

Interest in Lung Screening among a Sample of Adult Muslims in the United States

Omar F. Attarabeen^{*1}, Fadi Alkhateeb², Kevin Larkin³, Usha Sambamoorthi⁴, Michael Newton⁵ and Kimberly Kelly⁴

¹Department of Pharmacy Practice & Administration, School of Pharmacy and Health Professions, University of Maryland Eastern Shore.

²Associate Dean of Academic Affairs and Assessment, South College School of Pharmacy in Knoxville.

³Department of Psychology, Eberly College of Arts and Sciences, West Virginia University.

⁴Robert C. Byrd Health Sciences Center, Department of Pharmaceutical Systems and Policy, West Virginia University.

⁵Robert C. Byrd Health Sciences Center, Department of Clinical Pharmacy, West Virginia University.

Abstract

In general, Muslims in the United States are highly vulnerable to lung cancer due to exhibiting high rates of tobacco use. Fortunately, lung cancer mortality could be reduced by regularly undergoing preventive lung screening. Muslims' engagement with preventive lung screening is not studied in the literature.

This study investigated the associations between the Social Cognitive Theory factors and being interested in preventive lung screening in a sample of adult US Muslims.

A cross-sectional design was utilized to collect data from a convenience sample of adult US Muslims. An online survey collected data on smoking history, cognitive factors, social factors, and whether individuals are interested in undergoing lung screening. Binomial logistic regression analyses were conducted to identify the factors associated with having an interest in preventive lung screening.

Although 370 participants completed the survey, only 271 participants from 30 states met the eligibility criteria (≥ 18 years old Muslim individuals who live in the US). Based on smoking history, 16 participants were found eligible for preventive lung screening, but none of them ever had a screening at the time of data collection. Participants were more likely to express an interest in lung cancer screening if they had more positive attitudes about lung screening, a higher perceived value of screening, and greater self-efficacy regarding the ability to undergo lung screening.

The surveyed sample of US Muslims seemed to suffer from low uptake of preventive lung screening, which may indicate a low level of interest in preventive medicine in general. Addressing personal attitudes, perceived value of screening, and self-efficacy in future interventions could increase interest in preventive lung screening among adult US Muslims.

Keywords: Muslims, Lung Screening, Social Cognitive Theory, Environmental Factors, Religiosity.

Introduction

In the United States (US), lung cancer is the leading cause of cancer-related death and the second most commonly diagnosed cancer ⁽¹⁾. In fact, mortality attributed to lung cancer in the US exceeds mortality attributed to colorectal, breast, and brain cancers combined ⁽²⁾. The US Preventive Services Task Force (USPSTF) recommends annual preventive low-dose computed tomography (LDCT) screening for current and former smokers (unless they quit smoking more than 15 years ago) aged 50 to 80 years, and who have at least 20 pack-year smoking history ⁽³⁾. Although 7 million individuals in the US are expected to be eligible for LDCT, less than 4% of them have screened for lung cancer over the past few years ⁽⁴⁾. Individuals from minority groups exhibit lower survival rates due to lung cancer and more advanced stages at diagnosis compared with the general population ^(5,6).

As a minority group in the US, the Muslim population ranges between 3 and 7 million, and comprises one of the fastest growing minorities in the US because of high fertility rate and immigration ^(7,8,9). Because they exhibit high rates of tobacco use, US Muslims might be at a higher risk for lung cancer ^(10,11).

US Muslims are reported to seek alternative medicine such as spiritual healing in lieu of clinical care, or seek assistance and support from family members instead of healthcare professionals ⁽¹²⁾. Therefore, their readiness to engage in preventive health measures, such as lung screening, might be limited compared with the rest of the US population. Because US Muslim men exhibit higher rates of tobacco use compared to US Muslim women, US Muslim men might be at a higher risk for lung cancer ⁽¹³⁾.

*Corresponding author E-mail: ofattarabeen@umes.edu

Received: 8/12/2022

Accepted: 23/2/2023

This theory proposes that behavior is one of 3 components that interact during the decision-making process. Thus, cognitive and environmental factors influence behavioral decisions. According to the theory, cognitive factors in terms of lung screening include 5 constructs: **knowledge** about the screening, **outcome expectations** (i.e., perceived personal impact) of the behavior, **perceived value** of the behavioral consequences of the behavior, personal overall views (i.e., **attitudes**) regarding the behavior, and **self-efficacy** regarding the ability to complete the behavior. The model also includes 3 constructs in terms of environmental factors: **vicarious learning** (i.e., learning by imitation), **perceived social norms**, and **barriers and facilitators** to completing a particular behavior⁽¹⁴⁾.

Religiosity and acculturation are also environmental factors that may influence individuals' adoption of social norms. Religiosity refers to an individuals' degree of adherence to the beliefs, doctrines, and practices of a particular religion⁽¹⁵⁾. On the other hand, acculturation measures the level of compliance with the host cultural environment⁽¹⁶⁾. Thus, religiosity and acculturation can influence social norms, and therefore, influence behavior. Additionally, it is notable that the majority (63%) of US Muslims are foreign-born⁽¹⁷⁾. Thus, they may have distinct cognitive (e.g., beliefs) and environmental (e.g., social norms) factors compared to other Americans. Therefore, the SCT is believed to be ideal to utilize in this study due to its inclusion of cognitive and environmental factors that might be associated with interest in lung screening.

Previous research investigating the factors associated with being interested in lung screening is scant. Therefore, there was a need for a study that utilizes a comprehensive theoretical framework, such as the Social Cognitive Theory (SCT)⁽¹⁴⁾. Understanding the factors associated with interest in lung screening is essential in guiding efforts to improve adherence to this preventive screening among eligible individuals. To overcome the paucity of research on psychosocial factors that influence decisions to engage in lung cancer screening among US Muslims, the current research project investigated the association of psychosocial factors with being interested in lung screening in a sample of adult US Muslims using the SCT as a theoretical framework. The current study aimed to examine the SCT factors that are associated with interest in lung screening in a sample of adult Muslims in the US. The first objective was to investigate the associations between SCT factors and interest in lung screening in a sample of adult US Muslims. The second objective was to further address the impact of social norms by investigating the associations between interest in lung screening and religiosity as well as acculturation. The third objective was to

examine the interaction effect of sex and tobacco use history on interest in lung screening.

Materials and Methods

Design

A cross-sectional design was utilized to collect data from a convenience sample of adult US Muslims. After providing their informed consent online, participants completed an online survey using Qualtrics Software platform. The survey was available for participants to complete in English, Arabic, Farsi, and Urdu. Eligibility criteria included adult Muslims who reside in the US regardless to their smoking history. Children were excluded from the study (<18 years old). The survey collected data on smoking history, cognitive factors, social factors, and whether individuals are interested in undergoing lung screening. Binomial logistic regression analyses were conducted to identify the factors associated with having an interest in preventive lung screening.

Procedures

Using web-based search engines, an Internet search was conducted to identify Islamic centers and organizations in the US. Once Institutional Review Board approval was obtained at West Virginia University, an online advertisement, a cover letter, and a link to the survey were sent to these centers and organizations relying on the contact information that was available online for them. These centers and organizations were asked about their willingness to share the study information with members of their communities. Further, the online advertisement was posted on their Facebook webpages if they allowed the public to post ads. Data was collected in 2017. The questionnaire took approximately 15 minutes to complete.

Measures

The survey was part of a larger study that investigated tobacco use and smoking cessation among US Muslims. A copy of the entire survey is attached. It included 74 questions that were divided into 5 sections. These sections addressed tobacco use, smoking cessation, lung screening, personal as well as religious beliefs, and demographic characteristics, respectively. The survey was created by the authors. Then, the survey items were reviewed by a panel of field experts prior to data collection. Scoring of different scales and measures was explained in previous literature⁽¹³⁾.

The primary variable of interest (i.e., interest in lung screening) was assessed using an item that inquired about whether participants would be interested in being screened for lung cancer if it was made available to them for free, consistent with previous research⁽¹⁸⁾. In terms of cognitive factors, **knowledge** of lung cancer screening was measured using three items that assessed the efficacy, safety, and eligibility of screening. The answers consistent with the state of science were summed to a final

knowledge scale (0=least knowledge – 3=most knowledge). This method of assessing knowledge is consistent with previous research⁽¹⁹⁾. **Outcome expectations** were measured by assessing the perceived impact of lung screening on the respondent's personal health⁽²⁰⁾. Outcome Expectations were assessed on a scale from 1 (lowest) to 5 (highest), based on perceived personal impact of lung screening on surveyed individuals. **Perceived value** was measured by assessing participants' perceived importance of the screening consequences⁽²¹⁾. In addition, perceived value was assessed on a scale from 1 (lowest) to 5 (highest), based on perceived value and consequences, whether positive or negative, of screening on individuals. Overall opinions about lung screening were assessed in order to measure **Attitudes**⁽²²⁾, which were assessed on a scale from 1 (lowest) to 5 (highest), based on perceived personal overall views of preventive lung screening. Finally, using a continuous scale (0% – 100%), participants' confidence in their ability to undergo lung screening were measured in order to assess **self-efficacy**⁽²³⁾. More details on the assessment of these cognitive factors were explained in previous research⁽¹³⁾.

In terms of environmental factors, 2 items measured **vicarious learning** by assessing whether any first-degree family members or friends had ever undergone lung screening⁽²⁴⁾. Additionally, 2 items measured **social norms** by assessing the perceived appropriateness of lung screening among first-degree family members and friends⁽²⁵⁾. Responses to social norms items were assessed using a 5-point ordinal scale, and then transformed into a 3-point ordinal scale. The Brief Acculturation Scale and the Duke University Religion Index were used to measure acculturation and religiosity, respectively^(26,27). During analysis, however, overall scores for these 2 constructs were normalized to range from zero to 100. With regard to **barriers and facilitators**, one item was used for each to assess whether participants discussed lung screening with their physicians anytime during the past 12 months. Lung screening awareness was measured using one item that assessed whether participants had ever heard of "low-dose computer tomography"⁽²⁸⁾. Finally, the demographic characteristics were assessed following previous research⁽¹³⁾.

Statistical analysis

The bivariate associations between the primary variable of interest (i.e., interest in lung

screening) and SCT variables (i.e., cognitive and environmental factors) were individually examined using unadjusted binomial logistic regression analyses. The variables that demonstrated modest significance ($p \leq 0.1$) in the bivariate analyses were included in an adjusted binomial logistic regression model. Consistent with previous research investigating factors that are associated with interest in lung screening, all variables were entered into the model in one step⁽¹⁸⁾. Finally, because US Muslim men exhibit elevated rates of tobacco use compared to US Muslim women, binary logistic regression was conducted to examine the interaction effect of sex and tobacco use history on interest in lung screening⁽¹³⁾. For this purpose, tobacco use history was dichotomized into 2 categories: never used tobacco, and currently or formerly used tobacco. Finally, the association between eligibility for screening and interest in lung screening was examined with Chi-square analysis. Statistical analyses were completed with SPSS, version 23.

Results

Three hundred seventy participants completed the questionnaire, of which 98 participants did not meet the eligibility criteria (4 participants younger than 18 years old, 61 participants from outside the US, 25 participants did not affiliate with Islam, and 8 participants had a personal history of lung cancer). One duplicate record was identified. Eligible participants (n=271) completed the questionnaire in English (n=180), Arabic (n=88), Farsi (n=2), and Urdu (n=1). Due to missing data, however, the logistic model was conducted using data from only 262 participants. Respondents' ages ranged from 19 to 70 (median age = 32). The sample was fairly split between males and females (females=47%; males=53%). The majority of participants were married (78%), identified as white (72%), reported being employed (68%), and were foreign-born (60.2%). Three participants were Hispanic or Latino/a. In terms of tobacco use, 64.2% of participants reported being either former or current tobacco users. More than half of the sample (53.4%) had never heard of LDCT screening, yet the majority of participants (59.9%) were interested in completing lung screening. More detailed description of the demographic characteristics and associations with the primary outcome variable is shown in Table 1.

Table 1. Descriptive Statistics for Demographic Characteristics, Unadjusted Odds Ratios, 95% Confidence Interval, and Wald Chi-Square from Binary Logistic Regression on Interest in Lung Screening. Adult (≥ 18 years) Muslims in the United States.

		Interested in being Screened for Lung Cancer?		UOR (95% CI)	Wald	p-value
		No N=105 (40.1%)	Yes N=157 (59.9%)			
Demographic Characteristic						
Sex	Female	N=58 (46.8%)	N=66 (53.2%)	0.588 (0.357 – 0.967)	4.369	.037
	Male	N=47 (34.1%)	N=91 (65.9%)			
Age		M=36.36 (SD=11.81)	M=34.68 (SD=11.53)	0.988 (0.967 – 1.009)	1.307	.253
Marital Status	Married or living as married	N=82 (40.0%)	N=123 (60.0%)	1.015 (0.558 – 1.846)	0.002	.962
	Not married	N=23 (40.4%)	N=34 (59.6%)			
Race	White	N=71 (37.6%)	N=118 (62.4%)	1.449 (0.839 – 2.501)	1.772	.183
	Non-white	N=34 (46.6%)	N=39 (53.4%)			
Employment Status	Employed	N=72 (40.7%)	N=105 (59.3%)	0.925 (0.545 – 1.571)	0.082	.774
	Not employed	N=33 (38.8%)	N=52 (61.2%)			
Education (Scale from 1 – 4)		M=2.82 (SD=1.02)	M=2.90 (SD=1.03)	1.069 (0.839 – 1.360)	0.291	.590
Income (Scale from 1 – 9)		M=5.58 (SD=1.98)	M=5.20 (SD=1.94)	0.905 (0.796 – 1.029)	2.307	.129
Health insurance	No	N=11 (55.0%)	N=9 (45.0%)	0.520 (0.207 – 1.301)	1.953	.162
	Yes	N=94 (38.8%)	N=148 (61.2%)			
Self-assessed health (Scale from 0 – 100)		M=85.24 (SD=19.44)	M=81.74 (SD=18.79)	0.990 (0.977 – 1.004)	2.098	.148
Sect	Sunnah	N=45 (34.1%)	N=87 (65.9%)	1.657 (1.007 – 2.728)	3.945	.047
	Something else	N=60 (46.2%)	N=70 (53.8%)			
Awareness of LDCT	No	N=61 (43.6%)	N=79 (56.4%)	0.731 (0.444 – 1.202)	1.526	.217
	Yes	N=44 (36.1%)	N=78 (63.9%)			
Ever changed religion	No	N=96 (38.9%)	N=151 (61.1%)	2.359 (0.814 – 6.839)	2.499	.114
	Yes	N=9 (60.0%)	N=6 (40.0%)			
Tobacco use status	Current user	N=37 (39.4%)	N=57 (60.6%)	0.869 (0.510 – 1.482)	0.265	.607
	Former user	N=9 (30.0%)	N=21 (70%)			
	Non-user	N=59 (42.8%)	N=79 (57.2%)	[Reference]		
Eligibility for lung screening?	Eligible	N=98 (39.8%)	N=148 (60.2%)	0.851 (0.307 – 2.361)	0.096	.757
	Not eligible	N=7 (43.8%)	N=9 (56.3%)			

Based on age and smoking history, only 16 participants (5.9% of the sample) were eligible for LDCT screening. Only one of them was asked by their healthcare provider about lung screening during the 12 months prior to data collection. More importantly, none of them had completed screening at the time of data collection. Chi-square analysis demonstrated that there was no significant association between eligibility for screening and interest in lung screening. In terms of the cognitive factors, all variables were significantly related to interest in lung screening (a total of 5 variables) in

bivariate analyses are presented in Table 2. This confirms that importance of each cognitive factor, when examined separately from other factors, in the decision making process for the surveyed individuals. The association of knowledge with interest in lung screening in the unadjusted binary logistic regression model was noteworthy. The direction of association was contrary to what was expected based on the SCT, as individuals with more knowledge about lung screening reported being less interested in undergoing lung screening.

Table 2. Descriptive Statistics of Cognitive Factors, Unadjusted Odds Ratios, 95% Confidence Interval, and Wald Chi-Square from Binary Logistic Regression on Interest in Lung Screening. Adult (≥ 18 years) Muslims in the United States

	Interested in being Screened for Lung Cancer?		UOR (95% CI)	Wald	p-value
	No N=105 (40.1%)	Yes N=157 (59.9%)			
Cognitive Factor					
Knowledge (Scale from 0 – 3)	M=2.22 (SD=0.92)	M=1.45 (SD=1.03)	0.460 (0.349 - 0.606)	30.431	<.001
Expectations (Scale from 1 – 5)	M=2.11 (SD=0.95)	M=3.20 (SD=0.98)	3.094 (2.256 - 4.244)	49.089	<.001
Perceived value (Scale from 1 – 5)	M=1.83 (SD=1.01)	M=3.21 (SD=0.99)	4.852 (3.211 - 7.332)	56.226	<.001
Attitudes (Scale from 1 – 5)	M=2.64 (SD=1.06)	M=3.89 (SD=0.75)	3.436 (2.541 - 4.647)	64.257	<.001
Self-efficacy (Scale from 0 – 100)	M=38.93 (SD=24.22)	M=63.06 (SD=25.37)	1.037 (1.026 - 1.048)	41.646	<.001

Table 3 describes the environmental factors and explains the associations with interest in lung screening. Based on the findings, 4 environmental factors were significantly associated with interest in lung screening in bivariate analyses. However, when

the adjusted Odds Ratios were calculated, as shown in Table 4, none of these environmental factors were significantly associated with interest in lung screening.

Table 3. Descriptive Statistics of Environmental Factors, Unadjusted Odds Ratios, 95% Confidence Interval, and Wald Chi-Square from Binary Logistic Regression on Interest in Lung Screening. Adult (≥ 18 years) Muslims in the United States

		Interested in being Screened for Lung Cancer?		UOR (95% CI)	Wald	p-value
		No N=105 (40.1%)	Yes N=157 (59.9%)			
Environmental Factor						
Vicarious learning – Family	No	N=102 (41.0%)	N=147 (59.0%)	0.432 (0.116 – 1.610)	1.563	0.211
	Yes	N=3 (23.1%)	N=10 (76.9%)			
Vicarious learning – Friends	No	N=103 (42.6%)	N=139 (57.4%)	0.150 (0.034 - 0.661)	6.289	.012
	Yes	N=2 (10.0%)	N=18 (90.0%)			
Social norms – Family (Scale from 1 – 3)		M=2.10 (SD=0.44)	M=2.28 (SD=0.50)	2.204 (1.272 - 3.819)	7.935	.005
Social norms – Friends (Scale from 1 – 3)		M=2.06 (SD=0.41)	M=2.24 (SD=0.47)	2.623 (1.429 - 4.817)	9.679	.002
Religiosity (Scale from 0 – 100)		M=51.77 (SD=32.34)	M=62.71 (SD=32.39)	1.010 (1.003 - 1.018)	6.899	.009
Acculturation (Scale from 0 – 100)		M=56.57 (SD=29.20)	M=50.94 (SD=32.72)	0.994 (0.986 - 1.003)	1.826	.177
Discussion with Physician	No	N=99 (39.6%)	N=151 (60.4%)	1.525 (0.478 – 4.864)	0.509	.476
	Yes	N=6 (50.0%)	N=6 (50.0%)			

Abbreviations: N, Number, M, Mean, SD, Standard Deviation, UOR, Unadjusted Odds Ratio, CI, Confidence Interval, Wald, Wald Chi-square, Sig., Statistically Significant at a level of 0.05

Results from the adjusted binary logistic regression model (Table 4) demonstrated that the

likelihood of being interested in completing lung screening was higher in individuals with higher

scores of perceived value of the preventive lung screening ($p < 0.006$) with an adjusted odds ratio of 1.743 (95% confidence interval of 1.176 - 2.585). In addition, Individuals with more positive attitudes about lung screening ($p = 0.006$) were more likely to have an interest in lung screening. The adjusted odds ratio was 2.296 (95% confidence interval of 1.384 -

3.809). Finally, the likelihood of being interested in completing lung screening was higher in individuals who reported greater self-efficacy with regard to the ability to undergo lung screening ($p = 0.010$) with an adjusted odds ratio of 1.018 (95% confidence interval of 1.004 - 1.032).

Table 4. Adjusted Odds Ratios, 95% Confidence Interval, and Wald Chi-Square from Binary Logistic Regression on Interest in Lung Screening. Adult (≥ 18 years) Muslims in the United States

	AOR (95% CI)	Wald	p-value	Sig.
Demographic Characteristics				
Sex				
	Female	0.740 (0.349 - 1.572)	0.612	.434
	Male	[Reference]		
Sect				
	Sunnah	1.131 (0.457 - 2.799)	0.071	.791
	Something else or nothing in particular	[Reference]		
Cognitive Factors				
	Knowledge	0.695 (0.466 - 1.037)	3.180	.075
	Expectations	1.472 (0.968 - 2.237)	3.267	.071
	Perceived value	1.743 (1.176 - 2.585)	7.643	.006 *
	Attitudes	2.296 (1.384 - 3.809)	10.353	.001 *
	Self-efficacy	1.018 (1.004 - 1.032)	6.571	.010 *
Environmental Factors				
Vicarious learning – Friends				
	No	0.237 (0.029 - 1.916)	1.824	.177
	Yes	[Reference]		
	Social norms - Family	0.567 (0.172 - 1.867)	0.871	.351
	Social norms - Friends	0.785 (0.222 - 2.784)	0.140	.708
	Religiosity	1.006 (0.993 - 1.020)	0.773	.379
Abbreviations: AOR, Adjusted Odds Ratio, CI, Confidence Interval, Wald, Wald Chi-square, Sig., Statistically Significant at a level of 0.05				

Finally, the results of binary logistic regression analysis that addressed the interaction effect between sex of respondent and tobacco use history on interest in lung screening demonstrated that the interaction was not statistically significant ($p = .455$).

Discussion

This study aimed to investigate the associations between SCT factors and interest in being screened for lung cancer in a sample of adult US Muslims. Due to the important association between preventive cancer screening and religiosity and acculturation, the associations between interest in being screened for lung cancer and religiosity as well as acculturation were also investigated^(29,30). More than half of the respondents have never heard of LDCT lung screening. This may indicate low health literacy among participants, which may partially explain why only 59.9% were interested in being screened for lung cancer even if it were made available to them.

Even though 16 participants in our sample were eligible to be screened based on age and smoking history, none of them had undergone lung screening, which indicated that this preventive health measure was not widely being utilized by participants in the study sample. One possible

explanation for this finding might be a lack of effective patient-provider communication, as only one out of those 16 individuals was asked by their healthcare provider about lung screening. Another explanation might be that physicians are not aware of the lung screening guidelines, or are still reluctant to endorse such a relatively new recommendation. Thus, more physicians will need to be encouraged to adopt the practice of recommending lung screening once it is more widely used by leading healthcare institutions. Our last interpretation is that physicians might give their attention to medical issues they believe have higher priority, such as smoking cessation. Therefore, they might spend time during healthcare encounters assisting smokers to quit, rather than convincing them to undergo lung screening. This interpretation is supported by a finding from another study on US Muslim smokers, in which the majority (79.5%) of smokers reported discussing smoking cessation with their healthcare providers⁽³¹⁾. It is noteworthy that 12 out of those 16 screening-eligible participants were men, which can be explained by higher rates of tobacco use in US Muslim men compared to US Muslim women.

Our results revealed that participants' attitudes toward lung screening, perceived value of the screening consequences, and self-efficacy regarding the ability to complete screening significantly influenced their interest in undergoing

lung screening. The direction of association for these factors with screening was consistent with previous research^(32, 34, 35). This emphasizes the key influence of individuals' cognitive factors on interest in lung screening among US Muslims.

The relative lack of association between interest in being screened for lung cancer and any environmental factors was a noteworthy observation. This finding, however, was not in line with previous research findings regarding other types of cancer. In terms of screening for breast and cervical cancers, for instance, previous research has cited cultural and religion-related factors to influence screening rates for US Muslims compared to other groups comprising the US population^(36,37). Therefore, the relative lack of association between environmental factors and interest in lung screening indicates that participants may have thought of lung screening as a personal decision to make after consulting with healthcare providers, and therefore, the social environment had little or no influence on this decision. This observation aligns with the theoretical foundations of certain individual health behavior theories, such as the Health Belief Model, that suggests that preventive healthcare-related decisions (i.e., uptake of preventive health services) are influenced exclusively by cognitive factors such as perceived benefits and self-efficacy⁽³⁸⁾. Another interpretation might be related to the relative recency of lung screening guidelines and low screening rate among eligible individuals, which results in a lack of role models from whom individuals can vicariously learn the behavior^(3, 4).

The association of knowledge with interest in lung screening in the unadjusted binary logistic regression model was noteworthy. The direction of association was contrary to what would be expected based on the SCT, as individuals with more knowledge about lung screening reported being less interested in undergoing lung screening. The unexpected direction of association might be related to the method knowledge was measured in this study. The answers consistent with the state of science for the 3 items that assessed knowledge happened to be in the negative. Therefore, some individuals may have scored higher on the knowledge scale due to their pessimistic views or fatalistic attitudes about lung screening, not because of their true knowledge about it. Another possible explanation for this finding is that individuals who were knowledgeable of lung screening were also aware of potential harm that can be associated with it, such as the risk of false-positive results⁽³⁹⁾. Worrying about such risks may have deterred individuals from wanting to screen, and therefore, made them hold fatalistic beliefs about lung cancer. Other studies also cited fatalism and worry about negative consequences as potential barriers to lung screening^(32,40,41). Nevertheless, when the effect of other cognitive and environmental factors was

adjusted for in the logistic regression model, the association between interest in lung screening and knowledge was no longer significant. This may indicate that other factors, such as overall views about the screening and perceived value of the consequences of screening, are more influential in the decision-making process regarding undergoing screening than knowledge of lung cancer screening.

The current study has certain limitations. First, recruitment was conducted online and it was voluntary. Therefore, the number of individuals who were given the chance to participate could not be estimated, and therefore, the response rate would not be measured. Second, due to sampling techniques, the majority of participants were younger than 55, and therefore, findings might not be generalizable to individuals who are eligible for lung screening. Third, the cross-sectional design hindered our ability to identify any causal relations between variables. Fourth, although lung screening is associated with a 16% reduction in lung cancer-related mortality among eligible individuals, it is only a "B" recommendation by the USPSTF, meaning that there is "moderate certainty that annual screening for lung cancer with LDCT has a moderate net benefit" in eligible individuals"^(3,39). Therefore, some of the observed findings might be explained by healthcare providers not perceiving this recommendation favorably. Fifth, construct validity is a concern for the knowledge scale due to the way it was measured as explained above. On the other hand, this study was the first study to investigate the SCT factors that are associated with interest in lung screening among adult Muslims in the US. Additionally, the study utilized a sound theoretical framework that allowed for a thorough review of the associations with the interest in lung screening. Including such a comprehensive theoretical framework was advantageous because the majority of participants were foreign-born. Therefore, they may have distinct health behavior attitudes due to different cultural backgrounds.

Conclusion

This study has presented important findings with regard to interest in lung screening among US Muslims. The study results demonstrated that the interest in completing preventive lung screening was higher in individuals who perceived the screening to be more valuable, who had more positive attitudes about the screening, and who reported greater self-efficacy with regard to the ability to undergo the screening.

This study might be a basis for future research into the development and evaluation of interventions that aim to improve adherence to preventive health measures, such as preventive lung screening. Such interventions can be based on demonstrating the benefits of LDCT screening, demonstrating the value of screening, and assisting and increasing individuals' confidence in their

ability to complete the screening. Future research aiming to increase lung screening rates among eligible individuals may elect to manipulate these cognitive factors, perhaps by educating patients to enhance the perceived value of screening benefits, modify their personal views about screening, and reduce the impact of perceived barriers in order to boost individuals' self-efficacy.

Acknowledgment

Thanks to Omar Abu Abed, Simin Falsafi, Ali Fakhimi, and Maleeha Hassan for assisting in translating the questionnaire. Additionally, many thanks to Dr. Derek Stewart for his invaluable assistance in preparing this manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethics Statement

The institutional Review Board at West Virginia University reviewed & approved this study.

Conflict of Interest

The authors declare that they have no conflict of interest.

Author Contribution

Omar F. Attarabeen: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration. **Fadi Alkhateeb:** Methodology, Resources, Data Curation, Writing - Original Draft. **Kevin Larkin:** Conceptualization, Methodology, Investigation, Writing - Original Draft. **Usha Sambamoorthi:** Methodology, Formal analysis, Investigation, Writing - Original Draft, Visualization. **Michael Newton:** Conceptualization, Methodology, Formal analysis, Visualization. **Kimberly Kelly:** Conceptualization, Methodology, Formal analysis, Resources, Writing - Original Draft.

References

1. Sayedd S. Tobacco use among NYC Muslims: results of the Nafis salaam community survey. *J Islam Med Ass N America* 2011;43(1):10-22.
2. Newport F, Himelfarb I. In US, strong link between church attendance, smoking. Gallup Incorporation, 2013.
3. Padela AI, Killawi A, Forman J, DeMonner S, Heisler M. American Muslim perceptions of healing: key agents in healing, and their roles. *Qual Health Res* 2012;22(6):846-858.
4. Attarabeen O, Alkhateeb F, Larkin K, Sambamoorthi U, Newton M, Kelly K. Tobacco use among adult Muslims in the United States. *Subst Use Misuse* 2019;54(8):1385-1399.
5. Abdullah SM. Social cognitive theory: A Bandura thought review published in 1982-2012. *Psikodimensia* 2019;18(1):85-100.
6. Dube, LF & Wingfield, SS. Economics, Sociology, Politics, and Religion: Success of Marketing Students. *Atlantic Economic Journal* 2008;36:503-504.
7. Hui K, Lent RW, Miller MJ. Social cognitive and cultural orientation predictors of well-being in Asian American college students. *Journal of Career Assessment* 2013;21(4):587-598.
8. Heimlich R. Muslim Americans: No signs of growth in alienation or support for extremism. 2011.
9. Hahn EJ, Rayens MK, Hopenhayn C, Christian WJ. Perceived risk and interest in screening for lung cancer among current and former smokers. *Res Nurs Health* 2006;29(4):359-370.
10. Flynn LR, Goldsmith RE. A short, reliable measure of subjective knowledge. *Journal of Business Research* 1999;46(1):57-66.
11. Borland R, Yong H, Balmford J, Cooper J, Cummings KM, O'Connor RJ, et al. Motivational factors predict quit attempts but not maintenance of smoking cessation: findings from the International Tobacco Control Four country project. *Nicotine Tobacco Res* 2010;12(suppl_1):S4-S11.
12. Shrier LA, Rhoads A, Burke P, Walls C, Blood EA. Real-time, contextual intervention using mobile technology to reduce marijuana use among youth: A pilot study. *Addict Behav* 2014;39(1):173-180.
13. Hyland A, Borland R, Li Q, Yong H, McNeill A, Fong GT, et al. Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2006 Jun;15 Suppl 3(Suppl 3):iii83-94.
14. Perkins KA, Parzynski C, Mercincavage M, Conklin CA, Fonte CA. Is self-efficacy for smoking abstinence a cause of, or a reflection on, smoking behavior change? *Exp Clin Psychopharmacol* 2012;20(1):56.
15. Kandel DB, Kiros G, Schaffran C, Hu M. Racial/ethnic differences in cigarette smoking initiation and progression to daily smoking: a multilevel analysis. *Am J Public Health* 2004 Jan;94(1):128-135.
16. Panday S, Reddy S, Ruiter R, Bergström E, Vries H. Determinants of smoking cessation among adolescents in South Africa. *Health Education Research* 2005;20(5):586-599.
17. Meredith LS, Wenger N, Liu H, Harada N, Kahn K. Development of a brief scale to measure acculturation among Japanese Americans. *Journal of Community Psychology* 2000;20(1):103-113.
18. Koenig HG BA. The Duke University Religion Index (DUREL): a five-item measure for use in epidemiological studies. *Religions* 2010;1(1):78-85.

19. Guadagnolo BA, Cina K, Helbig P, Molloy K, Reiner M, Cook EF, Petereit DG. Assessing cancer stage and screening disparities among Native American cancer patients. *Public Health Reports* 2009;124(1):79-89.
20. Allen JD, Leyva B, Torres AI, Ospino H, Tom L, Rustan S, et al. Religious beliefs and cancer screening behaviors among Catholic Latinos: implications for faith-based interventions. *J Health Care Poor Underserved* 2014 May;25(2):503-526.
21. Echeverria SE, Carrasquillo O. The roles of citizenship status, acculturation, and health insurance in breast and cervical cancer screening among immigrant women. *Med Care* 2006;788-792.
22. Attarabeen O, Alkhateeb F, Sambamoorthi U, Larkin K, Newton M, Kelly K. Impact of Cognitive and Social Factors on Smoking Cessation Attempts among US Adult Muslim Smokers. *Innovations in Pharmacy* 2020;11(3).
23. Quaife SL, Marlow LA, McEwen A, Janes SM, Wardle J. Attitudes towards lung cancer screening in socioeconomically deprived and heavy smoking communities: informing screening communication. *Health Expectations* 2017;20(4):563-573.
24. Lillie SE, Fu SS, Fabbrini AE, Rice KL, Clothier B, Nelson DB, et al. 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.
25. Farraye FA, Wong M, Hurwitz S, Puleo E, Emmons K, Wallace MB, et al. Barriers to endoscopic colorectal cancer screening: are women different from men? *Official journal of the American College of Gastroenterology* | *ACG* 2004;99(2):341-349.
26. Lechner L, De Vries H, Offermans N. Participation in a breast cancer screening program: influence of past behavior and determinants on future screening participation. *Prev Med* 1997;26(4):473-482.
27. Padela AI, Murrar S, Adviento B, Liao C, Hosseinian Z, Peek M, Curlin F. Associations between religion-related factors and breast cancer screening among American Muslims. *Journal of immigrant and minority health* 2015;17(3):660-669.
28. Padela AI, Peek M, Johnson-Agbakwu CE, Hosseinian Z, Curlin F. Associations between religion-related factors and cervical cancer screening among Muslims in greater Chicago. *Journal of lower genital tract disease* 2014;18(4):326.
29. Janz N, Becker M. The health belief model: A decade later. *Health Education Quarterly* 1984;11(1):1-47.
30. Pinsky PF, Church TR, Izmirlian G, Kramer BS. The National Lung Screening Trial: results stratified by demographics, smoking history, and lung cancer histology. *Cancer* 2013;119(22):3976-3983.
31. Jonnalagadda S, Bergamo C, Lin JJ, Lurslurchachai L, Diefenbach M, Smith C, et al. Beliefs and attitudes about lung cancer screening among smokers. *Lung Cancer* 2012;77(3):526-531.
32. Carter-Harris L, Brandzel S, Wernli KJ, Roth JA, Buist DS. A qualitative study exploring why individuals opt out of lung cancer screening. *Fam Pract* 2017;34(2):239-244..
33. Xia C, Dong X, Li H, Cao M, Sun D, He S, et al. Cancer statistics in China and United States, 2022: profiles, trends, and determinants. *Chin Med J* 2022;135(05):584-590.
34. Siegel RL, Miller KD, Fuchs HE, Jemal A. *Cancer Statistics, 2021*. *CA Cancer J Clin* 2021 Jan;71(1):7-33.
35. Krist A, Davidson K, Mangione C, Barry M, Cabana M, Caughey A, et al. Screening for lung cancer: US Preventive Services Task Force recommendation statement. *JAMA* 2021;325(10):962-970.
36. Jemal A, Fedewa SA. Lung cancer screening with low-dose computed tomography in the United States—2010 to 2015. *JAMA oncology* 2017;3(9):1278-1281.
37. Schwartz KL, Crossley-May H, Vigneau FD, Brown K, Banerjee M. Race, socioeconomic status and stage at diagnosis for five common malignancies. *Cancer Causes & Control* 2003;14(8):761-766.
38. Wisnivesky JP, McGinn T, Henschke C, Hebert P, Iannuzzi MC, Halm EA. Ethnic disparities in the treatment of stage I non-small cell lung cancer. *American journal of respiratory and critical care medicine* 2005;171(10):1158-1163.
39. Wormald B. *The Future of World Religions: Population Growth Projections, 2010-2050*. Pew Research Center's Religion & Public Life Project 2015.
40. 2010 World Muslim population. *Proceedings of the 8th Hawaii international conference on arts and humanities*; 2010.
41. Mohamed B. *A new estimate of the US Muslim population*. 2016.



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).