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Determinants of Variations in Self-reported Barriers to Colonoscopy Among Uninsured Patients in a Primary Care Setting

Chinedum Ojinnaka · Ann Vuong · Janet Helduser · Philip Nash · Marcia G. Ory · David A. McClellan · Jane N. Bolin

Abstract Colorectal cancer (CRC) is the third most common type of cancer among both males and females in the United States and the second leading cause of cancer-related deaths. Although largely preventable through screening, early detection and removal of polyps, screening rates are considered sub-optimal. Perceived barriers to screening have been reported to influence screening rates. This paper examines variations in the extent to which uninsured patients identified barriers to CRC screening using colonoscopy based on race/ethnicity, educational attainment, age, gender, marital status and prior colonoscopy. Multivariate analyses showed that compared to Caucasians, African Americans had an increased likelihood of identifying lack of transportation as a barrier [odds ratio (OR) 2.68; 95 % confidence interval (CI) 1.35–5.32] while Hispanics were more likely to identify fear of finding cancer as a barrier (OR 2.09; 95 % CI 1.19–3.66). Compared to those with more than a high school education, there was increased likelihood of identifying lack of knowledge as a barrier among individuals with high school education (OR 3.51; 95 % CI 1.94–6.36) or less than a high school education (OR 2.16; 95 % CI 1.04–4.50). Our findings suggest that strategies aimed at increasing colonoscopy screening rates among underserved populations should take into consideration race/ethnicity, educational attainment, age, and prior colonoscopy experience when developing education and outreach plans to reduce barriers to colonoscopy.

Keywords Colorectal cancer · Uninsured · Barriers · Determinants · Variations

C. Ojinnaka (✉) · J. Helduser · J. N. Bolin
Department of Health Policy and Management, Texas A&M Health Science Center School of Public Health, College Station, TX 77843-1266, USA
e-mail: Ojinnaka@sph.tamhsc.edu

A. Vuong
Division of Epidemiology and Biostatistics, Department of Environmental Health, University of Cincinnati, College of Medicine, P.O. Box 670056, Cincinnati, OH 45267-0056, USA

P. Nash
Department of Family and Community Medicine, College of Medicine, Texas A&M Physicians Family Residency, Texas A&M Health Science Center, 2900 E. 29th Street, Bryan, TX 77803, USA

M. G. Ory · D. A. McClellan
Department of Health Promotion and Community Health Sciences, Texas A&M Health Science Center School of Public Health, College Station, TX 77843-1266, USA

Introduction

Colorectal cancer (CRC) is the third most common cancer among both males and females, and the second leading cause of cancer-related deaths in the United States [1], with a projected 136,830 newly diagnosed cases and 50,310 deaths in 2014 [2]. Colorectal cancer usually results from malignant transformation of adenomatous polyps that have resided in the colon or rectum for approximately 10 years [3]; thus, routine screening, and early detection and removal of polyps can prevent its occurrence. Consequently, the U.S. Preventive Services Task Force (USPSTF) recommends screening for individuals between age 50 and 75 using one of three methods: (1) fecal occult blood test (FOBT); (2) FOBT and sigmoidoscopy; or (3) colonoscopy [4]. Colonoscopy is regarded as the gold standard for CRC screening since it allows for visualization

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of the entire colon, as well as detection and removal of polyps during the same procedure with low rates of complications [5–8]. Studies have reported patients' [9] and physicians' [10] preferences for colonoscopy over other recommended screening methods.

A steady increase in adherence to recommended CRC screening guidelines has been reported over the past decade [11, 12]. This increase has been attributed to increased utilization of colonoscopy [11–13]. However, screening rates still fall short of Healthy People 2020 objectives [14], and disparities in screening guidelines adherence persist [13–17]. Blacks and Hispanics are less likely to be adherent to screening compared to whites and non-Hispanics [14]. Disparities in screening rates have also been noted across states [18], counties [19, 20] and census tract [21]. Furthermore, sub-optimal access to health care, such as lack of health insurance, is an established deterrent to CRC screening [22, 23]. Since proportions of uninsured individuals also exhibit geographic variations, particular communities could be at increased risk for CRC occurrence and mortality based on screening and health insurance rates. These communities could benefit from programs that improve access to screening through provision of free or subsidized tests such as colonoscopy.

However, such efforts could be undermined by perceived barriers to CRC screening. These barriers can be categorized as either *patient-level* or *system-level* barriers [24, 25]. Examples of previously reported *patient-level* barriers include embarrassment [26–28], fear of a negative outcome [28–32], fear or anticipation of pain [26, 27], drinking the laxative [28, 33], lack of transportation [34, 35], and lack of knowledge of CRC screening guidelines and recommended screening intervals [27, 36–38]. Reported *system-level* barriers include out-of-pocket cost or lack of insurance [39–41], medical mistrust [42, 43], and poor referral rates from healthcare providers [25, 38, 39].

Barriers to CRC screening using colonoscopy have been shown to demonstrate demographic variations [43–45]. It is therefore pertinent that programs aimed at increasing CRC screening among heterogeneous populations tailor their strategies to meet the needs of each represented group. Effective implementation of strategies to reduce disparities in CRC screening requires an understanding of perceived barriers and the variations that might exist across different socio-demographic groups. This paper examines the extent to which certain factors are perceived as barriers to colonoscopy among various subgroups of uninsured patients who received free or subsidized colonoscopies through the Texas Colon Cancer Screening, Training, Education and Prevention (Texas C-STEP) program. The diverse demographic characteristics of our participants allowed us the unique opportunity to explore variations in self-reported barriers among the uninsured.

Methods

Patients seeking financial assistance for CRC screening completed a form to determine eligibility for financial assistance based on income level and household size. Eligibility was also determined based on age. Individuals age 50 and above or below age 50 but at high risk for CRC based on personal or family history were eligible. Following determination of eligibility, questionnaires were then administered to collect information on demographics, family or personal history of colonoscopy, history of CRC screening, CRC knowledge and awareness, and perceived barriers to colonoscopy. Patients were asked to rate the extent to which various factors were perceived as barriers using a Likert scale with responses ranging from 1 (strongly disagree) to 5 (strongly agree). Questionnaires were administered in Spanish or English by the clinic-employed community health workers (CHWs).

Over a 24-month period, 546 residents of the seven target counties who were age-eligible (50–75 years) or at increased risk for CRC (based on family or personal history) qualified for and received a colonoscopy funded by the C-STEP project. Patients were consented for the colonoscopy procedure as part of usual care procedures at the family medicine residency clinic that is home to Texas C-STEP. Approximately two weeks before the procedure, patients participated in a "prep visit" with one of the clinic-based CHWs. During prep visits, the CHWs educated patients on appropriate bowel preparation and what to expect during and after the procedure; patients were also provided with free supplies of the laxative. All patient data were de-identified by the clinic's data analyst prior to data analysis, as approved by the organization's Institutional Review Board.

Due to insufficient numbers, we limited our analyses to individuals who self-reported their race/ethnicity as Caucasian, African American or Hispanic. Descriptive analysis of select demographic variables was conducted. Contingency tables for barriers to receiving a colonoscopy for colorectal screening by race/ethnicity and previous colonoscopy (yes/no) were analyzed with Chi square or Fisher's exact tests. Multivariate analyses using ordinal logistic regression was used to estimate adjusted odds ratios (ORs) and 95 % confidence intervals (CIs). Multivariate analysis was limited to respondents without missing data ($n = 382$). Separate ordinal logistic regression was conducted to determine the association between a number of characteristics, including race/ethnicity, marital status, gender, educational attainment, age and previous colonoscopy, and each identified barrier. These barriers included: embarrassment, fear of finding cancer, transportation, cost of the procedure, anxiety about the procedure, lack of knowledge about colonoscopies, drinking the laxative, religion, child care and

Table 1 Select characteristics of colonoscopy recipients

	No.	%
Gender		
Female	411	75.3
Male	135	24.7
Age (years)		
<50	109	20.0
50–74	433	79.3
>74	4	0.7
Race/ethnicity		
Caucasian	168	30.8
African American	113	20.7
Hispanic/latino	225	41.2
Asian/Pacific islander	13	2.4
American Indian/alaska native	1	0.2
Other	21	3.9
Missing	5	0.9
Education		
Middle school or less	122	22.3
Some high school/high school graduate	236	43.2
Some college or higher	78	14.3
Missing	110	20.2
Marital Status		
Divorced	75	13.7
Married	243	44.5
Separated	26	4.8
Single	133	24.4
Widowed	39	7.1
Missing	30	5.5
Insurance status		
Uninsured	540	98.9
Insured	5	0.9
Medicare	1	0.2
Previous colorectal cancer screening using colonoscopy		
No	414	75.82
Yes	92	16.85
Don't know	27	4.95
Missing	13	2.38
Previous colorectal cancer screening using fecal occult blood stool or fecal immunochemical test		
No	328	60.00
Yes	99	18.13
Don't know	36	6.59
Missing	83	15.20
Family/individual history of colorectal cancer		
No	342	62.6
Yes	74	13.6
Don't know	56	10.3
Missing	74	13.6
Family/individual history of polyps		
No	286	52.4
Yes	114	20.9
Don't know	72	13.2
Missing	74	13.6
Family/individual history of colorectal cancer or adenomatous polyp before age 50		
No	338	61.9
Yes	57	10.4
Don't know	76	13.9
Missing	75	13.7

anticipation of pain. Responses to the original Likert scale were condensed into three categories for analysis: 1 (disagree), 2 (neither agree nor disagree) and 3 (agree). Covariates in the multivariate model included race/ethnicity (Caucasian, African American, Hispanic), marital status (married, single), gender (male/female), education (<high school, some high school/high school graduate, >high school), age (<50, 50–64, ≥65) and previous colon cancer screening. The independent variables were chosen based on past literature and factors that have been shown to influence CRC screening [26–43, 45]. All models met the proportional odds assumption. Statistical tests were two-sided, and findings were considered statistically significant at $p < 0.05$. The analyses were conducted using Stata 12.1 [46].

Results

A total of 546 individuals received one or more colonoscopies over a 24-month period; however, surveys were administered only once. Approximately three-quarters of respondents were female; almost 80 % of participants were between the ages of 50 and 74 years (Table 1). Many of the individuals self-reported as Hispanic/Latino (41.2 %), followed by Caucasian (30.8 %) and African American (20.7 %). With regard to educational attainment, most of the colonoscopy recipients had at least some high school or higher level education (57.5 %). Ninety-nine percent of the colonoscopy recipients were uninsured; the remaining recipients were underinsured and needed assistance because of significant co-pays. Only about 16.9 % of respondents reported having had a previous screening colonoscopy; 18.1 % reported previous CRC screening using fecal occult blood test or fecal immunochemical test. Prior history (self or family member) of CRC was not prevalent among this population (13.6 %); a larger proportion reported prior history of polyps (20.9 %). Of those who reported a

Table 2 Correct responses to colorectal cancer awareness questions

	Correct response	
	No.	%
People can have colon cancer without having any symptoms	399	85.3
Men have a much higher risk of colon cancer than women	177	37.8
Starting at age 50, average risk individuals should be screened on a regular basis	435	93.0
Colon cancer can be prevented if detected with early screening tests	432	92.3
People cannot get colon cancer unless it runs in their family	400	85.5
Improving diet and increasing physical activity can reduce your risk of getting colon cancer	368	78.6
The risk of developing colon cancer increases with age	384	82.1

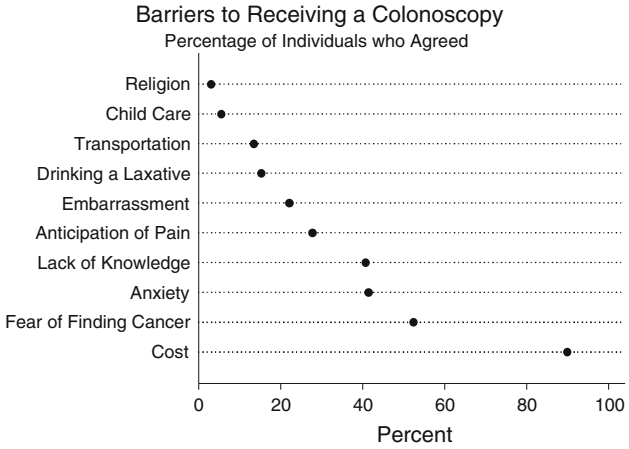

Fig. 1 Respondents' perception of barriers to colonoscopy

positive personal or family history of CRC or adenomatous polyps, 10.4 % occurred prior to age 50.

Individuals were asked to respond either true or false to a series of questions capturing CRC awareness. The percentages of individuals who correctly answered each of the CRC awareness questions are shown in Table 2. Over 90 % of respondents were aware that average-risk individuals should be screened on a regular basis starting at age 50 and that colon cancer could be prevented if detected with early screening tests. To a lesser extent, colonoscopy recipients were aware that: individuals with colon cancer may not have any symptoms; individuals can get colon cancer even if it does not run in their family; risk of getting colon cancer can be reduced with lifestyle changes, such as improving one's diet and increasing physical activity; and risk of developing colon cancer increases with age. However, more than 60 % incorrectly believed that men have a higher risk of colon cancer than women.

Figure 1 shows the percentages of individuals who either agreed or strongly agreed with each identified barrier in ascending order. As one would anticipate, cost proved to be the single most important concern among these uninsured participants, with almost 90 % identifying cost as a barrier to receiving a colonoscopy. Fear of finding cancer was observed to be the second highest barrier to screening with more than 50 % of respondents selecting either agree or strongly agree. Feelings of embarrassment and anticipation of pain were reported as deterrents by 22.1 and 27.8 % of respondents respectively. A similar proportion of individuals pinpointed lack of knowledge and feelings of anxiety as barriers to receiving a colonoscopy. Drinking a laxative and lack of transportation were comparable, with 15.3 and 13.5 % of participants, respectively, indicating that these factors were potential hindrances to CRC screening using colonoscopy. Religious beliefs and lack of child care were not generally perceived as obstacles to receiving a colonoscopy.

Table 3 displays the results of the contingency tables. Several significant differences in the distribution of responses were observed. Hispanics (29.7 %) were more likely than African Americans (11.6 %) or Caucasians (20.1 %) to report feelings of embarrassment as a barrier to receiving a colonoscopy (p value = 0.007). African Americans were more likely to perceive transportation as a barrier (24.2 %) compared to Caucasians (10.1 %) and Hispanics (10.8 %) (p value = 0.004). A significantly lower proportion of Caucasians compared to African Americans and Hispanics indicated that lack of knowledge about colonoscopy was a barrier to colon cancer screening (p value = 0.013).

Table 4 shows statistical outcomes from the multivariate analysis. Only results from models with significant findings are presented. The only barriers that exhibited racial variations were fear of finding cancer and transportation. Compared to Caucasians, Hispanics had an increased odds of identifying fear of finding cancer as a barrier (OR 2.09, 95 % CI 1.19–3.66) while African Americans had increased odds of agreeing that transportation was a barrier to colonoscopy (OR 2.68, 95 % CI 1.35–5.32).

Perception of barriers also varied with educational attainment. Compared to those who had more than a high school education, those who had some high school education or were high school graduates had increased odds of agreeing that fear of finding cancer (OR 2.29, 95 % CI 1.33–3.95), anxiety (OR 1.86, 95 % CI 1.08–3.21) and anticipated pain (OR 1.90, 95 % CI 1.05–3.42) were barriers. Surprisingly, those with less than a high school education did not identify these as barriers. Both individuals with less than a high school education (OR 2.16, 95 %

Table 3 Barriers to receiving a colonoscopy for colorectal cancer by race/ethnicity

	Caucasian		African American		Hispanic		*P* value
	No.	%	No.	%			
Feelings of embarrassment							0.007
Disagree	87	62.6	66	69.5	102	51.3	
Neither agree nor disagree	24	17.3	18	19.0	38	19.1	
Agree	28	20.1	11	11.6	59	29.7	
Fear of finding cancer							0.162
Disagree	51	36.2	29	30.2	58	29.3	
Neither agree nor disagree	27	19.2	14	14.6	25	12.6	
Agree	63	44.7	53	55.2	115	58.1	
Transportation							0.004
Disagree	115	82.7	62	65.3	154	77.8	
Neither agree nor disagree	9	6.5	10	10.5	24	12.1	
Agree	15	10.8	23	24.2	20	10.1	
Cost							0.668
Disagree	7	4.9	8	8.4	18	9.1	
Neither agree nor disagree	4	2.8	3	3.2	6	3.0	
Agree	132	92.3	84	88.4	175	87.9	
Anxiety about procedure							0.882
Disagree	62	43.7	39	41.1	77	38.5	
Neither agree nor disagree	24	16.9	18	19.0	35	17.5	
Agree	56	39.4	38	40.0	88	44.0	
Lack of knowledge about colonoscopies							0.013
Disagree	76	54.7	37	39.8	85	42.5	
Neither agree nor disagree	23	16.6	13	14.0	22	11.0	
Agree	40	28.8	43	46.2	93	46.5	
Child care							0.033
Disagree	119	85.6	74	80.4	180	90.5	
Neither agree nor disagree	15	10.8	8	8.7	10	5.0	
Agree	5	3.6	10	10.9	9	4.5	
Religion							0.010
Disagree	127	91.4	77	82.8	185	93.0	
Neither agree nor disagree	11	7.9	8	8.6	10	5.0	
Agree	1	0.7	8	8.6	4	2.0	
Drinking the laxative							0.084
Disagree	100	70.9	57	61.3	152	76.4	
Neither agree nor disagree	16	11.4	18	19.4	22	11.1	
Agree	25	17.7	18	19.4	25	12.6	
Anticipation of pain							0.275
Disagree	84	60.4	46	49.5	106	53.3	
Neither agree nor disagree	17	12.2	21	22.6	37	18.6	
Agree	38	27.3	26	28.0	56	28.1	

CI 1.04–4.50) and those with a high school education (OR 3.51, 95 % CI 1.94–6.36) had increased odds of agreeing that lack of knowledge was a barrier.

With regards to age, individuals between ages 50 and 64 (OR 2.2, 95 % CI 1.06–4.59), and those above age 65 (OR 3.92, 95 % CI 1.07–14.44), had increased odds of agreeing that transportation was a barrier compared to those below age 50.

Compared to those who had a prior colonoscopy, those who had no previous colonoscopy had increased odds of agreeing that embarrassment (OR 2.36, 95 % CI 1.29–4.30), transportation (OR 2.22,95 % CI 1.06–4.68),

Table 4 Multivariate analyses of self-reported barriers

Independent variables	Embarrassment		Fear of finding cancer		Transportation		Anxiety	
	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value
Race/ethnicity								
White	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
Black	0.62 (0.34–1.14)	0.124	1.30 (0.76–2.24)	0.340	2.68 (1.35–5.32)	0.005	0.95 (0.55–1.62)	0.839
Hispanic	1.57 (0.91–2.73)	0.103	2.09 (1.19–3.66)	0.010	1.69 (0.83–3.34)	0.145	1.03 (0.61–1.74)	0.910
Marital status								
Married	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
Single	1.28 (0.84–1.94)	0.256	0.97 (0.64–1.47)	0.892	1.42 (0.85–2.38)	0.180	0.97 (0.66–1.45)	0.897
Gender								
Female	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
Male	1.32 (0.82–2.11)	0.258	1.29 (0.80–2.09)	0.298	1.08(0.60–1.93)	0.805	0.72 (0.46–1.14)	0.163
Education								
Greater than high school education	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
High school	1.24 (0.68–2.26)	0.479	2.29 (1.33–3.95)	0.003	1.254(0.62–2.52)	0.526	1.86 (1.08–3.21)	0.026
Less than high school education	1.29 (0.62–2.66)	0.496	0.95 (0.47–1.93)	0.896	0.78(0.32–1.92)	0.587	1.22 (0.61–2.44)	0.568
Age								
<50 years	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
50–64	1.14 (0.68 1.92)	0.617	0.76 (0.46–1.26)	0.286	2.2(1.06–4.59)	0.035	1.11 (0.68–1.81)	0.664
≥65 years	1.94 (0.69–5.46)	0.212	0.60 (0.20–1.82)	0.370	3.92(1.07–14.44)	0.040	1.73 (0.58–5.15)	0.322
Previous colon cancer screening								
Yes	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
No	2.36 (1.29–4.30)	0.005	1.22 (0.73–2.07)	0.442	2.22(1.06–4.68)	0.035	2.44 (1.44–4.13)	0.001
Not sure	2.58 (0.93–7.16)	0.076	0.87 (0.33–2.27)	0.768	1.29(0.34–4.79)	0.708	1.59 (0.61–4.13)	0.346

	Lack of knowledge		Drinking the laxative		Pain	
	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value
Race/ethnicity						
White	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
Black	1.53(0.88–2.68)	0.135	1.31(0.72–2.39)	0.381	1.28(0.74–2.24)	0.376
Hispanic	1.59(0.92–2.75)	0.096	1.14(0.61–2.12)	0.686	1.38(0.80–2.39)	0.242
Marital status						
Married	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
Single	1.12(0.74–1.69)	0.597	1.45(0.89–2.34)	0.134	1.21(0.80–1.83)	0.358
Gender						
Female	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–

Table 4 continued

	Lack of knowledge		Drinking the laxative		Pain	
	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value	Adjusted OR (95 % CI)	*p* value
Male	1.53(0.95–2.47)	0.080	0.65(0.37–1.14)	0.131	0.88(0.55–1.42)	0.607
Education						
Greater than high school education	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
High school	3.51(1.94–6.36)	0.000	1.43(0.77–2.68)	0.259	1.90(1.05–3.42)	0.033
Less than high school education	2.16(1.04–4.50)	0.039	0.58(0.25–1.37)	0.215	1.09(0.52–2.28)	0.817
Age						
<50 years	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
50–64 years	1.512(0.92–2.51)	0.101	1.44(0.79–2.62)	0.231	0.86(0.53–1.41)	0.550
>65 years	2.92(0.88–9.72)	0.081	0.62(0.12–3.20)	0.566	0.79(0.25–2.44)	0.678
Previous colon cancer screening						
Yes	1.0 (ref)	–	1.0 (ref)	–	1.0 (ref)	–
No	2.11(1.23–3.61)	0.006	0.57(0.32–0.99)	0.045	1.53(0.89–2.64)	0.124
Not sure	1.54(0.59–4.03)	0.375	0.30(0.09–1.01)	0.051	0.99(0.36–2.73)	0.989

anxiety (OR 2.44, 95 % CI 1.44–4.13), lack of knowledge (OR 2.11,95 % CI 1.23–3.61) were barriers. However, they had decreased odds of agreeing that drinking the laxative was a barrier (OR 0.57, 95 % CI 0.32–0.99).

Discussion

We examined CRC-related knowledge and awareness among uninsured residents of the seven-county Brazos Valley region of Texas who received financial assistance for colonoscopies through the Texas C-STEP program. We examined variations in self-reported barriers across race/ethnicity, gender, marital status, educational attainment, previous receipt of colonoscopy, and age.

According to the CDC, a 60 % reduction in CRC deaths will occur if everyone ≥50 years of age receives a screening for CRC [1]. This statistic emphasizes the importance of increasing access to CRC screening procedures. Since lack of health insurance has been consistently reported to adversely influence CRC screening [17, 22, 23, 45, 47, 48], the uninsured could be at an increased risk for CRC. However, studies have also shown that even when there is equal access to CRC screening tests such as endoscopy, compliance is sub-optimal [49, 50]. The increased implementation of programs aimed at providing free CRC screening using colonoscopy to the underserved [49, 50] indicates a need to examine barriers to CRC screening using endoscopy, as well as, develop ways to circumvent these barriers in order to ensure favorable outcomes of such programs. Identifying barriers was particularly important for our target population, because the Brazos Valley region of Texas has less than desirable CRC screening rates, with more than three-quarters of age-eligible residents reporting never being screened for CRC [51, 52]. Furthermore, four of the counties (Burleson, Grimes, Robertson and Washington) have CRC incidence rates that are higher than the state's average (42.5 per 100,000) and four counties (Burleson, Grimes, Leon and Washington) have mortality rates higher than state average of 16.1 per 100,000 [53].

Awareness

In this study, we found that most respondents were aware that early detection can prevent colon cancer and that screening should be commenced by age 50, although 62 % of the participants incorrectly thought that males have a higher risk for CRC than females. In spite of this high level of awareness, only about 20 % of participants had received a prior screening for CRC using any of the recommended tests. Sub-optimal screening guidelines adherence among individuals with high level of CRC knowledge has also

been reported in previous studies [24, 40]. This finding among our participants (high awareness with low adherence) could be compounded by their uninsured status, making CRC screening especially using colonoscopy a seemingly insurmountable barrier.

Barriers Reported

Indeed cost of colonoscopy was reported as the most commonly identified barrier to deciding to undergo the procedure. This is in agreement with previous studies that have demonstrated that financial constraints such as lack of insurance, out-of-pocket payment, and high deductibles or co-pay are barriers to CRC screening using colonoscopy [34, 39–43, 54, 55]. Community-based screening programs such as the Texas C-STEP project are, therefore, an invaluable asset for improving accessibility to colonoscopy by reducing the cost barrier. However, eliminating cost does not always result in CRC screening compliance [26, 28, 35]. This reinforces the need to identify other factors that act as deterrents to CRC screening.

Influence of Race/Ethnicity on Reported Barriers

In this study, we found that self-reported barriers exhibited socio-demographic variations. In multivariate analyses, African Americans were more likely to identify lack of transportation as a barrier to screening while Hispanics were more likely to identify fear of finding cancer as a barrier. Walsh et al. [56] also reported that Latinos were more likely than Whites to identify fear of a cancer diagnosis as a barrier to receiving CRC screening and a study comprised of only Hispanics also found that fear of finding cancer was significantly associated with not adhering to physician's recommendation to obtain a colonoscopy [57]. Therefore, educational interventions aimed at increasing CRC screening among uninsured Hispanics should consider emphasizing the benefits of early detection of polyps or early stage cancer. Also, stakeholders working with African American populations to improve CRC screening uptake might need to provide access to free transportation to achieve this goal. The Texas C-STEP program has been able to provide transportation assistance when needed through community partnerships, potentially reducing the effect of this barrier on CRC screening adherence.

Role of Gender

There are inconsistent reports on the effect of gender on colonoscopy utilization rates [45]. Some studies have reported higher rates among males [17], while others report higher rates among females [45]. However, Vaidya et al. 2012 [58], reported no gender difference. Although the United States Census Bureau estimates that about 49 % of Brazos Valley region residents are females [59], 80 % of our participants were female. The high proportion of females taking advantage of Texas C-STEP assistance might indicate that female gender is a facilitator for colonoscopy utilization in this region. This high female to male proportion might also have been influenced by the fact that most of our CHWs are females, or it may also reflect patterns of annual or biannual cervical cancer screenings, when CRC screening is likely to be offered. However, gender had no significant effect on reported barriers among our respondents, despite the fact that self-reported barriers to CRC screening have been found to exhibit gender variations [28, 32, 40, 60].

Role of Education

Consistent with other studies [26, 27, 45, 50], we observed that individuals with some high school education or a high school degree had higher odds of identifying fear of finding cancer, pain, and lack of knowledge as barriers to CRC screening compared to those with higher education. More than 70 % of the U.S population does not have a bachelor's degree or higher [59]. This statistic holds true for our target counties, although our study includes only uninsured individuals [59]. It is important therefore, that educational strategies incorporate materials designed to reduce the impact of fear of finding cancer following screening, or procedure-associated pain, on suboptimal screening rates among those with lower educational status.

Influence of Age

CRC barriers previously reported among older individuals include lack of awareness of screening guidelines, discomfort, and fear of complications [45]. In the present study, lack of transportation was a significant barrier to CRC screening using colonoscopy for respondents over the age of 50. This also indicates that the C-STEP strategy of providing free transportation is relevant for our target population.

Influence of Prior Colonoscopy

We also found that patients who never had a colonoscopy had higher odds of reporting feelings of embarrassment, lack of transportation, anxiety, and lack of knowledge as barriers compared to those who had a previous colonoscopy. In agreement, studies have reported that individuals who never had a colonoscopy were more likely to regard the procedure as embarrassing [26, 30]. Fear of the procedure, fear of sedation, and fear of finding cancer have also been reported to be more significant among non-screened individuals compared to screened individuals

[30]. Similar to the study of Basch et al., [30] we also observed that drinking a laxative was identified as a barrier more among those who had a previous colonoscopy. Although this is a challenging barrier to overcome, it points to the need for continued scientific investigation into ways to reduce the inconvenience of bowel preparation prior to colonoscopy.

The heterogeneous demographic characteristics of Texas C-STEPs' uninsured colonoscopy recipients enabled us identify variations that exist in self-reported barriers to CRC screening, particularly colonoscopy. Our results suggest that race/ethnicity, age, educational attainment and prior colonoscopy, may impact barriers to CRC screening using colonoscopy among uninsured/low-income patients. It is therefore prudent to consider these factors when developing and implementing strategies for preventive education and outreach. More population-specific strategies are recommended to improve target audience response to CRC screening guidelines adherence.

There are some limitations to our study. Our analyses were based on self-reported data and therefore limited in the ability to validate responses as accurate. Secondly, our classification of educational attainment might have resulted in varied interpretation by respondents. In addition, study results may not be generalizable to other populations as our participants were predominantly uninsured individuals and were recruited from within a seven county region of Texas. Finally, a comparison of identified barriers between the insured and uninsured would have been desirable. However, such a study is beyond the scope of this project. In spite of these limitations, this paper identifies barriers experienced in CRC screening using colonoscopy by poor and underserved populations. An increased awareness of how self-reported barriers are influenced by demographic and other factors can help guide more targeted strategies to increase CRC screening rates among such disadvantaged populations.

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