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National Survey of Patient Factors Associated with Colorectal Cancer Screening Preferences

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ABSTRACT

Recommended colorectal cancer screening modalities vary with respect to safety, efficacy, and cost. Better understanding of the factors that influence patient preference is, therefore, critical for improving population adherence to colorectal cancer screening. To address this knowledge gap, we conducted a panel survey focused on three commonly utilized colorectal cancer screening options [fecal immunochemical test or guaiac-based fecal occult blood test (FIT/gFOBT), multi-target stool DNA (mt-sDNA) test, and colonoscopy] with a national sample of U.S. adults, ages 40–75 years and at average risk of colorectal cancer, in November 2019. Of 5,097 panelists invited to participate, 1,595 completed the survey (completion rate, 31.3%). Our results showed that when presented a choice between two colorectal cancer screening modalities, more respondents preferred mt-sDNA (65.4%) over colonoscopy, FIT/gFOBT (61%) over colonoscopy, and mt-sDNA (66.9%) over FIT/gFOBT. Certain demographic characteristics and awareness of and/or experience with various screening modalities influenced preferences. For example, uninsured people were more likely to prefer stool-based tests over colonoscopy [OR, 2.53; 95% confidence interval (CI), 1.22–5.65 and OR, 2.73; 95% CI, 1.13–7.47]. People who had heard of stool-based screening were more likely to prefer mt-sDNA over FIT/gFOBT (OR, 2.07; 95% CI, 1.26–3.40). People who previously had a stool-based test were more likely to prefer FIT/gFOBT over colonoscopy (OR, 2.75; 95% CI, 1.74–4.41), while people who previously had a colonoscopy were less likely to prefer mt-sDNA or FIT/gFOBT over colonoscopy (OR, 0.39; 95% CI, 0.24–0.63 and OR, 0.40; 95% CI, 0.26–0.62). Our survey demonstrated broad patient preference for stool-based tests over colonoscopy, contrasting the heavy reliance on colonoscopy for colorectal cancer screening in clinical practice and highlighting the importance of considering patient preference in colorectal cancer screening recommendations.

Prevention Relevance: Our national survey demonstrated broad patient preference for stool-based tests over colonoscopy, contrasting the heavy reliance on colonoscopy for colorectal cancer screening in clinical practice and highlighting the importance of considering patient preference in colorectal screening recommendations.

Introduction

Colorectal cancer is the second most frequent cause of cancer-related deaths in the United States among women and men combined (1, 2). In 2020, an estimated 104,610 cases of colorectal cancer and 53,200 colorectal cancer–related deaths are expected (1). Although several colorectal cancer screening methods have been shown to reduce colorectal cancer incidence rates and improve colorectal cancer survival rates (3–5), nearly one-third of eligible adults in the United States have never completed colorectal cancer screening (6) and colorectal cancer screening continues to be underutilized among persons experiencing socioeconomic disadvantages, racial and ethnic minorities, and certain age groups (7–9).

The U.S. Preventive Services Task Force recommends several colorectal cancer screening strategies for average-risk adults ages 50–75 years: annual guaiac-based fecal occult blood test (gFOBT) or fecal immunochemical test (FIT); multi-target stool DNA (mt-sDNA) test every 1 or 3 years; colonoscopy every 10 years; CT colonography every 5 years; flexible sigmoidoscopy every 5 years; or flexible sigmoidoscopy every 10 years with annual FIT (10). These colorectal cancer screening modalities vary with regards to their safety, efficacy, and cost. Patients may prefer different screening modalities depending upon test attributes and their unique circumstances (11, 12). It has been suggested that when making colorectal cancer screening recommendations, healthcare providers should engage their patients in shared decision-making, a process that weighs the pros and cons of available screening options and takes into account patient preferences (13). This approach is also consistent with the argument that the best colorectal cancer screening method is the one that patients are most likely to complete (10).

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To identify factors associated with patient preferences among colorectal cancer screening modalities and determine how colorectal cancer screening awareness and experiences are associated with those preferences, we designed and conducted a national survey to assess awareness, beliefs, and behaviors related to colorectal cancer screening among U.S. adults. Here, we examine differences in patient preference among three commonly used colorectal cancer screening modalities (FIT/gFOBT, colonoscopy, and mt-sDNA) in a national sample of average-risk U.S. adults and evaluate these differences in terms of sociodemographic characteristics, healthcare access, health status, and colorectal cancer screening awareness and experience.

Materials and Methods

Survey design and implementation

Data were collected from a survey developed by the authors and implemented by the National Opinion Research Center (NORC) at the University of Chicago (Chicago, IL). A general population sample of U.S. adults ages 40–75 years was selected from NORC's AmeriSpeak Panel using sampling strata based on age, sex, race/ethnicity, and education. The size of the selected sample per sampling stratum was determined by the population distribution for each stratum, taking into account expected differences in survey completion rates by demographic groups to ensure that the sample was representative of the U.S. population. In households with more than one adult panel member, only one adult was randomly selected to participate. Panelists may participate in AmeriSpeak studies by web or by phone. This study was deemed exempt by the NORC Institutional Review Board.

Data collection

We planned to obtain completed surveys from 1,500 panelists. Prior studies using this panel have obtained an average survey completion rate of 35%. We estimated a survey completion rate of 35% and a qualification rate of 90%. Our survey was pretested on a small sample of English-speaking AmeriSpeak web-mode panelists ($n = 50$) who were invited to participate on October 25, 2019. No changes were made to the survey based on these pilot results. The survey itself was fielded between November 8 and 25, 2019. To encourage participation, NORC sent up to two email reminders to sampled web-mode panelists; for the phone survey, NORC dialed the sampled phone-mode panelists throughout the field period. All sampled panelists were offered an incentive equivalent to $5 to complete the survey.

A total of 1,595 completed surveys (1,433 by web and 162 by phone) were obtained from 5,097 panelists who were invited to participate, resulting in a survey completion rate of 31.3%. The survey's margin of error was 3.14% at a 95% confidence level. The margin of error was calculated by NORC assuming we have a binomial variable where 50% of respondents give each answer (giving the most conservative margin of error). The margin of error for this hypothetical variable was then calculated at a 95% confidence level, assuming all completed surveys answered the question and taking into account the design effect, which is the amount of variance under the complex design divided by the variance under the simple random sampling.

Measures

The survey was developed by the authors, drawing survey items from existing public surveys, such as the Health Information National Trends Survey, and modifying and developing items as needed.

Sociodemographic characteristics

The following sociodemographic variables were obtained from the AmeriSpeak demographic profile data: age, sex, race/Hispanic ethnicity, education, employment, income, and marital status.

Healthcare access

Respondents were asked whether they were currently covered by any of several types of health insurance or health coverage plans. We collapsed and categorized the responses as "no insurance," "private insurance," or "public insurance." In cases were respondents selected both a public and private source, we categorized them as having private insurance. Respondents were also asked how long it had been since they last visited a healthcare provider for a routine checkup. We categorized responses as "less than 2 years ago," "3–5 years ago," and "more than 5 years ago or never."

Health status

Respondents were asked to rate their general health as excellent, very good, good, fair, or poor. We combined responses to fair and poor, which were reported infrequently. Using self-reported height and weight, we calculated body mass index for each respondent and categorized them according to the Centers for Disease Control and Prevention standards as underweight, normal weight, overweight, or obese (14). Respondents were also asked to indicate whether they had ever received a cancer diagnosis.

Colorectal cancer screening awareness and experience

Respondents were asked a series of questions about whether they had ever heard of specific colorectal cancer screening modalities, ever received a specific colorectal cancer screening exam, and whether a healthcare provider had recommended a specific colorectal cancer screening modality to them during the past 12 months. Questions about mt-sDNA referred to the test as Cologuard, as it is the brand name of the only mt-sDNA test currently available. Before answering the questions, respondents were given the following descriptions about the screening modalities.

> *"Stool-based tests, such as the FIT and the gFOBT, for colorectal cancer screening check for blood in human stool, which is associated with the possibility of colorectal cancer or precancer. These tests are conducted through*

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stool samples collected using an at-home kit that is then sent to a laboratory.

Cologuard is a stool-based test for colorectal cancer screening. It identifies altered DNA and/or blood associated with the possibility of colorectal cancer or precancer that is shed into human stool from the lining of the colon. These tests are conducted through stool samples collected using an at-home kit that is then sent to a laboratory.

A colonoscopy is a colorectal cancer screening test that examines the entire colon by inserting a tube into the rectum. People prepare for this test by taking laxatives that completely empty their bowel. The procedure requires sedation (taking medications to produce a state of calm or sleep) and, therefore, requires that people have someone to drive them home from the procedure."

In the multivariable models, responses to these items with regard to mt-sDNA and FIT/gFOBT were collapsed into one category: stool-based colorectal cancer screening, in which a positive response to at least one modality was categorized as "yes" overall. All respondents who reported having not heard of each colorectal cancer screening option were categorized as "no" for the corresponding utilization question and the provider recommendation question.

Colorectal cancer screening preference

Respondents were asked three questions about relative preference between colonoscopy and mt-sDNA, between colonoscopy and FIT/gFOBT, and between mt-sDNA and FIT/gFOBT. The specific wording of these items is included in **Table 1**.

Statistical analyses

Sampling weights were applied to the data to correct for potential bias introduced by nonresponsiveness, noncoverage, and panel attrition and to allow the estimates to be nationally representative. Analyses were focused on the subpopulation of respondents ages 45–75 years (for whom population screening is recommended; ref. 15) and those at average risk of developing colorectal cancer ($N = 1{,}062$). As such, respondents were excluded if they reported any of the following: history of colorectal cancer (personal or immediate family member), ulcerative colitis, Crohn disease, inflammatory bowel disease, familial adenomatous polyposis (personal or immediate family member), Lynch syndrome (personal or immediate family member), or colorectal polyps. Prior to analysis, we assessed whether there were any significant differences in our primary outcome variables (colorectal cancer screening preferences) by survey mode or by language of survey completion (English vs. Spanish) and observed no significant differences.

Weighted descriptive statistics and Rao–Scott χ^2 test (16) were used to examine differences in colorectal cancer screening preferences by sociodemographic characteristics, healthcare access, health status, and colorectal cancer screening modality awareness and experience. A series of logistic regression models was conducted to assess the independent associations of sociodemographic characteristics, healthcare access, health status, and colorectal cancer screening awareness and experiences with patient preference between colonoscopy and mt-sDNA (colonoscopy as the reference category), colonoscopy and FIT/gFOBT (colonoscopy as the reference category), and FIT/gFOBT and mt-sDNA (FIT/gFOBT as the reference category). The regression models were weighted to account for deviations from a pure equal probability sample design, sampling and nonsampling error, sample design, and nonresponse. We only included variables that were statistically significant at the bivariate level in the final models. We estimated variance using the Taylor series method to account for the complex survey design (17). Given that the sampling weights were dependent on the demographic make-up of the full sample compared with the population, to ensure correct variance estimation, we took into account the complex design of the entire sample when analyzing the subpopulation by including all observations in the analysis, but assigning zero weight to observations not in the subpopulation (18–20). Statistical analyses were conducted in R using the "survey" package (20, 21). $P < 0.05$ was considered statistically significant.

Results

Table 1 summarizes the weighted estimates of overall patient preference for specific colorectal cancer screening modalities and differences in preference by sociodemographic characteristics (age, sex, race/ethnicity, education, employment status, income, and marital status). When given a choice between colonoscopy and the mt-sDNA test, 65.4% of respondents chose the mt-sDNA test, with significant differences observed by race/ethnicity. Specifically, higher preference for the mt-sDNA test over colonoscopy was observed in non-Hispanic White and other/multi-race individuals ($P = 0.003$). When given a choice between colonoscopy and FIT/gFOBT, 61% chose FIT/gFOBT; no statistically significant differences by sociodemographic characteristics were observed. When given a choice between the mt-sDNA test and FIT/gFOBT, 66.9% chose the mt-sDNA test, with significant differences observed by employment status. Specifically, higher preference for the mt-sDNA test over FIT/gFOBT was observed among those who were retired ($P = 0.048$).

Table 2 summarizes the weighted estimates of healthcare access, health status, colorectal cancer screening modality awareness and experience, and differences in screening preferences by healthcare access, health status, and colorectal cancer screening modality awareness and experience. A majority of the population had heard of colonoscopy (90.5%), FIT/gFOBT (67.1%), and the mt-sDNA test (60.9%). Just more than half reported having ever had a colonoscopy (57.4%), while fewer reported having ever had a FIT/gFOBT (28.5%) or mt-sDNA test (13.9%). More than a quarter of the population indicated that a healthcare provider had recommended colonoscopy (26.4%) during the past 12 months, whereas reported

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Table 1. Weighted[a] estimates of sociodemographic characteristics for the total sample and CRC screening preference by sociodemographic characteristics.

		CRC screening preference					
		If your healthcare provider gave you a choice between having a colonoscopy and a Cologuard test, which would you choose?		If your healthcare provider gave you a choice between having a colonoscopy and a FIT/gFOBT test, which would you choose?		If your healthcare provider gave you a choice between having a Cologuard and a FIT/gFOBT test, which would you choose?	
	Total (N = 1,062)	(n = 1,043)[b]		(n = 1,029)[c]		(n = 1,003)[d]	
	N (%)	N (% Cologuard)	P	N (% FIT/gFOBT)	P	N (% Cologuard)	P
Total		700 (65.4)		643 (61.0)		679 (66.9)	
Age in years							
45–54	390 (37.6)	273 (68.7)	0.160	256 (65.2)	0.236	243 (61.2)	0.062
55–64	391 (36.3)	253 (66.3)		222 (58.4)		250 (69.9)	
65–75	281 (26.1)	174 (59.4)		165 (58.2)		186 (71.5)	
Sex[e]							
Male	491 (48.0)	309 (64.6)	0.720	285 (59.7)	0.605	309 (66.5)	0.877
Female	565 (51.6)	388 (66.1)		355 (62.1)		368 (67.2)	
Other or prefer not to answer	4 (0.4)	2 (100)		0 (0)		2 (100)	
Race/ethnicity							
White, NH	765 (66.2)	527 (70.2)	0.003	481 (64.1)	0.118	507 (70.0)	0.076
Black, NH	108 (11.7)	63 (49.1)		55 (47.1)		64 (64.4)	
Hispanic	114 (14.2)	59 (54.7)		57 (57.8)		65 (53.4)	
Asian, NH	18 (1.6)	13 (59.9)		14 (69.0)		9 (62.4)	
Other or multiple race, NH	57 (6.3)	38 (69.8)		36 (58.3)		34 (69.5)	
Education							
Less than high school	54 (12.2)	26 (56.1)	0.066	26 (64.3)	0.368	30 (56.8)	0.261
High school	211 (29.6)	128 (60.3)		116 (55.3)		127 (64.8)	
Some college	424 (25.7)	299 (71.7)		269 (64.2)		275 (71.1)	
Bachelor's degree or higher	373 (32.6)	247 (68.2)		232 (62.3)		247 (68.6)	
Employment status							
Currently employed	574 (52.2)	377 (64.6)	0.165	353 (61.2)	0.531	355 (64.8)	0.048
Not currently employed	212 (22.2)	148 (72.0)		128 (64.2)		139 (62.7)	
Retired	276 (25.6)	175 (61.4)		162 (57.7)		185 (75.1)	
Income ($)							
<25,000	220 (23.4)	147 (67.3)	0.842	127 (63.5)	0.786	128 (64.7)	0.837
25,000–59,999	313 (29.2)	209 (63.3)		197 (60.3)		206 (66.1)	
60,000–124,999	373 (32.6)	240 (64.8)		222 (58.8)		242 (69.3)	
>125,000	156 (14.8)	104 (67.9)		97 (63.5)		103 (66.2)	
Marital status							
Married or living with a partner	666 (63.3)	425 (64.3)	0.438	396 (61.0)	0.748	438 (68.7)	0.382
Widowed, divorced, separated	262 (24.6)	183 (65)		165 (59.1)		159 (64.8)	
Never married	134 (12.2)	92 (72.2)		82 (64.4)		82 (61.0)	

Note: P values from Rao–Scott χ^2 test.
Abbreviations: CRC, colorectal cancer; NH, non-Hispanic.
[a]N is unweighted, % is weighted.
[b]Missing = 19.
[c]Missing = 33.
[d]Missing = 59.
[e]Missing = 2.

recommendations of FIT/gFOBT (18.5%) and the mt-sDNA test (9.1%) were less frequent.

Preference between the mt-sDNA test and colonoscopy differed significantly by health insurance status and several of the colorectal cancer screening awareness and experience variables (**Table 2**). Those with no health insurance more frequently chose the mt-sDNA test over colonoscopy as their preferred colorectal cancer screening modality (P = 0.029). Regarding preference differences by colorectal cancer screening awareness and experience, the mt-sDNA test was more frequently chosen over colonoscopy among those who had not heard of colonoscopy (P = 0.017), previously not had a colonoscopy (P < 0.001), not had a healthcare provider recommend colonoscopy in the past 12 months (P = 0.001), had heard of FIT/gFOBT (P = 0.009), previously had a FIT/gFOBT (P = 0.047), had a healthcare provider recommend a FIT/gFOBT during the prior 12 months (P = 0.001), and had heard of the mt-sDNA test (P = 0.021).

Preference between FIT/gFOBT and colonoscopy differed significantly by health insurance status, time since a

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Table 2. Weighted[a] estimates of healthcare access, health status, and CRC screening awareness and experience for the total sample and CRC screening preference by patient characteristics.

		CRC screening preference					
		If your healthcare provider gave you a choice between having a colonoscopy and a Cologuard test, which would you choose?		If your healthcare provider gave you a choice between having a colonoscopy and a FIT/gFOBT test, which would you choose?		If your healthcare provider gave you a choice between having a Cologuard and a FIT/gFOBT test, which would you choose?	
	Total ($N = 1{,}062$)	($n = 1{,}043$)[b]		($n = 1{,}029$)[c]		($n = 1{,}003$)[d]	
	N (%)	*N* (% Cologuard)	*P*	*N* (% FIT/gFOBT)	*P*	*N* (% Cologuard)	*P*
Total		700 (65.4)		643 (61)		679 (66.9)	
Health insurance[e]							
Private insurance	525 (46.2)	349 (65.9)	0.029	318 (60.5)	0.007	342 (66.8)	0.213
Public insurance	470 (46.5)	301 (62.2)		277 (58.1)		299 (68.9)	
No insurance	66 (7.2)	49 (82.5)		47 (83)		37 (54.4)	
Recent healthcare visit[f]							
Within the last 2 years	967 (92.5)	630 (64.9)	0.604	576 (59.7)	0.025	623 (67.7)	0.178
3–5 years ago	49 (4.4)	35 (70)		33 (71.7)		26 (52.2)	
More than 5 years ago or never	41 (3.1)	31 (74)		30 (82.7)		26 (61.9)	
General health rating							
Excellent	112 (10.7)	69 (61)	0.145	63 (54.7)	0.584	67 (61.4)	0.389
Very good	394 (34.5)	270 (70.8)		236 (61.7)		266 (71.4)	
Good	382 (36.6)	243 (60.7)		237 (60.1)		233 (64.9)	
Fair or poor	174 (18.2)	118 (67)		107 (65)		113 (65.6)	
Body mass index[g]							
Under to normal weight	250 (23.9)	164 (66.3)	0.321	146 (60.3)	0.682	158 (64.7)	0.608
Overweight	378 (36.1)	261 (68.7)		238 (63.2)		251 (69.7)	
Obese	417 (40)	265 (62.1)		249 (59.3)		261 (66.4)	
Personal history of cancer diagnosis[h]							
Yes	129 (12.8)	76 (57)	0.106	66 (52.1)	0.096	90 (69.9)	0.568
No	931 (87.2)	622 (66.5)		575 (62.2)		587 (66.3)	
Ever heard of colonoscopy[i]							
Yes	963 (90.5)	620 (64)	0.017	566 (59.7)	0.041	623 (67.6)	0.207
No	98 (9.5)	80 (79.9)		77 (73.8)		55 (59.4)	
Ever had a colonoscopy							
Yes	611 (57.4)	352 (56.8)	<0.001	316 (52.7)	<0.001	407 (71.6)	0.006
No	451 (42.6)	348 (77)		327 (72.2)		272 (60.8)	
Provider recommended colonoscopy during past 12 months							
Yes	265 (26.4)	155 (54.1)	0.001	137 (52.7)	0.015	180 (70.3)	0.333
No	797 (73.6)	545 (69.5)		506 (64)		499 (65.7)	
Ever heard of FIT/gFOBT							
Yes	725 (67.1)	503 (68.9)	0.009	472 (64.9)	0.004	456 (66.6)	0.853
No	337 (32.9)	197 (58.1)		171 (52.7)		223 (67.4)	
Ever had a FIT/gFOBT							
Yes	293 (28.5)	207 (71.6)	0.047	212 (74.7)	<0.001	159 (56)	<0.001
No	769 (71.5)	493 (62.9)		431 (55.3)		520 (71.4)	
Provider recommended FIT/gFOBT during past 12 months[j]							
Yes	194 (18.5)	156 (79.7)	0.001	153 (77.9)	<0.001	101 (55.4)	0.005
No	866 (81.5)	542 (61.9)		489 (57)		577 (69.9)	
Ever heard of Cologuard							
Yes	646 (60.9)	457 (68.9)	0.021	397 (60.5)	0.774	479 (77)	<0.001
No	416 (39.1)	243 (59.7)		246 (61.7)		200 (50.4)	
Ever had a Cologuard							
Yes	126 (13.9)	93 (72.8)	0.170	84 (71.4)	0.039	101 (76.8)	0.083
No	936 (86.1)	607 (64.2)		559 (59.2)		578 (65.2)	
Provider recommended Cologuard during past 12 months[k]							
Yes	94 (9.1)	77 (77.8)	0.108	76 (83.3)	<0.001	73 (73.1)	0.405
No	965 (90.9)	620 (64.1)		565 (58.7)		606 (66.3)	

Note: *P* values from Rao–Scott χ^2 test.
Abbreviation: CRC, colorectal cancer.
[a]*N* is unweighted, % is weighted.
[b]Missing = 19.
[c]Missing = 33.
[d]Missing = 59.
[e]Missing = 1.
[f]Missing = 5.
[g]Missing = 17.
[h]Missing = 2.
[i]Missing = 1.
[j]Missing = 2.
[k]Missing = 3.

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respondent's most recent healthcare visit, and by several of the colorectal cancer screening awareness and experience variables (**Table 2**). Those without health insurance ($P = 0.007$) and those whose last healthcare visit was more than 3 years ago ($P = 0.025$) more frequently chose FIT/gFOBT over colonoscopy. Regarding preference differences by colorectal cancer screening awareness and experience, FIT/gFOBT was more frequently chosen over colonoscopy among those who had not heard of colonoscopy ($P = 0.041$), not had a colonoscopy ($P < 0.001$), not had a healthcare provider recommend colonoscopy during the past 12 months ($P = 0.015$), had heard of FIT/gFOBT ($P = 0.004$), previously had a FIT/gFOBT ($P < 0.001$), had a healthcare provider recommend a FIT/gFOBT during the prior 12 months ($P < 0.001$), previously had an mt-sDNA test ($P = 0.039$), and had a healthcare provider recommend the mt-sDNA test during the prior 12 months ($P < 0.001$).

Preference between the mt-sDNA test and FIT/gFOBT differed significantly by several of the colorectal cancer screening awareness and experience variables (**Table 2**). Mt-sDNA testing was more frequently chosen over FIT/gFOBT among those who previously had a colonoscopy ($P = 0.006$), not previously had a FIT/gFOBT ($P < 0.001$), not had a healthcare provider recommend a FIT/gFOBT during the prior 12 months ($P = 0.005$), and had heard of the mt-sDNA test ($P < 0.001$).

Table 3 summarizes the results of three multivariable logistic regression models examining the differences in colorectal cancer screening preferences by sociodemographic

Table 3. Results of logistic regression models examining the differences in CRC screening preferences by sociodemographic characteristics.

	If your healthcare provider gave you a choice between having a colonoscopy and a Cologuard test, which would you choose? Odds of choosing Cologuard ($n = 1{,}039$)[a] OR (95% CI)	**If your healthcare provider gave you a choice between having a colonoscopy and a FIT/gFOBT test, which would you choose? Odds of choosing FIT/gFOBT ($n = 1{,}025$)[a] OR (95% CI)**	**If your healthcare provider gave you a choice between having a Cologuard and a FIT/gFOBT test, which would you choose? Odds of choosing Cologuard ($n = 1{,}000$)[a] OR (95% CI)**
Age in years			
45–54	Reference	Reference	Reference
55–64	0.82 (0.54–1.24)	0.75 (0.50–1.11)	1.31 (0.88–1.94)
65–75	**0.59 (0.34–0.99)**	0.75 (0.46–1.24)	1.09 (0.60–1.97)
Sex[b]			
Male	Reference	Reference	Reference
Female	1.13 (0.80–1.59)	1.13 (0.82–1.57)	1.06 (0.75–1.50)
Race/ethnicity			
White, NH	Reference	Reference	Reference
Black, NH	**0.38 (0.22–0.64)**	**0.45 (0.26–0.78)**	0.86 (0.47–1.59)
Hispanic	**0.47 (0.26–0.83)**	0.64 (0.36–1.14)	0.58 (0.32–1.03)
Asian, NH	0.62 (0.22–1.90)	1.22 (0.40–4.45)	0.73 (0.23–2.61)
Other or multiple race, NH	0.89 (0.41–2.06)	0.71 (0.36–1.45)	1.08 (0.50–2.47)
Education			
Less than high school	0.62 (0.29–1.31)	1.21 (0.57–2.63)	0.73 (0.33–1.65)
High school	0.71 (0.45–1.13)	0.78 (0.50–1.22)	0.93 (0.57–1.51)
Some college	1.20 (0.81–1.79)	1.11 (0.76–1.60)	1.17 (0.79–1.74)
Bachelor's degree or higher	Reference	Reference	Reference
Employment status			
Currently employed	Reference	Reference	Reference
Not currently employed	1.60 (0.94–2.75)	1.07 (0.66–1.73)	1.02 (0.62–1.68)
Retired	1.11 (0.70–1.76)	0.93 (0.60–1.45)	1.51 (0.90–2.56)
Income ($)			
<25,000	1.22 (0.68–2.18)	1.35 (0.79–2.33)	1.04 (0.61–1.79)
25,000–59,999	0.98 (0.62–1.54)	1.18 (0.77–1.81)	0.94 (0.61–1.47)
60,000–124,999	Reference	Reference	Reference
>125,000	1.00 (0.60–1.67)	1.11 (0.69–1.80)	0.84 (0.51–1.42)
Marital status			
Married/living with a partner	Reference	Reference	Reference
Widowed, divorced, separated	1.26 (0.79–2.02)	0.97 (0.63–1.51)	0.82 (0.53–1.28)
Never married	1.51 (0.87–2.69)	1.24 (0.73–2.13)	0.69 (0.41–1.18)

Note: Statistically significant associations ($P < .05$) are bold.
Abbreviations: CRC, colorectal cancer; NH, non-Hispanic.
[a]Sample size lower than 1,062 due to missing responses; list-wise deletion was used for each analysis.
[b]The response category "other or prefer not to respond" was omitted from analysis because it was rarely selected ($n = 4$).

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Table 4. Results of logistic regression analyses examining the differences in CRC screening preferences by healthcare access, health status, and CRC awareness and experience, controlling for sociodemographic characteristics.

	If your healthcare provider gave you a choice between having a colonoscopy and a Cologuard test, which would you choose?		If your healthcare provider gave you a choice between having a colonoscopy and a FIT/gFOBT test, which would you choose?		If your healthcare provider gave you a choice between having a Cologuard and a FIT/gFOBT test, which would you choose?	
	Odds of choosing Cologuard		Odds of choosing FIT/gFOBT		Odds of choosing Cologuard	
	Unadjusted (n = 1,018)[d] OR (95% CI)	Adjusted[a] (n = 1,018) OR (95% CI)	Unadjusted (n = 1,004)[d] OR (95% CI)	Adjusted[b] (n = 1,004) OR (95% CI)	Unadjusted (n = 979)[d] OR (95% CI)	Adjusted[c] (n = 979) OR (95% CI)
Health insurance						
Private insurance	Reference	Reference	Reference	Reference	Reference	Reference
Public insurance	0.88 (0.60–1.28)	1.04 (0.65–1.68)	0.80 (0.55–1.16)	0.83 (0.57–1.22)	1.19 (0.80–1.76)	1.07 (0.70–1.65)
No insurance	2.06 (0.96–4.85)	**2.53 (1.22–5.65)**	**2.49 (1.04–6.79)**	**2.73 (1.13–7.47)**	0.72 (0.33–1.61)	0.72 (0.33–1.61)
Recent healthcare visit						
Within the last 2 years	Reference	Reference	Reference	Reference	Reference	Reference
3–5 years ago	0.75 (0.32–1.88)	0.69 (0.31–1.60)	1.15 (0.52–2.71)	1.12 (0.52–2.55)	0.52 (0.24–1.11)	0.53 (0.25–1.15)
More than 5 years ago or never	0.96 (0.35–2.99)	0.89 (0.35–2.52)	2.31 (0.93–6.79)	2.19 (0.85–6.76)	1 (0.43–2.49)	0.96 (0.42–2.35)
General health rating						
Excellent	Reference	Reference	Reference	Reference	Reference	Reference
Very good	1.43 (0.81–2.53)	1.40 (0.78–2.5)	1.29 (0.71–2.34)	1.30 (0.72–2.34)	1.54 (0.82–2.86)	1.56 (0.83–2.93)
Good	0.89 (0.48–1.63)	0.92 (0.49–1.70)	1.20 (0.63–2.25)	1.28 (0.69–2.38)	1.13 (0.59–2.13)	1.15 (0.59–2.20)
Fair or poor	1.27 (0.64–2.51)	1.24 (0.62–2.49)	1.61 (0.79–3.25)	1.75 (0.87–3.55)	1.20 (0.56–2.53)	1.28 (0.59–2.80)
Body mass index						
Normal weight	Reference	Reference	Reference	Reference	Reference	Reference
Overweight	1.26 (0.80–1.98)	1.22 (0.77–1.91)	1.23 (0.78–1.94)	1.20 (0.75–1.91)	1.33 (0.83–2.12)	1.36 (0.85–2.17)
Obese	0.94 (0.59–1.49)	1 (0.63–1.60)	0.99 (0.61–1.59)	1.06 (0.65–1.72)	1.16 (0.72–1.85)	1.17 (0.73–1.89)
Cancer history						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	0.78 (0.47–1.31)	0.74 (0.44–1.24)	0.74 (0.44–1.23)	0.69 (0.41–1.16)	1.12 (0.65–1.99)	1.06 (0.60–1.89)
Ever heard of stool-based colorectal cancer screening						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	**1.72 (1.05–2.84)**	1.55 (0.92–2.63)	0.97 (0.60–1.58)	0.89 (0.54–1.46)	**2.15 (1.31–3.52)**	**2.07 (1.26–3.40)**
Ever had stool-based colorectal cancer screening						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.15 (0.73–1.82)	1.31 (0.83–2.08)	**2.43 (1.54–3.88)**	**2.75 (1.74–4.41)**	**0.43 (0.27–0.68)**	**0.41 (0.26–0.67)**
Provider recommended a stool-based test for colorectal cancer screening during past 12 months						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	**1.76 (1.05–2.99)**	**1.78 (1.06–3.04)**	1.66 (0.98–2.85)	1.68 (0.99–2.89)	0.74 (0.45–1.22)	0.75 (0.46–1.25)
Ever heard of colonoscopy						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	0.88 (0.42–1.73)	0.90 (0.42–1.82)	1.03 (0.50–2.07)	1.07 (0.50–2.18)	0.88 (0.48–1.61)	0.86 (0.46–1.57)
Ever had a colonoscopy						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	**0.42 (0.27–0.64)**	**0.39 (0.24–0.63)**	**0.44 (0.29–0.67)**	**0.40 (0.26–0.62)**	**1.59 (1.05–2.39)**	1.48 (0.98–2.25)
Provider recommended a colonoscopy during past 12 months						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	**0.56 (0.36–0.85)**	**0.63 (0.41–0.96)**	0.75 (0.50–1.12)	0.83 (0.55–1.25)	1.02 (0.65–1.60)	1.03 (0.67–1.61)

Note: Statistically significant associations ($P < .05$) are bold.
Abbreviation: CRC, colorectal cancer.
[a]Adjusted for age and race.
[b]Adjusted for race.
[c]Adjusted for employment status.
[d]Sample size lower than 1,062 due to missing responses; list-wise deletion was used for each analysis.

characteristics. The odds of choosing mt-sDNA testing over colonoscopy were significantly lower among those ages 65–75 years [OR, 0.59; 95% confidence interval (CI), 0.34–0.99] compared with those who were younger. Compared with non-Hispanic Whites, non-Hispanic Blacks (OR, 0.38; 95% CI, 0.22–0.64) and Hispanics (OR, 0.47; 95% CI, 0.26–0.83) were less likely to choose mt-sDNA testing over colonoscopy. The odds of choosing FIT/gFOBT over colonoscopy were significantly lower among non-Hispanic Blacks (OR, 0.45; 95% CI, 0.26–0.78) compared with non-Hispanic Whites.

Table 4 summarizes the results of three multivariable logistic regression models examining the differences in colorectal

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cancer screening preferences by healthcare access, health status, and colorectal cancer screening awareness and experience, adjusting for sociodemographic characteristics. The odds of choosing mt-sDNA testing over colonoscopy were significantly higher among those who have no health insurance (OR, 2.53; 95% CI, 1.22–5.65) and those who had a healthcare provider recommend a stool-based colorectal cancer screening test in the past 12 months (OR, 1.78; 95% CI, 1.06–3.04), but were significantly lower among those who had previously had a colonoscopy (OR, 0.39; 95% CI, 0.24–0.63) and those who had a healthcare provider recommend colonoscopy in the past 12 months (OR, 0.63; 95% CI, 0.41–0.96). The odds of choosing FIT/gFOBT over colonoscopy were significantly higher among who have no health insurance (OR, 2.73; 95% CI, 1.13–7.47) and those who had previously had a stool-based colorectal cancer test (OR, 2.75; 95% CI, 1.74–4.41), but were significantly lower among those who had previously had a colonoscopy (OR, 0.40; 95% CI, 0.26–0.62). The odds of choosing mt-sDNA testing over FIT/gFOBT were significantly higher among those who had heard of stool-based colorectal cancer screening (OR, 2.07; 95% CI, 1.26–3.40), but were significantly lower among those who had previously had a stool-based colorectal cancer screening test (OR, 0.41; 95% CI, 0.26–0.67).

Discussion

The results from our nationally representative survey of U.S. adults demonstrated notable variations in preferences for three commonly utilized colorectal cancer screening modalities. When given a choice between colonoscopy and the mt-sDNA test, the majority of the population preferred mt-sDNA testing. Similarly, when given a choice between colonoscopy and FIT/gFOBT, most preferred FIT/gFOBT, and when given a choice between the mt-sDNA test and FIT/gFOBT, most preferred mt-sDNA testing. These findings, which consistently point to a patient preference for stool-based tests, and specifically the mt-sDNA test, are in contrast to previously reported clinician preferences for colorectal cancer screening by colonoscopy (22, 23). Prior research has raised concerns that the common practice of recommending colonoscopy alone may actually reduce adherence to colorectal cancer screening, particularly among racial/ethnic minorities, and that offering stool-based screening tests or a choice of either stool-based screening or colonoscopy may improve uptake of colorectal cancer screening and adherence (23, 24).

While awareness of colorectal cancer screening options in the population was generally high, fewer than half reported ever having taken one of the colorectal cancer screening tests. A participant's awareness and prior use of a particular screening option mirrored the participant having received a provider recommendation about that option during the prior 12 months, with colonoscopy as the most frequently recommended test, followed by FIT/gFOBT and the mt-sDNA test. Indeed, both prior use and receiving a clinician recommendation were independently associated with preference. This pattern is consistent with previous research demonstrating that clinician recommendation is a key factor associated with completing colorectal cancer screening (25–27), and highlights the critical role of provider–patient communication in shaping patients' colorectal cancer screening awareness, knowledge, and decisions. Provider education and training efforts may be needed to encourage covering multiple colorectal cancer screening options and adopting a shared decision-making approach during discussions about colorectal cancer screening.

In addition, preference for colorectal cancer screening modalities was found to be independently associated with age and race/ethnicity. Mt-sDNA testing was less preferred over colonoscopy among adults ages 65–75 years (compared with younger adults), and among non-Hispanic Blacks and Hispanics (compared with non-Hispanic Whites). Similarly, preference for FIT/gFOBT over colonoscopy was lower among non-Hispanic Blacks compared with non-Hispanic Whites. However, although less often than non-Hispanic Whites, roughly half of Hispanic and non-Hispanic Black respondents preferred stool-based testing over colonoscopy, and specifically the mt-sDNA test over FIT/gFOBT. Our data add to previous research evaluating racial/ethnic variations in colorectal cancer screening modality preferences, where findings have been mixed. While some have found greater preference for colonoscopy among non-Hispanic Whites and for stool-based tests among racial/ethnic minorities (23, 28), others have found greater preference for colonoscopy among racial/ethnic minorities (29–31). These findings may reflect variations in preferences for test attributes among subpopulation groups. On the other hand, they may also result from inequitable diffusion of information about newer colorectal cancer screening tests across segments of population with varying levels of access to medical innovations and differences in provider–patient communication with regard to colorectal cancer screening options to non-Hispanic White patients versus racial/ethnicity minority patients (32–34). Finally, preference for colorectal cancer screening modalities was found to be associated with health insurance status, with those who have no health insurance preferring both stool-based tests over colonoscopy, likely reflecting cost-related barriers.

It is worth noting that findings in this study reflect patients' existing preferences regarding three commonly recommended colorectal cancer screening modalities and the associations between the preferences and their existing awareness and experiences regarding colorectal cancer screening, existing healthcare experiences and access, and existing financial and social contexts. We did not examine what people's screening preferences would be under the condition that they were fully informed of each modality's specific attributes and fully understood the pros and cons of each modality based on their unique needs, resources, and contexts. To minimize the possibility that information from the survey may change patients' preferences, we only provided necessary, minimum description for each

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screening modality. It is possible that some of the reported preferences were due to lack of knowledge or misperceptions about certain modalities, and some patients may change their preferences after they were fully informed of the attributes and pros and cons of each modality through a shared decision-making process with their healthcare providers.

Overall, our findings highlight the importance of having multiple colorectal cancer screening options made available to patients and the need for healthcare providers to engage patients in shared decision-making to help explain the unique characteristics of each screening modality in relation to patients' personal, financial, and cultural context to facilitate informed choices about colorectal cancer screening. This approach may be particularly beneficial for improving colorectal cancer screening uptake among disadvantaged populations, such as racial/ethnic minorities, patients with low levels of health literacy, and those with language barriers. In addition, patient education efforts to improve awareness and knowledge of various colorectal cancer screening modalities are needed, particularly regarding the stool-based screening modalities where awareness was around 60% compared with 90% for colonoscopy. Such education efforts should consider tailoring content and implementation strategies to the needs and sociocultural context of the target populations. Moreover, patient navigation has been shown to have a positive impact on colorectal cancer screening completion (35–38). It is important to target navigation efforts to populations that need assistance in completing colorectal cancer screening the most, for example, disadvantaged populations that face substantial barriers to navigate through the often fragmented, complex healthcare system and patients who have failed to complete prior colorectal cancer screening efforts (13). In addition, navigation efforts need to be tailored to the target population to address the specific barriers the population is facing and cover the entire colorectal cancer screening continuum from initiation of screening to completion of the follow-up colonoscopy, if positive results were returned from noninvasive screening modalities.

Limitations

First, the cross-sectional design of this survey precludes the examination of causal relationships. Second, we relied on self-reported data, rather than objective measures of colorectal cancer awareness and screening, which may contain misreporting due to inaccuracies in participants' memory or tendency to provide socially desirable responses. Nevertheless, our primary outcome of interest (colorectal cancer screening preference) was appropriately captured through self-reporting and previous research has shown that self-reports of colorectal cancer screening behaviors are generally accurate (39). Third, to reduce respondent burden, we limited our examination of colorectal cancer screening preferences to the three most commonly recommended and commonly used screening modalities, thus we were unable to capture patient preferences regarding other less widely used colorectal cancer screening modalities, including CT colonography and flexible sigmoidoscopy (40–42). Future research should include all recommended screening modalities to obtain a more comprehensive understanding of patient colorectal cancer screening preferences. Finally, another potential limitation is that the overall survey response rate was low (31.3%), thus the generalizability of our findings may be impacted by nonresponse bias. It is likely that people who were more interested in the topic area or more comfortable discussing colorectal cancer screening were more likely to have completed the survey (43). However, our sample was selected using rigorous stratification to ensure adequate population representation, and our data were weighted to be nationally representative and reduce nonresponse biases. In addition, our response rate was similar to other cross-sectional national surveys in the United States (44) and survey researchers across multiple disciplines have witnessed a gradual decline in survey participation over time (45).

Conclusions

Recommended colorectal cancer screening modalities vary with respect to efficacy, safety, cost, and acceptability (10). Understanding and incorporating patient preferences for colorectal cancer screening are critical to improve population adherence to colorectal cancer screening and to reach population health goals. Our findings suggest that patients broadly prefer stool-based tests over colonoscopy, which is in contrast to the predominance of colonoscopy utilization for colorectal cancer screening in clinical practice. In addition, prior use of colorectal cancer screening options and receiving a clinician recommendation were independently associated with screening preference, which highlights the critical role of provider–patient communication in facilitating patients' colorectal cancer screening awareness, knowledge, and decision-making. Finally, age and race/ethnicity differences in screening preferences exist independent of other factors, suggesting a need for further research on patient preferences and potential differences in provider–patient communication about colorectal cancer screening options by subpopulation groups. These findings underscore the importance of continuing to offer colorectal cancer screening options to patients and encourage healthcare providers to engage patients in shared decision-making to discuss these various options in alignment with patient needs, resources, and preferences.

Authors' Disclosures

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Authors' Contributions

X. Zhu: Formal analysis, writing–original draft, writing–review and editing. **P.D. Parks:** Conceptualization, methodology, writing–review and editing. **E. Weiser:** Conceptualization, resources, funding acquisition, methodology, project administration, writing–review and editing. **K. Fischer:** Data curation, software, formal analysis. **J.M. Griffin:** Writing–review and editing. **P.J. Limburg:** Conceptualization, resources, supervision, funding acquisition, methodology, project administration, writing–review and editing. **L.J. Finney Rutten:** Conceptualization, supervision, methodology, writing–original draft, project administration, writing–review and editing.

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Cancer Prevention Research

National Survey of Patient Factors Associated with Colorectal Cancer Screening Preferences

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