



Knowledge and attitudes towards low dose computed tomography lung cancer screening and smoking among African Americans – a mixed method study

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Background: The purpose of this study is to investigate knowledge, attitudes, and smoking cessation needs for African Americans who receive low dose computed tomography (LDCT) in an effort to reduce the health burden of lung cancer.

Methods: A mixed method study was conducted among African Americans who received LDCT. Data were gathered using a self-administered questionnaire and structured in-depth interview. Descriptive statistics were used to provide summary information on knowledge, attitude and smoking behaviors. Thematic analysis was used to analyze interview data. The sample size for both the quantitative and qualitative approach was fifteen.

Results: The results showed that 73% of participants were male, the mean age was 61.8 (SD =4.6) years old, and 66.7% of participants had an income less than \$20,000. Eighty percent had an education level of high school or below and 73.3% were overweight or obese. Smoking history was long (mean years =39 SD =14.9), but the number of cigarettes smoked per day was low (mean =9.2 SD =7.3), and 64% of the patients had a low nicotine dependence. Assessment of knowledge and attitudes towards LDCT revealed that participants had a moderate/lower knowledge score (mean =4.3 SD =2.6), and most had a positive attitude. All participants planned to quit smoking, with 73% planning to quit within the next 6 months. Similar findings were also observed in the qualitative analysis.

Conclusions: African Americans who receive LDCT lung cancer screening in this study have a moderate/lower knowledge score and positive attitude towards LDCT. Most were not heavy smokers and had a lower nicotine dependence. Understanding the factors associated with smoking cessation among at-risk African American smokers will help reduce disparities in lung cancer burden, and is important to improve health for medically underserved minority populations.

Keywords: Smoking; cancer; health disparities; African American

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Introduction

Smoking and cancer health disparities

African Americans have both the highest incidence and mortality of lung cancer compared to any other racial/ethnic group (1). In 2011–2015, Louisiana residents had higher lung and bronchus cancer incidence rates, compared with the U.S. national incidence rates (68.8 vs. 54.6 per 100,000). This incidence rate of tobacco-related cancer was even higher for African American males in Louisiana (325.3 vs. 278.6 per 100,000) (1).

Smoking is a major risk factor for lung cancer and other chronic disease (2). Currently, compared to their White counterparts, African-Americans are more likely to have a more advanced stage of lung cancer at the time of diagnosis, lower rates of accessing care, lower lung cancer survival rates, and higher incidence and mortality rates (3). In 2016, approximately 21.4% of African-American adults were current smokers of cigarettes (1). African-Americans are more likely to smoke highly addictive mentholated cigarettes, which contributes in part to lower smoking cessation rates in this population (4). Studies have also found that African Americans are less likely to quit smoking successfully compared to European Americans (5). African American smokers are less likely to meet established lung cancer screening eligibility criteria compared to Whites (6). Physicians are also less likely to recommend cancer screening for African-Americans compared to Whites (7).

Current LDCT recommendations and utilization

The International Association for the Study of Lung Cancer (IASLC) recommends offering LDCT screening to people age 55–74 with at least a 30 pack year smoking history, who are actively smoking or who have quit in the past 15 years, and have no other life-limiting comorbid conditions (8–10). The U.S. Preventive Services Task Force (USPSTF) extends this recommendation to age 80 (11). However, other organizations, such as the American Association for Thoracic Surgery (AATS), recommend LDCT screening for two high-risk populations: (I) individuals who meet the NLST criteria listed above; and (II) individuals over age 50 with greater than a 20 pack year smoking history, who also have one additional risk factor for lung cancer, such as having cancer in the past, emphysema, pulmonary fibrosis, a family history of lung cancer, and exposure to certain substances (including asbestos, arsenic, beryllium, cadmium, chromium, diesel fumes, nickel, radon, silica

and uranium) (12). Conversely, the American Academy of Family Physicians (AAFP) does not recommend LDCT screening, stating that the evidence for LDCT screening is insufficient (13). Previous studies, however, suggest that these current eligibility standards disproportionately exclude African-Americans from obtaining LDCT screening, due to this population's increased risk of developing lung cancer (5,14). Recent studies also show that recommendation of LDCT screening is low among primary care physicians (15). Furthermore, a retrospective analysis of electronic medical record data from patients ages 55–80 with no history of lung cancer showed that uptake of LDCT remains very low in this population (16). Another study also showed that primary care providers report ordering chest X-rays more often than LDCT screenings (17).

Reasons and barriers for LDCT lung cancer screening

There are several risks and limitations of LDCT lung screening. Although the amount of radiation in LDCT lung screening is small, radiation can increase a person's risk of cancer. False-positive results can lead to unnecessary follow-up tests and surgeries that may have more risks. Over-diagnosis can also lead to treatment that is not needed (18). Many reasons exist for why smokers decline to participate in LDCT, including feeling as though one is "too old to benefit," preferring to not know one's lung cancer status, and low perceived effectiveness of early detection strategies (19–21). Ali *et al.* found that emotional barriers, transportation, and comorbid illness were commonly reported barriers in obtaining LDCT (20). Furthermore, LDCT referral rates remain low among physicians, in part due to gaps in physician knowledge (22).

Knowledge and attitudes towards LDCT

A study that assessed heavy smokers' knowledge of lung cancer screening with LDCT found that knowledge scores differed across education levels, but no differences were observed between participants who met or did not meet the 30-pack-year screening eligibility criterion (23). Older smokers possess an overall positive belief and interest towards LDCT, and are more likely to utilize LDCT if they believe that LDCT scans are accurate, that early detection of lung cancer will lead to good prognosis, that they are at high risk for lung cancer, and are not afraid of CT scans (24). Moreover, a survey of 80 patients who were referred for

LDCT found that adherent patients trusted their providers and believed that LDCT was accurate, and that early detection of lung cancer is useful. Non-adherent patients reported intent to obtain LDCT in the future (25). Barriers to receiving LDCT include lack of knowledge of LDCT, cost, radiation exposure, and transportation issues (26). In addition, some patients report receiving little information about LDCT from providers, and are unaware that LDCT is a screening test for lung cancer (27,28).

Mazzone *et al.* developed a centralized counseling and shared decision-making model for lung cancer screening, which was found to positively affect patients' knowledge of the harms and benefits of LDCT (29).

LDCT lung cancer screening is recommended only for adults who have no symptoms of lung cancer, but who are at high risk for developing lung cancer, based on their smoking history and age (8-10). Lung cancer screening is not a substitute for quitting smoking (30). Although smoking is a major risk factor for lung cancer and other chronic diseases, quitting smoking or avoiding secondhand and third-hand smoke are the most effective approaches of reducing lung cancer risk (31).

This study will be a first step in exploring and addressing the smoking cessation needs of at-risk African American smokers undergoing lung cancer screening to expand our understanding of the ideal teachable moment, and barriers for a smoking cessation intervention in a lung cancer screening context. An understanding of the cognitive factors associated with smoking cessation among at-risk African American smokers will help reduce disparities in lung cancer burden, including incidence and mortality. This work has great potential to help reduce the enormous public health burden of lung cancer by improving the health for medically underserved minority populations.

Methods

Study design and participants

This study applied a cross-sectional design via a face-to-face interview and survey questionnaire. Eligible participants were African Americans smokers ages 55–77 years old who had either had 30+ pack-years of smoking or had received an LDCT exam in the past year. A professional interviewer interviewed all participants (N=15) and required them to complete a questionnaire. Participants were asked to give written informed consent to confirm that they understood the rights and privacy protection disclaimer

before the interview. The survey was a paper-based, anonymous questionnaire, with patients self-reporting demographics, tobacco use, quit attempts, perceived risk of lung cancer, knowledge of LDCT screening, and attitude towards LDCT screening information. This patient survey was conducted from September to December 2018 at University Medical Center New Orleans (UMC-NO). Our study protocol was reviewed and approved by the Institutional Review Board of LSUHSC-NO (approval #10104).

Nicotine dependence

This study adopted the heaviness of smoking index (32) which is a short version of the Fagerstrom test of nicotine dependence (33) to identify patients' nicotine dependence level. The short version is a questionnaire that provides an ordinal measure of cigarette dependence, based on responses to the following two questions: item 1 “On average, about how many cigarettes a day do you smoke now?” (scoring: less than 10 =0; 10–19 =1; 20–29 =2; 30 or more =3); item 2 “How soon after you wake do you smoke your first cigarette?” (scoring: after 60 minutes =0; 31–60 minutes =1; 6–30 minutes =2; within 5 minutes =3). The total score ranges between 0 and 6, with scores from 0 to 2 indicating very low nicotine dependence, scores of 3 indicating low nicotine dependence, scores of 4 indicating moderate nicotine dependence, scores of 5 indicating high nicotine dependence, and scores of 6 indicating very high nicotine dependence.

Stage of change for smoking cessation

We used the question “Are you planning to quit smoking within the next 1 to 6 months?” to ask participants' plans for smoking cessation (34). The four possible responses are: “thinking of quitting smoking within the next month”; “thinking of quitting smoking within the 6 months”; “thinking of quitting smoking at some point, but not within the next 6 months”; and “absolutely not thinking of quitting smoking.”

Tried to quit

Participants were asked about their smoking cessation experiences in the past a year using the following question: “In the past 12 months, have you stopped smoking for one day or longer because you were trying to quit?”, with binary

responses (yes and no).

Perceive risk of lung cancer

This study used two questions to measure participants' perceived risk of lung cancer (35): question 1: "How likely do you think it is that you will develop lung cancer in the future?", with five levels of responses (very low, somewhat low, moderate, somewhat high, and very high); and question 2: "Compared to the average person your age, would you say that you are more likely, moderate, or less likely to get lung cancer?", with five levels of responses (less likely, somewhat less likely, moderate, somewhat likely, and more likely).

Knowledge for LDCT screening

Questions were developed based on reviewing the LDCT knowledge and other similar studies (23,36). We assessed knowledge of LDCT screening with ten questions: "1. About 85% of lung cancer deaths are caused by smoking?", "2. Lung cancer rank as #1 cause of cancer death in the US?", "3. About half of people with an abnormal CT scan will have lung cancer?", "4. Can a CT scan suggest that you have lung cancer when you do not?", "5. Can CT scan miss a tumor in your lungs?", "6. Without screening, is lung cancer often found a later stage when cure is less likely?", "7. Can CT scan find lung disease that is not cancer?", "8. CT scan cannot find heart disease?", "9. Lung cancer screening with a CT scan lower about 20% chances of dying from lung cancer?", "10. Will all tumors found in the lungs grow to be life threatening?" Each question had three levels of responses (yes, no, and I don't know), and overall accuracy of responses was calculated based on the number of correct answers. The total score ranges between 0 and 10, with higher scores indicating greater knowledge of LDCT screening.

Attitudes towards LDCT screening

The attitude questionnaire was contextually modified based on the concepts of previous studies (24). We assessed attitudes towards LDCT screening via seven questions: "1. LDCT scan with no lung cancer will decrease worry about developing cancer.", "2. LDCT scans scare me.", "3. You believe that you are at high risk for lung cancer.", "4. If you were asked today – you would agree to a LDCT scan.", "5. You believe that early detection of lung cancer will result in a good prognosis.", "6. Screening accuracy is important

to you whether to have a LDCT.", "7. Screening cost is important to you whether to have a LDCT.". Each question had three levels of response (agree, disagree, and neutral).

Subject demographics

Seven demographic variables were considered: age, gender, income, education, marriage status, insurance type, and body mass index (BMI). Gender was classified as female or male. Income level included five categories (less than \$20,000, \$20,000–\$29,999, \$30,000–\$39,999, \$40,000–\$49,999, and higher than or equal to \$50,000). Education level was classified into three groups (Grades 9 through 11, Grade 12 or GED, and College 1 to 3 years). Marriage status was classified into three categories (married, divorced, and single, never married and not now living with a partner). Insurance type included private health insurance, Blue Cross and Blue Shield, HMOs, Medicaid, Medicare, and other. BMI was classified into normal weight (<25 kg/m²), overweight (25–29.9 kg/m²), and obese (≥30 kg/m²).

Statistical analyses

In our quantitative analysis, descriptive statistics were used to provide summary information on demographics, smoking status, nicotine dependence, stage of change, quit smoking attempts, perceived risk of lung cancer, knowledge of LDCT screening, and attitude towards LDCT screening. Statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA). In our qualitative analysis, two people coded the data using thematic analysis techniques. NVivo was used to analyze the data and TPB was used to develop themes.

Results

This study interviewed 15 participants, the range of ages was 55 to 70, and the mean age of the sample was 61.8 (SD 4.6). As shown in *Table 1*, 73.3% of the participants were male, and 66.7% of them had an income below \$20,000. Eighty percent of participants had an education level of high school or below, and 73.3% were overweight or obese.

Smoking

The mean years smoked was 39 (SD 14.9) and the mean number of cigarettes smoked per day was 9.2 (SD 7.3). As shown in *Table 2*, 64% of patients had low or very low

Table 1 Patient demographics

Variables	n (%)
Age, mean (SD) (55–70 years old)	61.8 (4.6)
Gender	
Female	4 (26.7)
Male	11 (73.3)
Annual income	
Less than \$20,000	10 (66.7)
Less than \$30,000	0 (0.0)
Less than \$40,000	3 (20.0)
Less than \$50,000	1 (6.7)
\$50,001–\$70,000	1 (6.7)
The highest level of education	
Grades 9 through 11	5 (33.3)
Grade 12 or GED	7 (46.7)
College 1 to 3 years	3 (20.0)
Marriage	
Married	5 (33.3)
Divorced	2 (13.4)
Single, never married and not now living with a partner	8 (53.3)
Insurance*	
Health insurance ¹	3 (20.0)
Medicaid	8 (53.3)
Medicare	8 (53.3)
Other	1 (6.7)
BMI (kg/m ²)	
Normal (<25)	4 (26.7)
Overweight (25–29.9)	3 (20.0)
Obese (≥30)	8 (53.3)

¹, health insurance (e.g., private health insurance, Blue Cross and Blue Shield, HMOs); *, a participant may have one more insurance. GED, graduate equivalency degree; HMO, Health Maintenance Organization.

nicotine dependence. Seventy-three point three percent of participants were trying to quit smoking in the past 12 months. All participants planned to quit smoking, with about 73% of participants planning to quit smoking within the next 6 months.

Participants are aware of the health impacts of smoking, noting that cigarettes are “*really bad for your health*”. Many of their first thoughts around smoking referred to the negative toll that cigarette smoking has on the human body, such as “*cancer*”, “*heart attacks*”, “*pneumonia*”, and “*chest pains*.”

“*It’s hard I tell you. It is hard. You know what, I had a heart attack one time, and I got out of the hospital from the heart attack, I went and got me a cigarette. I had the heart attack because of the cigarettes.*” Female, 60 years old.

“*It [smoking] really messed my life up...It messed with my health...I suddenly have pain in my shoulders, pain in my back. I be out of breath, be short winded...I’m scared that if I smoke, I’m gonna get sick again and the cancer gonna reoccur...Because I had the surgery, I smoked two the day of the surgery. I told the doctor and he really got on me about smoking, so it kind of scared me...So once I started doing the chemo and the radiation, it just motivated me to try to stop.*” Male, 65 years old.

“*Shortness of breath*” was the most commonly mentioned negative health impact the 15 participants personally experienced. The natural aging process also complicated these negative health impacts.

“*Right now, it’s causing me breathing problems, and I’m up in age, and it’s causing me a lot. When I get a cold, I’m real short winded...It [smoking] worsened it...because of the breathing disorder when I get sick it’s just hard for me to breathe. I mean, real hard.*” Male, 57 years old.

Many participants had family members and peers who had suffered health issues, some of these same health issues as a result of smoking. A family history of cancer was a pattern.

“*My mother smoked cigarettes when she was young. She had her first kid, which was me in ’59. She stopped smoking when she had my sister in ’66 and my mother just died 2015 from cancer and she had stopped smoking in ’66... My mother ain’t smoked in so long. And it kind of scares me, my mother stopped smoking that long and look what happened. I’m still smoking, it kind of intimidates me, you know?*” Male, 59 years old.

“*I lost a brother... [He] brother died of lung cancer, and I have a friend of mine, he had cancer now... He quit, he ain’t smoked in a while... My brother died at like 40 years old. He came home to my grandma and said, “I got cancer. I’m dying.” ... I cried for a little while. So they listened to him, I said, “Man, it’s time to stop [smoking]”.*” Male, 55 years old.

Some participants seemed to have low perceived susceptibility to negative health impacts of smoking because they hadn’t experienced any symptoms. In addition, some downplayed the effects of smoking.

“*I don’t see people much older than me. They’re up into their*

Table 2 Smoking status

Questions	n (%)
How long have you been smoking on a regular basis? (years), mean (SD)	39.3 (14.9)
On average, about how many cigarettes a day do you smoke now? mean (SD)	9.2 (7.3)
Fagerstrom test Nicotine dependence (heaviness of smoking index)	
Very low	4 (36.4)
Low	3 (27.3)
Moderate	2 (18.2)
High	2 (18.2)
Very high	0 (0.0)
Missing	4
Stage of change	
Are you planning to quit smoking within the next 1 to 6 months?	
Thinking of quitting smoking within the next month	7 (46.7)
Thinking of quitting smoking within the 6 months	4 (26.7)
Thinking of quitting smoking at some point, but not within the next 6 months	4 (26.7)
Absolutely not thinking of quitting smoking	0 (0.0)
Tried to quit*	
No	4 (26.7)
Yes	11 (73.3)
Perceive risk of lung cancer	
How likely do you think it is that you will develop lung cancer in the future?	
Very low	0 (0.0)
Somewhat low	3 (20.0)
Moderate	6 (40.0)
Somewhat high	3 (20.0)
Very high	3 (20.0)
Compared to the average person your age, would you say that you are more likely, moderate, or less likely to get lung cancer?	
Less likely	2 (13.3)
Somewhat less likely	4 (26.7)
Moderate	3 (20.0)
Somewhat likely	2 (13.3)
More likely	4 (26.7)

*, in the past 12 months, have you stopped smoking for one day or longer because you were trying to quit?

80s and 90s, and smoking never did bother them. So smoking, just different things to different people. Some of them go a lifetime, and it just does nothing to their lungs, and somebody that

don't smoke could get the cancer. You just don't know. Life is what it is, you know? The uncertainty." Male, 64 years old.

"Bad. I already know that. I know it's bad for you, but yet still,

heck, drinking water is bad for you, too. Everything you do these days is bad for you. If I'm going to kick it out of here, I'm might well kick it doing what I like to do." Female, 60 years old.

"I guess because I don't be short of breath, or I'm not coughing like they do when they got lung cancer or something like that...I still feel the same." Male, 58 years old.

Overall, when asked "Do you plan to quit smoking any time soon", participants had responses in favor of quitting. Responses ranged from "I would like to" to "I've been trying for the last 6, 7 months." Health reasons were the main motivator for intending to quit.

"Health. I seem to escape through any major problems as a smoker. Not saying I hadn't had any just no major problems where lot of times I kind of escaped through the cracks. But luck can run out, too." Female, 55 years old.

Another interesting motivator to quit was participants' grandchildren. At least 6 participants mentioned altering their smoking behavior to reduce secondhand smoke exposure for their grandchildren. They also described comments that their grandchildren shared that increased their motivation to quit, such as "Paw Paw, don't smoke". Participants reported wanting to quit smoking for longevity to continue bonding with grandchildren.

"I babysit my grand baby and can't smoke around him. So, I have him from 7:00 in the morning to nearly 6:00, 6:30 in the evening....They want me to stop...My children and my grandchildren. Yes... They criticize. You know they do. My granddaughters like "Oh, Nini, your breath stinks." You know that kinda stuff? So, that makes you want to [quit]" Female, 64 years old.

"I've got 12 grandkids. They told me to stop, and I told them I'm going to stop ... Which I don't do it for myself. I'm going to do it for them...I made a promise to them I'm going to quit for my birthday. So I'm going to have to stick to it." Male, 68 years old.

"And when my grandkids come over, they used to find my cigarettes and ball them up and throw them in the trash. And they'd say, "Mama, I don't want you smoking, I don't want you smoking, who gonna come to my graduation?" Well that sunk in... And I have great-grandkids now, and I like running behind them." Female, 65 years old.

The concept of personal motivation or willingness emerged in several interviews, indicating that a person has to be motivated to actually quit. Quitting smoking was viewed as hard, yet participants felt that if a person was motivated, they would try to quit. A female participant aged 65 years old was unsuccessful at quitting previously, but motivated to try again and making steps in that direction.

"And you know if you wanna do something, you gonna do it

because you wanna do it. Nobody can tell you to do it. You have to be the one to do it...I don't think you reading me a paragraph about quitting smoking is gonna help me. If I want to quit, I will quit. When [I have] things that I want to do, I do it. And if not smoking is one of the things I wanna do then I will do it." Female, 65 years old.

A few participants were hesitant in their responses, due to lack of motivation and also lacking alternatives to relieve stress.

"I'm not sure...The reason is I have to deal with my nerves after that. What's going to be better for my nerves? Smoking is to calm my nerves, but if I stop smoking, what's going to be better for my nerves?" Male, 64 years old.

"Because I ain't ready. I guess I got to be really ready and put it to my mind that's what I really want to do, and I think I'm not at that part where I'm ready to stop. I just slow down a little bit." Female, 60 years old.

LDCT lung cancer screening

Assessment of knowledge and attitudes towards LDCT revealed that 47% of the participants had lower knowledge and most had a positive attitude (Table 3). The mean score of LDCT knowledge was 4.3 (SD 2.6). The item difficulty ranged from 0% to 71% correct, and item uncertainty ranged from 21% to 78%. The two items assessing knowledge about the association between smoking and lung cancer and leading cause of cancer death (Items # 1 and #2) had higher proportions of correct responses. Several items had high levels of uncertainty (greater than 50%), suggesting that participants had lower knowledge about LDCT.

About half (53.3%) of participants perceived lung cancer risk as high, and screening was believed to be beneficial. As shown in Table 4, 92.9% of the participants, if asked today, would agree to a LDCT. About 53.3% of participants agreed that LDCT results showing no lung cancer would decrease worries about developing cancer. Participants also believed that they were at high risk for lung cancer. 86.7% of participants agreed that early detection of lung cancer would result in a good prognosis. In general, the beliefs about LDCT scans were positive. However, one third of participants agreed that they were scared by LDCT. In regards to the major concerns of LDCT Lung Cancer Screening, 92.9% agreed that accuracy was important, and 69.2% agreed that cost was an important factor in undergoing LDCT.

When asked "What made you choose to do a lung cancer

Table 3 LDCT lung cancer screening knowledge

Questions	Responses = Yes, n (%)	Responses = No, n (%)	Responses = DN, n (%)	Missing, n	Accurate, n (%)
1. About 85% of lung cancer deaths are caused by smoking?	1 (7.1)	10 (71.4)	3 (21.4)	1	10 (71.4)
2. Lung cancer rank as #1 cause of cancer death in the US?	0 (0.0)	10 (71.4)	4 (28.6)	1	10 (71.4)
3. About half of people with an abnormal CT scan will have lung cancer?	0 (0.0)	4 (28.6)	10 (71.4)	1	0 (0.0)
4. Can a CT scan suggest that you have lung cancer when you do not?	0 (0.0)	3 (21.4)	11 (78.6)	1	3 (21.4)
5. Can CT scan miss a tumor in your lungs?	2 (14.3)	2 (14.3)	10 (71.4)	1	2 (14.3)
6. Without screening, is lung cancer often found a later stage when cure is less likely?	0 (0.0)	7 (50.0)	7 (50.0)	1	7 (50.0)
7. Can CT scan find lung disease that is not cancer?	0 (0.0)	6 (42.9)	8 (57.1)	1	6 (42.9)
8. CT scan cannot find heart disease?	1 (8.3)	3 (25.0)	8 (66.7)	3	1 (8.3)
9. Lung cancer screening with a CT scan lower about 20% chances of dying from lung cancer?	1 (7.7)	6 (46.2)	6 (46.2)	2	6 (46.2)
10. Will all tumors found in the lungs grow to be life threatening?	1 (7.1)	3 (21.4)	10 (71.4)	1	1 (7.1)

Accurate rate for knowledge scores (n=11) (range, 1–8), mean =4.3; SD =2.6. LDCT, low dose computed tomography; DN, I don't know.

screening?”, participant responses usually fell into one of two categories: concern about lung health or doctor referral.

One participant who completed LDCT simply stated, “I wanted to find out did I have lung cancer.” Another participant opted for LDCT due to the unfavorable results of a previous X-ray.

“Because I had an X-ray that finally seen a spot on my lung, so that’s when we started doing the screening... my chest was bothering me, I thought it was a heart attack. When they gave me an X-ray, they seen a spot on my lungs. That’s what caused me to do the test.” Male, 65 years old.

In terms of doctor referral, doctors seemed to refer patients for the exam based on their smoking history.

“The doctor asked me to take one, since I’ve been smoking since I was 17. I’ve been smoking since I was 17, and I’m 58 now...” He actually said, “Since you’ve been smoking that long you need to take a test.” I said “Okay, I’ll take the test.” Male, 58 years old.

Some participants seemed unaware that they were doing the lung cancer screening, as if they did not consciously elect for the procedure. For example, participants stated “I didn’t choose it, the doctor [did]” or “They just told me to come down”. Instead, their providers scheduled the LDCT screening for them.

Those who had a record of a no show mentioned not being offered LDCT, as illustrated in the quotes below.

“It was never offered. I would rather have everything checked out, and if I do have a problem, I’d rather try to have it fixed

because I’ve been trying to have this fixed.” Male, 57 years old.

Participants who had not completed an LDCT screening were interested in scheduling the procedure. For example, a female participant aged 55 years old asked the interviewer, “Can you refer to my doctor that I need it done?”

LDCT results

Overall, participants did not mention receiving negative LDCT results, which led some participants to continue smoking. It appeared that some participants felt they could continue smoking until their results showed signs of cancer in their lungs.

“Well, the doctor preferred for me to get it every year to check my lungs... They said it wasn’t no problem, so I just continue on smoking. They don’t see nothing right now, so I just continue on smoking.” Male, 64 years old.

Here one participant described fear around receiving the screening results.

“It’s scary [the results]. It’ll scare me. Because like I said, I’m thinking about it now. I’m saying to myself, “Lord, what if this doctor sees something on my lungs? I can’t reach in there and get it.”” Male, 59 years old.

Timing of intervention with LDCT

Participants were asked “in your opinion when would be the best

Table 4 LDCT lung cancer screening attitude

Questions	n (%)
LDCT scan with no lung cancer will decrease worry about developing cancer	
Agree	8 (53.3)
Disagree	1 (6.7)
Neutral	6 (40.0)
LDCT scans scare me	
Agree	5 (33.3)
Disagree	3 (20.0)
Neutral	7 (46.7)
You believe that you are at high risk for lung cancer	
Agree	8 (53.3)
Disagree	2 (13.3)
Neutral	5 (33.3)
If you were asked today—you would agree to a LDCT scan	
Agree	13 (92.9)
Disagree	1 (7.1)
Neutral	0 (0.0)
Missing	1
You believe that early detection of lung cancer will result in a good prognosis	
Agree	13 (86.7)
Disagree	1 (6.7)
Neutral	1 (6.7)
Screening accuracy is important to you whether to have a LDCT	
Agree	13 (92.9)
Disagree	0 (0.0)
Neutral	1 (7.1)
Missing	1
Screening cost is important to you whether to have a LDCT	
Agree	9 (69.2)
Disagree	2 (15.4)
Neutral	2 (15.4)
Missing	2

LDCT, low dose computed tomography.

time for someone to talk to you about quitting smoking? Would it be before the screening or after the screening?” Two of the 15 participants said both before and after LDCT screening.

“Because you can tell me before the screening what I can do or what not to do or whatever, and then after the screening you can tell me what I can do properly so it won't happen again, so I said both of them.” Male, 59 years old.

However, more people said before, suggesting that their intention to quit was dependent on fear of negative LDCT results.

“That will prepare me for it, then let me know. Afterwards, I'd be smoking. If I know before, I already know what's going to happen. Can't wait until after.” Male, 65 years old.

“Before the screening...You just getting more information on it, prepare me for what could be, and hope it's not that, nothing [is] there.” Female, 64 years old.

Those that mentioned after felt, as previously mentioned, that they may not need counseling to quit if their results are fine. For example, one participant stated “then I would know what choices to take” as if a smoker couldn't take choices to quit irrespective of the LDCT screening. For these participants, their intention to quit was dependent on negative LDCT results.

“Well probably after...if I've already had the screening, I have results. And the results will tell me if I really really need to stop. So after, I wanna see what's first, or if there is anything wrong. And if there is something wrong, then I need to find out how to stop. But then that would scare me into not smoking at all anyway, if I'm dying the next day. But hopefully she would've told me that.” Female, 65 years old.

“I think after I'm doing a lung screening or a cancer screening, if I find out it's negative, then I would definitely think that would stop me from smoking.” Male, 62 years old.

Discussion

Quitting smoking and avoiding secondhand and third-hand smoke are the most effective approaches to reducing lung cancer risk (31). However, some smokers are still less likely to quit or less likely to successfully sustain a quit attempt. Smoking related disparities have been observed in African Americans, with African-Americans having higher incidence and mortality rates of lung cancer (3). In this study, about two-thirds of participants tried to quit smoking in the past

12 months and planned to quit smoking within the next 6 months. In addition, African American smokers who received LDCT lung cancer screening generally had low or very low nicotine dependence and were not heavy smokers. Another previous study also showed that African American smokers were less likely to meet established lung cancer screening eligibility criteria compared to Whites, because a lower percentage (16.5% *vs.* 33.0%) of them met the 30+ pack year smoking history criteria (6).

Researchers and smoking cessation programs have used several cessation approaches, including medication, quitline, counseling, and social media-based interventions (37). Other approaches include identifying “teachable moments” to increase quit rates, intent to quit, or readiness to quit (38,39). Previous studies have shown that the time of cancer diagnosis may be a teachable moment for smoking cessation (38). Thus, LDCT lung cancer screening may represent another teachable moment in assisting with smoking cessation among African American smokers. According to current guidelines, LDCT screening should be done annually until the patient no longer needs to be screened or no longer meets the screening criteria (8-10). It is important to know the characteristics of at-risk African American smokers undergoing LDCT screening. In this study, results showed that African American smokers who received LDCT had low knowledge of LDCT, but attitudes toward LDCT were relatively positive. However, accuracy and cost were identified as major concerns of LDCT, supporting the findings of previous studies (26). Recent studies also suggest that physicians’ knowledge and attitudes towards LDCT is associated with its utilization among patients (27,28).

Overall, participants did not report receiving negative LDCT results, which led some participants to continue smoking. It is interesting to note that negative LDCT test results may decrease motivation to quit among smokers. In this study, some participants felt that they could continue smoking until test results showed signs of cancer in their lungs. Previous studies have shown that patients are scared to know test results and take into consideration the possibility of over-diagnosis, false positive rates, and low positive predictive value (24). Future studies should examine how to appropriately integrate smoking cessation methods for patients undergoing LDCT lung cancer screening.

Conclusions

This study was a first step in exploring and addressing the smoking cessation needs of at-risk African American

smokers undergoing lung cancer screening. Results have the potential to expand our understanding of the ideal teachable moment, and identify barriers for a smoking cessation intervention in a lung cancer screening context. An understanding of the cognitive factors associated with smoking cessation among at-risk African American smokers will help reduce disparities in lung cancer burden, including incidence and mortality. This work has great potential to help reduce the enormous public health burden of lung cancer by improving the health of medically underserved minority populations.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Our study protocol was reviewed and approved by the Institutional Review Board of LSUHSC-NO (approval #10104). Participants were asked to give written informed consent to confirm that they understood the rights and privacy protection disclaimer before the interview.

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