Am J Cancer Res 2024;14(8):3873-3884
www.ajcr.us /ISSN:2156-6976/ajcr0156410

Original Article

#CRCandMe: results of a pre-post quasi-experimental study of a mass media campaign to increase early-onset colorectal cancer awareness in Utah and Wisconsin

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Received March 7, 2024; Accepted July 5, 2024; Epub August 25, 2024; Published August 30, 2024

Abstract: Overall colorectal cancer (CRC) incidence and mortality have been decreasing for several decades; however, since the early 1990s CRC incidence rates have nearly doubled among adults aged under 50 years. This study pilot-tested a community-based mass-media campaign aimed at improving knowledge and awareness of early-onset CRC in this population. The campaign (#CRCandMe) was deployed from June to September 2023 in Utah and Wisconsin. To evaluate its success (reach) and inform future campaigns, key performance indicators were defined (e.g., impressions, website traffic). To evaluate change in knowledge in the target population, the knowledge and awareness of participants recruited via consumer panels was assessed at baseline (n=235) and follow-up (n=161). The number of correct answers for each of seven knowledge items was calculated at baseline (pre-intervention) and follow-up (post-intervention). McNemar's test was employed to assess significant differences in the seven knowledge items between the two timepoints. The campaign delivered over 26.7 million impressions and nearly 43,000 clicks. A 15-second video ad received 221,985 plays, with 57,270 users watching to completion. Pre-survey results revealed that while 74% of participants were able to correctly identify CRC signs, only 18% could identify risk factors. Knowledge scores slightly improved from baseline to follow-up, with statistically significance for the question related to CRC signs (P=0.0004). This study demonstrated wide reach and may inform future larger-scale interventions and public health initiatives aimed at reducing CRC incidence and improving health outcomes for at-risk adults aged under 50 years.

Keywords: Cancer survivors, colorectal neoplasms, risk factors, young adult, young-onset

Introduction

Over the past three decades, as colorectal cancer (CRC) incidence and mortality among adults aged 50 years and older have declined, incidence among adults aged under 50 years has significantly increased, with early-onset CRC (EOCRC) projected to be a leading cause of cancer death by 2030 [1, 2]. A significant birth-cohort effect on CRC incidence, initially observed in the mid-1990s [3], has recently emerged as a public health emergency [4]. In 2018 and 2021 respectively, the American Cancer Society and the US Preventive Services Task Force (USPSTF) lowered the recommended age for initiation of CRC screening from 50 to 45 years for individuals at average risk [5, 6]; however, the largest increases in CRC incidence and mortality are occurring among individuals aged under 40 years, highlighting the importance of increased awareness and early detection among individuals at risk for EOCRC, who are frequently diagnosed at more-advanced disease stages [6-8].

While the underlying causes and mechanisms of EOCRC remain poorly understood, it is believed that the rising incidence can be attrib-

https://doi.org/10.62347/PGYM7724

uted to both modifiable (e.g., sedentary lifestyle, cigarette smoking) and nonmodifiable factors (e.g., family history, Lynch syndrome) [9-16]. Moreover, researchers have identified EOCRC "hotspots" (i.e., areas with high EOCRC or CRC mortality) [17, 18]. It is critical to raise awareness of an emerging epidemic as well as these probable risk factors, particularly in hotspots [19]. Limited knowledge of CRC symptoms is associated with poor health outcomes [20]. Knowledge can be a catalyst for encouraging health behaviors that decrease CRC risk and promote early-detection screening uptake. Unfortunately, even before the recent updates of screening recommendations, knowledge and awareness of CRC screening was low [21, 22]. Efforts to increase EOCRC awareness and knowledge may directly influence early detection, diagnosis, and treatment [23-25].

Community outreach and education models are considered effective strategies for engaging communities and encouraging adherence to recommended care [26, 27]. Integrated multi-media campaigns, in particular, can effectively promote health-related behavior change, including cancer screening, especially when supported by significant investment and widespread dissemination. Despite their success, these campaigns often fail to reach lower-screening communities and ensure accessibility [28-34]. Moreover, Takada et al. highlighted the crucial need for educational initiatives targeting young adults and healthcare providers to address the underemphasis on considering CRC in patients under 50 [35]. Unfortunately, only one study thus far has focused on young adults and EOCRC, relying solely on social media [33]. In response to this gap in knowledge, this study pilot-tested a mass-media awareness campaign with the primary goals of increasing EOCRC awareness and promoting early-detection behaviors among adults aged 18 to 49 years residing in hotspots in Utah and Wisconsin.

Methods

This quasi-experimental pre-post intervention study follows the Strengthening the Reporting of Observational Studies in Epidemiology cohort-study guidelines [36]. Prior to data collection, the Medical College of Wisconsin's Institutional Review Board approved all study procedures, marketing materials, and survey instruments (PRO44848). The study protocol, initially focused solely on Utah [37], was modified to include the state of Wisconsin and registered with ClinicalTrials.gov (No. NCT04715074). The target population for the intervention was residents of EOCRC mortality hotspots in Utah and CRC mortality hotspots in Wisconsin [18]. **Figure 1** presents a flowchart of the study-design process and timeline.

The intervention's reach and impact were measured via a survey distributed at baseline and follow-up. Potential survey participants were contacted via email from May to June 2023 and invited to complete the baseline survey. The mass-media campaign was employed from June 23 through August 31 and on September 14, 2023. Participants who completed the baseline survey were sent the follow-up survey during August and September 2023. In both Wisconsin and Utah, respondents were drawn as equally as possible from three control counties (i.e., counties not categorized as hotspots) and three intervention (hotspot) counties (Figure S1). We aimed for a total of 330 participants completing the baseline and follow-up surveys (165 from each state, split approximately equally between the intervention and control groups).

The design of this pilot study, a National Institutes of Health (NIH) Stage 1B Model for intervention development, has been described elsewhere [37]. A full-service cross-cultural marketing agency (Sensis, Glendale, CA, USA) worked with our team of EOCRC survivor-advocates and researchers to create the education campaign, entitled #CRCandMe. The phrase "*This poop has never been so important*" (Figure S2) was chosen to communicate that EOCRC is a public health emergency and that the target audience plays an essential role in EOCRC detection and prevention. Market-research partners led efforts to identify audiences that participated in behaviors that increased their risk for EOCRC, whom we targeted for the intervention via social media. While privacy policies limited targeting individuals with specific medical diagnoses (e.g., high cholesterol), we used proxies to identify high-risk populations, such as those with past or frequent purchases of statins and fast-food indicative of a high-cholesterol diagnosis or unhealthy dietary behaviors. The marketing

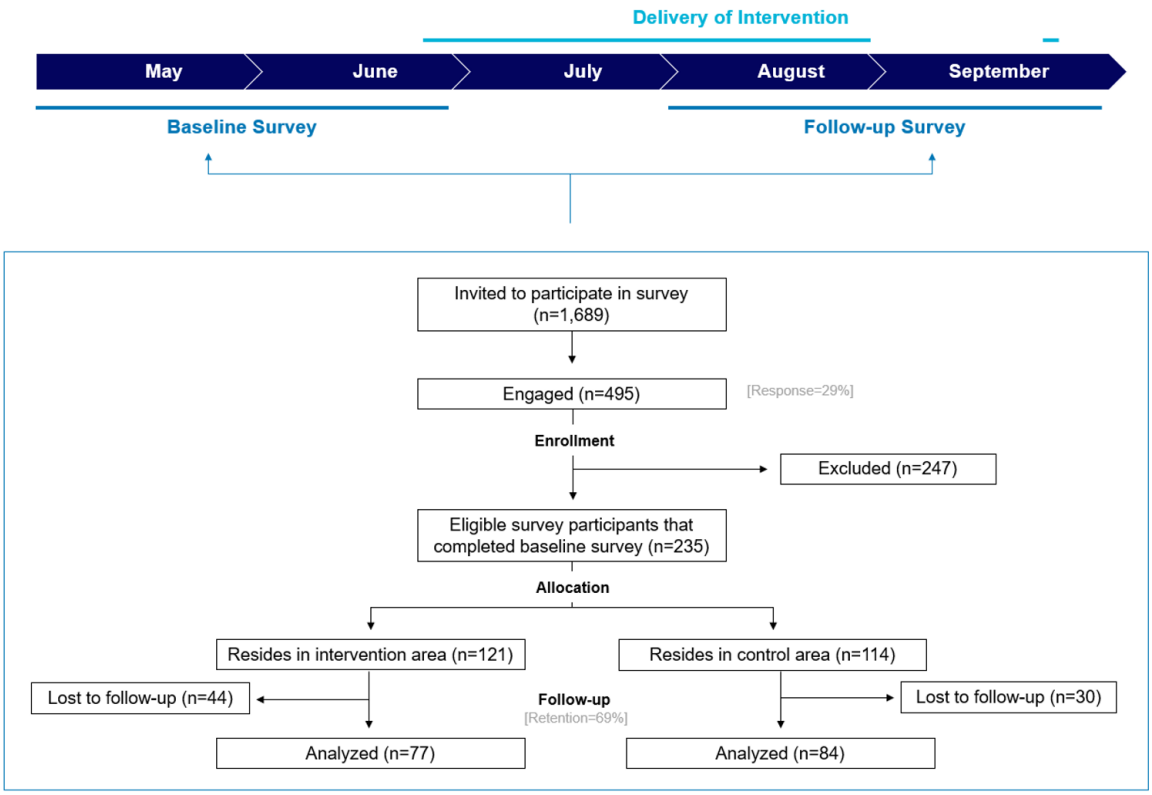

Figure 1. #CRCandMe study flowchart.

content used humor and imagery appealing to young people, evoked the severity of an EOCRC diagnosis, and presented a clear action viewers could take (i.e., visit CRCandMe.com to learn more).

Digital-marketing tactics were paired with a broad-reach out-of-home media plan (e.g., billboards, brochures; Table S1). Marketing materials provided large, high-profile images and content intended to attract interest from both local residents and people traveling through the targeted areas. The full digital media campaign comprised a static, carousel, and video ad for Facebook and Instagram; Google text ads; and banner ads on "brand-safe" websites (i.e., not inappropriate or offensive sites) likely to be visited by our target audience. All ads directed viewers to the campaign's educational website landing page.

To evaluate the campaign's success (reach) and inform future campaigns, we defined give key performance indicators: impressions, clicks, click-through rate (CTR), cost-per-click (CPC), and website traffic metrics (e.g., total visits). Impressions are the number of times an ad is seen. The projected total impressions for this campaign were roughly 23 million. CTR (total impressions divided by total clicks) measures how many people clicked through to the #CRCandMe website following ad exposure; depending on the industry, platform, marketing tactic, and ad type, a "good" CTR may range from about 0.1% to 5% or higher. CPC (total campaign cost divided by number of clicks generated) is a common pricing model for online advertising.

To evaluate short-term impact (i.e., knowledge change in the target population), Qualtrics (Seattle, WA, USA) recruited survey participants through partnerships with panel research companies, a method used previously [38]. Individuals were eligible if during the study period they were aged 18 to 49 years, resided in Wisconsin or Utah, had a smartphone or computer, and spoke and read English. Invitees engaged with the study by clicking a link to the baseline survey. Informed consent was obtained prior to participation via an informational letter provided as the first question on

the baseline survey. Participants who also completed the follow-up survey were included in a random drawing for one of three Apple watches, or one of two Apple iPads.

The primary outcome of interest was change in CRC knowledge from baseline to follow-up (three months), assessed at both timepoints using a prompted seven-item test comprising four true/false and three multiple-choice items (Table S2) relating to content on the #CRCandMe landing page (e.g., screening age, screening tests, CRC risk factors and signs). Each correct answer scored one point; a total knowledge score was calculated by adding the scores for all seven items.

The survey also collected demographic information (state of residence, current age, gender identity, self-identified race/ethnicity, five-digit ZIP code, personal CRC history) and asked participants where they would go first to obtain information about CRC. The race/ethnicity variable was used to reflect membership in a socially imposed marginalized racial/ethnic group; responses for these two concepts were combined for consistency with other literature and were explored separately to verify that doing so did not influence the study's findings (Table S3). Participant-reported five-digit ZIP codes were used to identify residence in a CRC hotspot (intervention area) or non-hotspot and to categorize rural/urban status, using the 2010 Rural Urban Commuting Areas (RUCAs) classifications to ZIP code areas dataset [39]. For this study, ZIP code areas were classified into four groups: metropolitan area, micropolitan area, small town, or rural area [39].

Statistical analysis

Usual data checks were conducted through exploratory analysis, including inspection for missing values and data-entry errors. Descriptive statistics were generated to examine the distribution of baseline characteristics in the analytic sample. Chi-square tests were used to compare the demographic characteristics of those completing the follow-up survey and those lost to follow-up. The baseline percentage of correct answers for each of the seven knowledge items and the cumulative knowledge score were reported. Differences were explored by intervention group and retention using chi-square and t-tests. Analyses were then restricted to individuals who provided both baseline and follow-up survey responses.

McNemar's test was used to test for significant differences in distributions for each knowledge item. Paired t-tests were conducted to compare the means of the total knowledge scores for the two timepoints. Due to some variables (i.e., knowledge items) being non-normally distributed at either baseline or follow-up, we also conducted nonparametric Wilcoxon signed-rank tests to further confirm results. Results were consistent across both parametric and nonparametric analyses; therefore, only t-tests are reported. To further explore our results' robustness, analyses were repeated for only individuals in hotspot areas at baseline. All analyses were performed in SAS version 9.4 (SAS Institute, Inc., Cary, NC, USA); a p-value of <0.05 was considered statistically significant.

Results

Media analytics

The final paid-media performance is shown in **Table 1**. Differences by state are available in Table S4. Overall, the three-month media campaign delivered 26,727,489 impressions and nearly 43,000 clicks, exceeding projections by 17%. Roughly 56% of impressions and 64% of clicks were from Wisconsin. In total, 42,736 people clicked through to the campaign's website, for an overall average CTR of 0.52%.

Social media ads drove most clicks to the website, with a CTR of 0.88% and 20,839 overall clicks. These ads' CPC of $0.71, around half of the $1.32 industry benchmark for the Facebook and Instagram platforms, showed strong engagement among interacting users. Costs were lowest and impressions highest for the carousel ad. The 15-second video ad saw the highest number of clicks (7,164 vs. 6,948 for the carousel ad and 6,727 for the static ad) and a CTR of 1.71%; the video ad received 221,985 total plays and 57,270 users (25.80%) watched it to completion.

Paid search ads drove consistent traffic, averaging a CTR of 12.33% and a CPC of $0.90. Women were more likely to click on search ads; several of the top-performing search terms that resulted in the display of our market-research partners' ads referred to "signs/symptoms in

Table 1. Key performance indicators (KPI) for #CRCandMe media campaign (06/23/2023-08/31/2023, 09/14/2023)

Tactic & Messaging Approach	Impressions	Clicks	Spend	CTR	CTR Bench-mark	CPC
Digital						
Digital Partner	4,889,014	12,505	$18,000.00	0.26%	0.12%	$1.44
Demand-side Platform	912,598	1,195	$9,586.44	0.13%	0.08%	$8.02
Social Media	2,365,987	20,839	$14,700.00	0.88%	0.80%	$0.71
Paid Search	66,498	8,197	$7,414.14	12.33%	5.0%	$0.90
Out-of-Home						
Outdoor & Transit						
Billboards	5,179,272	-	$16,090.00	-	-	-
Interior Bus Cards	600,000	-	$3,000.00	-	-	-
Print						
Storefront/Countertop	11,124,120	-	$28,475.00	-	-	-
Bathroom Signage	1,590,000	-	$19,875.00	-	-	-
Total	26,727,489	42,736	$117,775.58[a]	0.52%	-	$1.15

Note: Impressions: the number of times people saw the ad. For out-of-home tactics this is a statistic calculated through various sources including traffic data, travel surveys, and census data. CTR: click-through rate (total number of impressions divided by total number of clicks). CPC: cost per click (total campaign cost divided by total number of clicks generated). [a]Total spend includes a $500 Google paid-search credit and $1,135 in ad serving fees.

women" (data not shown). The top 5 keywords in descending order by CTR were: colorectal symptoms (19.80%), symptoms of bowel (8.17%), bowel cancer sign (20.89%), colon cancer screening (7.47%), and colorectal cancer (13.22%). "Early symptoms/signs", "CRC", and "colonoscopy"-related keywords also ranked highly. Additionally, as part of the out-of-home placement, over 5,000 print brochures were picked up across various distribution sites.

Survey results

Among 1,689 potential participants invited to complete the survey, roughly 29% (n=495) clicked on the survey link. Respondents who were ineligible or failed Qualtrics's quality checks (n=247) were excluded. In total, 235 individuals completed the baseline survey and 161 completed both baseline and follow-up surveys, a 69% retention rate. **Table 2** presents baseline characteristics of the total sample and of retained participants versus those lost to follow-up (LTFU). Most participants resided in Wisconsin, identified as female, self-identified as Non-Hispanic (NH) White, resided in a metropolitan area and in a CRC hotspot, and had never been diagnosed with CRC. At baseline, healthcare professionals and digital sources were the two most common responses to where participants would go first for information about CRC. Demographic characteristics of retained versus LTFU participants were not significantly different except that LTFU participants were less likely to self-identify as NH White. Differences in state of residence, self-identified race/ethnicity, and urban-rural classifications were observed between participants residing in intervention areas compared with control areas (Table S5).

Differences were explored by intervention group and retention (**Table 3**). At baseline, most participants correctly identified CRC signs; however, fewer than one in five correctly identified risk factors. Fewer participants in the intervention group (i.e., those residing in CRC hotspots) than in the control group correctly responded that 35 years is not the recommended screening age for CRC, that CRC can be prevented with a colonoscopy, and that certain lifestyle changes can reduce CRC risk. However, intervention-group participants were more knowledgeable about CRC risk factors than control-group participants. Compared with the control group, intervention-group participants had significantly lower odds of correctly identifying CRC signs. Between-group differences in other knowledge questions by intervention group included the null. The prevalence of correct answers at baseline for retained versus LTFU participants did not differ significantly. However, retained participants were more

Table 2. Baseline demographic characteristics of survey participants (n=235)

	Total Sample (n=235)	Retained (n=161 [68.51%])	LTFU (n=74 [31.49%])	*p*
State				0.5416
Utah	9 (3.83%)	7 (4.35%)	2 (2.7%)	
Wisconsin	226 (96.17%)	154 (95.65%)	72 (97.3%)	
Mean Age (STD)	33.55 (±8.29)	34.11 (±8.27)	32.34 (±8.26)	0.1278
Age Group (years)				0.2608
18-29	75 (31.91%)	47 (29.19%)	28 (37.84%)	
30-39	92 (39.15%)	62 (38.51%)	30 (40.54%)	
40-44	45 (19.16%)	36 (22.36%)	9 (12.16%)	
45-49	23 (9.79%)	16 (9.94%)	7 (9.46%)	
Gender Identity				0.2246
Female	168 (71.49%)	111 (68.94%)	57 (77.03%)	
Male	63 (26.81%)	48 (29.81%)	15 (20.27%)	
Gender diverse	4 (1.71%)	2 (1.24%)	2 (2.70%)	
Self-Identified Race and Ethnicity				0.0308*
NH, White	154 (65.53%)	110 (68.32%)	44 (59.46%)	
NH, Black	30 (12.77%)	22 (13.66%)	8 (10.81%)	
NH, Other	14 (5.96%)	6 (3.73%)	8 (10.81%)	
NH, Multiracial	6 (2.55%)	6 (3.73%)	-	
Hispanic	31 (13.19%)	17 (10.56%)	14 (18.92%)	
Rural-Urban Commuting Area				0.6776
Metropolitan	203 (86.38%)	140 (86.96%)	63 (85.14%)	
Micropolitan	16 (6.81%)	9 (5.59%)	7 (9.46%)	
Small Town	9 (3.83%)	7 (4.35%)	2 (2.70%)	
Rural	7 (2.98%)	5 (3.11%)	2 (2.70%)	
Ever Diagnosed with CRC				0.5026
Yes	11 (4.68%)	9 (5.59%)	2 (2.70%)	
No	224 (95.32%)	152 (94.41%)	72 (97.30%)	
Preferred Information Source				0.7072
Print	9 (3.83%)	6 (3.73%)	3 (4.05%)	
Digital	74 (31.49%)	47 (29.19%)	27 (36.49%)	
Healthcare Professionals	115 (48.94%)	81 (50.31%)	34 (45.95%)	
Health Authorities	28 (11.91%)	21 (13.04%)	7 (9.46%)	
Personal Network	7 (2.98%)	4 (2.48%)	3 (4.05%)	
Other/Don't know	2 (0.85%)	2 (1.24%)	-	
Intervention Assignment				0.2508
Intervention	121 (51.49%)	77 (47.83%)	44 (59.46%)	
Control	114 (48.50%)	84 (52.18%)	30 (40.54%)	

Abbreviations: LTFU = Lost to Follow-Up; STD = Standard Deviation; NH = Non-Hispanic; CRC = Colorectal Cancer. Note: Data based on baseline responses. Print includes newspaper, brochures, pamphlets, etc.; Health authorities includes government health agencies and cancer organizations. NH Other Race and Ethnicity includes, Asian, American Indian/Alaskan Native, and "other". Astericks (*) indicates statistically significant at <0.05.

likely to correctly answer questions about the recommended screening age for CRC, CRC risk factors, and lifestyle changes to reduce CRC risk, while LTFU participants were more likely to correctly respond to mortality-related statements.

Among intervention-group participants with follow-up responses, we observed subtle increases in CRC knowledge from baseline to follow-up; however, these changes were only statistically significant for identifying CRC signs (**Table 4**). Mean baseline and follow-up knowledge

Table 3. Proportion of survey participants demonstrating knowledge of colorectal cancer (CRC) at baseline (n=235)

Item	% Correct	Intervention Group				Follow-up Survey Status			
		Control (n=114)	Intervention (n=121)	OR (95% CI)	*p*	LTFU (n=74)	Retained (n=161)	OR (95% CI)	*p*
1. The recommended screening age for CRC is 35 years.	99 (42.13%)	53 (46.49%)	46 (38.02%)	0.71 (0.42, 1.19)	0.1885	28 (37.84%)	71 (44.10%)	1.30 (0.74, 2.28)	0.3666
2. CRC is the #4 biggest cancer killer.	38 (16.17%)	19 (16.67%)	19 (15.70%)	0.93 (0.47, 1.87)	0.8410	17 (22.97%)	21 (13.04%)	0.50 (0.25, 1.02)	0.0548
3. CRC is predicted to be the top cancer killer for people under age 50 by 2030.	176 (75.21%)	86 (75.44%)	90 (75.00%)	0.98 (0.54, 1.77)	0.9381	59 (79.73%)	117 (73.13%)	0.69 (0.36, 1.35)	0.2766
4. CRC can be prevented with a colonoscopy.	159 (67.66%)	79 (69.30%)	80 (66.12%)	0.87 (0.50, 1.50)	0.6022	54 (72.97%)	105 (65.22%)	0.69 (0.38, 1.27)	0.2378
5. Your risk for CRC is increased by all the following EXCEPT…	43 (18.30%)	18 (15.79%)	25 (20.66%)	1.39 (0.71, 2.71)	0.3344	11 (14.86%)	32 (19.88%)	1.42 (0.67, 3.00)	0.3561
6. A sign of CRC is…	174 (74.04%)	92 (80.70%)	82 (67.77%)	0.50 (0.28, 0.92)	0.0238*	58 (78.38%)	116 (72.05%)	0.71 (0.37, 1.37)	0.3040
7. Lifestyle changes to reduce your risk of CRC include all EXCEPT…	92 (39.15%)	49 (42.98%)	43 (35.54%)	0.73 (0.43, 1.24)	0.2425	26 (35.14%)	66 (40.99%)	1.28 (0.72, 2.27)	0.3927
Cumulative Knowledge Score	3.32 (±1.24)	3.24 (±1.24)	3.18 (±1.23)	-	0.9726	3.42 (±1.17)	3.28 (±1.27)	-	0.4304

Note: *p*-value based on chi-square test, cumulative knowledge score *p*-value based on t-test. Astericks (*) indicates statistically significant at <0.05. Abbreviations: OR = (crude) Odds Ratio; CI = Confidence Interval; CRC = colorectal cancer; LTFU = Lost to follow-up.

Table 4. Change in colorectal cancer (CRC) knowledge from baseline to follow-up, among retained participants, by intervention group (n=161)

Item	Knowledge Statement	Intervention Group (n=77)			Control Group (n=84)		
		Baseline	Follow-up	*p*-value[a]	Baseline	Follow-up	*p*-value[a]
1	The recommended screening age for CRC is 35 years.	31 (40.26%)	25 (32.47%)	0.1336	40 (47.62%)	32 (38.10%)	0.0736
2	CRC is the #4 biggest cancer killer.	8 (10.39%)	10 (12.99%)	0.5271	13 (15.48%)	15 (17.86%)	0.6171
3	CRC is predicted to be the top cancer killer for people under age 50 by 2030.	55 (72.37%)	56 (72.73%)	1.0000	62 (73.81%)	64 (76.19%)	0.6831
4	CRC can be prevented with a colonoscopy.	46 (59.74%)	43 (55.84%)	0.5637	59 (70.24%)	62 (73.81%)	0.4054
5	Your risk for CRC is increased by all the following EXCEPT…	17 (22.08%)	13 (16.88%)	0.3458	15 (17.86%)	15 (17.86%)	1.0000
6	A sign of CRC is…	49 (63.64%)	57 (77.03%)	0.0075*	67 (79.76%)	64 (76.19%)	0.0196*
7	Lifestyle changes to reduce your risk of CRC include all EXCEPT…	31 (40.26%)	36 (46.75%)	0.2752	35 (41.67%)	41 (48.81%)	0.2888
Mean Cumulative Knowledge Score (±STD)[b]		3.08 (±1.30)	3.12 (±1.29)	0.7920	3.46 (±1.23)	3.49 (±1.21)	0.8792

[a]*p*-value based on McNemar test. [b]*p*-value based on Paired t-test. *Statistically significant <0.05. Abbreviations: CRC = colorectal cancer; STD = standard deviation.

scores for the intervention group were not significantly different. Results for the control group were similar.

Discussion

This groundbreaking study represents one of the first community-based mass-media campaigns in the U.S. aimed at raising awareness about EOCRC and promoting early detection behaviors among adults aged 18-49 years. Targeting "hotspots" - regions in two distinctive areas of the U.S. with high EOCRC or CRC mortality rates - our study sought to make a significant impact on public health through informed and proactive engagement.

Results exceeded media performance goals and highlighted notable gaps in CRC knowledge. All marketing strategies during our three-month media campaign exceeded their CTR performance goals as set by the industry standard for each tactic. Most notably, the CTR of 12.33% for paid search ads surpassed the industry benchmark (5%) by 7.33 percentage points. The high CTR for the paid-search strategy may reflect the characteristics of our intervention sample, with nearly 30% of respondents reporting that the internet was their primary source of information about CRC. This suggests a strong digital engagement within our target population, indicating that online platforms are an effective medium for disseminating health information.

The proportion of survey respondents who correctly identified CRC signs increased overall from baseline to follow-up, with a higher increase observed among respondents residing in intervention areas. Of note, control-group participants had greater knowledge of CRC signs than intervention-group participants. This finding suggests that pre-existing knowledge levels may vary significantly between different populations, potentially influencing the baseline comparability of intervention and control groups. The absence of statistically significant baseline differences in other knowledge items between participants in intervention and control areas emphasizes that lack of knowledge or awareness alone does not appear to be a primary factor contributing to elevated CRC mortality rates in CRC hotspots; however, it is an important first step.

In contrast, fewer than half of participants knew that the recommended screening age for CRC is not 35 years. Our study is among the first since the 2021 update of the USPSTF guidelines to estimate the extent of knowledge of this change among a potentially at-risk population segment. Our results suggest that knowledge of this updated recommendation among the public remains low, highlighting a need for increased awareness in both the community and healthcare setting. With CRC rates rising among younger adults, more efficient and effective communication about the revised screening guidelines is essential to increase early detection and improve outcomes. Research underscores the significant influence of celebrities on individuals' knowledge, attitudes, and decision-making in health-related domains [40-42]. The "Katie Couric effect" - a 20% increase in colonoscopy utilization across America following Katie Couric's televised colo-

noscopy in 2000 - exemplifies the potential impact of such campaigns [31]. Researchers should develop collaborations with community partners to devise innovative strategies for targeting hard-to-reach populations in rural or sparsely populated areas and Tribal Lands that may lack high-speed internet coverage (groups with low participation in the current study).

Our study began before publication of the 2023 Fritz et al. study that identified four red-flag signs and symptoms (abdominal pain, rectal bleeding, diarrhea, and iron-deficiency anemia) associated with an elevated risk for EOCRC [43]. These indicators should be incorporated into EOCRC knowledge questions in future survey research as well as into public health efforts to encourage patients to contact their doctors if symptoms persist. Studies of novel methods to disseminate knowledge of these EOCRC symptoms to the Generation Z population (aged 11 to 26 years as of 2023), which derives information primarily from the internet [44], are also warranted. By addressing these identified gaps and leveraging both traditional and digital media channels, we can enhance the effectiveness of mass-media campaigns in raising awareness and promoting early detection behaviors, ultimately reducing EOCRC mortality rates.

Limitations

This study contributes valuable insights into the use of mass media to promote public health; however, certain limitations should be noted when interpreting the results of this study. While our team effectively maximized available resources, financial constraints inherently influenced the scope of data collection, analysis, and potential ancillary activities, which in turn influenced the study's comprehensiveness. Throughout the execution of our survey, we encountered several challenges. Firstly, we utilized a consumer panel comprising individuals with a level of internet access not generally available in rural areas. However, this choice aligns with the digital marketing focus of our campaign. Secondly, the challenge of not reaching the protocol-specified sample size constrained the depth of analysis possible and resulted in a predominant presence of survey respondents from Wisconsin, thereby limiting the generalizability of our findings. It's crucial to note that the primary focus of this study was on testing the feasibility and effectiveness of our intervention; therefore, the emphasis was on gathering preliminary insights and refining methodologies for future, more extensive studies. Although the reason for the low response rate is not readily apparent, it is surprising given the consumer panel company has a co-headquarter in Utah. Thirdly, the survey did not include a specific question about participants' awareness of or exposure to our mass-media campaign, restricting our ability to directly assess the campaign's impact on those surveyed. Furthermore, concerning our media outcomes, population-reach calculations were typically extrapolated using publicly available data, resulting in very rough estimates. However, this method aligns with the industry standard for media campaigns thus making results comparable across studies. Lastly, our study did not ascertain respondent educational attainment. Despite these limitations, the study's strength lies in its ability to efficiently leverage available resources, implementing impactful strategies within the allocated budget.

Conclusion

In our pilot study of a community-based mass-media campaign targeting adults aged 18 to 49 in Utah and Wisconsin, follow-up data indicated a significant improvement in correctly identifying CRC signs. Our findings have implications for future large-scale public health initiatives, with a focus on reducing EOCRC cases and enhancing the well-being of at-risk young adults, which could be explored in future studies.

Acknowledgements

The authors extend gratitude to Eleanor Mayfield, ELS, for editorial support; Brooks Bell, Dr. Margaret Handley, Candace Henley, Walter Hickman, Wenora Johnson, Cordero McCall, and Dr. Tiana Rogers for study insight; Medical College of Wisconsin Cancer Center's Biostatistics Shared Resource for the development of Figure S1_B; and DAPD for website development support. This research was supported by the Medical College of Wisconsin; the V Foundation for Cancer Research; the Colorectal Cancer Equity Foundation; and by the National Cancer Institute (NCI) - an entity of the National Institutes of Health (NIH) - under

Grant K01CA234319. The views expressed in this content are solely the responsibility of the authors and do not necessarily represent the official of the NIH or other mentioned funder.

Disclosure of conflict of interest

Dr. Charles R Rogers offers scientific input to research studies through an investigator services agreement with Exact Sciences.

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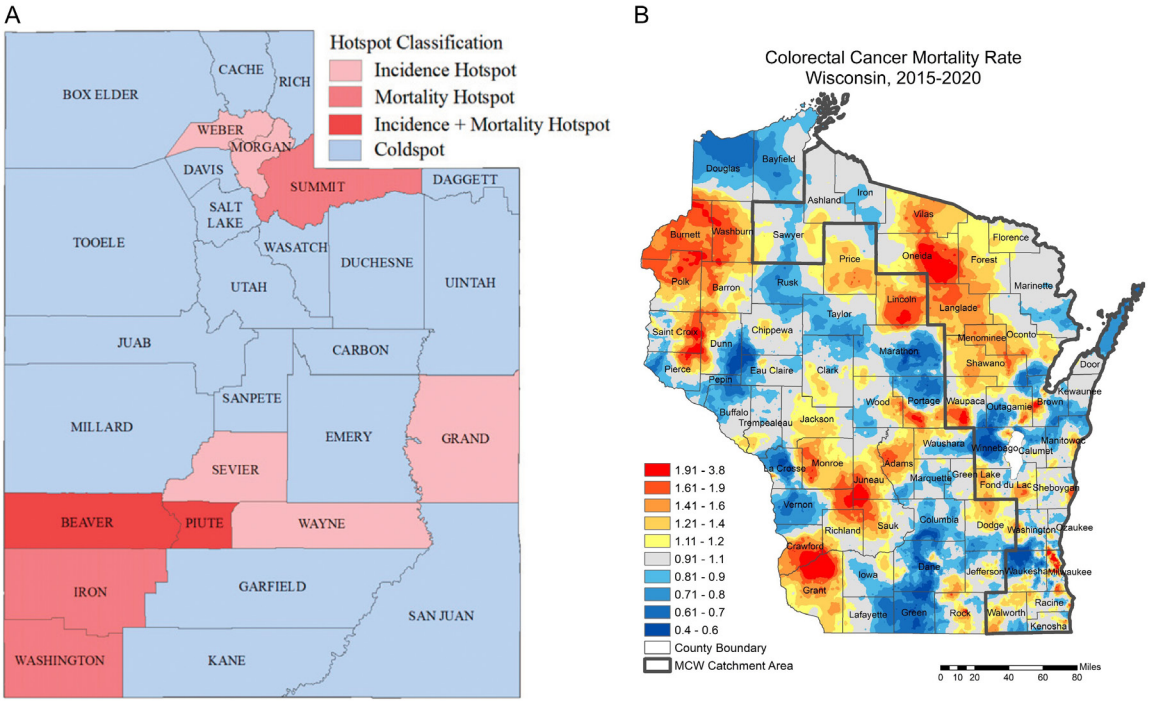

Figure S1. Study populations in (A) Utah, and (B) Wisconsin, based on application of hotspot analysis. (A) EOCRC hotspots for incidence, mortality, or both among adults 18-49 years of age in Utah. (B) CRC mortality among adults 50 years of age or older in Wisconsin.

Figure S2. #CRCandMe advertisement example.

Table S1. Intervention components: messaging approaches for the mass media campaign (06/23/2023-08/31/2023, 09/14/2023)

Tactic	Messaging Approach	Description	Quantity	
			UT	WI
Digital	Digital Partner	Ad partners that offer various digital ad placements (e.g., banners, videos, etc.).	N/A	N/A
	Demand-side Platform	Ad platform that allows ad buying through high-quality traffic automation.	N/A	N/A
	Social	Social media platforms (e.g., Facebook) that promote ads.	N/A	N/A
	Paid Search	Google Search engine that allows ads to be placed in result pages.	N/A	N/A
Out-of-Home: Outdoor & Transit	Billboards	Outdoor ad placements in typically high-traffic locations.	-	4
	Interior Bus Cards	Card ads placed inside city buses.	16	-
Out-of-Home: Print	Storefront/Countertop	In-store ads (e.g., signs and window displays).	110	60
	Bathroom Signage	In-store ads (i.e., poster) directly posted inside store bathrooms.	64	42
	Brochures	Distributable ads to hand to customers.	~3,000	~2,000

Table S2. Seven-item colorectal cancer (CRC) knowledge statements assessed at baseline and follow-up

Item	Knowledge Statement	Response Categories
1	The recommended screening age for CRC is 35 years.	True; **False**.
2	CRC is the #4 biggest cancer killer.	True; **False**.
3	CRC is predicted to be the top cancer killer for people under age 50 by 2030.	**True**; False.
4	CRC can be prevented with a colonoscopy.	**True**; False.
5	Your risk for CRC is increased by all the following EXCEPT…	Smoking; Drinking Alcohol; Lack of Physical Activity; **High Cholesterol**; Diabetes; Obesity.
6	A sign of CRC is…	Blood in your stool; Persistent craps, gas, or pain; Unexplained weight loss; Stool the size of a pen or pencil; No symptoms at all; **All of the above**.
7	Lifestyle changes to reduce your risk of CRC include all EXCEPT…	Eat less red meat; Drink less alcohol; Eat more vegetables and whole grains; **Avoid harmful UV radiation**; Eat less processed foods; Exercise most days of the week.

Note: Bold indicates correct answer.

Table S3. Race and Ethnicity as separate variables for survey participants (n=235)

	n (%)
Two Separate Variables	
Race	
White	160 (68.09%)
Black	31 (13.19%)
American Indian/Alaska Native	9 (3.83%)
Asian	7 (2.98%)
Multiracial	11 (4.68%)
Other Race	17 (7.23%)
Ethnicity	
Hispanic	26 (11.06%)
Latino	5 (2.13%)
Not Applicable	204 (86.81%)
Race and Ethnicity Combined	
NH, White	154 (65.53%)
NH, Black	30 (12.77%)
NH, Other[a]	14 (5.96%)
NH, Multiracial	6 (2.55%)
Hispanic	31 (13.19%)

The combined variable captures the intersectionality of racial and ethnic identities, reflecting a more holistic approach to participants' backgrounds. A hierarchical approach was employed to categorize participants, prioritizing Hispanic identity first. If a participant identified as Hispanic, they were categorized as such regardless of their racial identification; non-Hispanic participants were then classified based on their racial identity. [a]Other race and ethnicity includes: American Indian/Alaska Native, Asian, and "other". Abbreviation: NH, Non-Hispanic.

Table S4. Key performance indicators (KPI) for #CRCandMe by intervention state

State	Tactic & Messaging Approach	Impressions[a]	Clicks	Spend	CTR[b]	CTR Benchmark	CPC[c]
UT		11,088,067	15,302	$52,156.39	0.66%	-	$1.22
	Digital						
	Digital Partner	880,022	2,626	$4,461.84	0.30%	0.12%	$1.70
	Demand-side Platform	492,594	646	$5,051.20	0.13%	0.08%	$7.82
	Social Media	923,756	7,984	$5,495.56	0.86%	0.80%	$0.69
	Paid Search	33,735	4,046	$3,722.79	11.99%	5.0%	$0.92
	Out-of-Home						
	Outdoor & Transit						
	Billboards	-	-	-	-	-	-
	Interior Bus Cards	600,000	-	$3,000.00	-	-	-
	Print						
	Storefront/Countertop	7,197,960	-	$18,425.00	-	-	-
	Bathroom Signage	960,000	-	$12,000.00	-	-	-
WI		15,639,422	27,434	$64,984.19	0.46%	-	$1.13
	Digital						
	Digital Partner	4,008,992	9,879	$13,538.16	0.25%	0.12%	$1.37
	Demand-side Platform	420,004	549	$4,535.24	0.13%	0.08%	$8.26
	Social Media	1,442,231	12,855	$9,204.44	0.89%	0.80%	$0.72
	Paid Search	32,763	4,151	$3,691.35	12.67%	5.0%	$0.89
	Out-of-Home						
	Outdoor & Transit						
	Billboards	5,179,272	-	$16,090.00	-	-	
	Interior Bus Cards	-	-	-	-	-	
	Print						
	Storefront/Countertop	3,926,160	-	$10,050.00	-	-	
	Bathroom Signage	630,000	-	$7,875.00	-	-	

Abbreviations: UT, Utah; WI, Wisconsin; CTR, Click-through Rate; CPC, Cost-Per-Click. [a]Impressions: the number of times people saw the ad. For out-of-home tactics this is a statistic calculated through various sources including traffic data, travel surveys, and census data. [b]CTR: the total number of impressions divided by the total number of clicks. [c]CPC: calculated by dividing the total cost of the campaign by the number of clicks generated.

Table S5. Baseline demographic characteristics of survey participants, by intervention group (n=235)

	Intervention (n=121 [51.49%])	Control (n=114 [48.51%])	*p*-value
State			0.0135*
Utah	1 (0.83%)	8 (7.02%)	
Wisconsin	120 (99.17%)	106 (92.98%)	
Age Group in years			0.5241
18-29	36 (29.75%)	39 (34.21%)	
30-39	48 (39.67%)	44 (38.60%)	
40-44	22 (18.18%)	23 (20.18%)	
45-49	15 (12.40%)	8 (7.02%)	
Gender Identity			0.4506
Female	83 (68.60%)	85 (74.56%)	
Male	35 (28.93%)	28 (24.56%)	
Gender diverse	3 (2.48%)	1 (0.88%)	
Self-Identified Race and Ethnicity			0.0001*
NH, White	64 (52.89%)	90 (78.95%)	
NH, Black	25 (20.66%)	5 (4.39%)	
NH, Other[a]	20 (16.53%)	11 (9.65%)	
NH, Multiracial	7 (5.79%)	7 (6.14%)	
Hispanic	5 (4.13%)	1 (0.88%)	
Rural-Urban Commuting Area			<0.0001*
Metropolitan	118 (97.52%)	85 (74.56%)	
Micropolitan	-	16 (14.04%)	
Small Town	1 (0.83%)	8 (7.02%)	
Rural	2 (1.65%)	5 (4.39%)	
Ever Diagnosed with CRC			0.3795
Yes	5 (4.14%)	6 (5.25%)	
No	116 (95.87%)	108 (94.74%)	
Preferred Information Source			0.7078
Print	4 (3.31%)	5 (4.39%)	
Digital	38 (31.4%)	36 (31.58%)	
Healthcare Professionals	62 (51.24%)	53 (46.49%)	
Health Authorities	13 (10.74%)	15 (13.16%)	
Personal Network	4 (3.31%)	3 (2.63%)	
Don't know/Other	4 (3.31%)	2 (1.75%)	
Follow-up Status			0.0974
Retained	77 (63.64%)	84 (73.68%)	
Lost to follow-up	44 (36.36%)	30 (26.32%)	

[a]Other race and ethnicity includes: American Indian/Alaska Native, Asian, and "other". *p*-value calculated using off chi-square tests. Astericks (*) indicates statistically significant at <0.05.