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Cancer genetic testing among a diverse sample of American Muslims

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Abstract

Background

American Muslims face notable cancer disparities. Yet we know little about cancer genetic testing among this group. The current study aims to explore: 1) interest in cancer genetic testing, 2) predictors of interest, focusing on religion and discrimination factors, and 3) preferences for receiving cancer genetic education and testing among a diverse community sample of American Muslims.

Methods.

We surveyed a community-based convenience sample of 158 American Muslims from the DC-Maryland-Virginia area. Our primary outcome was interest in cancer genetic testing; secondary outcomes were preferred delivery channels and facilitators for receiving genetic education and testing. Predictors included sociodemographics, cancer history, knowledge, and religion and discrimination factors. We conducted descriptive statistics, student's t-tests, Chi-square tests, and logistic regression.

Results.

Participants ranged 18 to 72 years (Mean = 34). The majority were foreign-born (62%). Seventy six percent strongly agreed or agreed with interest in testing. Only spirituality (OR = 2.72, 95% CI: 1.24, 5.96) and discrimination in healthcare due to looking Muslim (OR = 2.81, 95% CI: 1.23, 6.39) were independently associated with interest in testing. Participants most preferred cancer genetic education via: a document (83%), doctor (80%), genetic counselor (80%), or a website (79%). Participants least preferred a chatbot (30%). Participants most highly endorsed as facilitators of testing: informational materials (59%), insurance coverage (59%), at-home testing kits (52%), and integrating testing into routine care (44%).

Discussion & Conclusions

Addressing religion and discrimination factors may promote access to cancer genetic testing among the under-researched population of American Muslims, as well as aligning future interventions with their preferences.

Introduction

Muslims are the fastest growing religious group in the United States (Mogahed et al., 2022; Mohamed, 2018). Over the next 25 years, the American Muslim population is expected to more than double from 3.45 million individuals in 2017 to 8.1 million by 2050 (Mogahed et al., 2022; Mohamed, 2018). While 20% of American Muslims are US-born, American Muslims are a predominantly immigrant population, originating largely from South Asia, Asia-Pacific, the Middle East, North Africa, sub-Saharan Africa, and Europe. Socioeconomically, American Muslims tend to be lower income— 40% of Muslim Americans have household incomes less than $30,000/year (Mogahed et al., 2022; Mohamed, 2018). Their religion

acts as a unifying factor integrated in various aspects of their lifestyle, including healthcare (Padela & Zaidi, 2018).

American Muslims report lower cancer screening rates relative to non-Muslims (Afsah & Kaneko, 20231130; Ahmed & Mushahid, 2023; Azhar et al., 2022; Hasnain et al., 2014; Islam et al., 2017). A survey of 240 mammogram-eligible Muslim women found that 37% had not had a mammogram in the past 2 years, 30% lower than the national average (Padela et al., 2015). Among 207 first-generation American Muslim women, only 52% of screening-age women reported a mammogram in the prior two years, which was substantially lower than the national rate of 67% at the time (Hasnain et al., 2014). Further, community-based studies report disproportionately lower colorectal cancer screening among Muslims relative to non-Muslims (Majeed et al., 2023).

Multilevel factors have been linked with lower cancer screening rates among American Muslims. Individual-level factors include Islam-related beliefs and knowledge of cancer screening (Al Alawi et al., 20230228; Al-Amoudi et al., 2015; Alkhaifi et al., 2023; Choudhri et al., 2024). Predictors also span the interpersonal (Azhar et al., 2022; Samari et al., 2018) (e.g. perceived discrimination in healthcare) and system (Majeed et al., 2023) (e.g., lack of culturally or religiously-concordant providers) levels. Religion-related factors may be particularly salient (Choudhri et al., 2024; Majeed et al., 2023; Padela et al., 2012, 2014, 2015; Padela & Zaidi, 2018). Islam provides a unifying lens through which to make healthcare decisions among American Muslims (Choudhri et al., 2024; Majeed et al., 2023; Padela et al., 2012, 2014, 2015; Padela & Zaidi, 2018). Islam-based beliefs about stewarding the body to good health and predestination (Afsah & Kaneko, 20231130; Padela & Zaidi, 2018), as well as one's spirituality, religiosity, and religious coping (i.e. the use of religious beliefs, practices, and community to manage stress) can influence cancer screening decisions (Al-Amoudi et al., 2015; Azhar et al., 2022; Choudhri et al., 2024; Islam et al., 2017; Moey et al., 2022). Perceived religion-based discrimination (i.e., Islamophobia) has also been associated with reduced healthcare utilization (Samari et al., 2018). Taken together, existing studies warrant further examination of the role of religion and discrimination-related factors on cancer control behaviors.

Germline genetic testing for hereditary cancer risk is becoming increasingly important as a cancer prevention and control strategy for the general population. Cancer genetic testing is a blood or saliva-based test that identifies if an individual carries an inherited genetic mutation that increases their risk of developing cancer. Among individuals found to be at increased risk, follow-up risk management strategies can reduce breast, ovarian, colorectal, and endometrial cancer risk and mortality significantly (Bernstein et al., 2015; De Jong et al., 2006; Liu et al., 2023; Prince et al., 2017; Salhab et al., 2010; Valachis et al., 2014). Despite these benefits, cancer genetic testing remains severely underutilized overall, and particularly among minoritized groups (Chapman-Davis et al., 2021; Clarke & Van El, 2022; Dharwadkar et al., 2022; Mittendorf et al., 2021; Muller et al., 2018; Paiella et al., 2023; Parikh et al., 2020; Sayani, 2019; Suther & Kiros, 2009; Tawfik et al., 2023).

To our knowledge, there have been no studies examining cancer genetic testing among American Muslims. It is likely that American Muslims may face barriers in accessing cancer genetic testing comparable to the disparities they face regarding cancer screening. However, little is known about awareness, interest, and attitudes toward cancer genetic testing, as well as factors that may influence genetic testing interest among American Muslims, including religion and discrimination-related factors. Given the lack of research on cancer genetic testing among the under-researched and growing group of American Muslims, the aims of our current work are to assess interest in cancer genetic testing, factors influencing interest in cancer genetic testing including religion and discrimination factors, and preferences for receiving cancer genetic education and testing within a diverse, community sample of American Muslims.

Methods

Sample and Recruitment

We recruited a community-based convenience sample of American Muslims from the DC-Maryland-Virginia (DMV) area between August 2024 and September 2024. Eligible individuals were aged 18 years or older, currently residing in the DMV, and self-reported Muslims. The first author (MH) established communication with leadership at eight DMV-based Muslim-serving community organizations. Five were mosques (ADAMS mosque in Virginia, and the MCC, ICM, ICCP, and Maqaame Ibrahim mosques in Maryland), and three were predominantly Muslim-facing community organizations (DMV Jobs group, DMV Refugees Network, MFC AFSP Volunteers). We distributed the study flyer, eligibility screener and survey through in-person events, and text message (e.g., community organization WhatsApp groups) and online listservs. The study flyer clarified that no prior knowledge of cancer genetic testing was needed.

Across four weeks of recruitment, we distributed the screener to approximately 2783 individuals. However, we could not determine the number of duplicates across the online/text listservs, nor the exact number of community members who received information about the survey during in-person recruitment. Thus, the number of unique individuals to whom the screener was distributed is likely less than 2783. Overall, 223 participants completed the screener for an estimated response rate of 8.0%. The true response rate was likely higher given the factors described above, particularly the duplicates across DMV-area listservs.

Of the 223 screener completers, 48 did not meet eligibility criteria. Specifically, two did not self-identify as Muslim; three were younger than 18 years; six lived outside the DMV; 37 did not meet a criterion for living in select DMV counties that we had implemented but later removed. Of the 175 eligible participants who completed the screener, five (3%) did not complete the survey, and six (3%) had high missing data or did not respond to the primary outcome, leaving 164 survey participants. Of the 164 survey participants, six (4%) reported prior cancer genetic testing. Since this group was too small for separate analyses, we excluded them from subsequent analyses – leaving a final sample of n = 158.

Procedures

We administered a three-item eligibility screener in person and electronically. As stated, inclusion criteria were to be: aged 18 years or older, currently residing in the DMV, and self-reported Muslim. Eligible individuals received the survey in person or electronically. The survey included 40-items and took 10–15 minutes to complete. Participants who completed the survey received a $25 e-gift card to compensate their participation.

Measures

Primary Outcome

Interest in cancer genetic testing (GT). We assessed interest in GT with a single item adapted from prior research (Kaphingst et al., 2022): “I am interested to learn more about cancer genetic testing” on a 5-point Likert scale. For analyses, we dichotomized GT interest as strongly agree vs. all other categories (agree through strongly disagree). We chose this operationalization to examine strong interest in genetic testing, as strong interest is more closely linked to behavioral uptake. Further, this dichotomization is closest to a median splite, which maximizes our power in subsequent analyses.

Secondary outcomes

Preferences for genetic education. We evaluated participant preferences for receiving education about genetic testing with the following question: “If you were thinking about getting genetic testing, how would you prefer to receive information about genetic testing?” For each delivery channel option (a document, a video, a website, chatbot, speaking with a doctor, speaking with a genetic counselor, speaking with a community health worker or patient navigator), participants rated their preference on a scale of 1 to 3 (1 = I do not prefer this, 2 = I am ok with this, 3 = I highly prefer this). For analyses, we created a binary measure (0 = do not prefer, 1 = am ok or highly prefer) for each option.

Facilitators of genetic testing. To assess facilitators of genetic testing, we provided a menu of 14 clinically validated options (e.g. transportation, more information) adapted from our prior research (Gómez-Trillos et al., 2020; Steffen et al., 2017) and asked, “Which of the following would make it easier for you get cancer genetic testing?” Participants selected all options that applied.

Predictors

Demographics. Participants self-reported age, sex at birth, race, highest education completed, employment status, annual household income, foreign-born status, years living in the USA, and health insurance type.

Cancer history. Participants self-reported personal and family history of cancer.

Knowledge. Participants self-rated their knowledge of hereditary cancer via the item, “How would you rate your knowledge of hereditary cancer?” and their knowledge on genetic testing via the item, “How would you rate your knowledge of genetic testing?” both rated from 0 = very little to 10 = a lot. We operationalized these as continuous measures as the data were roughly symmetric and distributed.

Participants selected all settings where they regularly received healthcare in the last three years (hospital, community clinic, private clinic, do not regularly receive healthcare).

We assessed value for ancestral culture through a single face-valid five-point Likert-scale item: “It is important to me to keep the culture(s) of my ancestors.” For analyses, we dichotomized value for ancestral culture as strongly agree/agree (n = 95) vs neither/disagree/strongly disagree (n = 57).

We measured religion-related factors: spirituality, religiosity in daily life, role of religion in cancer screening, positive religious coping, and negative religious coping. For *spirituality*, we employed a single face-valid item: “How spiritual do you consider yourself?” where participants self-rated from 0 = not at all to 10 = very spiritual. For analyses we dichotomized spirituality at the median of 8 due to a skewed distribution. We assessed *religiosity in daily life* with a single face-valid item: “How important is religion to your daily life?” Although the existing literature rarely examines religiosity in daily life, we added this measure as daily practice is salient in the context of Islam (e.g., five daily prayers). Participants rated themselves from 0 = not at all to 10 = very important. Due to an extreme right skew at the value of 10, we analyzed the item as binary: 10 and < 10. We evaluated the role of *religiosity in cancer screening* with a single face-valid item: “How much does religion influence your desire to get cancer screenings?” Participants rated themselves from 0 = not at all to 10 = a lot. We analyzed the item as continuous as data were roughly symmetric and distributed. To measure *positive* and negative *religious coping*, we used the Positive Religious Coping subscale (summary score ranging 7 to 28; cronbach’s α = .90) and *Negative Religious Coping subscale* (summary score ranging 5 to 20; cronbach’s α = .85), from the 12-item Psychological Measure of Islamic Religiousness scale (Abu Raiya et al., 2008; Raiya et al., 2007). Higher summary scores indicate higher positive/negative religious coping. An example positive religious coping subscale item is, “When I face a problem in life, I look for a stronger connection with Allah” and an example negative religious coping subscale item is, “When I face a problem in life, I believe that I am being punished for bad actions I did.” For analyses, we treat the measures as continuous as they are validated sub-scales.

We measured discrimination in healthcare using the 7-item Everyday Discrimination in Healthcare Scale (Peek et al., 2011; Williams et al., 1997) (Cronbach’s α = .89), where higher summary scores (ranging 7 to 35) indicate greater perceived discrimination. We also employed a single five-point Likert scale face-valid item: “I feel like I have experienced discrimination due to looking Muslim in a healthcare setting, in my life”. For analysis, we dichotomized this measure as strongly agree/agree (n = 45) vs neither/disagree/strongly disagree (n = 107) to conceptually capture having ever experienced Islamophobia in healthcare.

Analyses

We summarized sample characteristics and key study measures using descriptive statistics. To identify bivariate associations with our primary outcome, interest in genetic testing, we employed student's t-tests and Chi-square tests. To evaluate multivariate associations with our primary outcome, we employed a logistic regression with backward elimination, inputting only those variables with $p < 0.05$ bivariate associations with interest in genetic testing.

To analyze our secondary outcomes on intervention preferences and facilitators, we assessed the frequency with which participants endorsed delivery channel options and perceived facilitators. All analyses used two-tailed tests at a significance level of 0.05. Analyses were completed using SPSS 29 (*IBM SPSS Statistics for Macintosh*, 2022).

Results

Sample Characteristics

As displayed in Table 1, our sample had a mean age of 34.3 years (SD = 10.9; range = 18 to 72). The majority of the participants were South Asian (64%), female (80%), and foreign-born (62%). Among those born outside the US, the mean years in the USA was 16.5 (SD = 11.4). The sample was socioeconomically diverse with 5% having incomes less than $20,000, 17% between $20,000 and $59,999, 17% between $60,000 and $99,999; and 34% $100,000 or more; 17% had Medicaid or no insurance; and 15% did not regularly receive any healthcare.

Table 1
Sample Characteristics (n = 158)

Characteristic	*n*	%
Age (mean, SD)	(34.3, SD = 10.9)	
Sex at birth		
Female	127	80.4%
Male	31	19.6%
Race/ethnicity		
African, African American, Black	11	7.0%
Central/East Asian	9	5.7%
Middle Eastern/North African	25	15.8%
South Asian	101	63.9%
White	5	3.2%
Other	7	4.4%
Foreign-born	98	62.0%
Years in USA (mean, SD)	(16.5, SD = 11.4)	
Highest educational level		
High school	11	7.0%
Some college	26	16.5%
College	46	29.1%
Graduate school	63	39.9%
Missing	12	7.6%
Household income		
<$20,000	9	5.7%
$20, 000 - $59,999	27	17.1%
$60,000 - $99,999	27	17.1%
$100,000 or more	54	34.2%
Missing	41	25.9%
Employment		
Full-time work	74	50.0%

Characteristic	*n*	%
Part-time work	22	13.7%
Full-time homemaker or caregiver	18	11.2%
Unemployed, seeking	15	9.3%
Student	12	7.5%
Other	5	3.1%
Missing	12	7.6%
Insurance		
Private	96	60.8%
Public	27	17.1%
No insurance	8	5.1%
Prefer not to say	15	9.5%
Missing	12	7.6%

Key study measures

Overall, 76% of the sample reported interest in cancer genetic testing (see Table 2) of whom 33% indicated strong interest. About half the sample (50.6%) had a family history of cancer. Participants reported relatively low self-rated knowledge of hereditary cancer (Mean = 4/10; SD = 3) and genetic testing (Mean = 3/10; SD = 3).

Table 2
Key Study Variables (n = 158)

Characteristic	*n*	%
Interest in genetic testing		
Strongly agree	52	32.9%
Agree	68	43.0%
Neither agree nor disagree	32	20.3%
Disagree	6	3.8%
Strongly disagree	0	0.0%
Cancer history		
Has personal history of cancer	7	4.4%
Has family history of cancer	80	50.6%
Knowledge		
Knowledge of hereditary cancer	(4.0, SD = 3.0)	
Knowledge of GT	(3.0, SD = 3.0)	
Regular healthcare [a]		
Hospital	46	29.1%
Community clinic	26	16.5%
Private clinic	77	48.7%
No regular healthcare	24	15.2%
Everyday Discrimination in Healthcare Scale	(14.1, SD = 4.6)	
Discrimination in healthcare		
Agree	45	28.7%
Disagree	107	67.7%
Value ancestral Culture		
Agree	95	60.1%
Disagree	57	36.1%
Spirituality (mean, SD)		

[a] Categories are not mutually exclusive; participants were able to select multiple responses for where they regularly received healthcare in the past 3 years.

Characteristic	*n*	%
Rating < = 8	85	53.8%
Rating > 8	65	41.1%
Positive religious coping	24.1 (SD = 4.3)	
Negative religious coping	9.0 (SD = 3.8)	
Religiosity in daily life (mean, SD)		
Rating of 10	96	60.8%
Rating <10	55	34.8%
Religiosity in screening (mean, SD)	(5.3, SD = 3.4)	

[a] Categories are not mutually exclusive; participants were able to select multiple responses for where they regularly received healthcare in the past 3 years.

Bivariate associations

As displayed in Table 3, in bivariate analyses, interest cancer genetic testing was associated with: having family history of cancer (p=.024) and being South Asian (p=.028). In terms of religion and discrimination factors, interest in cancer genetic testing was associated with: greater self-reported role of religion in cancer screening (p=.015), greater experiences of discrimination in healthcare (p=.009), and higher spirituality (p=.016). No sociodemographics were significantly associated with interest in testing; but household income (p=.058) approached significance.

Table 3

Bivariate Results of Differences Between Participants Who Are Strongly Interested and Not Strongly Interested in Cancer Genetic Testing

Variable		Strongly Interested	Not Strongly Interested	p-value
Continuous variables M ± SD				
Age (years)		34.0 ± 11.0	35.0 ± 11.0	.628
Years lived in the USA		16.5 ± 11.8	16.5 ± 11.3	.994
Knowledge of hereditary cancer		4.4 ± 2.8	3.5 ± 2.7	.058
Knowledge of genetic testing		3.8 ± 3.0	2.8 ± 2.7	.056
Religiosity in cancer screening		6.3 ± 3.1	4.8 ± 3.4	.015*
Positive religious coping		24.9 ± 4.7	23.7 ± 4.1	.104
Negative religious coping		8.6 ± 3.5	9.3 ± 4.0	.270
Everyday Discrimination in Healthcare Scale [a]		14.0 ± 4.1	14.2 ± 4.8	.824
Categorical variables n (%)				
Sex at birth	Female	41 (78.8%)	86 (81.1%)	.734
	Male	11 (21.2%)	20 (18.9%)	
South Asian ethnicity [b]	Yes	27 (51.9%)	74 (69.8%)	.028*
	No	25 (48.1%)	32 (30.2%)	
Born in the USA	Yes	26 (46.0%)	36 (33.0%)	.138
	No	28 (53.8%)	70 (66.0%)	
Highest education	≥ College	40 (78.4%)	69 (72.6%)	.442
	< College	11 (21.6%)	26 (27.4%)	
Household income [c]	≥ $100k	24 (46.2%)	30 (28.3%)	.058
	< $100k	19 (36.5%)	44 (41.5%)	
	Missing	9 (17.3%)	32 (30.2%)	
Employment	Full-time	31 (60.8%)	43 (45.3%)	.074
	Not full-time	20 (39.2%)	52 (54.7%)	
Insurance [c]	Private	34 (70.8%)	62 (60.8%)	.106

Variable		Strongly Interested	Not Strongly Interested	p-value
Continuous variables M ± SD				
	Public	10 (20.8%)	17 (16.7%)	
	Missing	4 (8.3%)	23 (22.5%)	
Regular healthcare [d]	Hospital	18 (34.6%)	28 (26.4%)	.286
	Private clinic	27 (51.9%)	50 (47.2%)	.574
Cancer history	Yes	3 (5.8%)	4 (3.8%)	.567
	No	49 (94.2%)	102 (96.2%)	
Family history of cancer	Yes	33 (63.5%)	47 (44.3%)	.024*
	No	19 (36.5%)	59 (55.7%)	
Value ancestral culture	Agree	35 (68.6%)	60 (59.4%)	.267
	Disagree	16 (31.4%)	41 (40.6%)	
Spirituality	≤ 8	22 (43.1%)	63 (63.6%)	.016*
	> 8	29 (56.9%)	36 (36.4%)	
Religiosity in daily life	= 10	34 (66.7%)	62 (62.0%)	.573
	< 10	17 (33.3%)	38 (38.0%)	
Discrimination in healthcare	Agree	22 (43.1%)	23 (22.8%)	.009**
	Disagree	29 (56.9%)	78 (77.2%)	

Variable	Strongly Interested	Not Strongly Interested	p-value
Continuous variables M ± SD			
Notes. Independent samples t-tests were used for continuous variables; chi-square tests were used for categorical variables. p < .05 = *, p < .01 = **.			
[a] The validated 7-item Everyday Discrimination in Healthcare Scale summary score (range = 7–35) measures perceived discrimination in healthcare.			
[b] We only present a South Asian measure ('yes, South Asian' vs. 'no, not South Asian') because no other race group was sufficiently large to analyze as an individual group.			
[c] We created three-level categorical measures for income (<$100k, >$100,000 or more, and missing) and insurance (private, public, missing), where one category captured missing responses as both had significant missing data. We included the eight individuals who had no insurance in the missing group. We compared a listwise deletion approach (i.e. restricted to complete cases) to our 'missing indicator' approach. Our results did not change substantively across the approaches. Thus, we concluded that the high missingness in our income and insurance measures did not significantly affect our conclusions.			
[d] We created binary measures for each setting. For instance, a binary measure was: 'yes, regularly receive care at hospital, 'no, did not receive care at hospital'. To ensure adequate cell sizes, only categories with at least 30 participants (i.e., hospital, private clinic) were retained as binary variables.			

Multivariate associations

In the initial step of a multivariable logistic regression with backward elimination, we inputted the five measures with P<.05 associations with genetic testing interest: being South Asian, having family history of cancer, role of religion in cancer screening, perceived discrimination in healthcare, and spirituality. As displayed in Table 4, the final model indicates that the only variables independently associated with interest in cancer genetic testing were: spirituality (OR = 2.72, 95% CI: 1.24, 5.96) and discrimination in healthcare due to looking Muslim (i.e., Islamophobia) (OR = 2.81, 95% CI: 1.23, 6.39).

Table 4
Results from multivariate logistic regression

	p-value	*Odds Ratio*	*95% CI*
Discrimination in health	.014	2.807	[1.234, 6.388]
Spirituality	.013	2.715	[1.237, 5.960]
Note. We only inputted the variables that had a significant bivariate association at alpha=.05 with interest in cancer genetic testing: South Asian ethnicity, family history of cancer, religiosity in cancer screening, discrimination in healthcare (binary), and spiritualty. We outputted variables that were significant at alpha=.0549 value with interest in cancer genetic testing.			

Preferences for receiving cancer genetic services

From a list of seven options, participants most frequently endorsed the following preferences for receipt of genetic education (Table 5): a document (82%), a website (77%), doctor (76%), genetic counselor (75%), a video (72%), and a patient navigator (63%). Participants were least interested in receiving genetic information via a chatbot (29%). Those who were not strongly interested in genetic testing selected fewer options than those who were strongly interested in testing (M = 0.81, SD = 1.2 vs. M = 1.94, SD = 1.78, p<.001). From a menu of 14 options, participants reported that the following would most facilitate receipt of testing: informational materials (59%), insurance coverage for most/all costs (59%), at-home testing kit (52%), offering testing as part of a routine medical appointment (44%), and if the genetic testing is near home (41%) (Table 6).

Table 5
Participant preferences for delivery through which to receive genetic information/counseling (n = 158)

		N	%
Document	Everything else	26	16.5%
	Prefer	130	82.3%
Video	Everything else	37	23.4%
	Prefer	114	72.2%
Website	Everything else	32	20.3%
	Prefer	122	77.2%
Chatbot	Everything else	106	67.1%
	Prefer	45	28.5%
Doctor	Everything else	30	19.0%
	Prefer	120	75.9%
Genetic counselor	Everything else	30	19.0%
	Prefer	119	75.3%
Patient	Everything else	50	31.6%
Navigator	Prefer	100	63.3%

Table 6
Participant endorsement of facilitators of cancer genetic testing (n = 158)

Characteristic	*n*	%
If I receive more informational materials	95	59.0%
If genetic counseling was over phone	64	39.8%
If genetic counseling was optional	38	23.6%
If I could receive at home testing kit	84	52.2%
If testing was a part of another routine medical appt	71	44.1%
If the clinic was close to home	66	41.0%
If I had transportation	28	17.4%
If I had childcare	14	8.7%
If clinic had flexible hours	57	35.4%
If insurance would pay most/all of the cost	95	59.0%
If another organization would help pay	63	39.1%
If my doctor recommended genetic testing	72	44.7%
If I trusted my doctor's recommendation	57	35.4%
If my family encouraged me to get genetic testing	37	23.0%

Discussion

Our study aimed to explore: interest in cancer genetic testing, factors influencing interest in testing, particularly religion and discrimination factors, and cancer genetic testing intervention preferences among a community sample of American Muslims. We found notable interest in cancer genetic testing—76% were interested; 33% were strongly interested in cancer genetic testing. Although multiple variables were associated with testing interest in bivariate analyses, only spirituality and perceived discrimination in healthcare due to looking Muslim (i.e. Islamophobia) were independently associated with greater interest in cancer genetic testing. In terms of preferences for the receipt of genetic information, participants most frequently endorsed the use of documents and a websites, followed by preference for doctors and genetic counselors. Future research is needed on which combinations of specialists vs non-specialists, as well as digital vs non-digital channels optimize cancer genetic service delivery.

In our sample interest in cancer genetic testing was comparable to prior samples. In previous community-based convenience samples, approximately 50–90% of participants reported interest in cancer genetic testing (Botoseneanu et al., 2011; Guo et al., 2022; Hay et al., 2018; Kaphingst et al., 2022; Roberts et al., 2022; Rubinsak et al., 2019), compared to 76% of our sample. Further, 30–90% (Alvord et

al., 2020; Roberts et al., 2022; Rubinsak et al., 2019) of these samples report *strong* interest in testing, compared to 32% of our sample. These data suggest that nearly 70% of certain samples remain less than *strongly* interested, with about 30% not *at all* interested in testing. By understanding the predictors of interest, we can close gaps in cancer genetic testing interest and, potentially, uptake among American Muslims.

Intriguingly, factors that typically drive interest in cancer genetic testing were not predictive in our sample of American Muslims. Demographic factors such as younger age and being female, and social determinants of health such as education and income have consistently been found to strongly predict interest in cancer genetic testing (Botoseneanu et al., 2011; Guo et al., 2022; Hay et al., 2018; Kaphingst et al., 2022; Nordin et al., 2004; Roberts et al., 2022; Rubinsak et al., 2019). Family history of cancer, cognitive factors (e.g., greater knowledge of hereditary cancer or cancer genetic testing) and psychosocial characteristics have also generally been associated with testing interest (Botoseneanu et al., 2011; Guo et al., 2022; Hay et al., 2018; Kaphingst et al., 2022; Nordin et al., 2004; Roberts et al., 2022; Rubinsak et al., 2019). Although some of these factors were associated at the bivariate level in this study (i.e., family history of cancer), none were independently associated with test interest. It is possible that these factors were non-significant in our sample because our participants' spirituality and experiences of perceived Islamophobia in healthcare are more salient.

Our findings reveal that leveraging American Muslims' spirituality is perhaps more salient for influencing interest in cancer genetic testing than other factors. This is noteworthy as spirituality is rarely examined in the context of cancer genetic testing, and when it has been findings were mixed (Austin et al., 2025; Botoseneanu et al., 2011; Schwartz et al., 2000). One explanation for the positive link between spirituality and testing interest is that Muslims who consider themselves more spiritual may place greater value on the Islamic call to steward the body to good health (Afsah & Kaneko, 20231130; Padela & Zaidi, 2018). Consequently, Muslims who consider themselves more spiritual may view cancer genetic testing as a proactive approach for stewarding the body to good health.

One of our most striking and surprising findings was that *greater* experiences of perceived Islamophobia in healthcare was associated with interest in cancer genetic testing. This contrasts with prior research that suggests the experience religious discrimination in healthcare deters service utilization (Samari et al., 2018). For example, a study of 240 Muslim women found that perceived Islamophobia in healthcare was linked with not having had a mammogram in the prior two years (Padela et al., 2015). One explanation for our paradoxical finding draws on Minority Stress Theory (Meyer, 2003) and resilience frameworks (Lewis et al., 2015). These frameworks suggest that discrimination can motivate health protective behaviors via fostering hypervigilance (Lewis et al., 2015). Another explanation could reflect our highly educated sample. Individuals with higher education are more likely to report concerns of discrimination (Das, 2020); further, individuals with higher education are more likely to report greater interest in genetic testing (Giri et al., 2020; Roberts et al., 2022). Future research with a more diverse sample in terms of education is needed to fully address this possibility.

The results of this study could have clinical implications. Notably, prior *religiously*-tailored interventions have preliminarily shown promise for improving cancer early detection behaviors among American Muslims (Abu Khait & Lazenby, 2021; Padela et al., 2018; Pratt et al., 2020). Examining the mechanisms for health behavior change among such religiously tailored interventions is needed, however, including given spirituality was the only significant religion-related factor in our sample. In Padela and colleagues' (Padela et al., 2018) religiously-tailored program, for example, the program increased mammography screening intention and behavior. However, the mechanisms for change were not causally examined. Similarly, Pratt and colleagues (Pratt et al., 2020) religiously tailored workshops were found to improve attitudes toward cervical cancer screening, but without examination of mechanisms of change. Nakajima and colleagues (Nakajima et al., 2022) administered a two-series workshop, that included a 25-minute video. The video improved intentions for colorectal screening. However, this study was observational and did not causally examine which spiritual and/or religious beliefs, barriers, and facilitators influenced health behavior outcomes. Future research is needed to identify which spiritual and/or religious factors influence health behavior outcomes.

Beyond designing cancer genetic promotion interventions to leverage American Muslims' experiences of spirituality and discrimination, there may be benefits to delivering interventions via non-specialist and specialist channels. Participants preferred receiving cancer genetic testing information from: a document, website, doctor, genetic counselor, video, and patient navigator, in that order. They also reported that mailed testing kits and incorporating testing into routine medical appointments would facilitate testing. These findings highlight potentially actionable strategies to increase access to genetic testing in this population. With traditional models of genetic service delivery reliant on the scarce workforce of genetic counselors, these findings suggest that novel models that utilize non-genetics providers (e.g., primary care doctors) and asynchronous options (e.g., document, website, video) are potentially acceptable strategies for expanding access among American Muslims. Future research is needed, however, to evaluate which delivery channels are appropriate for each aspect of service delivery.

Limitations. Our study had several limitations. The generalizability of our findings is limited as we relied on a community-based convenience sample recruited from the DC–Maryland–Virginia area. Additionally, our low response rate limits the conclusions that can be drawn from the study. It is important to note, that we closed the survey after approximately one-month with little repeat outreach. Further, we took measures to mitigate potential nonresponse bias, such as clarifying in the recruitment flyer that there is compensation for completing the survey and that no prior knowledge of cancer genetic testing is required. Still, the low response rate and highly select sample require that these results be interpreted with caution – particularly if considering American Muslims residing outside of the Maryland-Virginia-DC area. Finally, our study assessed stated interest in GT rather than GT uptake. To inform interventions that promote cancer genetic testing in this population, future research should examine predictors of testing uptake.

Conclusion

The study provides important exploratory insights into an under-researched population.

The associations between increased spirituality, perceived religion-based discrimination in healthcare, and interest in cancer genetic testing, demonstrates potential benefits of tailoring cancer genetic testing promotion interventions among American Muslims. Future research with larger, more representative samples can build on this work to better understand the mechanisms underlying these associations and to inform strategies to tailor interventions promoting cancer genetic testing among American Muslims.

Declarations

Competing Interests:

The authors declare that they have no conflicts of interest.

Ethics Approval:

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Approval was granted by the Georgetown-MedStar joint oncology Institutional Review Board (STUDY00007505).

Consent to participate:

Informed consent was obtained from all patients for being included in the study.

Consent to publish:

Informed consent to participate in the study was obtained from all individual participants.

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Author Contribution

MRH: conceptualization, study design, project management, data curation, analysis, writing, review; SK: data management, writing; SB: data management; CD: conceptualization, review, editing; MDS: conceptualization, study design, review, editing; AHDM: conceptualization, study design, review, editing.

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Data Availability

The authors welcome inquiries from investigators interested in possible collaboration and use of de-identified data from this study. The data has not been placed into a public repository.

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