



## Factors associated with colorectal cancer screening in a peer-counseling intervention study in partnership with African American churches

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### ABSTRACT

Colorectal cancer (CRC) mortality is 47% higher in African American men and 34% higher in African American women compared to non-Hispanic white men and women. This analysis assessed factors associated with CRC screening among 163 African American participants of a peer-counseling intervention study (2016–2018).

In a one-group pre/post-test pilot study, trained Community Health Advisors (CHAs) at 9 African American churches in Los Angeles (LA) promoted CRC screening via one-on-one counseling, print materials and telephone reminder calls. Participants completed telephone surveys 3–6 months after the intervention. We fit bivariate and multivariate mixed effects logistic regression models to assess correlates, including participants' demographic characteristics, access to care, cancer-related knowledge and attitudes and receipt of CHA counseling of (1) discussion of CRC screening with provider and (2) receipt of CRC screening during follow-up.

After controlling for gender and education, receipt of CHA counseling (OR 3.77) was significantly associated with discussing CRC screening with a provider during follow-up but not with CRC screening. Instead, a routine check-up in the past 12 months (OR 4.47) and discussion of CRC screening with a provider (OR 3.07) were significantly associated with CRC screening during follow-up. Residence in South LA (OR 0.38) was significantly associated with lack of CRC screening.

Findings confirm the important role of health care providers and suggest that residence in South LA constitutes an additional barrier to CRC screening. Further research and additional resources are needed to address disparities in the uptake of CRC screening among African Americans, especially in South LA.

### 1. Introduction

Colorectal cancer (CRC) is the second-leading cause of cancer death in the United States. Incidence and mortality have declined significantly over the past two decades, mainly due to earlier detection of CRC and pre-cancerous polyps through increased screening (Cronin et al., 2018). Yet, incidence and mortality for CRC among African Americans have remained significantly higher than in Whites: CRC mortality is 47% higher in African American men and 34% higher in African American women compared to non-Hispanic white men and women (American Cancer Society, 2019). Although disparities in screening rates among African Americans and non-Hispanic Whites have decreased in recent years, disparities in CRC mortality persist (American Cancer Society, 2019). An estimated 19% of the racial disparity in CRC mortality has

been attributed to lower screening rates among African Americans (Lansdorp-Vogelaar et al., 2012) and African Americans are significantly more likely than whites to report lack of a physician recommendation as the main reason for CRC non-screening (May et al., 2015; Coleman Wallace et al., 2013).

South Los Angeles (LA) has a population of more than 1 million people, including 27% African Americans. Based on statistics on access to health care, social determinants of health (education, employment status, poverty, housing) and physical determinants of health (e.g., neighborhood, air quality), it is the most under-resourced area in LA County. It also has a significantly higher CRC mortality than the rest of LA (Los Angeles County Department of Public Health, 2017). Churches are an important asset in the African American community and African Americans are more likely than any other racial/ethnic group to attend

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church at least once a week (Pew Research Center, 2014). Church-academic partnerships hold promise for reducing cancer disparities (Hou and Cao, 2017). They often utilize Community Health Advisors (CHAs) who are effective in promoting cancer screening (Gibbons and Tyus, 2007; Viswanathan et al., 2009; Navarro et al., 2007). We partnered with African American churches in LA and trained a cadre of CHAs to identify adults 50 to 75 years of age who were not up to date with national cancer screening guidelines (U.S. Preventive Services Task Force, 2020) and to provide a one-on-one intervention, urging participants to discuss screening with their provider and to obtain tests if needed.

This analysis is focused on identifying factors associated with CRC screening during the follow-up period among baseline non-adherent African American study participants. We will describe factors that are associated with two outcomes of the study: discussion of CRC screening with a provider and receipt of CRC screening, either stool blood test or colonoscopy. A better understanding of factors that are associated with CRC screening in this study can inform future interventions to promote cancer screening in church settings in LA.

## 2. Methods

Between 2015 and 2018, we invited 11 African American churches to participate in a one-group pre/post-test pilot study to promote cancer screening. Nine churches agreed to participate (82% participation rate), of which seven were located in South LA. Each of the nine churches identified, on average, 5 CHAs who received training to recruit study participants ages 50 to 75 at their church or through their social networks; assess participants' adherence to national screening guidelines for breast, cervical, colorectal and prostate cancer screening (U.S. Preventive Services Task Force, 2020); and provide one-on-one counseling, distribute print information and make a reminder phone call to participants who were not adherent to at least one of these screening guidelines. All of these intervention strategies to promote screening are recommended for broad dissemination by *The Community Guide* (The Community Preventive Services Task Force, 2016).

### 2.1. Baseline assessment of adherence to cancer screening guidelines

CHAs conducted a one-page assessment with each participant, depicted in (Maxwell et al., 2019), to collect name, gender, age, address, telephone number; receipt (ever had and when was the last test) of mammograms, Pap tests, Human Papilloma Virus (HPV) tests (women only), stool blood tests, sigmoidoscopy and colonoscopy. Men were asked if they ever had a Prostate Specific Antigen (PSA) test and if they had ever discussed the PSA test with a physician. Survey items were similar to those used in large population surveys, such as the Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention, 2019). CHAs read out lay-language definitions of the screening tests when needed. For each screening test, CHAs compared the answers to the national screening guidelines issued by the U.S. Preventive Services Task Force (2020) to determine adherence to screening guidelines for each participant. Each assessment took about 10 min to complete.

### 2.2. Intervention

The intervention was administered to participants who were non-adherent to at least one guideline for breast, cervical (women only) or CRC screening or for PSA discussion (men only). In a one-on-one conversation, CHAs explained the screening tests and followed counseling scripts to respond to barriers to all screening tests that were overdue. They documented intervention delivery by checking off issues they discussed in the counseling script for each participant. CHAs were trained to advise participants that stool-based CRC screening tests need to be completed yearly and colonoscopy every 10 years (U.S. Preventive Services Task Force, 2020), unless otherwise instructed by a health care

provider. CHAs did not assess cancer risk factors, but if participants revealed risk factors such as a family history of cancer, they were included in the study and advised that they may need more frequent screening and to discuss their screening schedule with a health care provider. For those who wanted more information, CHAs provided culturally appropriate print materials from the National Cancer Institute and the American Cancer Society. Finally, they urged participants to discuss cancer screening with their provider and to obtain any screening test that was overdue and made one reminder call (see more details of the intervention in Maxwell et al. (2019)).

### 2.3. Follow-up telephone survey

Participants who were non-adherent to at least one screening guideline for breast, cervical or CRC screening or PSA discussion with provider at baseline received a telephone follow-up survey 3 to 6 months after baseline (mean length of follow-up interval is 4.6 months) by a member of the research team who was not affiliated with any of the churches and who was not involved in intervention implementation. The follow-up survey was guided by the Multi-level Health Outcome Framework (MHOF), formerly Health Behavior Framework (Bastani et al., 2010). The MHOF is a synthesis of some of the common conceptual formulations in the area of health behavior and outcomes and takes a multi-level, socio-ecological perspective. The MHOF postulates that numerous factors at the level of the individual, provider, health care system and the broader geographic, social and political environment interact in complex ways to influence health. The MHOF has been applied and tested in a wide range of studies involving multiple racial and ethnic groups, disease targets, and intervention types (Bastani et al., 2015; Chen et al., 2013; Maxwell et al., 2010a; Taylor et al., 2011).

Survey administration took 20 min on average. The survey focused on individual factors of the MHOF, including demographic characteristics of respondents; access to health care; knowledge of colorectal cancer screening guidelines; and attitudes related to cancer screening in general (6 items). Items to assess constructs of the MHOF had been developed for previous studies with community input, using qualitative data collection and examination of existing instruments (Bastani et al., 2001). In prior studies, these items had been easily understood and had been related to each other and to other variables as expected, thus suggesting face validity and construct validity (Bastani et al., 2010; Maxwell et al., 2011, 2010b). We also assessed receipt of the CHA-led counseling intervention and two self-reported study outcomes during the follow-up period: discussion of cancer screening with a provider and receipt of any screening test that was overdue.

Participants who completed the follow-up survey were mailed a \$20 store gift card. The survey and all study procedures were approved by the University of California, Los Angeles Institutional Review Board.

### 2.4. Statistical analysis

All analyses were restricted to the subsample of 163 participants who were non-adherent to CRC screening guidelines at baseline and completed the follow-up survey. An attitude score was computed by recoding responses to 6 attitude items (1 = attitude is supportive of cancer screening; 0 = other) and summing scores, with higher scores indicating more positive attitudes related to cancer screening (range 0–6). A score was computed for knowledge of CRC screening guidelines by adding correct responses to 3 items (range 0–3). Number of health care visits in the last 12 months was dichotomized at the median (0–3 visits versus greater than 3 visits). The 26 South LA zip codes were categorized as “South LA” (Community Health Councils, 2008) and all other zip codes as “other”.

Bivariate relationships between receipt of the CHA counseling intervention and participant demographic characteristics, knowledge of CRC screening guidelines and cancer-related attitudes were assessed using mixed effects logistic regression models to account for clustering

on CHA.

We assessed bivariate relationships between the two study outcomes, discussion of CRC screening with a provider and receipt of CRC screening, and potential correlates using mixed effects logistic regression models accounting for clustering on CHA. The potential correlates included demographic characteristics, cancer related knowledge and attitudes, access to care, history of CRC screening at baseline and receipt of the intervention. A multivariable model was constructed by including gender and education, and other variables if they were bivariate associated with at least one of the outcomes at  $p < .05$ . Since three items assessing access to care were highly correlated (has a regular doctor, more than 3 health care visits in the last 12 months, had a routine check-up in the past 12 months), we selected only one of these measures (had a routine check-up in past 12 months) for the multivariable model. Residence in South LA versus other was not related to these three access to care items and was entered as a proxy for neighborhood context into the multivariate analyses. We repeated the logistic regression analyses with an alternative measure of access to health care (more than 3 health care visits in the last 12 months) and obtained similar results (data not shown in tables). All models included random intercepts for CHA only, since we detected no clustering at the church level. Analyses were conducted using SAS (version 9.4 for Windows, SAS Institute Inc. Cary NC, USA) and Stata (version 14.2 for Windows, StataCorp LLC. College Station, TX, USA).

### 3. Results

Out of 226 participants who were baseline non-adherent to CRC screening guidelines, 163 completed the follow-up survey (72% retention). There were no statistically significant differences between the participants who completed the follow-up survey ( $N = 163$ ) and non-completers ( $N = 63$ ) with respect to gender, age and residence (South LA zip codes versus other zip codes) and with respect to CRC screening history at baseline (ever had stool blood test; ever had a sigmoidoscopy or a colonoscopy; data not shown in tables).

As shown in Table 1, the sample was predominantly female. Most participants had health insurance and a regular doctor and had routine check-ups. Only 26% ever had a colonoscopy or sigmoidoscopy and 30% ever had a stool blood test at baseline. The majority (82%) stated that they discussed cancer screening with a CHA. Almost half reported that they discussed CRC screening with their provider during the follow-up period, but only 28% reported that they received CRC screening, either a stool-based test (15%) or a colonoscopy (13%).

As shown in Table 2, knowledge of CRC screening guidelines at follow-up was generally low, ranging from 20% of respondents who knew that a colonoscopy is recommended every 10 years to 61% who knew that stool blood tests are recommended once a year. The overall knowledge score of CRC screening guidelines was significantly higher among participants who reported receipt of CHA counseling than among those who did not receive counseling, but the difference was small (mean (SD) of 1.3 (0.7) versus 1.0 (0.7) on scale of 0 to 3,  $p = 0.02$ ).

Attitudes towards screening at follow-up were generally positive. The majority of participants believed in the efficacy of cancer screening, even in the absence of health problems, and in the efficacy of early detection for survival. About 20% of the respondents agreed with the fatalistic statement that "nothing can be done about cancer" and 61% stated that they were not afraid to undergo cancer screening due to fear of finding cancer. However, only 23% of the sample was aware that people who are 50 years of age and older have a higher chance of getting cancer than younger people. General attitudes towards cancer screening were similar among participants who recalled receiving CHA counseling and those who did not receive counseling.

Table 3 shows bivariate correlates of the two study outcomes in the subsample of 163 participants who were non-adherent to CRC screening at baseline and who completed the follow-up survey. Overall, 49% of respondents ( $N = 80$ ) reported that they discussed CRC screening with a

**Table 1**

Sample characteristics of African American participants ages 50–75 ( $N = 163$ ).

Characteristics	% (n)
<b>Demographic characteristics</b>	
Age in years (mean, standard deviation)	59 ± 6.9
Gender	
Males	38% (62)
Females	62% (101)
<b>Marital Status</b>	
Single	46% (75)
Married	30% (46)
Divorced, separated, widowed	24% (39)
<b>Income (14 missing)</b>	
<\$20,000	28% (41)
\$20,000 to <\$50,000	36% (54)
\$50,000 and more	36% (54)
<b>Education</b>	
High school graduate or less	20% (32)
Some college	44% (71)
College graduate	37% (60)
<b>Residence</b>	
South Los Angeles	60% (97)
Other	40% (66)
<b>Access to care</b>	
<b>Health Insurance</b>	
Private insurance or HMO	56% (89)
Medicaid or Medicare	33% (52)
Other insurance	4% (6)
None	7% (11)
Has a regular doctor	82% (134)
Has routine check-ups	81% (132)
Had more than 3 doctor's visits in last 12 months	50% (81)
Had a routine check-up in last 12 months at follow-up	76% (124)
<b>History of CRC screening at baseline</b>	
Ever had a colonoscopy or a sigmoidoscopy	26% (42)
Ever had stool blood test	30% (49)
Ever had either stool blood test or endoscopy	45% (74)
<b>Self-reported receipt of intervention</b>	
Discussed cancer screening history and what test they needed with their CHA	82% (134)
CHA recommended to discuss cancer screening with their physician	88% (144)
CHA recommended to obtain cancer screening	74% (121)
<b>Self-reported outcomes</b>	
Discussed CRC screening with provider during follow-up	49% (80)
Receipt of CRC screening during follow-up <sup>a</sup>	28% (46)

CHA = Community Health Advisor; CRC = Colorectal cancer.

<sup>a</sup> 27 participants reported receipt of a stool blood test, 21 reported colonoscopy, 2 reported both.

provider during the follow-up period and 28% of respondents ( $N = 46$ ) reported receipt of CRC screening.

Factors that were associated with discussing CRC screening with a provider during follow-up included receipt of the CHA-led intervention and access to care. Respondents who reported that they discussed their cancer screening history and what test they needed with their CHA were more than twice as likely to discuss CRC screening with their provider as those who reported that they did not receive the intervention (54% versus 24%,  $p < 0.005$ ). Those who had a regular doctor (57% versus 14%), who had more than 3 health care visits in the past 3 months (67% versus 32%) and who had a routine check-up in the past 12 months (56% versus 26%) were also significantly more likely to discuss CRC screening with a provider (all  $p < 0.001$ ). We did not find differences in CRC discussion with a provider with respect to participants' age, gender and education, residence in South LA versus other areas, health insurance, history of CRC screening at baseline, knowledge of CRC screening guidelines and cancer related attitudes.

Factors that were associated with receipt of CRC screening during

**Table 2**  
Relationship between receipt of colorectal cancer (CRC) screening counseling and knowledge of CRC screening guidelines and cancer-related attitudes at follow-up; Los Angeles, 2016–2018 (N = 163).

Variables	Total sample		Receipt of one-on-one counseling with CHA		p
	N	%	Yes (N = 134)	No (N = 29)	
<b>Knowledge of CRC screening guidelines at follow-up</b>					
People should start CRC screening age 50					<b>0.03</b>
Correct	75	46	89	11	
Incorrect	88	54	76	24	
People need a stool blood test once a year					NS
Correct	99	61	83	17	
Incorrect	64	39	81	19	
People need colonoscopy every 10 years					NS
Correct	32	20	91	9	
Incorrect	131	80	80	20	
<b>Cancer-related attitudes and barrier to screening</b>					
<i>Perceived efficacy of cancer screening</i>					NS
Do you believe that cancer screening tests can detect cancer in its early stages?					
<b>Yes</b>	154	94	81	19	
No	9	6	100	0	
<i>Perceived efficacy of cancer screening</i> You only need cancer screening when you have health problem. Do you ....					<b>&lt;0.05</b>
<b>Agree</b>	9	5	56	44	
<b>Disagree</b>	154	95	84	16	
<i>Perceived efficacy of early detection</i>					NS
Assuming a person gets cancer, how likely do you think early detection would increase this person's chance of survival? Would you say ....					
<b>Very likely</b>	136	83	83	17	
Other	27	17	78	22	
<i>Fatalism</i> Some people say that they either get cancer or they don't. There is nothing that can be done about it. Do you....					NS
Strongly agree/somewhat agree	34	21	71	29	
<b>Not agree with this</b>	129	79	85	15	
<i>Fear of finding cancer</i> Some people are afraid to undergo cancer screening because something wrong might be found. Would you say you are ....					NS
Very afraid/somewhat afraid	63	39	84	16	
<b>Not afraid</b>	100	61	81	19	
<i>Perceived susceptibility</i> Who do you think has a higher chance of getting cancer: people who are ....					NS
<b>50 years of age and older</b>	38	23	84	16	
Other	125	77	82	18	
<b>Scales (mean ± standard deviation)</b>					
Knowledge of CRC screening guidelines (scale from 0 to 3)	1.3 ± 0.8		1.3 ± 0.7	1.0 ± 0.7	<b>0.02</b>
Attitudes towards cancer screening <sup>a</sup> (scale from 0 to 6)	4.3 ± 1.2		4.4 ± 1.1	4.1 ± 1.3	NS

p values from mixed effects logistic regression accounting for clustering by CHA.

<sup>a</sup> Attitudes supportive of cancer screening (bolded responses) were coded as "1" and summed.

**Table 3**  
Bivariate correlates of patient-provider discussion of CRC screening and receipt of CRC screening during follow-up among African Americans who participated in a CHA-led church intervention to promote screening; Los Angeles, 2016–2018 (N = 163).

Variables	Discussion of CRC screening with provider (N = 163)		P	Receipt of CRC screening (N = 162)		P
	Yes (N = 80)	No (N = 83)		Yes (N = 46)	No (N = 116)	
<b>Continuous variables (mean ± standard deviation)</b>						
Age in years	58.3 ± 6.6	59.8 ± 7.1	NS	59.1 ± 6.6	59.0 ± 7.0	NS
Knowledge of CRC screening guidelines (Scale from 0 to 3)	1.3 ± 0.7	1.2 ± 0.8	NS	1.5 ± 0.8	1.2 ± 0.7	<b>0.021</b>
Attitudes towards cancer screening <sup>a</sup> (Scale from 0 to 6)	4.3 ± 1.2	4.3 ± 1.1	NS	4.3 ± 1.0	4.3 ± 1.2	NS
<b>Demographic characteristics</b>						
Gender			NS			<b>0.020</b>
Males	44	56		18	82	
Females	52	48		35	65	
Education			NS			NS
High school graduate or less	53	47		22	78	
Some college	41	59		29	71	
College graduate	57	43		32	68	
Residence			NS			<b>0.021</b>
South Los Angeles	48	52		22	78	
Other	50	50		38	62	
<b>Health Care Access</b>						
Insurance			NS			NS
Private Insurance or HMO	52	48		34	66	
Medicaid or Medicare	54	46		21	79	
Other insurance	50	50		50	50	
None	9	91		9	91	
Has a regular doctor			<b>0.0003</b>			<b>0.012</b>
Yes	57	43		33	67	
No	14	86		7	93	
Visited a doctor/health professional > 3 times in the past 12 months			<b>0.0001</b>			<b>0.012</b>
Yes	67	33		38	62	
No	32	68		20	80	
Had a routine check-up in past 12 months at follow-up			<b>0.001</b>			<b>0.003</b>
Yes	56	44		35	65	
No	26	74		8	92	
<b>History of CRC screening at baseline</b>						
Ever had colonoscopy or sigmoidoscopy			NS			NS
Yes	55	45		29	71	
No	47	53		28	72	
Ever had stool blood test			NS			NS
Yes	55	45		35	65	
No	46	54		25	75	
<b>Self-reported receipt of intervention</b>						
Discussed cancer screening history and what test they needed with their CHA			<b>0.005</b>			NS
Yes	54	46		29	71	
No	24	76		24	76	
CHA recommended to discuss cancer			NS			NS

(continued on next page)

**Table 3** (continued)

Variables	Discussion of CRC screening with provider (N = 163)		P	Receipt of CRC screening (N = 162)		P
	Yes N = 80	No N = 83		Yes N = 46	No N = 116	
screening with their physician						
Yes	51	49		28	72	
No	32	68		32	68	
CHA recommended to obtain cancer screening			<b>0.046</b>			NS
Yes	54	46		29	71	
No	36	64		27	73	
<b>Discussed CRC Screening with provider</b>						
Yes	–	–	–	41	59	<b>0.001</b>
No	–	–	–	17	83	

p values are from mixed effects logistic regression accounting for clustering by CHA.

<sup>a</sup> An attitude score was computed by recoding responses to 6 attitude items (1 = attitude is supportive of cancer screening; 0 = other) and summing scores, with higher scores indicating more positive attitudes related to cancer screening (range 0–6).

follow-up included gender and residence, access to care and discussion of CRC screening with a provider. Females were almost twice as likely as males to receive CRC screening during the follow-up period than males (35% versus 18%,  $p < 0.02$ ) and South LA residents were significantly less likely to receive CRC screening than participants outside of South LA (22% versus 38%,  $p < .02$ ). Those who had a regular doctor (33% versus 7%), who had more than 3 health care visits in the past 3 months (38% versus 20%) and who had a routine check-up in the past 12 months (35% versus 8%) were also significantly more likely to report receipt of CRC testing during the follow-up period (all  $p < 0.01$ ). Those who had discussed CRC screening with a provider were significantly more likely to obtain CRC screening (41% versus 17%,  $p = .001$ ). Knowledge of CRC screening guidelines was low overall but significantly higher among those who received CRC screening than among their counterparts who did not receive screening (mean (SD) of 1.5 (0.8) versus 1.2 (0.7),  $p = .021$ ). Receipt of CRC screening was not associated with attitudes towards cancer screening, history of CRC screening at baseline and receipt of the counseling intervention.

In multivariable analyses (Table 4), discussion of cancer screening with a CHA (OR 3.77) and had a routine check-up in the past 12 months (OR 3.55) were significantly associated with discussing CRC screening with a provider during follow-up. There were no significant differences by gender and residence in South LA versus other areas. Receipt of a routine check-up in the past 12 months (OR 4.47) and discussion of CRC screening with a provider (OR 3.07) were significantly associated with receipt of CRC screening during the follow-up period. Residence in South LA (OR 0.38) was significantly and inversely associated with receipt of CRC screening. There were no significant differences by gender and discussion of cancer screening with a CHA.

#### 4. Discussion

This analysis adds to the literature on the role of CHAs and African American churches in promoting CRC screening in an under-resourced area. Few studies in community settings have explored theory-based factors that are associated with intervention outcomes among study participants: the intermediate outcome of discussing CRC screening with a provider and the final outcome of receipt of CRC screening.

Although receipt of the counseling intervention was significantly associated with a higher knowledge score of CRC screening guidelines, knowledge was low in general. This may be due to the fact that CHAs

**Table 4**

Multivariable logistic regression models of discussion of CRC screening with provider and receipt of CRC screening during follow-up among African Americans (baseline non-adherent to CRC screening) who participated in a CHA-led church intervention to promote screening; Los Angeles, 2016–2018 (N = 163).

Variables	Discussion of CRC screening with provider during follow-up (N = 163)	Receipt of CRC screening during follow-up (N = 162)
	Adj. Odds Ratio (95% Confidence Interval)	Adj. Odds Ratio (95% Confidence Interval)
Gender	1.14 (0.54–2.39)	1.95 (0.84–4.54)
College graduate degree	1.45 (0.68–3.10)	0.80 (0.36–1.78)
Residence in South Los Angeles	1.16 (0.57–2.38)	<b>0.38 (0.17–0.83)</b>
Knowledge of CRC screening guidelines at follow-up (scale from 0 to 3)	1.08 (0.68–1.72)	1.72 (1.00–2.96)
Had a routine check-up in past 12 months at follow-up	<b>3.55 (1.49–8.47)</b>	<b>4.47 (1.20–16.68)</b>
Discussed cancer screening with CHA	<b>3.77 (1.36–10.43)</b>	0.56 (0.19–1.66)
Discussed screening with provider during follow-up	—	<b>3.07 (1.34–7.05)</b>

Results are from mixed effects logistic regression models accounting for clustering by CHA.

CHA = Community Health Advisor; CRC = colorectal cancer screening.

focused more on counseling regarding participants' specific barriers to CRC screening than on screening guidelines. Cancer-related attitudes were mostly positive and may have been supportive of screening prior to the intervention. We did find that almost 80% of participants were not aware that people 50 years of age and older had an increased risk of cancer, despite the counseling they received.

Health care access variables emerged as important correlates of CRC screening. Having a regular doctor, frequent doctor's visits and having routine check-ups may all encourage and provide opportunities for physicians to recommend CRC screening. In our study, CHAs encouraged participants to discuss CRC screening with a physician because it is a necessary intermediate step to obtain CRC screening. Patient-provider communication and a physician's recommendation to obtain a screening test are among the most important predictors of screening (Katz et al., 2004; Peterson et al., 2016). However, physician recommendation for screening is unacceptably low among African Americans and racial minorities are more likely than Whites to report lack of provider recommendation for CRC screening (May et al., 2015; Coleman Wallace et al., 2013; Bromley et al., 2015). The fact that in our study, receipt of the CHA counseling intervention was significantly related to discussing CRC screening with a provider, after controlling for access to care and demographic characteristics, is encouraging and suggests that the CHA counseling intervention achieved its purpose.

However, while almost half of our participants who were overdue for CRC screening reported discussing CRC screening with a provider, only 28% reported receipt of CRC screening during the follow-up period. Based on the MHO (Bastani et al., 2010), intentions to obtain screening do not automatically translate into behavior. Consistent with prior research (Maxwell et al., 2019; Melvin et al., 2019), cost, lack of time, "feeling fine", dislike of colonoscopy procedure, lack of health care access and lack of obtaining routine check-ups are important individual level barriers to screening, even in our highly insured sample. Other variables that we did not assess may also have functioned as barriers, including system-level barriers such as lack of a patient and provider reminder systems (Sharma et al., 2019). Discrepancies between the type of screening test recommended and patient preferences may also have functioned as a barrier (Luque et al., 2018), although our sample reported receipt of both stool-based tests and colonoscopy.

While a discussion about CRC screening with a provider and having routine check-ups predict receipt of CRC screening, consistent with Ioannou et al. (2003), residence in South LA, which could be considered a proxy measure of neighborhood context, was inversely related to receipt of screening. It is noteworthy that residence in South LA emerged as a statistically significant predictor of CRC screening *after* adjustment for important individual-level covariates. This suggests that South LA residents experience additional barriers to screening. Many studies have assessed individual factors related to CRC screening such as demographics, access to care, knowledge of cancer screening guidelines and attitudes related to cancer screening (Brittain et al., 2016), but only few studies have examined broader geographic and social determinants of CRC screening (Blair et al., 2019; Doubeni et al., 2012; Beyer et al., 2016; Halbert et al., 2016). Nevertheless, there is growing recognition that low socioeconomic status, poverty and other social determinants of health make access to screening more challenging. Neighborhood factors such as the availability and quality of health care facilities and community perceptions about these facilities are important to utilization of health care services (Beyer et al., 2016; Halbert et al., 2016).

In the absence of additional information about participants' life circumstances, area-level indicators may be useful in identifying population groups that are the most under-resourced and the least likely to obtain cancer screening. Our finding of significantly lower odds of screening among South LA residents confirms the influence of social and environmental contexts in addition to individual-level and provider-level factors on CRC screening and the need for further research in this area as well as additional resources to address disparities in the uptake of CRC screening.

#### 4.1. Limitations:

The survey focused on a limited set of individual-level factors of the MHOF with only one variable (zip code) as a proxy for neighborhood context (Bastani et al., 2010). In addition, study completers may differ from drop-outs with respect to receipt of the intervention, study outcomes, knowledge and attitudes and other unmeasured variables. The study used a one-group pre/post design and data were obtained in a cross-sectional survey administered at follow-up, with limitations to drawing causal inferences, although most of the factors that were investigated preceded intervention outcomes (e.g., South LA zip code preceded receipt of CRC screening). Study outcomes and receipt of the CHA counseling intervention were self-reported and these variables may suffer from recall and social desirability bias. However, CHAs provided completed counseling scripts for 89% of respondents who reported receipt of CRC counseling, thus confirming the majority of the self-reports regarding receipt of the intervention. Finally, some participants may not have been able to obtain a colonoscopy due to the relatively short follow-up period.

#### 4.2. Conclusions

Our findings suggest that a one-on-one counseling session delivered by trained CHAs can encourage African Americans to discuss CRC screening with their provider. However, counseling was not associated with receipt of CRC screening. Findings confirm the important role that health care providers have and suggest that residence in South LA constitutes an additional barrier to CRC screening. Further research and additional resources are needed to address disparities in the uptake of CRC screening among African Americans, especially in South LA.

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#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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