Understanding the Associations between Smoking-Related Risk Perception, Interest in Quitting Smoking, and Interest in Lung Cancer Screening among Homeless Adult Smokers

Pooja Agrawal 1, Matthew Taing 2,3, Tzu-An Chen 2,3, Sean M. Reuven 2,3, Michael S. Businelle 4, Darla E. Kendzor 4, Eric H. Bernicker 5 and Lorraine R. Reitzel 2,3,*

1 School of Medicine, University of Texas Medical Branch at Galveston, Galveston, TX 77555, USA; poagrawa@utmb.edu
2 Department of Psychological Health and Learning Sciences, University of Houston, 3657 Cullen Blvd Stephen Power Farish Hall, Houston, TX 77024, USA; mtaing@central.uh.edu (M.T.); tchen3@central.uh.edu (T.-A.C.); seanreuen99@gmail.com (S.M.R.)
3 HEALTH Research Institute, University of Houston, 4849 Calhoun Rd., Houston, TX 77024, USA
4 Health Promotion Research Center, The University of Oklahoma Health Sciences Center, 655 Research Parkway, Suite 400, Oklahoma City, OK 73104, USA; michael-businelle@ouhsc.edu (M.S.B.);
darla-kendzor@ouhsc.edu (D.E.K.)
5 Houston Methodist Cancer Center, Houston, TX 77030, USA; bernicker@houstonmethodist.org
* Correspondence: lrreitzel@uh.edu; Tel.: +1-713-743-6679

Received: 26 October 2020; Accepted: 25 November 2020; Published: 27 November 2020

Abstract: Individuals experiencing homelessness smoke cigarettes at high rates, suffer a disproportionate incidence of lung cancer, but are unlikely to be screened to enhance early detection. Understanding correlates of lung cancer screening (LCS) interest within this vulnerable group may lend insight into prevention and treatment efforts and reduce their smoking-related morbidity and mortality. This study sought to understand how risk perception and interest in quitting smoking relate to LCS interest among homeless adults. Participants comprised a convenience sample of CO-verified current smokers (N = 310; 72.6% men, M age = 43 + 11.7) from a homeless shelter in Dallas, TX. Participants self-reported risk perception, interest in quitting smoking, and interest in LCS. The average risk perception was 6.7 + 3.2 (range 0–10), 74.8% (n = 232) agreed or strongly agreed with interest in LCS, and 65.8% (n = 204) were interested in quitting smoking. Greater interest in quitting smoking, but not greater risk perception, was associated with greater interest in LCS (adjusted OR: 1.968, (95% CI: 1.213, 3.191), p = 0.006). Risk perception and interest in quitting smoking did not interact in their association with interest in LCS. Results suggest that homeless smokers with an interest in quitting may be receptive to LCS: a diagnostic tool by which cancers can be caught at earlier stages and prior to metastasis. However, few in the current sample would be eligible for LCS based on current guidelines; results have implications for altered screening practices among chronic smokers experiencing homelessness.

Keywords: lung cancer; homeless; smoking; lung cancer screening

1. Introduction

Over 500,000 individuals experience homelessness in the United States (US) on a given night [1]. Despite having largely limited financial means [2,3], homeless adults have high rates of cigarette use, which contributes to poor health outcomes among this population [4]. Previous research has found smoking prevalence estimates for homeless individuals to be between 70–80%, a rate that is...
at least five times higher than in domiciled adults [4,5]. Cigarette smoking is the primary risk factor for developing lung cancer, the second most commonly diagnosed cancer among adults in the US [6], and it has significant impacts on cell cycle progression and pulmonary function [7,8]. Based on their high smoking rates, it is not surprising that one of the more comprehensive studies on morbidity and mortality among individuals who were homeless found that lung cancer caused more than one third of their deaths [9].

Given the direct causal link between smoking and the development of lung cancer, beginning in 2013, the United States Preventive Services Task Force (USPSTF) recommended annual low-dose computed tomography (LDCT) lung cancer screening (LCS) for adults who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years [10]. Although LDCT has been demonstrated to reduce lung cancer mortalities by 20%, less than 15% of eligible adults are actually screened for lung cancer annually [11,12]. Given known barriers to accessing cancer screenings and care amongst individuals experiencing homelessness, it is likely that these individuals—despite being at elevated risk for lung cancers—are not well represented among those receiving LCS [13,14]. Illustrative of this point are studies that have found high levels of advanced stage disease (78%) and metastases (68%) at diagnosis among homeless men with lung cancers [14]. Moreover, relative to domiciled adults with non-small cell lung cancer (NSCLC), adults experiencing homelessness with NSCLC had a longer span of time between abnormality identification and biopsy (248 days vs. 116 days) and a shorter survival time (0.58 years vs. 1.30 years), potentially due to disparities in receipt of timely care due to a significantly greater proportion of missed medical appointments post-diagnosis (26% of appointments missed vs. 16% of appointments missed) [15]. Consequently, better engagement of homeless individuals in early lung cancer detection efforts may be needed to improve their morbidity and mortality outcomes [14].

Little is known about correlates of interest in LCS among homeless smokers. Previous research conducted among domiciled adults has found that greater smoking-related risk perception is linked with greater interest in LCS [16–20]. Moreover, interest in quitting smoking has also been linked with interest in LCS among housed adults [16,17]. However, the literature is mixed, with at least one study finding null relations between LCS interest and perceived worry/risk and chance of quitting smoking [21]. Among homeless smokers, it may be that smoking-related risk perception and interest in quitting smoking each directly relate to LCS interest, or they may interact with one another to predict interest in LCS. This information might be helpful for understanding how to enhance motivation for LCS among homeless smokers, by enhancing risk perception about smoking-related diseases and/or interest in quitting smoking. Moreover, research with domiciled adults suggests that LCS may serve as a teachable moment for smoking cessation and has been linked to higher motivation to stop smoking [22–24]. Thus, better understanding the correlates of LCS interest among homeless smokers may help to enhance both prevention and screening efforts in this group. Consequently, the purpose of the current study was to explore links between smoking-related risk perception, interest in quitting smoking, and interest in LCS among a sample of homeless adult smokers.

2. Materials and Methods

2.1. Participants and Procedures

Study procedures were approved by the Institutional Review Board (IRB) at the University of Texas Health Science Center at Houston (HSC-SPH-13-0277), approval date 5/22/13, and the University of Houston (13577-EX), approval date 8/30/13. Participants (N = 394) in the parent study comprised a convenience sample of homeless adults who were recruited from a large shelter in Dallas, TX, USA in 2013. This shelter was selected as a recruitment site based on its service to 85% of individuals experiencing homelessness in Dallas and due to a long-standing collaboration with the co-authors of this study [25,26]. Participants were recruited through two waves of data collection for a study that was primarily designed to assess the impact of a partial smoking ban at the shelter but that
also assessed health and health behaviors [27]. The partial smoking ban entailed making half of the courtyard within the confines of the shelter’s grounds a smoke-free zone. Data were collected prior to the partial ban (wave 1; June 2013) and following the partial ban (wave 2; August 2013). Recruitment was accomplished via flyer advertisement. Inclusion criteria were: aged 18 or over, English-speaking and literate at the 7th grade level or more as indicated by a score of >4 on the Rapid Estimate of Adult Literacy in Medicine—Short Form [28], and having spent at least the prior night at the shelter. Screening, written informed consent, and data collection were conducted on site. Participants received a USD 20 gift card as remuneration for their participation in either or each wave of data collection completed.

2.2. Measures

2.2.1. Participant Characteristics

Participant sociodemographic variables included age, sex, race (white versus minority race), education (in years; also quantified as GED/high school diploma or less versus some college/technical school or more), last month’s income (USD 0, 1–500, >500), employment status (at least part-time employed versus unemployed), health insurance status (any type versus none), and lifetime homelessness (in months).

Participant smoking-related variables included smoking rate (“How many cigarettes a day do you smoke on average?”), number of years smoked over the lifetime, and how soon after waking is the first cigarette smoked (within 5 min, 5–30 min, 31–60 min, or >60 min).

2.2.2. Smoking-Related Risk Perception

Smoking-related risk perception was measured with the question: “What are the chances of developing at least one smoking related disease if you do not quit smoking?”. This item was measured from 0%, which had the anchor “I definitely will not develop” to 100%, which had the anchor “I definitely will develop”. The option of 50% had the anchor of “I have a 50/50 chance”. Participants could select any number between 0% and 100% in increments of 10, and their responses were coded from 0–10 in the database.

2.2.3. Interest in Quitting Smoking

Interest in quitting smoking was assessed using a single item reading: “I would like to stop smoking”. Answer options were 0 = no or 1 = yes.

2.2.4. Interest in Lung Cancer Screening

Interest in LCS was an investigator generated single item reading: “I would be interested in taking a test that can screen for lung cancer”. Answer options were scored 1 to 5, where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The first two categories were collapsed into a single “disagree” category due to low frequencies of these two responses (n = 26 and n = 20, respectively).

2.3. Statistical Analysis

The current analyses are limited to the current smokers in the sample (310/394 = 78.7%), defined as having smoked at least 100 cigarettes over the lifetime and endorsing current smoking every day or some days during the week [29]. The restriction to this dataset was necessary, as some items of interest (e.g., interest in quitting smoking) were only administered to those who were current smokers. Data were explored using descriptive statistics. Sample comparisons based on interest in quitting smoking were performed using independent t-tests or chi-square tests for continuous and categorical variables, respectively. Ordinal logistic regression models were used to estimate associations of smoking-related risk perception, interest in quitting smoking, and interest in LCS, controlling for wave of data collection, smoking rate, age, sex, race, and education (in years). Additionally, the moderation
effect of interest in quitting smoking was examined via an interaction term following mean-centering of variables. The chi-square score test for the proportional odds assumption was employed to examine whether the ordinal regression model assumption was violated or not. All analyses were conducted using SAS version 9.4 in June 2020 [30]. Alpha was set at 0.05.

3. Results

The average risk perception was $6.7 + 3.2$ (range 0–10), 74.8% ($n = 232$) agreed or strongly agreed with interest in LCS, and 65.8% ($n = 204$) were interested in quitting smoking (see Table 1). Significant differences between those who were interested in quitting or not were found in age ($p = 0.03$), race ($p = 0.01$), employment status ($p = 0.047$), and interest in LCS ($p = 0.042$). Participants who were interested in quitting were older (44.28 vs. 41.03), more likely to be of a minority race (74.51% vs. 60.38%), unemployed (92.16% vs. 84.91%), and more likely to be strongly interested in LCS (30.88% vs. 16.98%, $p = 0.0082$). The proportional odds assumption was satisfied ($p > 0.05$).

Table 1. Participants’ characteristics by interest in quitting smoking.

| Sociodemographic Variables | Interest in Quitting Smoking | Total | No | Yes | $p$-Value |
|-----------------------------|-----------------------------|-------|----|-----|---------|
|                             | N (%)/M [SD] *               | 310   | 106 (34.19%) | 204 (65.81%) |         |
| Age                         | 43.17 [11.69]               | 41.03 [13.03] | 44.28 [10.80] | 0.0287  |
| Sex                         |                             |       |               |         | 0.3111  |
| Female                      | 85 (27.42)                  | 35 (33.02) | 50 (24.51)    |         |
| Male                        | 225 (72.58)                 | 71 (66.98) | 154 (75.49)   |         |
| Race                        |                             |       |               |         | 0.0102  |
| White                       | 94 (30.32)                  | 42 (39.62) | 52 (25.49)    |         |
| Minority                    | 216 (69.68)                 | 64 (60.38) | 152 (74.51)   |         |
| Last month’s income         |                             |       |               |         | 0.6978  |
| $0                          | 128 (44.14)                 | 49 (47.12) | 79 (42.47)    |         |
| $1–$500                     | 88 (30.34)                  | 31 (29.81) | 57 (30.65)    |         |
| >$500                       | 74 (25.52)                  | 24 (23.08) | 50 (26.88)    |         |
| Employment status           |                             |       |               |         | 0.0465  |
| At least part-time employed | 32 (10.32)                  | 16 (15.09) | 16 (7.84)     |         |
| Unemployed                  | 278 (89.68)                 | 90 (84.91) | 188 (92.16)   |         |
| Education (in years)        | 11.82 [1.58]                | 11.88 [1.57] | 11.79 [1.58] | 0.6385  |
| Education level             |                             |       |               |         | 0.2908  |
| GED/high school diploma or less | 225 (72.58)                 | 73 (68.87) | 152 (74.51)   |         |
| Some college/technical school or more | 85 (27.42)                 | 33 (31.13) | 52 (25.49)    |         |
| Health insurance            |                             |       |               |         | 0.3111  |
| Any type health insurance   | 78 (25.16)                  | 23 (21.70) | 55 (26.96)    |         |
| No health insurance         | 232 (74.84)                 | 83 (78.3)  | 149 (73.04)   |         |
| Lifetime homelessness (in months) | 39.34 [50.23]              | 36.81 [35.59] | 40.69 [56.57] | 0.4648  |
| Data collection wave        |                             |       |               |         | 0.9392  |
| Wave 1                      | 191 (61.61)                 | 65 (61.32) | 126 (61.76)   |         |
| Wave 2                      | 119 (38.39)                 | 41 (38.68) | 78 (38.24)    |         |

Smoking-Related Variables | N (%)/M [SD] *               |
Smoking rate (avg. cigarettes per day) | 12.02 [7.17] | 12.98 [6.90] | 11.56 [7.27] | 0.1144  |
Years of smoking over the lifetime | 19.14 [11.90] | 19.75 [12.36] | 18.84 [11.69] | 0.5436  |
Average pack-years * | 12.03 [11.50] | 13.49 [12.23] | 11.35 [11.11] | 0.1386  |
How soon after waking do you smoke your first cigarette? | 104 (35.49) | 35 (36.46) | 69 (35.03) | 0.7638  |
Within 5 min | 104 (35.49) | 35 (36.46) | 69 (35.03) | 0.7638  |
5–30 min | 98 (33.45) | 35 (36.46) | 63 (31.98) | 0.5436  |
31–60 min | 39 (13.31) | 11 (11.46) | 28 (14.21) | 0.1386  |
After 60 min | 52 (17.75) | 15 (15.63) | 37 (18.78) | 0.5436  |
Smoking-related risk perception (range: 0–10) | 6.70 [3.17] | 6.22 [3.22] | 6.93 [3.13] | 0.072  |
Interest in lung cancer screening | Strongly disagree | 26 (8.39) | 10 (9.43) | 16 (7.84) | 0.0416  |
Disagree | 20 (6.45) | 10 (9.43) | 10 (7.90) | 0.1386  |
Neither agree or disagree | 32 (10.32) | 15 (14.15) | 17 (8.33) | 0.5436  |
Agree | 151 (48.71) | 53 (50.00) | 98 (48.04) | 0.072  |
Strongly agree | 81 (26.13) | 18 (16.98) | 63 (30.88) | 0.1386  |

* SD: standard deviation. *pack-years = # of cigarettes smoked per day/20 × number of years smoked.
As seen in Table 2, greater risk perception was not significantly associated with interest in LCS (adjusted odds ratio (OR): 1.043, (95% CI: 0.927, 1.174), \( p = 0.48 \)); however, interest in quitting smoking was significantly associated with interest in LCS (adjusted OR: 1.968, (95% CI: 1.213, 3.191), \( p = 0.006 \)). The expected odds of greater interest in LCS were significantly greater for those who were interested in quitting smoking. However, the association of risk perception and interest in LCS was not moderated by interest in quitting smoking (\( p = 0.418 \)).

| Variables in Analysis                              | Odds Ratio   | 95% CI       | \( p \)-Value |
|---------------------------------------------------|--------------|--------------|---------------|
| Age                                               | 0.981        | (0.962, 1.000) | 0.051         |
| Sex (Ref: female)                                 | 1.448        | (0.884, 2.373) | 0.142         |
| Race (Ref: minority)                              | 1.256        | (0.757, 2.085) | 0.377         |
| Education (in years)                              | 1.166        | (1.012, 1.343) | 0.033         |
| Data collection wave (Ref: wave 1)                | 1.117        | (0.698, 1.786) | 0.645         |
| Smoking rate (average cigarettes smoked per day)  | 0.980        | (0.949, 1.012) | 0.211         |
| Smoking-related risk perception                    | 1.043        | (0.927, 1.174) | 0.480         |
| Interest in quitting smoking (Ref: no)            | 1.968        | (1.213, 3.191) | 0.006         |
| Smoking-related risk perception * Interest in quitting smoking | 1.062 | (0.918, 1.228) | 0.418         |

* CI: confidence interval. \( * \) = moderation term.

4. Discussion

Among this sample of adult homeless smokers, interest in quitting smoking was significantly associated with interest in LCS, a finding that has been reported in previous studies among domiciled adults [16,17]. The current study extended these results to a sample of homeless adults, a group with high rates of smoking and smoking-related disease, including lung cancers [2,4,9,31–33]. Results suggest that homeless smokers with an interest in quitting may be receptive to LCS: a diagnostic tool by which cancers can be caught at earlier stages and prior to metastasis [11,12]. This is important given that even routine cancer screenings are not undertaken as recommended among this group [13], and in particular because their lung cancers are typically caught at later stages of disease relative to their domiciled counterparts [14]. Thus, chronic homeless smokers with an interest in quitting smoking might also be screened for LCS eligibility and provided with a practical means by which to obtain it so as to enhance early detection. Moreover, interest in quitting smoking and interest in cancer screenings are each potentially malleable; therefore, future work should examine if interest in both can be further enhanced via, for example, brief motivational interviewing interventions with LCS-eligible homeless smokers [34–36]. Finally, there may be a reciprocal relationship between interest in quitting smoking and interest in LCS whereby LCS serves as a “teachable moment” that allows providers to initiate conversations with patients to reinforce their desire to quit [9–11]. Previous studies have found that after receiving LCS, the quit rate ranged from 11.9% to 15.5% [37], a rate much higher than the percentage of US adult smokers who successfully quit smoking in the past year (7.5%) [38]. As such, increasing access to LCS among eligible homeless smokers may further increase motivation to quit smoking and thereby help engender successful quit attempts. The current study was cross-sectional, however, and future longitudinal work is needed to delineate causal and potentially reciprocal pathways between interest in quitting smoking, interest in LCS, and LCS impacts on smoking cessation among this vulnerable group.

Contrary to some previous findings [16–20], risk perception was not significantly associated with interest in LCS. These results, however, may be expected given that many homeless people experience significant barriers to cancer screening that potentially detract from the perceived importance of early detection and prevention [39]. Factors such as low socioeconomic status may bar homeless patients from seeking LCS due to an inability to pay for a screening and follow-up care [39]. In a previous study conducted among domiciled adults, intention to screen for lung cancer dropped by 50% when participants were told that the screening was only available at their own expense [40]. One recent study has found that out-of-pocket LCS costs for uninsured patients were highly variable (range USD 49 to 2409) [41]. This variability may influence LCS participation rates among uninsured patients. Further,
Barriers related to housing status and food insecurity may detract from screening interest [13,42]. The importance of early detection and the role of LCS may also not be sufficiently understood among this population, which has low rates of health literacy and limited education compared to the general population [43,44]. In addition to a lack of access to a usual source of primary care [45], homeless individuals may receive infrequent tobacco use education during the limited healthcare they receive [46], further suggesting that homeless smokers may not be fully aware of the risks related to smoking and the relationship between smoking and disease incidence and thus would not be able to make informed perceptions of risk or the need to quit. Healthcare providers also often adopt fatalistic attitudes towards this population that consequentially normalize and reinforce smoking and detract from cessation efforts among homeless smokers [47]. These structural barriers to preventative care [9], coupled with competing priorities of day-to-day survival needs [48], may then mitigate LCS salience and interest among individuals experiencing homelessness. This paucity of screening coupled with disproportionate cancer mortality rates and increased late stage cancer diagnoses [9] indicate a need for system-wide interventions to increase access to preventative care, including LCS. Future studies should thus employ a qualitative approach to further delineate homeless smokers’ tobacco-related risk perceptions, beliefs regarding LCS benefits/barriers, and barriers to smoking cessation. Addressing existing misconceptions and barriers may ultimately encourage positive health behaviors such as smoking cessation and interest in pursuing LCS [49–54].

At the time of data collection, available guidelines for LCS consisted only of those from the American Association for Thoracic Surgery [55]; guidelines from the USPSTF [56] were released shortly after our data collection. Notably, in both cases, these guidelines (e.g., age 55–80 with ≥30 pack-year smoking history) exclude many of our study’s participants. In total, only 10 persons in our sample (3.23%) were eligible for LCS screening, at least based on their current smoking rate. However, the USPSTF is currently considering an update to the guidelines that would reduce age requirements from 55–80 to 50–80 and reduce the pack-year requirement from 30 to 20. If the new guidelines are approved, 32 participants (10.32%) would meet the eligibility criteria for screening. It should be noted that interest in LCS and eligibility for LCS are discrete concepts and homeless individuals are an extremely destitute group, with high rates of unemployment and low rates of insurance coverage [2,3]. Therefore, assessing pack-years using average cigarettes per day may reflect monetary availability and may very well underestimate chronic exposure to combustible tobacco accrued over time and prior to homelessness. Moreover, nicotine addiction may be satisfied by various tobacco products while experiencing homelessness, rendering cigarettes smoked per day in an average week not representative of prior or desired consumption. To this point, 49.49% of this study’s participants indicated that they now smoke fewer cigarettes per day than they did a year ago. Likewise, other research suggests high rates (e.g., 67.2%) of concurrent tobacco product use amongst smokers experiencing homelessness [31,33]. Additionally, as a result of limited financial resources, homeless smokers frequently adopt alternative smoking behaviors, such as borrowing cigarettes, sharing cigarettes, and smoking discarded cigarette butts/filters (in addition to traditional methods of smoking) [2,3,52]. These opportunistic smoking behaviors may then be inaccurately represented in traditional measures for cigarettes smoked per day and consequentially in a pack-year. Furthermore, although homeless adults have higher rates of current tobacco use than domiciled populations, one study has found that there was no difference in total pack-years between homeless and housed groups [15,57]. Given that homeless smokers experience high rates of cancers of the lung [9], current criteria for LCS—or at least the way smoking history is assessed and considered—may need to be altered for individuals experiencing chronic homelessness, given that reported smoking history or pack-years may not accurately reflect exposure [15]. As such, it may be more valuable to implement individualized risk-based selection that considers personal demographic, clinical, and smoking characteristics, as opposed to using standardized guidelines, to determine screening eligibility [58–60]. Personalized risk-based selection has been demonstrated to be more effective in preventing lung cancer deaths than selecting for subgroups per current USPSTF recommendations [61,62]. Thus, implementing personalized risk-based screening strategies can
potentially capture USPSTF-ineligible high-risk groups in addition to those who are currently eligible. Revising current guidelines to be more inclusive of homeless smokers and other non-traditional smokers cannot be effective without proper access to LCS and smoking cessation products. With regard to the former, although costs and lack of insurance are commonly endorsed barriers to screening, the Centers for Medicare and Medicaid services has recently approved coverage for LDCT scans among eligible adults, which may broaden its availability to low income groups [11]. With regard to the latter, some homeless serving agencies are beginning to embrace the provision of evidence-based smoking cessation services to their guests/clients [63]. Taken together, increased systematic support for healthcare and revised screening guidelines could potentially help to mitigate existing disparities among vulnerable groups such as homeless smokers.

Study limitations include those relevant to generalizability of results given the use of a convenience sample from a single shelter in Dallas, TX. Although this sample is relatively small (N = 310) and consists of more men (72.58%) than are represented in the overall US homeless population, it represents a demographic that is both sex-matched and racially similar to Dallas’ overall homeless adult population [64]. Additionally, although evidence-based smoking cessation interventions are not commonly provided to individuals experiencing homelessness, the shelter from which the participants were recruited did offer such services [4,26,47]. Thus, results may not be generalizable to individuals sheltering in centers without these resources. Moreover, we did not have access to data regarding who from our sample might be participating in the shelter’s smoking cessation services to adjust or otherwise account for this factor. Other limitations include the use of self-reported measures of risk perception and interest in LCS, which may be affected by bias. Furthermore, participants were only asked about interest in LCS and were not given information about related costs or procedures associated with LCS. In some ways, this may have avoided the influence of contextual factors such as access and expense on responses; however, responses cannot be considered a proxy for future intentions to participate in LCS or continued interest in LCS once potential access and financial challenges were explicated. Our risk perception assessment for smoking-related disease was limited to current smokers; thus, former smokers who might be eligible for LCS were not included in our analyses. Furthermore, risk perception related to other areas (e.g., safety, financial struggle, access to food, treatments for existing disease) was not assessed and therefore could not be examined in relation to risk perception for a smoking-related disease. The single measure of risk perception may benefit from additional measures that capture more detailed assessments of tobacco-related risks (i.e., cancer, respiratory diseases). Additionally, although we controlled for some variables in our analysis, additional factors not accounted for or assessed in this study (e.g., certain chronic conditions, experience with prior cancer screenings, smoking-related disease knowledge) may have affected the primary variables of interest or their association in unknown ways. Replication is needed. Lastly, the cross-sectional nature of this study excluded any assumptions regarding bidirectionality or causality. Future studies should seek to extend exploration for bidirectionality and causality within the contexts of smoking-related risk perception, interest in quitting smoking, and interest in LCS.

5. Conclusions

In summary, this study expands upon existing literature by supporting the link between interest in quitting and interest in LCS among a sample of homeless adults. These findings suggest that homeless smokers with an interest in quitting may be receptive to LCS. This is important because LCS may reduce lung cancer disparities within this group via early detection [9,14]. However, few smokers in the current sample would be eligible for LCS based on current guidelines; thus, results have implications for altered/personalized screening practices among chronic smokers experiencing homelessness. Implementing changes to existing guidelines to account for individual risk-based factors, coupled with increasing access for LCS and to evidence-based tobacco control and smoking cessation products, could help facilitate early detection and treatment of lung cancer among high risk, largely USPSTF-ineligible groups such as smokers experiencing homelessness.
Author Contributions: Conceptualization, P.A., L.R.R., M.S.B., D.E.K.; methodology, T.-A.C. and L.R.R.; software, T.-A.C.; validation, T.-A.C. and L.R.R.; formal analysis, T.-A.C.; investigation, L.R.R., M.S.B., D.E.K.; Resources, L.R.R.; data curation, M.S.B., T.-A.C.; writing—original draft preparation, P.A., M.T., L.R.R.; writing—review and editing, P.A., M.T., T.-A.C., S.M.R., M.S.B., E.H.B., L.R.R.; visualization, T.-A.C.; supervision, L.R.R., D.E.K., M.S.B.; project administration, L.R.R., M.S.B., D.E.K.; funding acquisition, L.R.R., M.S.B., D.E.K. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by institutional funding provided by the University of Texas Health Science Center, School of Public Health (to M.S.B.) and the University of Texas MD Anderson Cancer Center and the University of Houston (to L.R.R.). Data analysis and interpretation were supported by the National Cancer Institute grant P20CA221697 (to L.R.R.) and P30CA225520. The contents of this presentation are solely the responsibility of the authors and do not necessarily represent the official views of the sponsoring organizations.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. US Department of Housing and Urban Development. The 2019 Annual Homeless Assessment Report to Congress. Available online: http://www.hudexchange.info/resource/3948/2019-ahar-part-1-pit-estimates-of-homelessness-in-the-us/ (accessed on 3 August 2020).
2. Vijayaraghavan, M.; Neisler, J.; Wrighting, Q.; Reitzel, L.R.; Hebert, E.T.; Rash, C.J.; Kendzor, D.E.; Businelle, M.S. Income associations with cigarette purchasing behaviors and quit attempts among people experiencing homelessness. Addict. Behav. 2019, 95, 197–201. [CrossRef] [PubMed]
3. Wrighting, Q.; Businelle, M.S.; Kendzor, D.E.; LeBlanc, H.; Reitzel, L.R. Cigarette purchasing patterns, readiness to quit, and quit attempts among homeless smokers. Nicotine Tob. Res. 2017, 19, 1526–1530. [CrossRef] [PubMed]
4. Baggett, T.P.; Rigotti, N.A. Cigarette smoking and advice to quit in a national sample of homeless adults. Am. J. Prev. Med. 2010, 39, 164–172. [CrossRef] [PubMed]
5. Creamer, M.R.; Wang, T.W.; Babb, S.; Cullen, K.A.; Day, H.; Willis, G.; Jamal, A.; Neff, L. Tobacco product use and cessation indicators among adults—United States, 2018. Morb. Mortal. Wkly. Rep. 2019, 68, 1013–1019. [CrossRef] [PubMed]
6. American Cancer Society. 2019 Cancer Facts and Figures. Available online: https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2019/cancer-facts-and-figures-2019.pdf (accessed on 16 November 2020).
7. Office of the Surgeon General. The Health Consequences of Smoking—50 Years of Progress. Available online: https://www.ncbi.nlm.nih.gov/books/NBK179276/ (accessed on 3 August 2020).
8. Pizzuto, A.; Citarella, F.; Croghan, I.; Tonini, G. The effects of cigarette smoking extracts on cell cycle and tumor spread: Novel evidence. Future Sci. OA 2019, 5, FSO394. [CrossRef] [PubMed]
9. Baggett, T.P.; Chang, Y.; Porneala, B.C.; Bharel, M.; Singer, D.E.; Rigotti, N.A. Disparities in cancer incidence, stage, and mortality at Boston Health Care for the Homeless Program. Am. J. Prev. Med. 2015, 49, 694–702. [CrossRef]
10. Moyer, V.A. Screening for lung cancer: U.S. Preventive Services Task Force recommendation statement. Ann. Intern. Med. 2014, 160, 330–338. [CrossRef]
11. Paige, S.R.; Salloun, R.G.; Krieger, J.L.; Williams, M.; Xue, W.; Brumback, B. Promoting clinical conversations about lung cancer screening: Exploring the role of perceived online social support. J. Health Commun. 2020, 1–10. [CrossRef]
12. Kramer, B.S.; Berg, C.D.; Aberle, D.R.; Prorok, P.C. Lung cancer screening with low-dose helical CT: Results from the National Lung Screening Trial (NLST). J. Med. Screen. 2011, 18, 109–111. [CrossRef]
13. Chau, S.; Chin, M.; Chang, J.; Luecha, A.; Cheng, E.; Schlesinger, J.; Rao, V.; Huang, D.; Maxwell, A.E.; Usatine, R. Cancer risk behaviors and screening rates among homeless adults in Los Angeles County. Cancer Epidemiol. Biomarkers Prev. 2002, 11, 431–438. [PubMed]
14. Suh, K.J.; Kim, K.H.; Lim, J.; Park, J.H.; Kim, J.-S.; Choi, I.S. Lung cancer in homeless people: Clinical outcomes and cost analysis in a single institute. Can. Respir. J. 2016, 2016. [CrossRef] [PubMed]
15. Concannon, K.F.; Thayer, J.H.; Wu, Q.V.; Jenkins, I.C.; Baik, C.S.; Linden, H.M. Outcomes among homeless patients with non–small-cell lung cancer: A county hospital experience. *J. Oncol. Pract.* 2020, 16, e1004–e1014. [CrossRef] [PubMed]

16. Hahn, E.J.; Rayens, M.K.; Hopenhayn, C.; Christian, W.J. Perceived risk and interest in screening for lung cancer among current and former smokers. *Res. Nurs. Health.* 2006, 29, 359–370. [CrossRef] [PubMed]

17. Schnoll, R.A.; Bradley, P.; Miller, S.M.; Unruh, M.; Babb, J.; Cornfeld, M. Psychological issues related to the use of spiral CT for lung cancer early detection. *Lung Cancer* 2003, 39, 315–325. [CrossRef]

18. Bui, N.C.; Lee, Y.Y.; Suh, M.; Park, B.; Cho, H.; Kim, Y.; Choi, K.S. Beliefs and intentions to undergo lung cancer screening among Korean males. *Cancer Res. Treat.* 2018, 50, 1096–1105. [CrossRef]

19. Monu, J.; Triplette, M.; Wood, D.E.; Wolff, E.M.; Lavallee, D.C.; Flum, D.R.; Farjah, F. Evaluating knowledge, attitudes, and beliefs about lung cancer screening using crowdsourcing. *Chest* 2020, 158, 386–392. [CrossRef]

20. Lillie, S.E.; Fu, S.S.; Fabbrini, A.E.; Rice, K.L.; Nelson, D.B.; Doro, E.A.; Moughrabieh, M.A.; Partin, M.R. What factors do patients consider most important in making lung cancer screening decisions? Findings from a demonstration project conducted in the Veterans Health Administration. *Lung Cancer*. 2017, 104, 38–44. [CrossRef]

21. Quaife, S.L.; Vrinten, C.; Ruparel, M.; Janes, S.M.; Beeken, R.J.; Wetter, D.W. Smokers’ interest in a teachable moment? *J. Natl. Cancer Inst.* 2014, 106, dju122. [CrossRef]

22. Deppen, S.A.; Grogan, E.L.; Aldrich, M.C.; Massion, P.P. Lung cancer screening and smoking cessation: A teachable moment? *Med. Care* 2003, 18, 497. [CrossRef]

23. Cox, L.S.; Clark, M.M.; Jett, J.R.; Patten, C.A.; Waller, J.; McEwen, A. Smokers’ interest in a lung cancer screening programme: A national survey in England. *BMC Cancer* 2018, 18, 497. [CrossRef]

24. McBride, C.M.; Emmons, K.M.; Lipkus, I.M. Understanding the potential of teachable moments: The case of smoking cessation. *Health Educ. Pract.* 2014, 106, 156–170. [CrossRef] [PubMed]

25. Kendzor, D.E.; Allicock, M.; Businelle, M.S.; Sandon, L.F.; Gabriel, K.P.; Frank, S.G. Evaluation of a shelter-based diet and physical activity intervention for homeless adults. *J. Phys. Act. Health* 2017, 14, 88. [CrossRef] [PubMed]

26. Businelle, M.S.; Kendzor, D.E.; Kesh, A.; Cuate, E.L.; Poonawalla, I.B.; Reitzel, L.R.; Okuyemi, K.S.; Wetter, D.W. Small financial incentives increase smoking cessation in homeless smokers: A pilot study. *Addict. Behav.* 2014, 39, 717–720. [CrossRef] [PubMed]

27. Businelle, M.S.; Poonawalla, I.B.; Kendzor, D.E.; Rios, D.M.; Cuate, E.L.; Savoy, E.J.; Ma, P.; Baggett, T.P.; Reingle, J.; Reitzel, L.R. Smoking policy change at a homeless shelter: Attitudes and effects. *Addict. Behav.* 2015, 40, 51–56. [CrossRef]

28. Arozullah, A.M.; Yarnold, P.R.; Bennett, C.L.; Soltsyk, R.C.; Wolf, M.S.; Ferreira, R.M.; Lee, S.Y.; Costello, S.; Shakir, A.; Denwood, C., et al. Development and validation of a short-form, rapid estimate of adult literacy in medicine. *Med. Care* 2007, 45, 1026–1033. [CrossRef]

29. Centers for Disease Control and Prevention. Glossary—Adult Tobacco Use. Available online: https://www.cdc.gov/nchs/nhis/tobacco/tobacco_glossary.htm (accessed on 3 August 2020).

30. SAS Institute Inc. *SAS (Version 9.4)*; SAS Institute, Inc.: Cary, NC, USA, 2014.

31. Neisler, J.; Kirkendall, D.M.; Reitzel, L.R. Smoking policy change at a homeless shelter: Attitudes and effects related to quitting. *Drug Alcohol Depend.* 2018, 185, 133–140. [CrossRef]

32. Roncarati, J.S.; Baggett, T.P.; O’Connell, J.J.; Hwang, S.W.; Cook, E.F.; Krieger, N.; Sorensen, G. Mortality among unsheltered homeless adults in Boston, Massachusetts, 2000–2009. *JAMA Intern. Med.* 2018, 178, 1242–1248. [CrossRef]

33. Kish, D.H.; Reitzel, L.R.; Kendzor, D.E.; Okamoto, H.; Businelle, M.S. Characterizing concurrent tobacco product use among homeless cigarette smokers. *Nicotine Tob. Res.* 2015, 17, 1156–1160. [CrossRef]

34. Okuyemi, K.S.; Goldade, K.; Whembolua, G.L.; Thomas, J.L.; Eischen, S.; Sewali, B.; Guo, H.; Connett, J.E.; Grant, J.; Aihuwalia, J.S. Motivational interviewing to enhance nicotine patch treatment for smoking cessation among homeless smokers: A randomized controlled trial. *Addiction* 2013, 108, 1136–1144. [CrossRef]

35. Chan, D.N.; So, W.K. Effectiveness of motivational interviewing in enhancing cancer screening uptake amongst average-risk individuals: A systematic review. *Int. J. Nurs. Stud.* 2020, 103786. [CrossRef]

36. Maloney, A.; Rugen, K. Improving colorectal cancer screening rates using motivational interviewing. *J. Nurs. Educ. Pract.* 2018, 8, 138–144. [CrossRef]
37. Poghosyan, H.; Kennedy Sheldon, L.; Cooley, M.E. The impact of computed tomography screening for lung cancer on smoking behaviors: A teachable moment? Cancer Nurs. 2012, 35, 446–475. [CrossRef] [PubMed]
38. Centers for Disease Control and Prevention. Smoking Cessation: Fast Facts. Available online: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/cessation/smoking-cessation-fast-facts/index.html (accessed on 3 August 2020).
39. Asgary, R. Cancer screening in the homeless population. Lancet Oncol. 2018, 19, e344–e350. [CrossRef]
40. Jonnalagadda, S.; Bergamo, C.; Lin, J.J.; Lurslurchachai, L.; Diefenbach, M.; Smith, C.; Nelson, J.E.; Wisnivesky, J.P. Beliefs and attitudes about lung cancer screening among smokers. Lung Cancer 2012, 77, 526–531. [CrossRef]
41. Febbo, J.; Little, B.; Fischl-Lanzoni, N.; Narayan, A.K.; Tiersma, K.M.; Glover, M.; Shepard, J.O.; Flores, E.J. Analysis of out-of-pocket cost of lung cancer screening for uninsured patients among ACR-accredited imaging centers. J. Am. Coll. Radiol. 2020, 17, 1108–1115. [CrossRef]
42. Lebrun-Harris, L.A.; Baggett, T.P.; Jenkins, D.M.; Sripipatana, A.; Sharma, R.; Hayashi, A.S.; Daly, C.A.; Ngo-Metzger, Q. Health status and health care experiences among homeless patients in federally supported health centers: Findings from the 2009 patient survey. Health Serv. Res. 2013, 48, 992–1017. [CrossRef]
43. Penson, R.T.; Ferguson, L.A.; Haston, R.J.; Clark, J.R.; Demotes, A.; O’Connell, J.J.; Chabner, B.A.; Lynch, T.J., Jr. The Kenneth B. Schwartz Center at Massachusetts General Hospital hematology-oncology department: Hope for the homeless. Oncologist 2003, 8, 488–495. [CrossRef]
44. Asgary, R.; Alcabes, A.; Feldman, R.; Garland, V.; Naderi, R.; Ogedegbe, G.; Sckell, B. Human Papillomavirus knowledge and attitude among homeless women of New York City shelters. Womens Health Issues 2015, 25, 727–731. [CrossRef]
45. White, B.M.; Newman, S.D. Access to primary care services among the homeless: A synthesis of the literature using the equity of access to medical care framework. J. Prim. Care Community Health 2015, 6, 77–87. [CrossRef]
46. Prochaska, J.J. Failure to treat tobacco use in mental health and addiction treatment settings: A form of harm reduction? Drug Alcohol Depend. 2010, 110, 177–182. [CrossRef]
47. Baggett, T.P.; Tobey, M.L.; Rigotti, N.A. Tobacco use among homeless people—Addressing the neglected addiction. N. Engl. J. Med. 2013, 369, 201–204. [CrossRef] [PubMed]
48. Gelberg, L.; Gallagher, T.C.; Andersen, R.M.; Koegel, P. Competing priorities as a barrier to medical care among homeless adults in Los Angeles. Am. J. Public Health 1997, 87, 217–220. [CrossRef]
49. Young, R.F.; Severson, R.K. Breast cancer screening barriers and mammography completion in older minority women. Breast Cancer Res. Treat. 2005, 89, 111–118. [CrossRef] [PubMed]
50. Fernandez, M.E.; Palmer, R.C.; Leong-Wu, C.A. Repeat mammography screening among low-income and minority women: A qualitative study. Cancer Control. 2005, 12 (Suppl. 2), 77–83. [CrossRef] [PubMed]
51. Goldade, K.; Whembolu, G.L.; Thomas, J.; Eischen, S.; Guo, H.; Connett, J.; Des Jarlais, D.; Resnicow, K.; Gelberg, L.; Owen, G.; et al. Designing a smoking cessation intervention for the unique needs of homeless persons: A community-based randomized clinical trial. Clin. Trials 2011, 8, 744–754. [CrossRef]
52. Okuyemi, K.S.; Caldwell, A.R.; Thomas, J.L.; Born, W.; Richter, K.P.; Nollen, N.; Braunstein, K.; Abluvalia, J.S. Homelessness and smoking cessation: Insights from focus groups. Nicotine Tob. Res. 2006, 8, 287–296. [CrossRef] [PubMed]
53. Nguyen, M.A.; Reitzel, L.R.; Kendzor, D.E.; Businelle, M.S. Perceived cessation treatment effectiveness, medication preferences, and barriers to quitting among light and moderate/heavy homeless smokers. Drug Alcohol Depend. 2015, 153, 341–345. [CrossRef]
54. Shelley, D.; Cantrell, J.; Wong, S.; Warn, D. Smoking cessation among sheltered homeless: A pilot. Am. J. Health Behav. 2010, 34, 544–552. [CrossRef]
55. Jaklitsch, M.T.; Jacobson, F.L.; Austin, J.H.; Field, J.K.; Jett, J.R.; Keshavjee, S.; MacMahon, H.; Mulshine, J.L.; Munden, R.F.; Salgia, R.; et al. The American Association for Thoracic Surgery guidelines for lung cancer screening using low-dose computed tomography scans for lung cancer survivors and other high-risk groups. J. Thorac. Cardiovasc. Surg. 2012, 144, 33–38. [CrossRef]
56. U.S. Preventive Services Task Force. Lung Cancer: Screening. Available online: http://www.uspreventiveservicestaskforce.org/uspstf/recommendation/lung-cancer-screening (accessed on 3 August 2020).
57. Agaku, I.T.; King, B.A.; Dube, S.R. Current cigarette smoking among adults—United States, 2005–2012. Morb. Mortal. Wkly. Rep. 2014, 63, 29–34.
58. Bach, P.B.; Gould, M.K. When the average applies to no one: Personalized decision making about potential benefits of lung cancer screening. Ann. Intern. Med. 2012, 157, 571–573. [CrossRef] [PubMed]
59. Bach, P.B. Raising the bar for the U.S. Preventive Services Task Force. *Ann. Intern. Med.* 2014, 160, 365–366. [CrossRef] [PubMed]

60. Tammemägi, M.C. Application of risk prediction models to lung cancer screening: A review. *J. Thorac. Imaging.* 2015, 30, 88–100. [CrossRef] [PubMed]

61. Katki, H.A.; Kovalchik, S.A.; Berg, C.D.; Cheung, L.C.; Chaturvedi, A.K. Development and validation of risk models to select ever-smokers for ct lung cancer screening. *JAMA* 2016, 315, 2300–2311. [CrossRef] [PubMed]

62. Cheung, L.C.; Katki, H.A.; Chaturvedi, A.K.; Jemal, A.; Berg, C.D. Preventing lung cancer mortality by computed tomography screening: The effect of risk-based versus U.S. Preventive Services Task Force eligibility criteria, 2005–2015. *Ann. Intern. Med.* 2018, 168, 229–232. [CrossRef]

63. Taing, M.; Kyburz, B.; Leal, I.M.; Le, K.; Chen, T.-A.; Correa-Fernandez, V.; Williams, T.; O’Connor, D.P.; Obasi, E.M.; Casey, K. Clinician training in the adaptation of a comprehensive tobacco-free workplace program in agencies serving the homeless and vulnerably housed. *Int. J. Environ. Res. Public Health* 2020, 17, 6154. [CrossRef]

64. Metro Dallas Homeless Alliance. 2020 Dallas and Collin Counties Point in Time Homeless Count Results. Available online: http://www.mdhadallas.org/wp-content/uploads/2020/07/Final-2020-PIT-TX-600-Dallas-City-and-County-Irving-CoC.xlsx (accessed on 3 August 2020).

**Publisher’s Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.