, triggered some to seek screening. One smoker explained, “and my sister, had cancer and stuff and she died ... I think she was 51. So, I mean all of this has prompted me ...” Another male former smoker similarly responded, “My two friends died of lung cancer.”

Participants’ conveyed a nonchalant approach to lung screening and seemed to attenuate its potential for uncovering a serious illness or consequence of long-term smoking. As one former smoker explained, “I was a smoker for 35, 40 years, and I thought it would be a good thing to do to see if my lungs were damaged, or what.”

Participants’ Screening Impressions

Overall, screening experiences were not described as stressful. One former smoker said that the screening was “Just routine. Just as simple as donating blood.” When probed how they felt after the screening, most participants reported they felt “fine.” Participants’ lack of emotional impact was also evident when asked what their test result meant to them. A smoker with a negative screen responded, “No feelings really.” Among those who had a positive screening result at one timepoint, half seemed relatively unaffected by the positive screen and half were affected, describing the experience as “severe.” One smoker commented, “Oh, that meant a great deal to me ... so evidently I need to quit smoking cigarettes.”

Table 1. Participant Characteristics at Trial Enrollment

	Total (<i>n</i> = 35)	Current smoker (<i>n</i> = 17)	Former smoker (<i>n</i> = 18)
Age (<i>M</i> , <i>SD</i>)	61.0 (5.3)	59.9 (5.1)	62.1 (5.5)
Gender (<i>N</i> , %)			
Male	18 (51.4)	8 (47.1)	10 (55.6)
Female	17 (48.6)	9 (52.9)	8 (44.4)
Education (<i>N</i> , %) ^a			
<High School	3 (8.6)	2 (11.8)	1 (5.5)
HS	7 (20.0)	7 (41.2)	0 (–)
Post-high school	9 (25.7)	2 (11.8)	7 (38.9)
College and beyond	15 (42.9)	7 (41.2)	8 (44.4)
Race/ethnicity (<i>N</i> , %)			
White/non-Hispanic	32 (91.4)	15 (88.2)	17 (94.4)
Black/African American	2 (5.7)	2 (11.8)	0
Hispanic or Latino	1 (2.9)	0 (–)	1 (5.5)
Test result (<i>N</i> , %)			
Negative	24 (68.6)	11 (64.7)	13 (72.2)
False positive	10 (28.6)	6 (35.3)	4 (22.2)
True positive	1 (2.9)	0 (–)	1 (5.5)
Smoking history			
Smoked within 30 min of waking, <i>N</i> (%)	24 (68.6)	13 (76.5)	11 (61.1)
Quit attempt in the past year, <i>N</i> (%)		6 (35.3)	0 (–)
Highest number of cigarettes/day, <i>M</i> (<i>SD</i>)	28.91 (11.0)	29.0 (11.1)	28.8 (11.3)
Number of years smoked, <i>M</i> (<i>SD</i>)	44.97 (6.3)	43.6 (6.5)	46.47 (6.0)
Number of years quit, <i>M</i> (<i>SD</i>)		–	5.88 (4.9)
Medical history			
Has family history of lung cancer, <i>N</i> (%)	6 (17.1)	4 (23.5)	2 (11.1)
Has personal history of cancer, <i>N</i> (%)	3 (8.6)	1 (5.9)	2 (11.1)
Has personal history of smoking-related disease, <i>N</i> (%)	11 (31.4)	6 (35.3)	5 (27.8)

Note. ^aOne participant did not fill out their level of education.

Risk Perceptions

Personal Risk

Personal risk perceptions for lung cancer covered a spectrum of responses but primarily conveyed expressions of high risk. Current smokers expressed higher perceived personal lung cancer risk than former smokers; half of current smokers expressed that it was “highly likely” they would get lung cancer. Some smokers expressed a sense of inevitability, as one smoker mentioned, “If I don’t die of something else. I probably will from lung cancer ... if I keep smoking or if I quit.” Conversely, most former smokers were optimistic about the protective health benefits of their quit, reporting their risk for lung cancer as “low” or “unlikely.” Many former smokers displayed deterministic thinking and believed that if they had not already contracted lung cancer, they were in the clear. A former smoker replied, “I think I would have developed something by now.” or “I’d probably have [lung cancer] by now.”

In addition to varied perspectives on their level of risk, there were also notable differences in the quality of current versus former smokers’ responses about their personal risk of lung cancer. Current smokers’ responses were uncertain and vague. One current smoker, when asked how likely it would be to develop lung cancer if he continued smoking at his current level, replied, “I don’t know ... I have no idea.” Another current smoker responded, “Personally, I don’t think I’ll ever get cancer. Why, I don’t know.” In contrast, former smokers were likely to give a definitive response, percentage, or a justification for their response.

Comparative Risk

Compared to those with similar smoking history (“other current/former smokers—those who (had) smoke(d) about the same as you”), most current smokers described equal or higher risk of developing lung cancer and smoking-related diseases. In contrast, former smokers reported lower comparative risk for lung cancer and smoking-related diseases, which was often explicitly attributed to their quit status. Others identified their family history of lung cancer as a justification for their comparative risk responses. One former smoker explained, “I think I’ve really lowered my odds of having lung cancer, compared to someone who is smoking or has smoked as long as I did and still smoking. I think my odds are a lot better than them.” Another former smoker said, “I would feel it shouldn’t be a risk now because I have stopped [smoking]. Almost 4 years now.”

Objective Risk

Most participants overestimated the prevalence of lung cancer. This overestimation did not differ by smoking status but rather seemed influenced by personal experience, which appeared to make lung cancer more salient or tangible. One participant said, “Two of my friends died from it, and I’ve seen a lot of it. To me, it’s rather common. Maybe some other people don’t run across it at all, and they don’t think it’s common.” Another participant acknowledged, “... Just going by the people I know and the people I hang around with I know more people who have had lung cancer than I know who are diagnosed with MS or have AIDS.”

Emphysema and heart disease were the most frequently cited other smoking-related diseases. Notably, many participants seemed uncertain about their risk estimates, and some expressed the notion that smoking is bad for the body in general, without specifying particular areas that are impacted. When asked what other diseases are commonly associated with

smoking, a former smoker replied, “I have a funny feeling that it affects the organs in the body.” A smoker responded similarly, “It’s—I don’t know how to say it ... it affects all areas of the body, I don’t know where.”

Perceived Severity

Almost all participants thought that lung cancer was very severe. One smoker stated lung cancer is essentially a “death sentence,” if it is not discovered early on. Although most participants believed smoking-related diseases were “very severe,” many expressed skepticism regarding how much smoking actually mattered. Surprisingly, there was a great deal of uncertainty about how much smoking was a risk factor for lung cancer or other smoking-related diseases. Participants, particularly current smokers, talked about other factors that could cause lung cancer. For example, one smoker responded skeptically about the risk of smoking-related diseases, “I think it’s very serious, but I think that, smoking is definitely a contributing factor but I think that there’s a lot of other factors that come into play. You know, with the preservatives that they use, things like that... and I think that second hand smoke is an exaggeration.”

Worry

Overall, participants reported low levels of worry about lung cancer and other smoking-related diseases. The most frequently cited smoking-related worry was getting cancer, specifically lung cancer. Several people acknowledged that their heavy smoking history gave them cause to worry about developing lung cancer or smoking-related diseases, whereas others provided justifications for their lack of worry about health problems related to smoking. One smoker said, “I try not to worry. I try to keep that thing [lung cancer] out of my mind. The more you worry about it, the more detrimental it is to you.” The majority of participants described their worry intensity as “low” and frequency of worry as “not often.”

Current smokers qualified their low worry frequency with comments like, “not enough to quit.” Similarly, most participants reported “not often” worrying about smoking-related diseases. There appeared a disconnect between worry and risk perceptions, as illustrated by this interview in which a smoker alludes to smoking-attributable risk of cancer yet diminishes the worry experience:

Q: Which health problem associated with smoking do you worry most about?

A: Cancer.

Q: Why do you worry about it?

A: I’m a smoker.

Q: How likely do you think it is to develop lung cancer if you continue smoking at your current level?

A: I think I’m a pretty healthy guy so not likely.

Q: Compared to other smokers, those who smoke about the same as you, what do you think your risk of developing lung cancer is?

A: Not so likely.

Q: What are your worries about all of this?

A: I have no worries right now. I don’t really have time to worry.

Q: How often do you think you worry about getting lung cancer?

A: I don't think about it.

Q: How often do you worry about other smoking related diseases?

A: Not a lot.

Confidence to Quit Smoking/Remain Quit

Most former smokers were highly confident in their ability to stay quit. In contrast, the majority of current smokers endorsed "low" confidence in being able to quit smoking. A smoker responded, "I've tried many things believe me." Notably, a couple of current smokers avoided answering this question. Furthermore, if current smokers expressed confidence in their ability to quit, they were admittedly less confident in their ability to sustain or maintain a quit. One smoker responded, "I'm confident I can quit. The question is staying, you know, continuing. I'm pretty confident I can quit, it's just, you know, sticking to it."

Behavioral Intentions and Changes

No one reported having quit as a result of undergoing the screening process, but many had tried to alter their smoking behaviors, essentially engaging in harm reduction such as reducing their daily cigarette consumption. Some engaged in "quit talk," talking about quitting in the future, whereas others mentioned plans to quit in the future. One-third attempted to cut down or quit smoking. Many mentioned past quit attempts and the desire to quit yet cited older age, nicotine addiction, and stressors as barriers to quitting. Interestingly, many participants made a behavior change outside of the smoking realm, such as improving nutrition or engaging in physical activity.

DISCUSSION

To enhance our understanding of how the experience of lung screening affects risk perceptions and smoking behaviors, we conducted in-depth interviews with 35 NLST participants. The first objective explored, in accordance with the Health Belief Model, whether lung screening was a "cue to action." The rationale for seeking screening and screening experiences lacked the sense of urgency that would be expected from a cue or incident that would trigger a quit attempt (Parry, Fowkes, & Thomson, 2001). Indeed, most participants, despite high-risk perceptions for lung cancer and smoking-related diseases, denied concern about risk as a motivator for seeking screening. Participants saw screening as an opportunity to check-in, and screening experiences were not described as particularly stressful. Even participants who had received a positive screen did not seem particularly affected. This finding is discordant with the effects of false-positive mammography results, which have been found to be related to higher levels of anxiety, distress, and anxious mood (Barton et al., 2004; Brewer, Salz, & Lillie, 2007; Brodersen & Siersma, 2013; McGovern et al., 2004). This finding may be explained by NLST participants being informed about the possibility of a false-positive finding, during the screening consent (National Lung Screening Trial Research Team et al., 2011). It is also possible that participants' responses might have reflected greater levels of distress, had they been interviewed closer to the time of the positive screen result.

The second objective was to elucidate risk perceptions and underlying behavior change determinants for lung cancer and

smoking-related diseases. The Health Belief Model emphasizes cognitions as the mechanism for evaluation of health behaviors and facilitation of change. It proposes that in order to activate change, individuals must believe that they are at risk for the disease, feel confident that they can engage in protective behaviors, believe that the disease is serious, and believe that there are protective benefits to enacting change.

Our qualitative findings confirmed that similar to NLST survey findings (Park et al., 2009, 2012) and other recent lung screening studies (Patel et al., 2012; Schnoll et al., 2002), smokers expressed relatively high-risk perceptions. This finding suggests that smokers who undergo lung screening differ from smokers in the general population who underestimate their risks of lung cancer and smoking-related diseases (Ayanian & Cleary, 1999; Weinstein et al., 2005). In our study, smokers' high-risk responses were explicitly attributed to their heavy smoking history and were influenced by personal experiences and family history of lung cancer. However, the quality of current smokers' risk responses belied their expressed risk responses; their responses were vague in their descriptions and reasoning behind their high-risk perceptions, suggesting that they may actively avoid thinking about the dangers of smoking. These smokers likely use avoidance as a strategy to reduce cognitive dissonance, which is a dilemma that occurs when an individual's attitudes and behaviors conflict (Festinger, 1957; Kneer, Glock, & Rieger, 2012).

Consistent with our survey findings, former smokers expressed lower risk perceptions compared with current smokers. Despite their heavy smoking histories, they perceived having greatly lessened their risks by quitting smoking. The Precaution Adoption Process Model (Weinstein, 1988; Weinstein, Rothman, & Sutton, 1998) posits that individuals move through stages of awareness, and then salience, of a health threat, which will influence whether they take action against the threat. Among smokers, low-risk perceptions and presence of optimistic bias may be contraindications to quitting (Armor & Taylor, 1998; Dillard, McCaul and Klein, 2006; Weinstein et al., 2005). It is possible that optimistic bias makes former smokers vulnerable for relapse, although prior observational lung screening research has somewhat mitigated this concern (Anderson et al., 2009).

In exploring confidence levels, current smokers expressed low confidence in being able to quit. This low confidence was likely an important barrier to postscreening quitting. Alternatively, former smokers expressed high confidence to stay quit. Overconfidence in one's ability to remain quit has been associated with relapse among former smokers (Borland & Balmford, 2005; Segan, Borland, Hannan, & Stillman, 2008) and may represent a factor making former smokers vulnerable to relapse.

Although participants perceived lung cancer and smoking-related diseases as severe, they were not particularly worried. This is consistent with a review by Hay, Buckley, and Ostroff (2005), which concluded that cancer worry was low, even among high-risk individuals. Previous breast and colorectal cancer screening studies reported that high worry was a barrier to screening (Lerman & Schwartz, 1993; McQueen, Vernon, Meissner, & Rakowski, 2008; Miles & Wardle, 2006). The Self-Regulation Model (Leventhal, Safer, & Panagis, 1983) describes how an individual cognitively processes a perceived health threat and then manages the consequent emotions pertaining to the threat. When deciding whether to take preventative health behavior actions, an individual undergoes a repeated process of cognitive and emotional coping; low

worry, therefore, may be a signal that action will not be taken. Conversely, low worry may facilitate lung screening, but on the other hand, low worry may be a deterrent to quitting smoking.

Although most participants believed that lung cancer and smoking-related diseases were severe, skepticism, particularly among smokers, was heard regarding how much smoking actually contributed to lung cancer and other smoking-related diseases. This disconnect in causal associations with smoking may be attributable to disengagement beliefs (Bandura, 1986; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996) in which smokers distort threatening health information to reduce cognitive dissonance. This finding is similar to prior qualitative work eliciting smokers' perceptions about smoking and disease (Padmawati, Ng, Prabandari, & Nichter, 2009). In addition, the qualitative findings conveyed uncertainty about the other health risks of smoking, which is consistent with literature demonstrating smokers' low knowledge about smoking-related diseases (Weinstein, Slovic, Waters, & Gibson, 2004).

Our third objective was to explore postscreening behavioral intentions and changes. Despite high-risk perceptions, no smokers quit as a result of the screening. However, although no smokers quit smoking, the influence of screening could be interpreted through participants' engagement in harm-reduction behaviors. Harm reduction was illustrated by participants' reducing their daily smoking, which may be perceived as a safer way to smoke among smokers undergoing cessation interventions (Ng et al., 2010; Nichter, 2003). This harm-reduction behavior was also reported in a recent study conducted at the Mayo Clinic that found that smokers decreased their daily smoking rate by approximately five cigarettes in the year following lung screening (Shi & Iguchi, 2011).

Many mentioned engaging in other health behavior changes, such as increased physical activity and healthier eating. It is possible that participants engaged in these as "compensatory" behaviors as another way to reduce cognitive dissonance. Compensatory behaviors are motivated by beliefs that the negative effects of an unhealthy behavior can be compensated by engaging in a healthy behavior. Previous research by Weinstein and colleagues (2004) has demonstrated that smokers agree with myths that minimize dangers of smoking, such as "exercise undoes most smoking effects."

There are several limitations to the study to be noted. This study was conducted among a small, albeit randomly selected, sample of NLST participants, which limited our ability to meaningfully explore some factors, in particular initial screening result and follow-up screening results. Our findings concerning risk perceptions of individuals undergoing lung screening may not be reflective of the population at large. In particular, when patients are referred for lung screening in clinical practice due to an incidental nodule or suspicious finding, salient distress may result and may thus serve as a "cue to action. Lastly, it was not feasible to explore repeated risk perceptions more closely to the initial and follow-up screens.

SUMMARY AND CLINICAL IMPLICATIONS

In a recent review of LDCT screening risks and benefits revealed from the NLST, Aberle, Abtin, and Brown (2013) concluded that lung screening becomes substantially more

effective when combined with smoking cessation programs. Lung screening presents a critical opportunity and challenge for risk communication and cessation interventions. Despite high quit motivations of lung screening participants (Ashraf et al., 2009; Ostroff, Buckshee, Mancuso, Yankelevitz, & Henschke, 2001; Park et al., 2009; Taylor et al., 2007), at 1-year follow-up, NLST participants did not quit at higher rates than the general population (Park et al., 2012).

The current study indicates that low rates of postscreen quitting may be explained by our findings that lung screening did not appear to be a "cue" to action; smokers' risk beliefs were not well formed; disease severity was high but somewhat disconnected to smoking; worry was low, and confidence to quit was low. Former smokers' optimistic beliefs and high confidence could make them vulnerable to relapse, and thus, former smokers should be educated about their objective risks and encouraged to maintain abstinence for risk reduction benefits.

Our qualitative findings indicate that smoking cessation and relapse prevention interventions, delivered at lung screening, should explore risk perceptions, quit confidence, and other emotional factors associated with health-promoting behaviors. Cognitive and behavioral strategies to reduce dissonance, such as avoidance, disengagement beliefs, and compensatory behaviors, should be identified and addressed. As cognitive biases may deter engagement in smoking cessation and abstinence maintenance, the health benefits to quitting smoking, at any age, should be reinforced. Our findings suggest that a behavior change intervention strategy, such as Motivational Interviewing (MI), which is directive yet patient centered, could be an effective approach for a risk communication intervention. MI, delivered at the time of screening, could provide a framework to individualize risk tailoring. MI focuses on enhancing confidence, uncovering discrepancies, and resolving ambivalence, which our findings indicate should be targets of a smoking cessation and relapse prevention counseling intervention for these lung screening participants.

SUPPLEMENTARY MATERIAL

Supplementary Appendix 1 can be found online at <http://www.ntr.oxfordjournals.org>

FUNDING

This work was supported by a grant from the American Cancer Society's Mentored Research Scholar Award (MRS-005-05-CPPB), the American College of Radiology Imaging Network/National Lung Screening Trial (U01 CA079778, U01 CA080098).

DECLARATION OF INTERESTS

NAR discloses work as an unpaid consultant for Pfizer and Alere Wellbeing Inc. She has previously received funding from Nabi biopharmaceuticals and royalties from UpToDate.

These data were presented, as an oral presentation, at the 2013 Society for Research on Nicotine and Tobacco annual meeting.

REFERENCES

- Aberle, D. R., Abtin, F., & Brown, K. (2013). Computed tomography screening for lung cancer: Has it finally arrived? Implications of the national lung screening trial. *Journal of Clinical Oncology*, 31, 1002–1008. doi:10.1200/JCO.2012.43.3110
- American Cancer Society. (2013). *Cancer fast facts and figures 2013*. Atlanta, GA: American Cancer Society.
- Anderson, C. M., Yip, R., Henschke, C. I., Yankelevitz, D. F., Ostroff, J. S., & Burns, D. M. (2009). Smoking cessation and relapse during a lung cancer screening program. *Cancer Epidemiology, Biomarkers & Prevention*, 18, 3476–3483. doi:10.1158/1055-9965.EPI-09-0176
- Armor, D. A., & Taylor, S. E. (1998). Situated optimism: Specific outcome expectancies and self-regulation. *Advances in experimental social psychology* (Vol. 30, pp. 309–378). New York: Academic Press.
- Ashraf, H., Tønnesen, P., Holst Pedersen, J., Dirksen, A., Thorsen, H., & Døssing, M. (2009). Effect of CT screening on smoking habits at 1-year follow-up in the Danish Lung Cancer Screening Trial (DLCST). *Thorax*, 64, 388–392. doi:10.1136/thx.2008.102475
- Ayanian, J. Z., & Cleary, P. D. (1999). Perceived risks of heart disease and cancer among cigarette smokers. *Journal of the American Medical Association*, 281, 1019–1021. doi:10.1001/jama.281.11.1019
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (1996). Mechanisms of moral disengagement in the exercise of moral agency. *Journal of Personality and Social Psychology*, 71, 364–374. doi:10.1037/0022-3514.71.2.364
- Barton, M. B., Morley, D. S., Moore, S., Allen, J. D., Kleinman, K. P., Emmons, K. M., & Fletcher, S. W. (2004). Decreasing women's anxieties after abnormal mammograms: A controlled trial. *Journal of the National Cancer Institute*, 96, 529–538. doi:10.1093/jnci/djh083
- Borland, R., & Balmford, J. (2005). Perspectives on relapse prevention: An exploratory study. *Psychology & Health*, 20, 661–671. doi:10.1186/1472-6963-12-50
- Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: Developing taxonomy, themes, and theory. *Health Services Research*, 42, 1758–1772. doi:10.1111/j.1475-6773.2006.00684.x
- Brewer, N. T., Salz, T., & Lillie, S. E. (2007). Systematic review: The long-term effects of false-positive mammograms. *Annals of Internal Medicine*, 146, 502–510. doi:10.7326/0003-4819-146-7-200704030-00006
- Brodersen, J., & Siersma, V. D. (2013). Long-term psychosocial consequences of false-positive screening mammography. *Annals of Family Medicine*, 11, 106–115. doi:10.1370/afm.1466
- Byrne, M. (2001). Sampling for qualitative research. *Association of Perioperative Registered Nurses Journal*, 73, 494–498. doi:10.1016/S0001-2092(06)61990-X
- Byrne, M. M., Weissfeld, J., & Roberts, M. S. (2008). Anxiety, fear of cancer, and perceived risk of cancer following lung cancer screening. *Medical Decision Making*, 28, 917–925. doi:10.1177/0272989X08322013
- Dillard, A. J., McCaul, K. D., & Klein, W. M. (2006). Unrealistic optimism in smokers: Implications for smoking myth endorsement and self-protective motivation. *Journal of Health Communication*, 11(Suppl. 1), 93–102. doi:10.1080/10810730600637343
- Festinger, L. (1957). *A theory of cognitive dissonance*. Evanstone, IL: Row, Peterson.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, 18, 59–82. doi:10.1177/1525822X05279903
- Hay, J. L., Buckley, T. R., & Ostroff, J. S. (2005). The role of cancer worry in cancer screening: A theoretical and empirical review of the literature. *Psycho-oncology*, 14, 517–534. doi:10.1002/pon.864
- Kneer, J., Glock, S., & Rieger, D. (2012). Fast and not furious? reduction of cognitive dissonance in smokers. *Social Psychology*, 43, 81–91. doi:10.1027/1864-9335/a000086
- Lerman, C., & Schwartz, M. (1993). Adherence and psychological adjustment among women at high risk for breast cancer. *Breast Cancer Research and Treatment*, 28, 145–155. doi:10.1007/BF00666427
- Leventhal, H., Safer, M. A., & Panagis, D. M. (1983). The impact of communications on the self-regulation of health beliefs, decisions, and behavior. *Health Education Quarterly*, 10, 3–29.
- McGovern, P. M., Gross, C. R., Krueger, R. A., Engelhard, D. A., Cordes, J. E., & Church, T. R. (2004). False-positive cancer screens and health-related quality of life. *Cancer Nursing*, 27, 347–352. doi:10.1097/00002820-200409000-00003
- McQueen, A., Vernon, S. W., Meissner, H. I., & Rakowski, W. (2008). Risk perceptions and worry about cancer: Does gender make a difference? *Journal of Health Communication*, 13, 56–79. doi:10.1080/10810730701807076
- Miles, A., & Wardle, J. (2006). Adverse psychological outcomes in colorectal cancer screening: Does health anxiety play a role? *Behaviour Research and Therapy*, 44, 1117–1127. doi:10.1016/j.brat.2005.08.011
- National Comprehensive Cancer Network (NCCN). (2012). NCCN clinical practice guidelines in oncology: Lung cancer screening (Version 1.2012). Retrieved from <http://www.nccn.org>
- National Lung Screening Trial Research Team, Aberle, D. R., Adams, A. M., Berg, C. D., Black, W. C., Clapp, J. D., ... Sicks, J. D. (2011). Reduced lung-cancer mortality with low-dose computed tomographic screening. *The New England Journal of Medicine*, 365, 395–409. doi:10.1056/NEJMoa1102873
- Ng, N., Nichter, M., Padmawati, R. S., Prabandari, Y. S., Muramoto, M., & Nichter, M. (2010). Bringing smoking cessation to diabetes clinics in Indonesia. *Chronic Illness*, 6, 125–135. doi:10.1177/1742395310364253
- Nichter, M. (2003). Lessons from anthropological research on risk, responsibility and harm reduction. In B. H. Harthorn & L. Oaks (Eds.). *Risk, culture, and health inequality: Shifting perceptions of danger and blame*. Westport, CT: Greenwood Press.
- Ostroff, J. S., Buckshee, N., Mancuso, C. A., Yankelevitz, D. F., & Henschke, C. I. (2001). Smoking cessation following CT screening for early detection of lung cancer. *Preventive Medicine*, 33, 613–621. doi:10.1006/pmed.2001.0935
- Padmawati, R. S., Ng, N., Prabandari, Y. S., & Nichter, M. (2009). Smoking among diabetes patients in Yogyakarta, Indonesia: Cessation efforts are urgently needed. *Tropical Medicine & International Health: TM & IH*, 14, 412–419. doi:10.1111/j.1365-3156.2009.02241.x
- Park, E. R., Gareen, I. F., Jain, A., Ostroff, J. S., Duan, F., Sicks, J. D., ... Rigotti, N. A. (2012). Examining whether lung screening changes risk perceptions: National Lung Screening Trial participants at 1-year follow-up. *Cancer*, 1306–1313. doi:10.1002/cncr.27925
- Park, E. R., Ostroff, J. S., Rakowski, W., Gareen, I. F., Diefenbach, M. A., Feibelman, S., & Rigotti, N. A. (2009). Risk perceptions among participants undergoing lung cancer screening: Baseline results from the National Lung

- Screening Trial. *Annals of Behavioral Medicine*, 37, 268–279. doi:10.1007/s12160-009-9112-9
- Parry, O., Fowkes, F. G., & Thomson, C. (2001). Accounts of quitting among older ex-smokers with smoking-related disease. *Journal of Health Psychology*, 6, 481–493. doi:10.1177/135910530100600502
- Patel, D., Akporobaro, A., Chinyanganya, N., Hackshaw, A., Seale, C., Spiro, S. G., . . . Lung-SEARCH Investigators. (2012). Attitudes to participation in a lung cancer screening trial: A qualitative study. *Thorax*, 67, 418–425. doi:10.1136/thoraxjnl-2011-200055
- Romer, D., & Jamieson, P. (2001). The role of perceived risk in starting and stopping smoking. In P. Slovic (Ed.), *Smoking: Risk, perception & policy* (pp. 64–80). Thousand Oaks, CA: Sage Publications.
- Rosenstock, I. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2, 328–335.
- Schnoll, R. A., Miller, S. M., Unger, M., McAleer, C., Halbherr, T., & Bradley, P. (2002). Characteristics of female smokers attending a lung cancer screening program: A pilot study with implications for program development. *Lung Cancer*, 37, 257–265. doi:10.1016/S0169-5002(02)00106-X
- Segan, C. J., Borland, R., Hannan, A., & Stillman, S. (2008). The challenge of embracing a smoke-free lifestyle: A neglected area in smoking cessation programs. *Health Education Research*, 23, 1–9. doi:10.1093/her/cyl157
- Shi, L., & Iguchi, M. Y. (2011). “Risk homeostasis” or “teachable moment”? the interaction between smoking behavior and lung cancer screening in the Mayo Lung Project. *Tobacco Induced Diseases*, 9, 2. doi:10.1186/1617-9625-9-2
- Sinicroppe, P. S., Rabe, K. G., Brockman, T. A., Patten, C. A., Petersen, W. O., Slusser, J., . . . Petersen, G. M. (2010). Perceptions of lung cancer risk and beliefs in screening accuracy of spiral computed tomography among high-risk lung cancer family members. *Academic Radiology*, 17, 1012–1025. doi:10.1016/j.acra.2010.04.003
- Taylor, K. L., Cox, L. S., Zincke, N., Mehta, L., McGuire, C., & Gelmann, E. (2007). Lung cancer screening as a teachable moment for smoking cessation. *Lung Cancer*, 56, 125–134. doi:10.1016/j.lungcan.2006.11.015
- Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19, 349–357. doi:10.1093/intqhc/mzm042
- Townsend, C. O., Clark, M. M., Jett, J. R., Patten, C. A., Schroeder, D. R., Nirelli, L. M., . . . Hurt, R. D. (2005). Relation between smoking cessation and receiving results from three annual spiral chest computed tomography scans for lung carcinoma screening. *Cancer*, 103, 2154–2162. doi:10.1002/cncr.21045
- van der Aalst, C. M., van den Bergh, K. A., Willemsen, M. C., de Koning, H. J., & van Klaveren, R. J. (2010). Lung cancer screening and smoking abstinence: 2 year follow-up data from the Dutch-Belgian randomised controlled lung cancer screening trial. *Thorax*, 65, 600–605. doi:10.1136/thx.2009.133751
- Vierikko, T., Kivistö, S., Järvenpää, R., Uitti, J., Oksa, P., Virtama, P., & Vehmas, T. (2009). Psychological impact of computed tomography screening for lung cancer and occupational pulmonary disease among asbestos-exposed workers. *European Journal of Cancer Prevention*, 18, 203–206. doi:10.1097/CEJ.0b013e328329d800
- Weinstein, N. D., Marcus, S. E., & Moser, R. P. (2005). Smokers’ unrealistic optimism about their risk. *Tobacco Control*, 14, 55–59. doi:10.1136/tc.2004.008375
- Weinstein, N., Slovic, P., Waters, E., & Gibson, G. (2004). Public understanding of the illnesses caused by cigarette smoking. *Nicotine & Tobacco Research*, 6, 349–355. doi:10.1080/14622200410001676459
- Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*, 7, 355–386. doi:10.1037//0278-6133.7.4.355
- Weinstein, N. D., Rothman, A. J., & Sutton, S. R. (1998). Stage theories of health behavior: Conceptual and methodological issues. *Health Psychology*, 17, 290–299. doi:10.1037//0278-6133.17.3.290
- Weinstein, N. D., Slovic, P., & Gibson, G. (2005). Accuracy and optimism in smokers’ beliefs about quitting. *Nicotine & Tobacco Research*, 6, S375–S380. doi:10.1080/14622200412331320789
- Wender, R., Fontham, E. T., Barrera, E., Jr., Colditz, G. A., Church, T. R., Ettinger, D. S., . . . Smith, R. A. (2013). American Cancer Society lung cancer screening guidelines. *CA A Cancer Journal for Clinicians*, 63, 107–117. doi:10.3322/caac.21172