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Deaf patient-provider communication and lung cancer screening: Health Information National Trends survey in American Sign Language (HINTS-ASL)

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ABSTRACT

Objective: To assess whether mode of communication and patient centered communication (PCC) with physicians were associated with the likelihood of deaf smokers inquiring about lung cancer screening.
Methods: An accessible health survey including questions about PCC, modes of communication, smoking status and lung cancer screening was administered in American Sign Language (HINTS-ASL) to a nationwide sample of deaf adults from February to August 2017. Of 703 deaf adults who answered the lung screening question, 188 were 55–80 years old.
Results: The odds ratio of asking about a lung cancer screening test was higher for people with lung disease or used ASL (directly or through an interpreter) to communicate with their physicians. PCC was not associated with asking about a lung cancer screening test.
Conclusion: Current or former smokers who are deaf and use ASL are at greater risk for poorer health outcomes if they do not have accessible communication with their physicians.
Practice implications: Optimal language access through interpreters or directly in ASL is critical when discussing smoking cessation or lung cancer screening tests. Counseling and shared decision-making will help improve high-risk deaf patients' understanding and decision-making about lung cancer screening.

1. Background

1.1. Introduction

In the U.S., tobacco products inhaled into the lungs are the greatest preventable cause of death. Smoking causes almost nine out of ten lung cancer deaths [1]. Using data from a 2015 national survey, it was estimated that over 50% of cigarette smokers were motivated to quit, but less than ten percent followed through, leaving a sizable group that may benefit from adhering to lung cancer screening recommendations [2].

Low-dose computed tomography (LDCT) screening has been proposed as an early detection tool for those at high risk [3]. The U. S. Preventive Services Task Force (USPSTF) recommends that former and current smokers between the ages of 55 and 80 who have a 30 pack-year history and currently smoke or have quit within the past 15 years, receive an annual CT scan for early lung cancer detection. Limiting screening to these criteria was deemed by USPSTF to have a reasonable balance of benefits (early detection and treatment) and harms (incidental findings and over-diagnosis). Given the existence of these harms, patients must be must be involved in an informed discussion of the possible benefits, limitations, and known and uncertain harms before a decision is made to begin screening.

In a recent study of 3677 adults who participated in the 2014 Health Information National Trends survey, 795 adults aged 55 to 80 were former or current smokers. Among smokers, only 10% had asked their healthcare providers about lung cancer screening within the past year [4]. In other studies, focusing on care after lung cancer screening tests, patient-physician discussions about the lung cancer treatment and follow-up smoking cessation sessions through telephone-based communication were found to be associated with greater compliance to lung cancer-directed therapy among diagnosed patients [5] and smoking cessation among individuals who were not diagnosed with lung cancer after LDCT screening test [6]. Physicians' recommendations influence screening and patient-physician communication influences post-LCDT care, making it reasonable to hypothesize that physicians

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who provide accessible, patient-centered communication (PCC) techniques will facilitate access to lung cancer screening in the deaf population.

1.2. Smoking prevalence among deaf adults who use American Sign Language

Among deaf adults who use American Sign Language (ASL), little is known about their smoking prevalence and predicted risk factors. Nearly two decades ago, a study that used a secondary analysis of a national dataset found that the smoking prevalence among deaf adults was lower than for hearing adults [7]. While the smoking prevalence did not vary across education and income levels in their deaf adult sample, the lower smoking rate may either be a result of under-reporting or inaccessibility of orally delivered tobacco-related advertising.

In a 2008 Deaf Health Survey with Rochester, NY-based adult sample (n = 339) and 2013 (n = 211), 9.1% and 8.1% respectively self-identified as current smokers [8]. Another study in Chicago reported an even higher smoking rate among 203 deaf signers, with over half (52.5%) being current or former smokers [9]. It should be noted that the Rochester study had adults with higher levels of education compared to their counterparts in the Chicago study.

In health care, there is a stigma associated with disclosure of smoking status. Although patients can be highly motivated to quit smoking, they do not necessarily engage their providers in discussions about lifestyle changes, mainly due to fear of judgment, and refusal of continued treatment by the physician [10]. If a patient with a smoking history is also deaf and simultaneously experiences communication difficulties with healthcare providers, this can potentially increase the likelihood of the patient *failing to share* their smoking history or asking lung cancer-related questions.

1.3. Patient centered communication

PCC might affect the lung cancer screening test inquiry by deaf patients who are current or former smokers. PCC is critical in that it can significantly improve health outcomes [11], while reducing the cost of health care [12]. Higher perceived PCC scores have been correlated with a greater likelihood of patients asking their doctors questions. Furthermore, Street et al. [11] found that effective doctor-patient communication led to "increased access to care, greater patient knowledge and shared understanding, higher quality medical decisions, enhanced therapeutic alliances, increased social support, patient agency and patient empowerment." Clear communication is key to promoting disease prevention and early detection behaviors, such as smoking cessation and lung cancer screening (Fig. 1).

Research suggests that communication between deaf patients and physicians is suboptimal, which could lower the likelihood of a deaf patient being informed about lung cancer screening, particularly if deaf patients withhold their history of smoking. The deaf population, by virtue of communication and linguistic differences within the mainstream culture, has an increased likelihood of poor doctor-patient communication and reduced satisfaction with care. Bartlett et al. [13] found that patients with communication problems were three times more likely to experience a preventable adverse event than patients without communication problems.

Patient safety has been severely compromised in cases where communication was inadequate [14]. Patients reported not understanding their doctor's advice, receiving insufficient medication

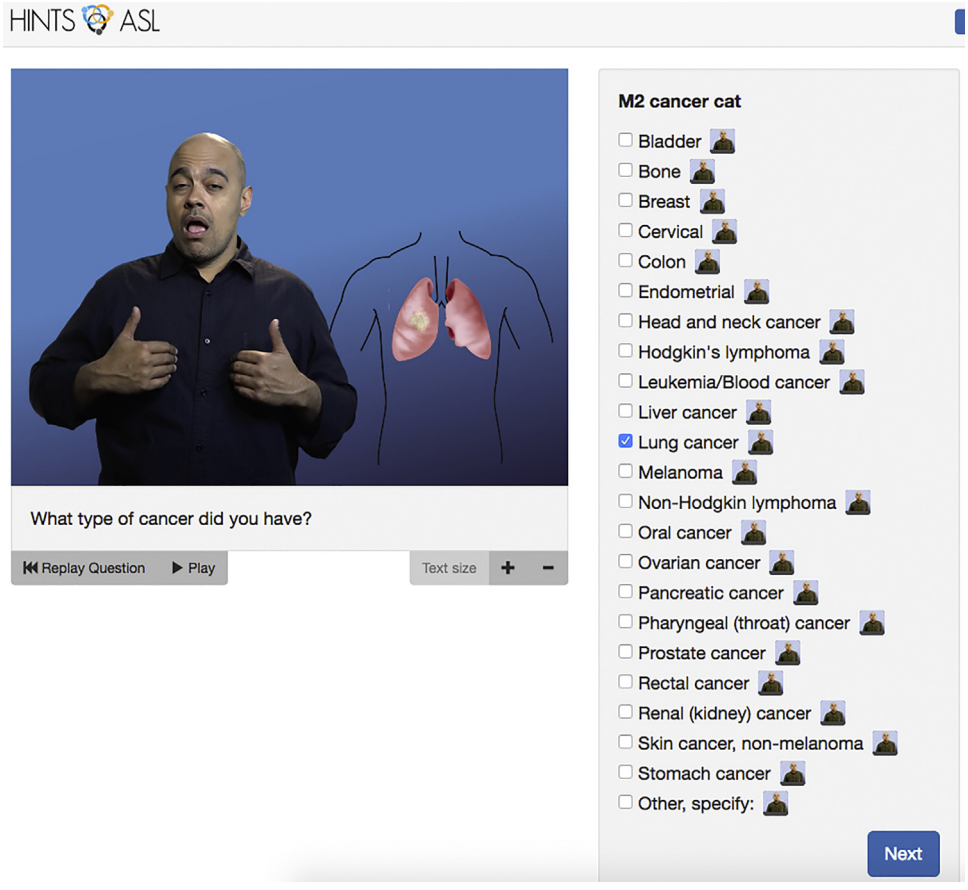

Fig. 1. Lung cancer answer option with medical illustration.

information and instructions, and experiencing uncertainty about how their case was being managed. Patients with hearing loss had lower ratings of patient-physician communication relative to patients without significant hearing loss [15]. Pregnant deaf women were less satisfied with prenatal care and doctor-patient communication [16]. Even in the Netherlands, which boasts a greater than 90% satisfaction with doctor-patient interactions [17], a sample of 32 deaf patients of 26 different general practitioners evaluated communication as "good" only 13% of the time [18].

1.4. Research questions and hypotheses

It is likely that current or past smokers who are deaf and use ASL may be at greater risk for poorer health outcomes if they do not perceive patient-physician communication to be accessible or satisfactory. Although public health surveillance suggests the presence of health disparities among deaf people who use ASL, there are no national data on smoking rates for this population [19].

In an attempt to fill this gap, an all-deaf research team, fluent in ASL, gathered health data from deaf people across the USA. This study examined the prevalence of current/former smokers. In addition, the perceived level of PCC and patient-physician mode of communication were analyzed for possible relationships with the likelihood of asking doctors questions about lung cancer screening.

Given the communication barriers that exist in the deaf population, effective PCC was hypothesized to be predictive of doctor-patient lung cancer screening discussions. Deaf people aged 55–80 who were former or current smokers and reported higher PCC scores were more likely to inquire about lung cancer screening. The mode that deaf patients use to communicate with physicians may also influence the likelihood of lung cancer screening discussions. Being able to communicate in one's preferred language may facilitate doctor-patient lung cancer screening conversations. Such conversations are even more important for deaf people because most mainstream public health smoking campaigns are inaccessible to deaf people. In this study, the following hypothesis was tested:

Using ASL to communicate with the provider (directly or through interpreter) and better patient centered communication scores are associated with asking about lung cancer screening (primary study outcome measurement).

2. Methods

The Health Information National Trends survey (hints.cancer.gov) in ASL [20] was administered to a nationwide sample of deaf adults from February to August 2017. Given that the recommended age range for lung cancer screening is 55–80, our analysis focused on this age range.

Smoking status: Participants were asked, "*What is your smoking status . . .* " with three response options provided: 1) never smoked, 2) former smoker, 3) current smoker.

Lung cancer test: A single question was used to gather information about the deaf person's lung cancer-related communication with his or her health care professional: *At any time in the past year, have you talked with your doctor or other health professional about having a test to check for lung cancer?* The responses included yes, no, and don't know.

Patient centered communication:PCC scores on a 100-point scale were calculated based on a transformation of the mean item score from the person's responses [never (1) to always (5)] to six items: *How often did the doctors, nurses, or other health care professionals you saw during the past 12 months do each of the following:*

1) Give you the chance to ask all the health-related questions you had?.
2) Give the attention you needed to your feelings and emotions?.
3) Involve you in decisions about your health care as much as you wanted?.
4) Make sure you understood the things you needed to do to take care of your health?.
5) Help you deal with feelings of uncertainty about your health or healthcare?.
6) In the past 12 months, how often did you feel you could rely on your doctors, nurses, or other health care professionals to take care of your health care needs?.

Modes of patient-physician communication: Deaf respondents were asked to select a mode that they used the most frequently with a health care professional that they saw the most. Response options included 1) ASL directly or through interpreter and 2) speaking/speechreading/writing.

2.1. Participant recruitment, consenting and other study procedures

Following IRB approval, the research staff began recruitment through national channels, focusing on ASL-using Deaf community members. Given the nature of this low-incidence and hard-to-reach population, a purposive strategic, respondent-driven sampling method was used to ensure adequate inclusion of deaf signers across the USA, including Hawaii and Alaska, with respect to key demographic characteristics such age, education, race/ethnicity, gender and sexual identity. Recruitment methods included snowball sampling through personal networks [21], flyers, and advertisements on deaf-centered organizations' websites and e-newsletters. Communication occurred through accessible channels, including mail, email, social media, and videochat programs. Prospective participants were informed that the survey included questions about health status, health communication, and health behaviors. We included only those who self-reported using ASL as their primary language, and excluded those under the age of 18 years old and those who had unilateral hearing loss. Each participant received a gift card for participating in the study.

If the participant met with research staff remotely, ASL instructions were given through a videoconferencing method and a survey link was emailed to the participant. Research staff remained visible to the participant through videoconferencing and was readily available to answer questions or troubleshoot as the participant progressed through the consent document and survey. For on-site administration, if the participant did not feel comfortable watching the ASL question as signed on the pre-recorded video, research staff repeated and signed the question for the participant. For some participants, such as those with low vision or who did not feel comfortable with self-administration on a computer, research staff signed all the questions and response options and recorded the participants' responses on the computer. The survey took approximately 1 h to complete. Respondents were allowed to stop anytime. No names or identifying information were included in the online survey, and a unique identifier was used to avoid storing personal information in the same online survey dataset. The identifying information was stored in a separate database that was accessible only to the principal investigator.

2.2. Statistical analyses

Based on power analysis using G*Power 3.1, a sample size of 127 should yield a power of around 0.80 and a medium effect size ($f^2 = 0.15$) in a multiple regression with 12 predictors. The sample size of 188 in this study should provide adequate power to detect statistical significance. Descriptive statistics were used to summarize the sample characteristics. Chi-square tests were used to describe the relationships among the variables. Un-weighted

descriptive statistics, such as cross-tabulation and percentage procedures, were used to describe the sample. Regression analysis was used to construct the best predictive model to provide an estimate of the person's likelihood of lung cancer test inquiry outcome. Model validation with regular bootstrapping was used to estimate performance for the final chosen model.

For the logistic regression analyses, the first model had all socio-demographics and main predictors (Model 1). Variables that had a p value of .10 or lower were retained for evaluation in the second model with an interaction of patient centered communication (PCC) and patient-physician communication modes added to the model (Model 2). The third model would include only the variables from model two that had a p value of .10 or lower (Model 3). Each model was evaluated for goodness-of-fit and strength of association to determine the final model that best predicted the lung cancer test inquiry outcome. Bootstrapping was used to calculate confidence intervals. SPSS 24.0 statistical program was used for all analyses.

3. Results

3.1. Sample description

Of the 703 participants accrued to the survey, 188 participants were aged 55 to 80 and answered all of the survey questions needed for this study. Within this subsample, 2.1% were current smokers and 34.6% were former smokers. Table 1 displays an unweighted summary of the demographic data for 188 participants aged 55–80. This sample included 9.6% who self-identified as lesbian, gay, or bisexual; 17.6% were people of color.

When asked about the hearing status of the respondent's parents, 21.8% of nonsmokers and 21.7% of former/current smokers reported having at least one deaf parent. Nearly 97% reported having health insurance coverage, which includes employer-supported insurance, private insurance, and Medicare/Medicaid of which many deaf people are eligible for through SSI/SSDI. Approximately 57% of nonsmokers and 55% of former/current smokers reported having a health care provider that they see regularly. About 81% of nonsmokers and 86% of former/current smokers rated their health as "good" or "very good."

Chi-square results in Table 2 indicated that significantly higher number of former/current smokers have talked about their own health with friends or family ($X^2 = 7.57$, $p < .01$) as well as asked doctors about a lung cancer test ($X^2 = 25.56$; $p < .001$), compared to those without a history of smoking. When the groups were separated by the mode of communication that they used with their doctors, only 9% (2/22) of former/current smokers who did *not* use ASL directly or through interpreters had asked their doctors about lung cancer screening. Among former/current smoker who used ASL during doctor visits, 32% (15/47) asked about lung cancer screening. No group differences emerged for family history of cancer and all other socio-demographic variables.

Multiple logistic regressions were performed to examine the effects of age, gender, race/ethnicity, education, existing lung disease, family history of cancer, personal history of cancer, discussion about their own health with family or friends, health insurance, regular provider, communication modes used with their healthcare provider, smoking status, and patient centered communication on the likelihood of asking doctors about lung cancer screening.

3.2. Assessment of models' fit

In Model 1, all socio-demographic variables were included in the analysis. For Model 2, significant as well as nominally significant variables from the first model were retained for evaluation (age, lung disease diagnosis, communication mode used with healthcare provider, and smoking status). The variable of interest, patient centered communication, was also retained. A new interaction term (PCC * communication mode used with healthcare provider) was added to Model 2. In this model, the interaction term was not found to be significant.

For Model 3, the interaction term and other non-contributing variables were removed. Predictors at p-value of .10 or lower were retained in this model. Although the third logistic regression model was statistically significant ($\chi^2(5) = 32.266$, $p < .001$) and had predictors that contributed significantly to the model, the first model (Model 1) had the best fit and thus was the final chosen model ($\chi^2(13) = 38.263$, $p < .001$). The Model 1 explained 31.6% (Nagelkerke R^2) of the variance in asking doctors about lung cancer tests and correctly classified 87.7% of cases. Table 3 presents the logistic regression results for this final model and reports predictors that are significant at .05 or lower.

After adjusting for variables of interest in this final model, those who asked about lung cancer tests were likely have a lung disease or use ASL to communicate directly or through an interpreter with a healthcare provider. Deaf people who had lung disease were about 3.6 times as likely to ask about lung cancer screening compared to others (adj OR: 3.604; bootstrap 95% CI: 1.359, 20.005). While the true odds ratio cannot be ascertained in the bootstrap distribution with a wide confidence interval, our data shows that the odds that ASL users would ask their doctors about lung cancer screening is higher compared to deaf respondents who do not use this communication method." After controlling for socio-demographic variables, as well as health indicators and communication variables, smoking status had nominally significant association ($p < .07$) with asking about lung cancer screening (adj OR: 2.439, bootstrap 95% CI: 0.751, 9.621). Deaf older adults who used to or currently smoke are twice as likely to ask about lung cancer screening than those without smoking history.

4. Discussion and conclusion

4.1. Discussion

The role of patient-education and empowerment through shared decision-making regarding the benefits and harms of low-dose CT lung screening is particularly essential given the fact that deaf current/former smokers are at greater risk for poorer health outcomes in the absence of accessible communication. According to Model 1, after adjusting for socioeconomic variables and health indicators, the mode of communication that the patient used with the doctor had a strong relationship with the deaf patient's likelihood of inquiring about lung cancer screening. This was true regardless of having a regular provider, health insurance, patient centered communication, level of education, race, gender, and even smoking status.

This finding has important implications for medical schools' recruitment criteria and medical training. It underscores the critical need to attract ASL-proficient students to medical training, as well as the value of training non-ASL proficient doctors about optimal ways to work with an ASL interpreter, the importance of not abridging information given to the patients, and to ensure accurate language access by using proficient interpreters who can manage the anticipated complexity of the medical visit [22,23].

This study also highlights the diversity of deaf patients' available and/or preferred modes of communication with their doctors, despite the relatively small sample size for the age-eligible smoker group and lack of generalizability to international deaf populations in other countries with different health systems and social and cultural contexts. Although the LGB ratio was higher relative to the general population, the sample size was robust in light of the low-incidence of ASL-using deaf individuals relative to

Table 1
Sociodemographic characteristics for deaf smokers (current and former) and deaf non-smokers aged 55–80 (N = 188).

Group						
	Non-smokers N = 119 Mean (SD)		Smokers (current and former) N = 69 Mean (SD)			t-test (*p*-value)
Age	66 (6)		67 (7)			−1.16 (.25)
BMI	29 (6)		30 (6)			−0.91 (.37)
PCC	71 (20)		72 (22)			0.67 (.42)
		Subgroups	n	%	n	%	X2 (*p*-value)
Gender							0.47 (.49)
		Male	44	37.0	29	42.0	
		Female	75	63.0	40	58.0	
Race							1.36 (.71)
		White	96	80.7	59	85.5	
		Black	9	7.6	4	5.8	
		Hispanic	9	7.6	5	7.2	
		Other	5	4.2	1	1.4	
Income							1.65 (.65)
		<$34,999	46	38.7	28	40.6	
		$35,000–$49,999	30	25.2	12	17.4	
		$50,000–$74,999	20	16.8	13	18.8	
		>$75,000	23	19.3	16	23.2	
Occupation							5.35 (.25)
		Employed	31	26.1	24	34.8	
		Unemployed	6	5.0	3	4.3	
		Homemaker	8	6.7	2	2.9	
		Retired	73	61.3	37	53.6	
		Disabled	1	0.8	3	4.3	
Lung Disease							3.16 (.08)
		Self-reported diagnosis	17	14.3	17	24.6	
		Never diagnosed	102	85.7	52	75.4	
Have friends or family members to talk to about own health							7.57 (.006)
		Yes	97	81.5	66	95.7	
		No	22	18.5	3	4.3	
Health insurance							.62 (.43)
		Yes	115	96.6	68	98.6	
		No	4	3.4	1	1.4	
Education							2.06 (.91)
		Less than high school	5	4.2	4	5.7	
		High school graduate	31	26.1	13	18.8	
		Vocational training or some college	34	28.6	20	29.0	
		College graduate	49	41.2	32	46.3	
Family history of cancer							1.31 (.52)
		None	29	24.4	12	17.4	
		Have history	81	68.1	52	75.4	
		Not sure	9	7.6	5	7.2	
Personal history of cancer							.001 (.99)
		None	81	68.1	47	68.1	
		Have or had cancer	38	31.9	22	31.9	
Regular provider							.12 (.73)
		Yes	72	60.5	40	58.0	
		No	47	39.5	29	42.0	
Communication modality with healthcare provider							.001 (.99)
		ASL (direct or interpreter)	81	68.1	47	68.1	
		English (written/oral) and others	38	31.9	22	31.9	
Talked to provider about lung cancer test							25.56 (.001)
		Yes	13	10.9	17	24.6	
		No	98	82.4	50	72.5	
		Not sure	8	6.7	2	2.9	
Have deaf parent(s)							.000 (.986)
		Yes	26	21.8	15	21.7	
		No	93	78.2	54	78.3	

the US population. Physicians need to recognize the communication preferences of their deaf patients, including use of an interpreter, or in some instances, their preference not to use an interpreter.

This study did not find significant interaction between PCC and communication mode with healthcare providers. Our findings illustrate that patient centered communication techniques alone are not enough to ensure that deaf people are likely to inquire about screening. Full access to communication either with concordant language use by the provider or through an interpreter is more effective than PCC alone.

There is a clear need for language access in patient centered care, regardless of the patient's age, race, gender or having a regular provider. This data mirrors that of McKee et al. [24], which found that deaf respondents who reported having a concordant provider (one who used ASL) were more likely to have received a flu vaccine and reported a greater number of preventative services. Even though the PCC scores were not significant in this model, the role of

Table 2
Multiple logistic regression model of factors associated to asking about lung cancer screening.

Variable	Model 1			Model 2 (variables with $p < 0.10$ retained in model)			Model 3 (variables with $p < 0.10$ retained in model)		
	B	SE B	Adj OR	B	SE B	Adj OR	B	SE B	Adj OR
Age	0.069	0.038	1.071	0.064	0.034	1.065	0.063	0.034	1.065
Race[a]	0.575	0.598	1.777						
Gender[b]	0.072	0.512	1.075						
Education[c]	−0.410	0.489	0.664						
Lung Disease	1.282	0.521	3.604**	1.495	0.477	4.461**	1.496	0.477	4.466**
Family history of cancer	0.270	0.546	1.310						
Personal history of cancer	0.523	0.492	1.686						
Discuss health with family/friends	1.249	1.116	3.488						
Health Insurance	−18.758	17259.7	0.000						
Regular provider	0.169	0.501	1.184						
Communication modality with healthcare provider[d]	2.149	0.787	8.574**	1.209	2.658	3.350*	2.123	0.775	8.364**
Smoking status[e]	0.891	0.481	2.439	0.870	0.445	2.388*	0.869	0.445	2.385*
Patient centered communication (PCC)	0.000	0.012	1.000	−0.009	0.036	0.991	0.003	0.010	1.003
PCC* Communication modality with healthcare provider				0.013	0.038	1.013			
Nagelkerke R^2	0.316			0.271			0.270		

[a] White is the reference group.
[b] Male is the reference group.
[c] College degree is the reference group.
[d] Spoken/Lipreading/Writing is the reference group.
[e] Nonsmoker is the reference group.
* $p < 0.05$.
** $p < 0.01$.

PCC techniques in providing satisfaction and trust still warrants further evaluation. Furthermore, our data indicates that there may be a need to focus on tobacco harm reduction and smoking cessation efforts among deaf African-American, Hispanic, and Caucasian populations that use ASL. According to nationwide data from the CDC [25], the prevalence of smoking among Hispanics is 10.1%, Caucasians is 16.6%, and African Americans is 16.7%. For the same groups in our sample of older deaf adults, there was a higher prevalence of smoking. Although the populations are similar, sampling strategies used in these two studies differ, making a comparison difficult. Yet, these elevated smoking statistics make it critical to focus on helping deaf smokers from different cultural and linguistic backgrounds to quit smoking and for current and past smokers to know the importance of being repeatedly screened for lung cancer.

Within our sample of former and current smokers who used ASL to communicate with their doctors, 32% had asked about lung cancer screening. Only 9% of those who did *not* use ASL directly or through interpreters had asked their providers about lung cancer screening test, compared to 10% in a hearing subgroup of former and current smokers [4]. This indicates that the non-ASL-using-with-providers deaf and hearing population are equally unlikely to talk to their provider about lung cancer screening. Byrne et al. [26] found that smokers are less likely to seek cancer screening, particularly if they had high nicotine dependence. If the same holds true for deaf smokers, it is especially important to focus screening

Table 3
Logistic Regression for Final Model Validation with Bootstrap for Lung Cancer Screening Test.

Variable	Log Reg Adj OR	95% CI for Log Reg (Lower)	95% CI for Log Reg (Upper)	Bootstrap[f](95% BootCI; Lower)	Bootstrap[f](95% BootCI; Upper)
Age	1.071	0.995	1.153	0.993	1.212
Race[a]	1.777	0.550	5.741	0.391	8.820
Gender[b]	1.075	0.394	2.928	0.313	3.789
Education[c]	0.664	0.255	1.729	0.174	2.190
Lung Disease	3.604*	1.298	10.004	1.359	20.005
Family history of cancer	1.310	0.449	3.822	0.368	7.272
Personal history of cancer	1.686	0.643	4.425	0.560	6.673
Discuss health with family/friends	3.488	0.391	31.091	0.548	7.202E + 08
Health Insurance	0.000	0.000	.	0.000	8.773E-08
Regular provider	1.184	0.443	3.163	0.348	4.674
Communication modality with healthcare provider[d]	8.574**	1.834	40.076	2.770	863928008.672
Smoking status[e]	2.439	0.951	6.254	0.751	9.621
Patient centered communication (PCC)	1.000	0.977	1.023	0.754	10.257

* $p < 0.05$.
** $p < 0.01$.
*** $P < 0.001$.
[a] White is the reference group.
[b] Male is the reference group.
[c] College degree is the reference group.
[d] Spoken/Lipreading/Writing is the reference group.
[e] Nonsmoker is the reference group.
[f] Bootstrap is based on 5000 replications.

efforts on this segment of the deaf population. It is critical to encourage providers to communicate with all their patients about the importance of cancer screening.

There is a growing trend to view health inequities and health disparities in the deaf population through a social justice lens, particularly through a focus on community-based participatory research [19,27]. It has been reported that smoking serves as a form of self-medication for various health ailments, both physical and psychological [28–30]. Deaf people report encountering many stressors [31,32]. They live in a hearing-dominant society with ableism and oppression. They also experience the stresses associated with intersectional identities, including race, gender, sexuality and multiple disabilities [33–36]. Thus, it is possible that our sample of deaf smokers uses smoking as a form of self-medication. If this is the case, it is important to encourage providers to ensure interpreter access, so that deaf patients can be informed about their health risks. Providers would then be better positioned to promote tobacco harm reduction or smoking cessation among deaf smokers. Given these circumstances, future research could develop a clinical or CBPR-based public health information intervention, to be designed and implemented by this subpopulation. This intervention could be analyzed for its success in increasing lung cancer screening.

4.2. Conclusion

Given that there are few tailor-made health services for the deaf, it is unrealistic to expect that provider language concordance can be implemented as a model for healthcare service delivery [23,37,38]. Therefore, it is critical to ensure that language access is in place prior to counseling and shared decision-making processes. It is efficacious to focus efforts on improving patient-provider relationships regardless of the provider's fluency in the patient's primary language, as long as the provider supports language access. We support facilitating streamlined and convenient processes to arrange interpreter services in medical settings. Furthermore, we support the establishment of patient screening and electronic medical records systems to facilitate identification of subpopulations within the deaf community in need of specific preventative services. This is in line with already existing electronic screening processes that allow providers to be made aware of subpopulations needing linguistic access or cultural sensitivity, such as racial, ethnic, or linguistic minorities or gender non-conforming."

A successful deaf patient-provider relationship includes a clear understanding of the need for effective communication and language access. This goes beyond the mere provision of an interpreter. It includes a commitment to and respect for the lived experiences of deaf patients and wide variety of communication preferences. Such sensitivity will increase the deaf patients' trust in the doctor, which can in turn increase adherence to health care instructions. It would also be wise for providers to follow guidelines of acceptance, integrity, and equity in approaching patient centered communication [39].

4.3. Practice implications

Results from this study carry significant public health relevance for deaf people who are at risk for lung cancer. This study highlights the critical importance of language access, the quality of the patient-provider relationship as enhanced by patient-centered care and informed decision-making processes. Counseling and shared decision-making can help improve high-risk deaf patients' understanding and decision-making about lung cancer screening.

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Appendix A. Supplementary data

An adaptation of this article in American Sign Language is available in the supplementary link https://doi.org/10.1016/j.pec.2018.03.003.

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