



Stool DNA-based versus colonoscopy-based colorectal cancer screening: Patient perceptions and preferences

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Abstract

Objective: Stool DNA (sDNA) tests offer a noninvasive form of colon cancer screening for patients, and although the test is expected to increase uptake of colon cancer screening, it is unknown if patients' perceptions of the sDNA test differ according to race and other patient characteristics.

Methods: We conducted a self-administered survey of patients undergoing both a colonoscopy and an sDNA test to evaluate perceptions of sDNA testing.

Results: Of the 613 participants who were sent surveys, 423 responded (69% response rate). Respondents self-identified as African American ($n=127$, 30%), Caucasian ($n=284$, 67%), and other ethnicity ($n=12$, 3%). In general, participants found the sDNA test more suitable than a colonoscopy ($n=309$, 75%). In univariate analyses, a higher percentage of Caucasians as compared with African Americans found the sDNA test more suitable than a colonoscopy (89% vs. 76%, $p<0.01$), and more Caucasians than African Americans preferred the sDNA test (43% vs. 32%, $p<0.05$). Adjustment for covariates reduced these racial differences to no significance. A family history of colorectal cancer remains a significant factor for patient's preferences for screening regardless of race.

Conclusions: Our study shows no racial differences in the perception of and preference for sDNA testing for colon screening. Intervention to increase the uptake of sDNA testing may help reduce racial disparities in colorectal cancer.

Keywords: Colon cancer screening; race; stool DNA test; patient perceptions

Introduction

Colorectal cancer is the second leading cause of cancer-related deaths, and nonscreening accounts for most of these deaths [1, 2]. Among all colon cancer deaths, a significantly higher proportion of patients are African American [3]. African Americans not only have a higher mortality rate than Caucasians, but also have a higher incidence rate, the highest of all races [1–3]. The reasons for these disparities are complex; however, a lower uptake of colon cancer screening among African Americans has been

speculated as a key contributing factor [4–8].

Although a number of screening options are available – including a fecal occult blood test, a fecal immunochemical test, sigmoidoscopy, and colonoscopy – a stool DNA (sDNA) test recently approved by the US Food and Drug Administration may be promising for improving screening, particularly in underserved and vulnerable populations, who may be less likely to undergo colonoscopy [9, 10].

Increasing uptake of colon screening is crucial for reducing colorectal cancer

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incidence and mortality. Assessing patients' perceptions of the available screening options is important in understanding acceptance of the screening technology [5, 6, 11–14]. One study of low-income Hispanic and African American patients who were scheduled for but never had a colonoscopy at a safety-net hospital found the strongest reasons for patients not having a colonoscopy to be psychological barriers, such as discomfort, embarrassment, and pain [5]. A few studies investigated these barriers among different races and found that African American patients, more so than Caucasian patients, were fearful of finding cancer, felt embarrassed by the procedure, and felt the procedure was unnecessary [6, 11, 12].

In addition to these barriers, patients have cited hospital transportation, bowel preparation, and time off from work as impediments to a colonoscopy [13–15]. Although these same logistic barriers to a colonoscopy do not exist in a stool-based colon screening, it is not known if patients' perceptions of the procedure differ when compared with that for a colonoscopy. Additionally, to our knowledge, there are no data comparing potential differences in perceptions of the sDNA test between Caucasians and African Americans. Therefore, we conducted a survey-based study to assess patients' perceptions of the sDNA test and if perceptions varied across race, between Caucasians and African Americans.

Methods and materials

We prospectively recruited patients referred for a screening colonoscopy at the University Hospital Health System in Cleveland, Ohio, to participate in a comparative study of colonoscopy versus sDNA testing for colon screening. We excluded patients who (a) were younger than 30 years or older than 80 years, (b) had a personal or family history of a cancer syndrome, such as hereditary nonpolyposis colorectal cancer or familial adenomatous polyposis, (c) had a previous diagnosis of colon polyps, (d) had prior colon resection, (e) had a diagnosis of inflammatory bowel disease, and (f) had a prior or current cancer diagnosis, except for nonmelanoma skin cancer. Patients who agreed to participate in the study used a stool collection kit to collect stool samples for sDNA testing and fecal immunochemical testing, followed by colonoscopy. The stool collection kit was mailed to each participant's residence together with an instruction booklet for stool collection and

specimen shipping. The participation rate for the study was 64.9% among those eligible, and those recruited and those not recruited did not differ in age, race, or sex ($p>0.05$). All patients provided written informed consent, and this study was approved by the University Hospitals Case Medical Center Institutional Review Board.

After completion of both components, patients were sent a survey consisting of 19 questions, fixed-choice items as well as blank, open-ended questions, assessing perception of and experience with the sDNA test. Fixed-choice items included five-point Likert-scale questions evaluating the difficulty of using the stool collection kit, difficulty of shipping, and perceptions of using the test. For ease of interpreting patients' responses, we grouped answers with a rating of either 1 or 2 together and answers with a rating of either 4 or 5 together. Questions also evaluated suitability of the sDNA test compared with a colonoscopy, the medical and physical suitability of the test, and the preferred colon cancer screening method (fecal occult blood test/fecal immunochemical test, sDNA test, or colonoscopy). The survey's Flesch-Kincaid grade level score was 5.7, indicating that the survey was easy to read at approximately a sixth grade level. Demographic information, family history, and medical history were self-reported and collected via a computer-assisted telephone interview before the colonoscopy.

All responses were included in the analysis and questions left blank were coded as "no response." We first performed univariate analysis (χ^2 test for categorical variables and t test for continuous variables) to evaluate differences between Caucasians and African Americans. We then performed multivariate analysis adjusted for age, sex, income, education, and family history of colon cancer in multinomial regression and ordinary linear regression. A p value of 0.05 or less was considered statistically significant. All statistical analyses were performed with R (version 3.1.2).

Results

Of the 613 participants who had the sDNA test and a colonoscopy, 423 (69%) completed the perception survey. Among the respondents, 30% ($n=127$) self-identified as African American and 67% ($n=284$) self-identified as Caucasian. The remaining respondents (3%, $n=12$) consisted of participants



who self-identified as Asian or Hispanic or refused to disclose their race, and they were grouped together because of the small sample size. Of those surveyed, 269 respondents (64%) were female and 154 respondents (36%) were male. There were statistical differences between African Americans and Caucasians in sex, education, and income (Table 1).

In general, participants found the sDNA test more suitable than a colonoscopy ($n=309$, 75%), and the most commonly cited reasons were the absence of bowel preparation ($n=75$, 24%), no loss of work ($n=39$, 13%), and ease of completion ($n=22$, 7%). Most respondents (76%) found the sDNA test comfortable, and only a small fraction (9%) found it uncomfortable. If their physicians recommended the sDNA test, 84% of all respondents would be likely or somewhat likely to undergo the again. Interestingly, only 37% selected the sDNA test as their preferred method for colon screening, despite the majority of responders' favorable views.

In univariate analysis, race-stratified analysis revealed differences in patient preferences. The most preferred method of colon screening among both Caucasians (43%) and African Americans (32%) was the sDNA test (Table 2), although, compared with Caucasian patients, more African American patients were unsure of their preferred screening method (30% vs. 23%, $p<0.05$) and more preferred a colonoscopy (17% vs. 10%, $p<0.05$). A higher percentage of Caucasians found the sDNA test more suitable for their medical and physical needs than a colonoscopy (89% vs. 76%, $p<0.01$). African Americans also perceived the sDNA test to be more accurate than Caucasians (79% vs. 55%, $p<0.001$), yet were more embarrassed by it (10% vs. 2%, $p<0.01$). However, all these racial differences were reduced to no significance in multivariate analyses controlled for age, sex, education, income, and family history of colorectal cancer (Table 3). Family history of colorectal cancer remains a significant factor influencing patients' preference for the screening modality (Table 2) regardless of race.

Table 1. Descriptive characteristics of study participants

	Caucasian $n=284$	African American $n=127$	p Value
Age (years)	57.4 \pm 8.01	57.1 \pm 8.39	0.81
Sex			<0.001
Male	119 (42%)	30 (24%)	
Female	165 (58%)	97 (76%)	
Education			<0.001
High school graduate or lower	43 (15%)	54 (43%)	
Some college or technical school	65 (23%)	53 (42%)	
Bachelor's degree or higher	173 (61%)	16 (13%)	
Unknown	3 (1%)	4 (3%)	
Income			<0.001
\leq \$15,000	10 (4%)	49 (39%)	
Between \$15,000 and \$29,000	17 (6%)	26 (20%)	
Between \$30,000 and \$44,000	22 (8%)	15 (12%)	
Between \$45,000 and \$69,000	49 (17%)	15 (12%)	
\geq \$70,000	166 (58%)	12 (9%)	
Unknown	20 (7%)	10 (8%)	
Family history of colon/rectal cancer			0.22
Yes	79 (28%)	26 (20%)	
No	200 (70%)	97 (76%)	
Unknown	5 (2%)	4 (3%)	



Table 2. Colorectal cancer screening preferences by race and family history of colorectal cancer

	FOBT <i>n</i> =46	sDNA test <i>n</i> =154	Colonoscopy <i>n</i> =51	No preference <i>n</i> =43	Unsure <i>n</i> =96	Univariate <i>p</i>	Multivariate <i>p</i>
Race ^a						0.035	0.67
Caucasians (<i>n</i> =268)	36 (14%)	115 (43%)	30 (11%)	27 (10%)	60 (22%)		
African Americans (<i>n</i> =122)	10 (8%)	39 (32%)	21 (17%)	16 (13%)	36 (30%)		
Family history of colorectal cancer ^b	<i>n</i> =45	<i>n</i> =155	<i>n</i> =54	<i>n</i> =43	<i>n</i> =94	0.21	0.019
Yes (<i>n</i> =99)	13 (13%)	35 (36%)	21 (21%)	7 (7%)	23 (23%)		
No (<i>n</i> =292)	32 (11%)	120 (41%)	33 (11%)	36 (13%)	71 (24%)		

FOBT, fecal occult blood test, sDNA; stool DNA.

^aSome Caucasians (*n*=19) and African Americans (*n*=5) left the answer to this question blank.

^bSome patients with a family history (*n*=8), some patients without a family history (*n*=15), and one patient with an unknown family history left the answer to this question blank.

Discussion

We found no differences between Caucasian and African American patients' perceptions of the sDNA test, and family history of colorectal cancer is the only significant patient characteristic factor influencing patients' preference for the screening modality regardless of their race. Patients with a family history of colorectal cancer are likelier to prefer colonoscopy for screening than those with a no family history of colorectal cancer. Consistent with other studies of stool collection tests, patients in our study found the lack of bowel preparation, no loss of work, no hospital trip, and the easiness of the test to be the major benefits of the stool test [16–18].

Despite the large portion of patients who had positive experiences with the sDNA test in terms of ease of use and comfort, we did not observe an overwhelming preference for the sDNA test as opposed to other modalities. This may be because at present there are very few data on the accuracy and effectiveness of the sDNA test as compared with colonoscopy screening. African American patients slightly preferred the sDNA test, with an almost equal percentage being unsure about their preferred screening method, and more white participants, on the other hand, preferred the sDNA test relative to being unsure.

The majority of Caucasians and African Americans would undergo the sDNA test again if their physicians recommended it. Thus, it is conceivable that the hesitancy about undergoing the test may be dispelled by physician-initiated

intervention. Targeted physician-patient communication about screening modalities may improve uptake, as other studies have found an improvement in patient uptake with in-depth discussions with the treating physicians about screening options [19–21].

One of the strengths of this study is the participants' participation in both screening colonoscopy and the sDNA test, which allowed an adequate comparison to be made. Another strength of our study is the relatively large sample size, with excellent representation of African Americans, allowing direct comparison between the two racial groups. One major limitation of this study is potential selection bias. To participate in the study, a patient must be willing to have the scheduled colonoscopy and to participate in the stool collection component. Therefore, the patients included in our analysis may be more health conscious and motivated than the general average-risk screening eligible population. Cost is an important factor influencing the widespread adoption and uptake of sDNA testing for colon cancer screening in the general population. Unfortunately, we did not enquire how cost may affect the patients' perceptions or preferences for screening in our survey. The US Food and Drug Administration has recently approved the sDNA test for screening, and the Centers for Medicare and Medicaid Services now endorses insurance coverage of sDNA testing for screening. As such, cost is unlikely to be perceived as a barrier for insured patients to use sDNA testing for screening.



Table 3. Perceptions of the stool DNA test by race

	Caucasian	African American	Univariate <i>p</i>	Multivariate <i>p</i> ^a
How easy or difficult to understand were the instructions about preparation for the stool test?				
Easy (1 and 2)	251 (88%)	109 (86%)	0.09	0.85
Neutral (3)	27 (10%)	10 (8%)		
Difficult (4 and 5)	6 (2%)	8 (6%)		
How easy or difficult to understand were the instructions about collecting the stool sample for the test?				
Easy (1 and 2)	253 (89%)	109 (86%)	0.61	0.36
Neutral (3)	22 (8%)	12 (9%)		
Difficult (4 and 5)	9 (3%)	6 (5%)		
How easy or difficult was having a bowel movement for you?				
Easy (1 and 2)	233 (83%)	96 (76%)	0.20	0.84
Neutral (3)	30 (11%)	17 (13%)		
Difficult (4 and 5)	17 (6%)	13 (10%)		
Overall, how comfortable or uncomfortable was the stool test for you?				
Comfortable (1 or 2)	217 (76%)	98 (77%)	0.78	0.20
Neutral (3)	42 (15%)	16 (13%)		
Uncomfortable (4 and 5)	25 (9%)	13 (10%)		
How embarrassing was it for you to take the stool test?				
Not embarrassing (1 and 2)	250 (89%)	105 (84%)	0.01	0.67
Neutral (3)	24 (9%)	8 (6%)		
Embarrassing (4 and 5)	7 (2%)	12 (10%)		
Overall, how much anxiety or nervousness did preparation for the stool test cause you?				
Not anxious (1 and 2)	235 (84%)	100 (79%)	0.47	0.49
Neutral (3)	32 (11%)	17 (13%)		
Anxious (4 and 5)	13 (5%)	9 (7%)		
Overall, how much anxiety or nervousness did taking the stool test cause you?				
Not anxious (1 and 2)	238 (85%)	102 (82%)	0.14	0.19
Neutral (3)	30 (11%)	12 (10%)		
Anxious (4 and 5)	11 (4%)	11 (9%)		
How accurate or inaccurate do you believe the stool test to be?				
Accurate (1 and 2)	131 (55%)	96 (79%)	< 0.001	0.13
Neutral (3)	95 (40%)	19 (16%)		
Inaccurate (4 and 5)	11 (5%)	6 (5%)		



Table 3. (continued)

	Caucasian	African American	Univariate <i>p</i>	Multivariate <i>p</i> ^a
If your physician recommended regular screening with the stool test, how likely or unlikely would you be to repeat it?				
Likely (1 and 2)	244 (88%)	100 (81%)	0.12	0.71
Neutral (3)	19 (7%)	11 (9%)		
Unlikely (4 and 5)	15 (5%)	13 (10%)		
Compared with colonoscopy, would this stool test be more or less suitable to your medical or physical needs?				
More suitable	226 (89%)	87 (76%)	0.002	0.52
Less suitable	29 (11%)	27 (24%)		

^aAdjusted for age, sex, income, education, and family history of colon cancer; perceptions were treated as continuous variables in the model.

Overall, the majority of both African Americans and Caucasians viewed the sDNA test as easy and comfortable for them, more suitable to their needs, and would undergo the sDNA test again. There is no racial difference in the perception of and preference for the method of screening. Given the noninvasive nature of the sDNA test, widespread adoption and uptake of sDNA testing might be an effective screening strategy for reducing the racial disparities in colorectal cancer. Further studies are warranted to develop targeted interventions to increase the uptake of this new screening technology, particularly in African Americans.

Conflict of interest

The authors declare no conflict of interest.

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References

1. Siegel R, Ma J, Zou Z, Jemal A. Cancer statistics, 2014. *CA Cancer J Clin* 2014;64:9–29.
2. Meester RG, Doubeni CA, Lansdorp-Vogelaar I, Goede SL, Levin TR, Quinn VP, et al. Colorectal cancer deaths attributable to nonuse of screening in the United States. *Ann Epidemiol* 2015;25:208–13.
3. Agrawal S, Bhupinderjit A, Bhutani MS, Boardman L, Nguyen C, Romero Y, et al. Colorectal cancer in African Americans. *Am J Gastroenterol* 2005;100:515–23.
4. Marcella S, Miller JE. Racial differences in colorectal cancer mortality. The importance of stage and socioeconomic status. *J Clin Epidemiol* 2001;54:359–66.
5. Bazargan M, Ani C, Bazargan-Hejazi S, Baker RS, Bastani R. Colorectal cancer screening among underserved minority population: discrepancy between physicians' recommended, scheduled, and completed tests. *Patient Educ Couns* 2009;76:240–7.
6. Janz NK, Wren PA, Schottenfeld D, Guire KE. Colorectal cancer screening attitudes and behavior: a population-based study. *Prev Med* 2003;37:627–4.
7. Ioannou GN, Chapko MK, Dominitz JA. Predictors of colorectal cancer screening participation in the United States. *Am J Gastroenterol* 2003;98:2082–91.



8. Richards RJ, Reker DM. Racial differences in use of colonoscopy, sigmoidoscopy, and barium enema in Medicare beneficiaries. *Dig Dis Sci* 2002;47:2715–9.
9. Imperiale TF, Ransohoff DF, Itzkowitz SH, Levin TR, Lavin P, Lidgard GP, et al. Multitarget stool dna testing for colorectal-cancer screening. *N Engl J Med* 2014;370:1287–97.
10. Office of the Commissioner. Press announcements – FDA approves first non-invasive DNA screening test for colorectal cancer [cited 2015 Mar 10]. Available from: <http://www.fda.gov>.
11. Bastani R, Gallardo NV, Maxwell AE. Barriers to colorectal cancer screening among ethnically diverse high- and average-risk individuals. *J Psychosoc Oncol* 2001;19:65–84.
12. Bass SB, Gordon TF, Ruzek SB, Wolak C, Ward S, Paranjape A, et al. Perceptions of colorectal cancer screening in urban African American clinic patients: differences by gender and screening status. *J Cancer Educ* 2011;26(1):121–8.
13. Gluecker TM, Johnson CD, Harmsen WS, Offord KP, Harris AM, Wilson LA, et al. Colorectal cancer screening with CT colonography, colonoscopy, and double-contrast barium enema examination: prospective assessment of patient perceptions and preferences. *Radiology* 2003;227:378–84.
14. Harewood GC, Wiersema MJ, Melton LJ. A prospective, controlled assessment of factors influencing acceptance of screening colonoscopy. *Am J Gastroenterol* 2002;97:3186–94.
15. Weitzman ER, Zapka J, Estabrook B, Goins KV. Risk and reluctance: understanding impediments to colorectal cancer screening. *Prev Med* 2001;32:502–13.
16. Yang D, Hillman SL, Harris AM, Sinicrope PS, Devens ME, Ahlquist DA. Patient perceptions of stool DNA testing for pan-digestive cancer screening: a survey questionnaire. *World J Gastroenterol* 2014;20:4972–9.
17. Berger BM, Schroy PC, Rosenberg JL, Lai-Goldman M, Eisenberg M, Brown T, et al. Colorectal cancer screening using stool DNA analysis in clinical practice: early clinical experience with respect to patient acceptance and colonoscopic follow-up of abnormal tests. *Clin Colorectal Cancer* 2006;5:338–43.
18. Schroy PC, Heeren TC. Patient perceptions of stool-based DNA testing for colorectal cancer screening. *Am J Prev Med* 2005;28:208–14.
19. Laiyemo AO, Adebogun AO, Doubeni CA, Ricks-Santi L, McDonald-Pinkett S, Young PE, et al. Influence of provider discussion and specific recommendation on colorectal cancer screening uptake among U.S. adults. *Prev Med* 2014;67:1–5.
20. Hawley ST, Volk RJ, Krishnamurthy P, Jibaja-Weiss M, Vernon SW, Kneuper S. Preferences for colorectal cancer screening among racially/ethnically diverse primary care patients. *Med Care* 2008;46:S10–6.
21. Yepes-Rios M, Reimann JOF, Talavera AC, Ruiz de Esparza A, Talavera GA. Colorectal cancer screening among Mexican Americans at a community clinic. *Am J Prev Med* 2006;30:204–10.