



# Systematic Review of Interventions to Increase Stool Blood Colorectal Cancer Screening in African Americans

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## Abstract

African Americans experience colorectal cancer (CRC) related disparities compared to other racial groups in the United States. African Americans are frequently diagnosed with CRC at a later stage, screening is underutilized, and mortality rates are highest in this group. This systematic review focused on intervention studies using stool blood CRC screening among African Americans in primary care and community settings. Given wide accessibility, low cost, and ease of dissemination of stool-based CRC screening tests, this review aims to determine effective interventions to improve participation rates. This systematic review included intervention studies published between January 1, 2000 and March 16, 2019. After reviewing an initial search of 650 studies, 11 studies were eventually included in this review. The included studies were studies conducted in community and clinical settings, using both inreach and outreach strategies to increase CRC screening. For each study, an unadjusted odds ratio (OR) for the CRC screening intervention compared to the control arm was calculated based on the data in each study to report effectiveness. The eleven studies together recruited a total of 3334 participants. The five studies using two-arm experimental designs ranged in effectiveness with ORs ranging from 1.1 to 13.0 using interventions such as mailed reminders, patient navigation, and tailored educational materials. Effective strategies to increase stool blood testing included mailed stool blood tests augmented by patient navigation, tailored educational materials, and follow-up calls or mailings to increase trust in the patient-provider relationship. More studies are needed on stool blood testing interventions to determine effectiveness in this population.

**Keywords** Colorectal cancer · Cancer screening · Stool blood tests · Colonoscopy · African Americans

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## Introduction

Although all population groups in the U.S. are affected by cancer, minority communities experience a higher cancer burden. Notably, African Americans exhibit higher cancer death rates and lower survival rates compared to other racial or ethnic groups [1]. Minority communities are more likely to be poor, medically underserved, and have limited access to quality health care, leading to cancer health disparities. These persistent disparities may be attributed in part to lower rates of completing recommended cancer screenings and increased risk factors, which are more prevalent among low-income and uninsured individuals living in minority communities [1].

Colorectal cancer (CRC) is the third most commonly diagnosed cancer in men and women in the United States with an estimated 101,420 new cases [2]. CRC continues to affect African Americans at disproportionately higher rates

than non-Hispanic whites despite improved screening and treatment (Jackson, Oman, Patel & Vega, 2016). The CRC incidence rate between 2011 and 2015 was 24% higher for African American men and 19% higher for African American women [1]. Moreover, CRC mortality rates were 47% higher in African American men and 34% higher in African American women than in non-Hispanic whites [1]. The cancer health disparity in mortality is decreasing at a faster rate in African American women than in men, possibly due to differences in risk factors (e.g., physical activity and diet) and from higher CRC screening rates in women which has improved early detection [1]. Other factors associated with CRC disparities across the cancer continuum may include genetic and microbiomic influences, differences in tumor biology, environmental causes, structural barriers such as costs, transportation and availability of healthcare facilities, and individual barriers including lack of knowledge, low self-efficacy, low health literacy, and mistrust of providers [3, 4]. Patient factors, provider-related factors, health care system-related factors, and structural factors all contribute to CRC disparities for African Americans [4]. In the current era of COVID-19, elective surgeries are being postponed and cancer screenings deferred because of fear of exposure to the virus in hospitals and clinics; therefore, mail-based screenings such as stool blood CRC screening are a safer alternative.

## Colorectal Cancer Screening Recommendations

The U.S. Preventive Service Task Force recommends that screening for CRC start at age 50 and continue until age 75 [5]. CRC screening options generally include a high-sensitivity stool blood test [fecal immunochemical test (FIT), guaiac-based fecal occult blood test (gFOBT), or multitarget stool FIT-DNA test] or a direct visualization test (colonoscopy, flexible sigmoidoscopy, or CT colonography). Early detection with colonoscopy can detect precancerous polyps and abnormalities in the colon and rectum to reduce mortality with this test which is done every 10 years. CRC screening may also involve annual stool blood tests, such as the FIT or gFOBT, and follow-up with diagnostic colonoscopy if needed for abnormal findings. Communication of abnormal FIT results are associated with improved adherence to follow-up colonoscopy [6].

The American Cancer Society (ACS) recently updated its screening recommendations with a “qualified recommendation” for beginning CRC screening for adults beginning at 45 years old and a “strong recommendation” for beginning screening at 50 years and older until the age of 75 in May 2018. A recent study reported that CRC screening more than doubled among people between 45 and 49 years since the

ACS guideline change [7]. In 2009, the American College of Gastroenterology (ACG) recommended that African Americans begin screening at 45 years old [8, 9]. The difference in age recommendations is related to the type and quality of evidence for individuals aged 45–49 years old. Currently, the most common tests used in the U.S. to adhere to CRC screening recommendations include either a colonoscopy every 10 years or an annual stool blood test (FIT or gFOBT).

There is no consensus on which test recommendation will yield higher adherence rates to CRC screening recommendations; however, studies suggest that stool blood tests may be more acceptable and beneficial for African American communities to reach recommended screening levels [10]. Moreover, there are many regions of the U.S. where access to colonoscopy is suboptimal [11]. A previous systematic review focused on CRC screening by colonoscopy in African Americans concluded that patient, provider, and systematic barriers to screening could be modifiable to improve screening rates [12]. These barriers were classified into the following three domains: (1) patient factors—psychological (fear) and lack of knowledge; (2) provider factors—confusion about age recommendations, low knowledge of patient barriers, and lack of counseling; and (3) system factors—costs, insurance coverage, and limited primary care visits [12]. Other barriers to CRC screening adherence include difficulty in scheduling appointments, provider preferences for one screening modality over another which may limit access, poor healthcare infrastructure including low access to gastroenterology specialists, and available health education resources. While many CRC screening interventions focus on increasing colonoscopy screening, stool blood tests can be done in the privacy of a person’s home, are more cost effective, and can yield higher rates of adherence [13, 14].

While there are many different intervention possibilities to ameliorate these cancer health disparities, focusing on increasing colorectal cancer screening in minority and underserved communities is one that has been widely implemented in both health care system and community-based contexts using both outreach and inreach strategies [15–21]. Many of these programs emphasize colonoscopy screening, which is an example of an invasive screening, but several other methods of noninvasive screening tests exist, but require more frequent screening intervals. Mailed invitations to complete stool blood testing is an effective outreach approach frequently used by medical providers.

To critically assess and synthesize the available evidence for the effectiveness of colorectal cancer screening programs in primary and community health care, this systematic review aims to review quality studies testing different strategies for increasing stool blood colorectal cancer screening rates in African Americans. There have been no systematic reviews focused specifically on clinical and behavioral interventions to increase stool blood colorectal screening. Studies

might include both endoscopic and stool blood methods for their outcomes, but this review sought to identify studies focused on stool blood testing, as a less expensive alternative to colonoscopy in minority communities. The objective of this systematic review is to assess the effectiveness of colorectal cancer screening using stool blood testing approaches, specifically in studies which included either exclusively African Americans, or were conducted in health systems with a high proportion of African American patients.

## Methods

### Search Criteria and Study Selection

The inclusion criteria were the following items:

1. Studies using a randomized controlled trial or quasi-experimental study design. Control groups could include both usual care or other types of clinical or behavioral interventions to increase colorectal cancer screening such as may be used in comparative effectiveness study designs.
2. Studies had to include substantial participants of African Americans (> 50% of the study sample) and be conducted in the U.S.
3. Studies needed to include a screening completion outcome involving stool blood testing such as high sensitivity and high specificity gFOBT, FOBT, or FIT.
4. Only peer-reviewed studies published in scientific journals were included.

The exclusion criteria were the following items:

1. Studies that were literature reviews, case studies, or quality improvement initiatives without an experimental research design.
2. Studies that did not include a comparison group.
3. Studies that duplicated the findings from another previously published study to report findings on a subset of participants from the original study.
4. Studies that did not measure a colorectal cancer screening outcome, such as studies which only measured changes in knowledge or screening intentions.
5. Studies that did not include greater than 50% African Americans in the participant sample.
6. Studies conducted outside of the U.S.

A research librarian searched bibliographic databases which included Scopus, Web of Science, and CINAHL from database inception until March 16, 2019. The following syntax illustrates the search strategy used:

((colon OR colorectal OR sigmoid OR rectum OR rectal OR colonic OR anus) N5 (cancer OR neoplasm OR tumor OR tumour)) AND (((stool OR feces OR fecal OR faeces OR faecal) N5 (screen\* OR specimen)) OR immunochem\* OR immunoassay\* OR "occult blood" OR fobt) AND (black OR blacks OR "african american" OR "african americans")

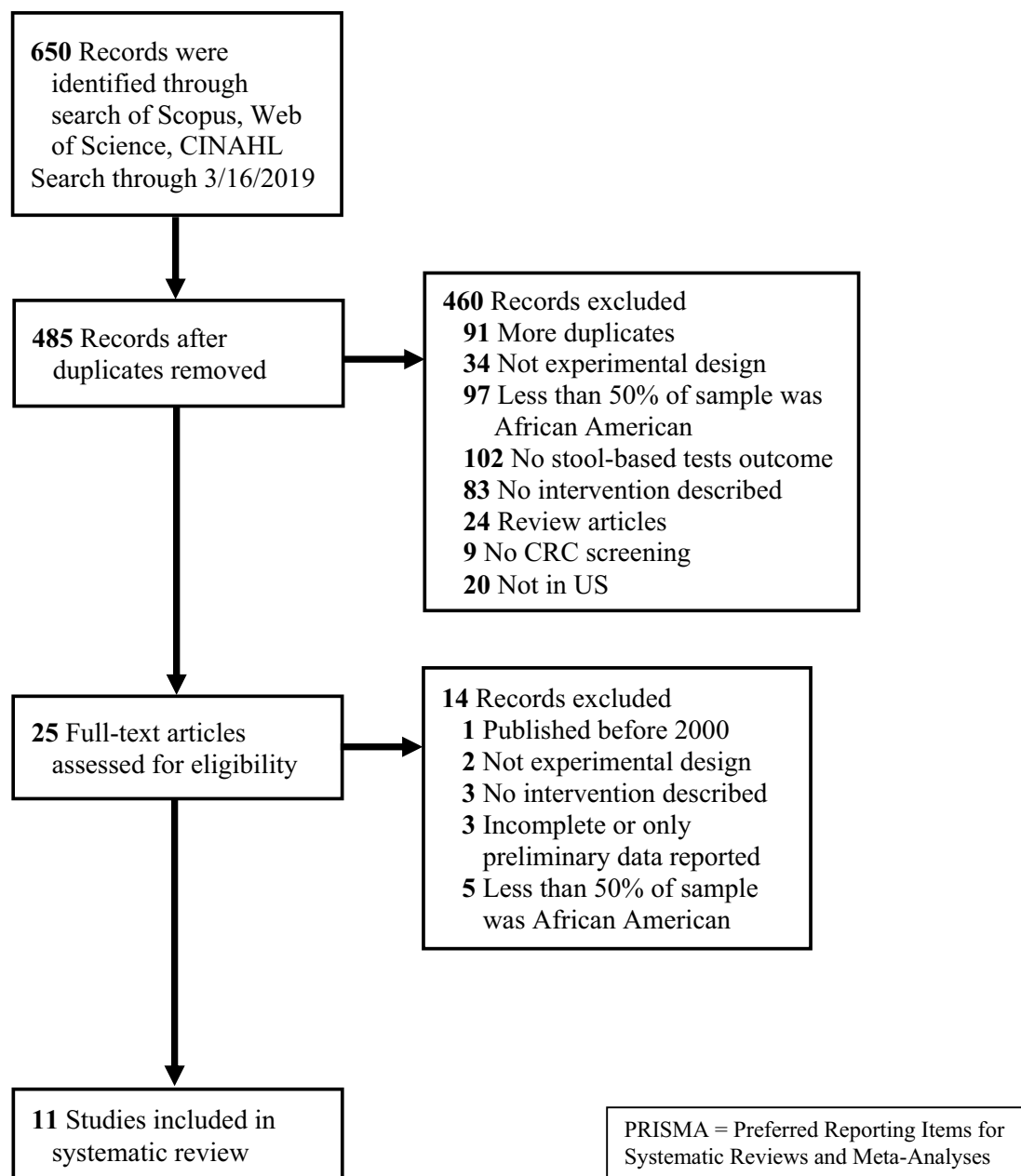
After the search of bibliographic databases, 650 citations were identified. Eight references were eliminated since there were no author names and were either published guidelines or news articles that included no screening outcome or intervention. Next, 269 duplicates were identified, and the database was reduced to 381 references. Two independent reviewers examined the remaining articles using the inclusion and exclusion criteria and 25 articles met criteria for full text review. Articles published before 2000 were eliminated. The rationale for excluding older articles was to account for recent advances in stool blood CRC testing technology, such as the introduction of stool DNA (sDNA) technology in 2000 and the later approval of FIT by the Centers for Medicare and Medicaid Services (CMS) in 2003 [13]. A third reviewer examined all decisions of the two independent reviewers to resolve disagreements on article inclusion and conducted the full text review of the 25 articles (Fig. 1). After a thorough review of each article, 14 articles were additionally excluded, leaving a final group of 11 articles for article abstraction [14, 22–31]. The most common reasons for excluding articles included: (1) less than 50% of the study sample were African American; (2) did not meet study design parameters; (3) no study outcomes included stool blood test outcomes; and (4) review articles or qualitative studies.

### Study Coding

To abstract information from each study, the reviewers employed a form adapted from a previous systematic review [32]. The form included questions on sample setting, sample size, study design, randomization procedures, follow-up time periods, target population, intervention description, control group description, participant demographics, type of screening tests, means of screening confirmation (chart versus self-report), and study outcomes by study arm and screening adherence. Two reviewers collected information from the included articles independently on the article abstraction form and discussed any discrepancies in data abstraction to come to consensus.

### Analysis

There was substantial heterogeneity among the studies identified based on study design, sample size, follow-up time period to measure outcomes, and study site/setting. For example, several studies used more conventional



**Fig. 1** PRISMA diagram of study

experimental designs with two study arms, other studies were efficacy studies comparing two variations of an intervention, while other studies used three or more study arms or factorial designs. For study site, some studies were clinic-based while others were community-based, so the target population for these studies were considerably different. For each study, an unadjusted odds ratio (OR) for the CRC screening intervention compared to the control arm was calculated based on the raw data reported in each study to determine the effectiveness. Given the substantial

heterogeneity between included studies, the decision was made not to conduct a meta-analysis since it was not possible to calculate an overall summary OR estimate for the odds of receiving a stool blood test at time of primary study completion. Moreover, for a few studies, it was not possible to disaggregate specific types of CRC screening test completion in the outcome data (e.g., colonoscopy versus gFOBt), which is acknowledged in the study limitations.

## Results

For the 11 identified studies, eight of the studies included African American study participants of greater than 80% of the total sample (Table 1). Three of the studies included study samples of African Americans ranging between 62 and 70% [22, 23, 31]. The 11 included studies had greater proportion of African American women participants compared to men (range 59–88%). Most of the 11 studies included participants in the age range for recommended colorectal cancer screening (i.e., 50 to 75 years). However, of the 11 studies, one study focused on only older participants between 65–75 years [28], and two studies enrolled older individuals up to age 80 years [26] or 94 years [30]. Education level varied among participants in the included studies. Four of the studies reported that > 70% of participants had completed high school [14, 22–24], whereas four other studies reported < 45% [14, 22–24, 27–29, 31]. The other three included studies did not report on education level [25, 26, 30].

Included studies varied in study designs (Table 2). Six of the studies were randomized controlled trials with two study arms. Many of these studies were comparing an enhanced intervention in clinical settings, such as using patient navigation or telephone outreach compared to a standard intervention approach using mail-delivered stool blood tests. Other two-arm studies were efficacy studies, for example comparing different combinations of educational materials for FIT completion [14] or comparing variations of a church-based community intervention [27]. Three of the other included studies employed three study arms or a factorial design. The interventions in these studies included community-based approaches (e.g., lay health advisors) [24] and educational approaches in clinics (e.g.,

pamphlets and videos) [22, 30]. Two of the included studies conducted interventions in rural areas [22, 24].

The results for the two-arm randomized controlled studies ranged in effectiveness (Table 3). Some studies reported modest improvements. For example, one study reported a 27% increase in CRC screening from baseline using a telephone outreach strategy [23] and another study reported a 44% increase in CRC screening from baseline using a video intervention [25]. However, a few studies reported more dramatic increases in CRC screening participation, with one study reporting an 82% screening adherence post-intervention from implementing a tailored print intervention and FIT kit [14]. The five studies using two-arm experimental designs ranged in effectiveness with odds ratios (OR) ranging from 1.1 to 13.0 using interventions such as mailed reminders, patient navigation, and tailored educational materials [23, 25, 26, 28, 29]. While the study by Goldberg et al. [26] had a large OR (13.0; CI 3.7–46.5), there was a small sample size of only 119 participants. Two studies with large samples which focused on increasing stool blood testing were found to have findings that did not reach statistical significance, such as the study by Friedman et al. [25] with an OR of 1.4 (CI 0.7–2.7) and the study by Horne et al. [28] with an OR of 1.1 (CI 0.7–1.6). The Myers et al. study [29] tested a tailored navigation intervention compared to standard mailed reminders and found significant results with an OR of 1.5 (CI 1.0–2.2) for the FIT screening outcome only.

The results for the three-arm studies also ranged in effectiveness (Table 4). Similar to the two-arm studies, some studies reported modest differences between intervention and control. For example, one study reported a 17% increase in CRC screening from baseline using a tailored print and video intervention [24]; a second study reported a 30% increase in CRC screening from baseline using a decision aid intervention [31]; and a third

**Table 1** Demographics: percent representation by race, ethnicity, gender

Study	Black	Hispanic/ Latina	White	Asian/Asian American	Native American	Other	Male	Female	Mean age <sup>a</sup>	High school completion
Arnold et al. [22]	70	–	30	–	–	–	20	80	–	71
Basch et al. [23]	63.2	–	16.2	–	–	19.7	28.9	71.1	–	89.9
Campbell et al. [24]	99	–	–	–	–	–	26	74	52 years	84.1
Christy et al. [14]	93	3	–	–	–	7	52	48	56 years	77
Friedman et al. [25]	87.5	5	5	–	–	2.5	15.6	84.4	61 years	–
Goldberg et al. [26]	82.4	3.3	9.2	–	–	5.1	26	74	–	–
Holt et al. [50]	100	–	–	–	–	–	30.2	69.8	60 years	9.1
Horne et al. [28]	100	–	–	–	–	–	27.5	72.5	–	43.5
Myers et al. [29]	100	–	–	–	–	–	31.4	68.6	–	40.5
Powe et al. [30]	84	–	16	–	–	–	12	88	74 years	–
Schroy et al. [31]	62	–	34	1	–	2	41	59	–	22

<sup>a</sup>When mean age not reported, age categories and percentages were often reported instead, refer to articles for details

**Table 2** Intervention overview of included studies

Study	Design	Recruitment	Geographic location of program	Intervention description	Duration of program	Follow-up
Arnold et al. [22]	3-arm quasi-experimental study	Multistep process. Medical assistant identified potentially eligible participants by age. 2 clinics in enhanced care arm, 2 in educational strategy arm, 2 in nurse support arm	Rural Louisiana	Clinic-based, health literacy pamphlet and video	3 years	12 months, 24 months, and 36 months (primary)
Basch et al. [23]	2-arm randomized controlled trial	Eligible participants from a membership list of a health benefit fund were contacted by telephone to assess eligibility and interest in the study	New York City	Clinic-based, tailored telephone outreach	6 months	6 months
Campbell et al. [24]	Randomized trial, 2X2 factorial	Churches were initially contacted by telephone to determine eligibility. Those that expressed interest were sent a packet of study information and enrollment materials by mail	Rural North Carolina	Church-based, lay health advisor, tailored newsletters and videos	6 to 8 months	12 months
Christy et al. [14]	2-arm efficacy study	Passive, active, and snowball recruitment methods to recruit community-based participant sample. Geographic regions randomly assigned to study conditions	Tampa Bay, FL	Community-based, photonovella + FIT or brochure + FIT	2 to 4 weeks	6 months
Friedman et al. [25]	2-arm randomized controlled trial	Participants were recruited from the waiting room of a medical outpatient community clinic	Houston, TX	Clinic-based, educational videos	–	3 months
Goldberg et al. [26]	2-arm randomized controlled trial	Random sample of patients in patient registry in a large urban hospital	Cook County, IL	Clinic-based, mailing FOBT cards and reminders 2 weeks prior to appointments	12 months	12 months
Holt et al. [50]	2-arm efficacy study	African American churches randomized to study conditions	Birmingham, AL	Church-based, spiritually-based lay health advisor, non-spiritually-based health advisor	–	1 month, 12 months (primary)

Table 2 (continued)

Study	Design	Recruitment	Geographic location of program	Intervention description	Duration of program	Follow-up
Horne et al. [28]	2-arm randomized controlled trial	Population-based and convenience-sampling from the Medicare enrollment database, clinical, and community settings	Baltimore, MD	Community-based, education-only arm compared to patient navigation arm	4 years	Range 2 to 46 months
Myers et al. [29]	2-arm randomized controlled trial	Patients recruited from three primary care practices. Randomly assigned to two study arms	Philadelphia, PA	Clinic-based, standard intervention arm compared to tailored intervention arm	4 years	6 months (primary), 12 months
Powe et al. [30]	3-arm randomized controlled trial	15 senior centers were randomly selected and assigned to groups. Eligible participants within each center were at least 50 years old, oriented to time and location, and reported that they had not participated in a study on colorectal cancer within the past year	South Carolina	Senior citizen centers, full intervention, video-only, standard treatment	12 months	6 months, 12 months (primary)
Schroy et al. [31]	3-arm randomized controlled trial	Primary care patients recruited from 2 urban ambulatory care sites. Opt-out approach, opt-in electronic flagging, and opt-in letter were the recruitment methods	Boston, MA	Safety net hospital, decision aid alone or decision aid plus personalized risk assessment tool	5 years	6 months, 12 months (primary)

**Table 3** Screening effectiveness for stool blood tests of included two-arm studies

Study	Screening test	N (intervention/control)	Baseline adherence, n (%) (intervention)	Follow-up adherence, n (%) (intervention)	Baseline adherence, n (%) (control)	Follow-up adherence, n (%) (control)	OR (95% CI)
Basch et al. [23] <sup>a</sup>	FOBT, sigmoidoscopy, colonoscopy	226/230	0	61 (27)	0	14 (6.1)	5.70 (3.08–10.55)
Basch et al. [23]	FOBT only	226/230	0	30 (13)	0	1 (0)	39.27 (5.30–290.97)
Christy et al. [14]	FIT	144/186	0	118 (81.9)	0	168 (90.3)	0.27 (0.15–0.50)
Friedman et al. [25]	FOBT	110/50	0	48 (43.6)	0	18 (36)	1.38 (0.69–2.74)
Goldberg et al. [26]	FOBT	59/60	0	24 (40.7)	0	3 (5)	13.03 (3.65–46.48)
Holt et al. [50]	FOBT	152/133	15 (9.9)	12 (7.9)	8 (6)	20 (15)	0.48 (0.23–1.03)
Horne et al. [28] <sup>a</sup>	FOBT, sigmoidoscopy, colonoscopy	578/642	476 (82.5)	543 (94)	527 (82.1)	584 (91)	1.54 (1.00–2.38)
Horne et al. [28] <sup>b</sup>	FOBT only	–	–	–	–	–	1.09 (0.72–1.64)
Myers et al. [29] <sup>c</sup>	FIT, colonoscopy	384/380	0	145 (38)	0	90 (23.7)	1.95 (1.43–2.68)
Myers et al. [29] <sup>c</sup>	FIT only	384/380	0	82 (21.5)	0	58 (15.3)	1.51 (1.04–2.19)

<sup>a</sup>Overall CRC screening rates shown<sup>b</sup>OR reported in article, raw numbers not reported<sup>c</sup>6 months primary outcome data shown**Table 4** Screening effectiveness for stool blood tests of included three-arm studies

Study	Screening test	N (intervention/control)	Baseline Adherence, % (intervention)	Follow-up Adherence, % (intervention)	Baseline adherence, % (control)	Follow-Up Adherence, % (control)	OR (95% CI)
Arnold et al. [22] <sup>a</sup>	FOBT	90/116	0	44 (48.9)	0	55 (47.4)	1.06 (0.61–1.84)
Campbell et al. [24] <sup>b</sup>	FOBT	76/69	15 (19.7)	28 (36.8)	21 (30.4)	15 (21.7)	2.1 (1.00–4.39)
Powe et al. [30] <sup>c</sup>	FOBT	54/80	0	33 (61)	0	23 (29)	3.89 (1.88–8.09)
Schroy et al. [31] <sup>d</sup>	FOBT, sigmoidoscopy, colonoscopy, DCBE, FOBT + flexible sigmoidoscopy	269/276	35 (13)	116 (43.1)	36 (13)	96 (34.8)	1.42 (1.01–2.01)

<sup>a</sup>Enhanced care and health literacy education arms combined, compared to nurse support arm, 36 months outcome data shown<sup>b</sup>Tailored print and video arm compared with control arm reported. The tailored print and video arm was more effective compared to the control arm than the lay health advisor arm compared to the control arm, which is not reported here<sup>c</sup>Cultural and self-empowerment arm, compared to modified and traditional arms combined, 12 months outcome data shown<sup>d</sup>Overall screening rates shown; comparison between decision aid vs. control arm. DCBE, double-contrast barium enema

study reported a 49% increase in CRC screening from baseline using different variations of a mailed intervention [22]. However, one study reported a more dramatic increase in CRC screening of 61% screening adherence

post-intervention following receipt of a tailored group intervention using video education in senior centers [30]. While several of these studies used either 6-month or 12-month primary outcomes, a few studies examined



repeat stool blood testing outcomes during a longer time period, such as the study by Arnold et al. which examined third-year stool blood testing outcomes [22].

For nine of the 11 studies included in the review which used random assignment of participation to intervention or control arm, there was relatively low attrition of participants. For the clinical studies, outcomes could be tracked for virtually all participants through electronic patient records. A few studies reported higher research participant attrition between 33 and 42%. The most common limitation reported was the higher number of African American female participants than male in several studies. In addition, a few studies cited CRC screening outcomes based on self-report, which is less reliable than patient chart verification (Table 5).

## Discussion

This systematic review examines summary findings from 11 experimental studies designed to test the effectiveness of interventions to increase colorectal cancer screening, specifically using stool blood CRC screening approaches such as FIT or gFOBT in African American communities. The eleven studies together enrolled a total of 4364 participants (88% African American). Based on these summary findings which tested effectiveness of clinical and behavioral interventions, a tailored navigation approach either by telephone or in person, might be a potentially effective strategy for increasing CRC screening in African American communities as these interventions tested in two arm studies to control conditions were associated

**Table 5** Methodological quality of included studies

Study	Allocation methods	Attrition	Other potential limitations
Arnold et al. [22]	Quasi-experimental	Low attrition reported (9%)	Method of determining FOBT receipt not reported. Differences between arms in socio-demographics, and sample was predominately composed of African American female participants in FQHCs
Basch et al. [23]	Random assignment	Low attrition (7% in intervention arm; 4% in control arm)	All participants had health insurance and a physician, and stool blood test kits were not provided
Campbell et al. [24]	Random assignment	Medium attrition reported (42%)	Method of determining CRC screening was based on self-report. There was a small sample size and factorial design limited comparative analysis
Christy et al. [14]	Random assignment	Not reported	Not possible to isolate providing the FIT kit from print educational materials since both study arms used educational materials in the efficacy study
Friedman et al. [25]	Random assignment	Not reported	Sample was predominately composed of African American female participants
Goldberg et al. [26]	Random assignment	No attrition reported (0%)	Study was completed at one clinical primary care setting site. Study was completed only in one single year, so repeat FOBT card return data were not collected
Holt et al. [50]	Random assignment	Low attrition reported (10%)	Method of determining CRC screening based on self-report. Participation was not limited based on not being up-to-date with CRC screening
Horne et al. [28]	Random assignment	Low to medium attrition reported (33% in intervention arm; 23% in control arm)	Method of determining CRC screening based on self-report. High percentage of participants were up-to-date at baseline
Myers et al. [29]	Random assignment	Low attrition reported (< 1%)	The sample was predominately composed of African American female participants. All participants were patients at primary care practices
Powe et al. [30]	Quasi-experimental	Not reported	The sample was predominately composed of African American female participants. There was a small sample size and 3-arm study design limited comparative analysis
Schroy et al. [31]	Random assignment	No attrition reported (0%)	No blinding of providers to one of two intervention arms (decision aid plus personalized risk assessment or decision aid alone)

with percentage point differences ranging from 6 to 36% [23, 25, 26, 29].

The outcomes for the three-arm studies testing variations of interventions in efficacy studies or testing two different variations of an intervention compared to controls, did not report markedly different findings from the two-arm studies. The study by Arnold et al. [22] was unique because it reported 3-year outcomes for stool blood testing, an outcome worth examining because of the recommendation for annual screening. Except for the study by Schroy et al. [31], the studies using experimental designs other than two-arm experimental designs had relatively small sample sizes. The study by Schroy et al. [31] reported that a decision aid improved overall CRC screening rates, but did not report outcomes separately for stool blood testing. The study by Christy et al. [14] was particularly notable for the very high FIT kit return of 87% of all participants, and the finding that prior screening status did not predict uptake. In this study, African American participants either received a FIT kit plus a CDC standard CRC screening educational brochure or FIT kit plus a tailored photonovella, as well as reminder letters for those not returning the FIT kit within a month-long time-frame, and both approaches were effective.

Two of the included studies, both three-arm studies, were identified as taking place in rural areas [22, 24]. Previous literature has found that the types of screening tests used for colorectal cancer may differ between rural and urban settings [33]. Screening rates by colonoscopy or sigmoidoscopy have increased in both rural and urban populations; however, screening rates via FOBT have decreased in urban populations but increased in rural populations, possibly due to greater access to colonoscopy in urban areas and lack of access to colonoscopy services in rural settings [33]. The results from the two included studies in rural areas reported increases in CRC screening uptake, specifically FOBT screening, which provides further support for the preference for FOBT screening in rural areas.

This systematic review included studies that implemented interventions in clinic or community settings. Our results showed that the two-arm studies that were implemented in clinic-based settings had higher odds ratios than the two-arm studies implemented in community-based settings. Based on these results, implementing CRC screening interventions in clinic-based settings may lead to greater CRC screening uptake among African Americans than community outreach strategies outside of a clinical setting, possibly due to clinical interactions, audit and feedback systems, or other electronic means to remind patients of screening appointments.

Another finding in this systematic review indicated females were more likely to engage in FIT and FOBT, which is consistent with the results of studies examining stool based testing in articles that were eventually excluded after thorough review [34–38]. However, in the

included studies, there were larger samples of women than men, which might partially explain these findings, as well as highlight the challenges of recruiting African American men to cancer screening studies. The findings from this group of articles also suggests the promise of culturally tailored interventions to improve CRC screening, such as the use of trusted community venues (e.g., churches, barber and beauty shops) to recruit participants and the implementation of patient navigation approaches to increase trust in providers.

More research is needed to test effective interventions for increasing CRC screening in minority communities and to test whether combined modalities or offering stool blood testing as a frontline strategy increases overall CRC screening rates. Unfortunately, some African American communities have higher levels of uninsured individuals, poor access to healthcare services, lower perceived benefits of CRC screening, lower perceived risk of colorectal cancer, and lower engagement in preventive health behaviors [39, 40]. The previously listed factors have also been cited as barriers for engaging minorities in CRC screening [12, 41]. In light of the economic burden of CRC screening, utilizing FIT and gFOBT can provide a low-cost first-line screening test and be the deciding factor for medically underserved communities to engage in colorectal cancer screening [42]. An examination of the studies in this review identified this frontline screening strategy with FIT or gFOBT can be cost effective. A previous study by Hester et al. [42] indicated stool blood testing presented fewer barriers for completion such as lack of transportation to the facility, bowel preparation, and absence from work, which may impede CRC screening with colonoscopy. When the barriers to CRC screening are removed, there is an opportunity to increase rates of screening among minority and non-minority groups. Consistent with the literature, our findings indicated the feasibility and acceptability of FIT and gFOBT in African American communities as a primary screening strategy (Baker et al. 2014; Davis et al. 2010; Rawl et al. 2008).

This systematic review focused on stool blood testing as one convenient method to increase CRC screening in medically underserved communities. Other studies using experimental designs reported similar findings but were excluded because of smaller African American patient samples [37, 38, 43]. Some identified studies employed other minority samples in their interventions. For example, the experimental study by Muller et al. [44] reported the effectiveness of the low-cost strategy of text messaging for increasing CRC screening among Alaska Native patients. Even though the current systematic review only included studies with a substantial representation of African American study participants, other studies examining diverse populations also reported the need for innovative interventions to increase CRC screening in different community and clinical settings.

## Clinical Implications

Based on the Healthy People 2020 objectives, the 2020 target for adults between 50 and 75 years to receive CRC screening was 70.5%; however, 2018 data indicated only 65.2% of adults had completed screening [45]. This systematic review provides some evidence for future strategies to promote CRC screening, especially for increasing the use of FOBT among African Americans. Behavioral interventions may be more efficient if delivered through mail reminders or by using patient navigators. The content of such interventions should include tailored messages. If tailored materials are not available, a standard CRC screening educational brochure may also be effective. For rural African Americans, if primary care settings are not easily reachable, FOBT may be a more accessible choice and preferable method to promote CRC screening behavior. Furthermore, the screening rates achieved by these interventions fall well short of the goal of 80% screening rate (by 2018 and in every community) proposed by the National Colorectal Cancer Round Table (NCCRT), which includes the American Cancer Society and the Centers for Disease Control and Prevention (CDC) [46].

## Strengths and Limitations

The rigor of the current systematic review lies in the methodology for the article search protocol pertaining to inclusion criteria (e.g., type of study design, peer-reviewed studies in scientific journals, presence of comparison groups) and search strategy. However, some studies may not have been included in the initial search because of the particular search terms used or article indexing procedure that may have excluded an article from the search. The included studies varied in study quality. Seven of the 11 studies included randomization of study participants, and five of the 11 studies were randomized controlled trials. Because of variations in reporting study findings and not stratifying by screening modality, for a few studies it was not possible to isolate the effect of the stool blood testing method. It is recommended that screening outcomes are disaggregated in the reporting of study outcomes. A meta-analysis was not possible for this review because of the heterogeneity in study designs and reported outcomes. Some studies did not report odds ratios so the decision was made to calculate odds ratios for all studies based on the data presented in each article. A systematic review of U.S.-based CRC screening interventions reported that CRC screening interventions which include a combination of screening methods might be most effective; however, most clinic-based interventions might need to provide the array of screening options if they are part of their menu of services [47]. Some clinics, such as federally-qualified

health centers (FQHC), might only provide stool blood testing and referral to colonoscopy, so these types of clinics would be more likely to be study sites for a stool blood testing approach only. Future reviews might include all stool blood testing interventions regardless of population served to determine preferences in actual clinical practice settings to test whether they may be differences by geography or racial group.

## Conclusion

The option to choose stool blood testing is part of a comprehensive cancer education approach to increase CRC screening. Our findings align with the Healthy People 2020 objective, which seeks to increase colorectal cancer screening based on current guidelines. Recent guidelines from leading medical and community health organizations (i.e., United States Preventative Task Force, the American Cancer Society, the American Academy of Family Physicians, and Task Force on Community Preventive Services) recommend the use of stool blood testing for colorectal cancer screening, ideally leading to early detection and a reduction in mortality rates [48, 49]. The low-cost and decreased barriers compared to colonoscopy (e.g., time off work, access to a medical facility, and transportation) might provide an opportunity for some minority populations experiencing CRC disparities to increase participation in screening. However, without sufficient knowledge of these tests and the recommended screening intervals for such screening, minority communities cannot receive the full benefits of CRC cancer prevention. Strategies to increase stool blood testing in African Americans include standard mailed blood stool tests augmented by patient navigation, tailored educational materials, and follow-up calls or mailings to increase trust in the patient-provider relationship. To increase overall CRC screening in African Americans also requires decreasing barriers to access for preventive screenings by increasing insurance coverage and lowering out of pocket healthcare costs.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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