



HHS Public Access

Author manuscript

Am J Health Behav. Author manuscript; available in PMC 2021 June 30.

Published in final edited form as:

Am J Health Behav. 2020 May 01; 44(3): 353–363. doi:10.5993/AJHB.44.3.8.

#CRCFREE: Using Social Media to Reduce Colorectal Cancer Risk in Rural Adults

Kaitlin Voigts Key, BSN, RN [Doctoral Candidate],
University of Kentucky College of Nursing, Lexington, KY

Adebola Adegboyega, PhD, RN [Assistant Professor],
University of Kentucky College of Nursing, Lexington, KY

Heather Bush, PhD [Kate Spade & Co. Foundation Endowed Professor],
Department of Biostatistics, University of Kentucky College of Public Health

**Mollie E. Aleshire, DNP, MSN, FNP-BC, PPCNP-BC, FNAP [DNP Program Director/
Associate Professor],**
University of North Carolina at Greensboro School of Nursing, Greensboro, NC

Omar A. Contreras, DrPH, MPH [Program Director of Policy and Translational Research],
Office of Community Outreach and Engagement, The University of Arizona Cancer Center

Jennifer Hatcher, PhD, MPH, RN [Professor]
Mel & Enid Zuckerman College of Public Health, Associate Director for Community Outreach & Engagement, The University of Arizona Cancer Center

Abstract

Objectives: In this study, we pilot-tested #CRCFree, a Facebook-based intervention aimed at reducing colorectal cancer (CRC) risk in rural Appalachian adults at risk for CRC.

Methods: Participants were 56 rural Appalachian adults aged 50 years. Daily #CRCFree Facebook posts addressed diet, physical activity, and CRC screening. Participants' sociodemographics, diet, body mass index, physical activity, and CRC screening status were measured pre- and post- intervention. The Healthy Eating Index (HEI) and the Dietary Inflammatory Index (DII) assessed dietary patterns. Facebook engagement was measured throughout the intervention. A post-intervention focus group evaluated intervention acceptability.

Results: Participants were Caucasian, aged 58 ± 6 years, and predominantly female (66%). Post-intervention, HEI scores increased (49.9 ± 9.9 vs 58.6 ± 12.1 , $p < .001$), and DII scores decreased from baseline (2.8 ± 1.1 vs 1.6 ± 1.7 , $p = .002$). There was no change in physical activity, BMI, or CRC screening status. Focus group participants found the intervention to be educational and motivating.

Correspondence Ms Key; kaitlin.key@uky.edu.

Conflict of Interest Disclosure Statement

All authors of this article declare they have no conflicts of interest.

Conclusions: These reprovide preliminary evidence to support using Facebook to address CRC risk in this population. Participants were responsive to this intervention, and Facebook is a novel and accessible modality for health promotion.

Keywords

colorectal cancer; behavioral risk factors; Facebook; Appalachia; rural health

Appalachia is the term given to the area surrounding the Appalachian Mountain chain in the eastern United States (US).¹ The region is comprised of 420 counties in 13 states, and has a population of over 25 million people, with nearly 1.2 million people residing specifically in Appalachian Kentucky.¹ More than 40% of Appalachian residents live in rural areas, and these rural residents experience stunning cancer disparities as compared to their non-rural counterparts. These disparities are further exacerbated by the level of poverty and lack of health insurance experienced by those in Appalachia. In addition, Appalachian Kentucky has a higher percentage of uninsured adults (18.6%) in comparison to the non-Appalachian region of Kentucky (16.9%), and has a median household income of \$33,840 per household, which is 40% less than the national median.²

Colorectal cancer (CRC) is the fourth leading cause of cancer-related death in the US.^{3,4} Colorectal cancer incidence is high in the Appalachian region of the US,⁵ and higher in Kentucky than in any other state. Furthermore, only 5 US states have higher rates of CRC mortality than Kentucky.³ The highest rates of CRC are found in the rural Appalachian portion of Kentucky, geographically located in the eastern part of the state, where the morbidity is 57.9 per 100,000 compared to 50.6 per 100,000 in the non-Appalachian part of the state.⁶ From 2012 to 2016, CRC-related death rates were 14.2 per 100,000 in the US,³ 15.4 per 100,000 in Kentucky's non-Appalachian counties, and 19.8 per 100,000 in Appalachian Kentucky.⁶

The most effective way to reduce CRC mortality is secondary prevention via screening.⁴ For individuals with average CRC risk, regular screening with stool-based tests or direct visualization tests should begin at age 45 to 50 years and continue until age 75.^{7,8} Despite CRC screening's efficacy in decreasing CRC deaths,⁴ it remains an underutilized preventive health measure, particularly in Appalachian Kentucky.⁹ In the Appalachian Kentucky Area Development Districts, more than 36% of adults have not had a colonoscopy or sigmoidoscopy^{3,9} and in numerous Appalachian Kentucky counties, only 40%-61% of adults are estimated to have had any type of CRC screening in their lifetime.¹⁰ The suboptimal rates of CRC screening in Appalachian Kentucky¹¹ in addition to the other social determinants of health experienced by this vulnerable population, place this region's residents at increased risk for CRC.^{5,7}

In addition to the CRC morbidity and mortality associated with lack of CRC screening, modifiable behavioral factors such as body mass index (BMI), physical activity, smoking, and dietary intake also affect CRC risk.⁴ The American Cancer Society states that the associations between diet, weight, exercise, and CRC risk are the strongest for any type of cancer,⁴ with increased CRC risk for individuals who are obese, physically inactive, and consume a diet low in fruits, vegetables, and fiber, and a diet high in red meats and

processed meats. Conversely, moderate levels of physical activity, never smoking, and consuming fruits, vegetables, fiber, and dairy have been shown to decrease relative CRC risk. When multiple CRC risk factors are present, the relative CRC risk increases.⁴

Many Appalachian Kentucky adults have multiple CRC risk factors that place them at a higher risk for CRC than the general population. Obesity, physical inactivity, smoking, and poor diet are all CRC risk factors that are more prevalent in Appalachian Kentucky than in non-Appalachian Kentucky and the US as a whole.^{12,13} For example, the prevalence of adult obesity in Appalachian Kentucky is the highest in the region at 35.2%, and is 4% higher than in non-Appalachian Kentucky.¹² Additionally, physical inactivity is reported by 32.8% of adults in Appalachian Kentucky.¹²

CRC Risk Reduction Strategies in Appalachia Kentucky

The disparate CRC morbidity and mortality experienced by Appalachian Kentuckians points to a critical need for multilevel, culturally appropriate interventions that address the factors placing this population at increased risk for CRC. Interventions that promote evidence-based cancer screenings have reduced cancer risk among populations similar to Appalachian Kentuckians by employing strategies such as telephone-based interventions, motivational text messaging, lay health workers, and mailed information.^{14–16} However, most interventions have focused on behavioral lifestyle changes or increased uptake of cancer screenings, and interventions that combine both behavioral risk factors and screening uptake are uncommon.

Social media platforms offer an innovative opportunity to leverage commonly used technology to intervene with rural populations with this combined focus. Social media platforms allow individuals to construct a profile and identify and interact with other users.¹⁷ Sixty-nine percent of the general public use social media, and from 2011 to 2016, the percentage of adults aged 50 to 64 using social media nearly doubled from 36% to 64%.¹⁸ Facebook is the social media platform most commonly accessed by adults aged 50 to 64, with 61% of adults in this age group using Facebook.¹⁸ Furthermore, it is also the most accessed social media website among rural US adults.¹⁸ Given the exponential increases in social media users to-date, it is opportune to explore how social media can be used as a platform to conduct cancer risk reduction interventions.

The popularity of Facebook has made it a viable option for the integration of social media platforms as cancer-risk reduction interventions. Among young adult cancer survivors, Facebook interventions showed to provide supportive mechanisms through invitation-only group interactions, improved quality of life, as well as increases in physical activity post-recovery.¹⁹ When interventions were compounded with Facebook messaging as well as digital modalities, such as Fitbits, exercise adherence in cancer survivors was greater than with messaging alone.¹⁹ Other studies also have used Facebook as a social support network among women diagnosed with stage IV breast cancer.²⁰ Furthermore, Facebook breast cancer groups have been effective in increasing awareness and advocacy, fundraising, and patient/caregiver support to more than one million members.²¹ Despite the growing

popularity of social media, Facebook-based interventions exploring colorectal cancer risk are limited.

Whereas research evaluating the use of Facebook interventions in a randomized controlled setting is limited, evidence suggests Facebook health communications can be designed to improve health knowledge and behavioral outcomes.²² Facebook has been used for interventions focused on health promotion, prevention, and screening behaviors in rural populations.^{15,22} Thus, the purpose of this study was to examine the applicability, feasibility, efficacy, and acceptability of a 12-week social media-based intervention aimed at reducing multiple risk factors for CRC in older rural Appalachian adults at risk for CRC.

METHODS

Study Design

We used a mixed-methods research design for this study. We collected quantitative data pre-intervention and post-intervention. Subsequently, we collected qualitative data via a participant focus group and a community health worker (CHW) interview to examine the feasibility and acceptability of a Facebook-based intervention. Participants received \$25 gift cards as an honorarium at study enrollment and an additional \$25 gift card honorarium upon completion of post-intervention data collection.

For the intervention, the research team created a library of evidence-based Facebook posts targeting modifiable CRC risk factors. The Facebook posts addressed the topics of nutrition, physical activity, CRC susceptibility, family history and CRC risk, the CRC screening experience, and community and financial CRC screening resources. The posts included polls, scenarios, recipes, videos, and consumer CRC information.

Two CHWs recruited participants for this study through a local center in Appalachia Kentucky. This center provides access to medical, social, and environmental services for Kentucky residents. Using purposive sampling, participants receiving services at this center were invited by the CHWs to enroll in the study. After potential eligibility was determined, a face-to-face meeting was arranged for pre-intervention data collection. After enrollment and baseline assessments, participants were invited to join a secret Facebook group (#CRCFree) that could be found or accessed only by an invited group member. Facebook accounts were set up for individuals without prior accounts, and participants were instructed to accept the invitation to become part of #CRCFree.

During the 12-week intervention, 3 daily posts, from the created library, were made to the #CRCFree page, and all participants were instructed to view the #CRCFree page regularly. Throughout the duration of the intervention, the #CRCFree page was monitored by the CHWs and research team members, which included registered nurses and a nurse practitioner. To maintain participant engagement during the 12-week intervention, there were Facebook challenges, each one week in duration. The first challenge aimed to increase physical activity by encouraging participants to walk more and post their daily step totals from their Fitbits to #CRCFree. The individual with the highest number of steps received a water bottle. Next, participants were challenged to post a healthy adaptation of their favorite

meal (recipe) to #CRCFree. The participant with the highest number of ‘likes’ from other study participants received a healthy cookbook.

Data Collection

We conducted a pretest-posttest intervention survey evaluation. We collected data using REDCap-based surveys at baseline and after completion of the intervention protocols, approximately 12 weeks later.²³ A subset of study participants (N = 7) was selected randomly to participate in a small group interview at a local community location after completion of the study. The focus group was conducted at the 12-week time point to assess satisfaction with the intervention and obtain usability and feasibility data. The focus group provided an interactive avenue to explore opinions about the Facebook intervention and shared experiences among the participants. We used a semi-structured interview protocol with open-ended questions and probes to elicit discussion as a guide during the focus group. The focus group lasted approximately 60 minutes and was electronically recorded. Additionally, we conducted a key informant individual interview with a CHW.

Sample

Trained CHWs recruited 60 rural Appalachian Kentuckians to participate in this study as described above. The CHWs lived in the Appalachian communities and worked for an established, trusted place for healthcare information in Appalachian Kentucky. Inclusion criteria for this study were being age ≥ 50 years, at risk for CRC based upon non-compliance with current screening guidelines, one or more additional modifiable CRC risk factors (being overweight or obese, sedentary lifestyle, diet low in fruits and vegetables), and having a mobile phone and Internet access. Exclusion criteria were a personal history of CRC, inability to speak or read English, and cognitive impairment that would limit ability to consent, answer questions, or participate in the intervention.

Measures

Sociodemographic characteristics.—We collected sociodemographic information including age, income, education level, family composition, marital status, and various other health indicators via self-report questionnaires using REDCap electronic surveys.

Physical activity.—Physical activity was measured with a Fitbit device as well as by self-report. At the initial data collection visit, participants were provided with a Fitbit (a consumer wearable activity tracker device),²⁴ instructed to wear the Fitbit at all times during the study, and provided with instructions on using the Fitbit, creating a Fitbit account, and downloading Fitbit data. We asked participants to use a personal computer and download Fitbit data weekly throughout the intervention to measure the physical activity of participants. As needed throughout the intervention, research staff used individual Facebook messages to prompt participants to wear the Fitbit and download Fitbit data. Additionally, a self-report question assessing physical activity was included in baseline and post-intervention surveys. Participants were asked to rate their activity level on a scale that included “Sedentary,” “Low Activity,” “Active,” and “Extremely Active.”

Body mass index.—BMI was calculated using height and weight measurements collected at pre-intervention and post-intervention time points. Height and weight were measured with a professional grade stadiometer and a professional grade digital body weight scale. All over-garments and shoes were removed prior to obtaining height and weight measurements.

CRC screening status.—CRC screening status was measured using questions adapted from the Behavioral Risk Factor Surveillance System Questionnaire.²⁵ Participants were asked if they had ever had a colonoscopy or fecal occult blood test (FOBT) at baseline (“A blood stool test is a test that may use a special kit at home to determine whether the stool contains blood. Have you ever had this test using a home kit?” and “A Colonoscopy is an exam in which a tube is inserted in the rectum to view the colon for signs of cancer or other health problems. Have you ever had this exam?”). During the post-intervention survey, participants were asked if they had received CRC screening since beginning the study (A blood stool test is a test that may use a special kit at home to determine whether the stool contains blood. Have you had this test since you were enrolled in this study/project?).

Dietary patterns.—Vio-Food Frequency Questionnaires (Vio-FFQ), a Web-interfaced food frequency questionnaire, was used to assess the dietary patterns of participants at baseline and post-intervention.²⁶ The Vio-FFQ is an electronic dietary health questionnaire that has been established as a valid, accurate, and reliable measure of dietary patterns.²⁷ Based upon participant responses, Vio-FFQ provided nutrient vector output that was subsequently used to calculate Healthy Eating Index and Dietary Inflammatory Index scores.

Healthy Eating Index-2010.—The Healthy Eating Index 2010 (HEI) is a validated and reliable measure of diet quality that conforms to the US Department of Agriculture Dietary Guidelines for Americans.^{28,29} The HEI assigns point values to 12 different food components to make up the HEI score. HEI scores are based on an individual’s adherence to the Dietary Guidelines, with higher scores indicating a closer adherence to the guidelines, with a maximum score of 100.²⁹

Dietary Inflammatory Index.—Pro-inflammatory diets have been previously associated with increased CRC incidence.³⁰ The Dietary Inflammatory Index (DII) is a population-based calculation that quantifies the inflammatory effect of an individual’s diet.³¹ The DII score has a range of –8.87 to 7.98, with positive scores indicative of a proinflammatory diet. Conversely, negative DII scores are indicative of an anti-inflammatory diet.³¹ Data obtained from Vio-FFQ were used to calculate DII scores for all participants.³¹

Intervention engagement.—Intervention engagement was measured by the number of Facebook posts viewed participants over the 12-week intervention. A trained research assistant monitored all Facebook posts and tracked participant viewing of Facebook posts. Participants with a high level of engagement were defined as those who had viewed more than 50% (90 posts) of all Facebook posts. Those who had a low level of engagement were those who viewed less than 50% (<90 posts) of Facebook posts.

Data Analysis

Frequencies, distributions, means, and standard deviations summarized variables. Independent 2-sample t-tests, chi-square analyses, and Fisher's exact tests were used to examine differences among sociodemographic characteristics between the high and low Facebook engagement groups (≥50% of posts vs <50% of posts).

Paired t-tests and change scores were used to examine differences in dietary pattern scores, physical activity, and BMI from baseline to post-intervention. To examine CRC screening behavior changes, frequencies were examined for the post-intervention survey questions asking if the participant had received a colonoscopy or blood stool test since study enrollment. Data analysis was conducted using SPSS for Macintosh, version 23.³³ An *a priori* level of statistical significance of .05 was used for all statistical tests.

The qualitative data from the focus group and key informant interview were analyzed by 2 research team members. The team members listened to the electronically recorded focus group sessions and key informant interview and summarized the results. Two researchers then independently carried out content analysis of data. Any discrepancies between results were discussed and resolved with the entire research team.

RESULTS

Sixty participants were enrolled in this study. At the end of the 12-week intervention, follow-up surveys were completed by 93% of the participants (N = 56). There were 7 focus group participants and one CHW interview participant.

Sociodemographic Data

Table 1 describes participant characteristics. All study participants were Caucasian, aged 58 ± 6 years, and 50% of the sample reported having a high school education or GED. Most of the sample was female (66%), married or partnered (68%), and indicated that they made enough money to “make ends meet” (73%). There were no statistically significant differences in sociodemographic characteristics between participants with high and low levels of #CRCFree engagement.

Applicability and Feasibility of #CRCFree

To assess applicability of this intervention, we examined participant compliance with CRC screening guidelines. At baseline, 73% of participants (N = 41) had never had CRC screening in the form of a colonoscopy or blood stool test. Fifteen participants reported having CRC screening in the past, but still remained out of compliance with current CRC screening recommendations. To examine the applicability and feasibility of a Facebook-based intervention in this population, we collected data regarding the use of social media and electronic devices (Table 1). Most participants used mobile phones (70%), but many used tablets (45%) or laptop computers (32%). All participants were likely to use social media websites on a given day, with 87% of participants reporting that they were very/extremely likely to use social media on a given day.

Applicability and feasibility of the intervention was supported further by the focus group and the key informant interview. Participants in the focus group stated that they use social media on a daily basis and that they believed a Facebook-based health intervention has the potential to reach many rural Appalachian residents. The CHW provided further evidence of applicability, stating: “Many participants had been on Facebook [before enrolling in the study], so there was no issue with creating account and adding them to the secret group.” The CHW stated that participants enjoyed Facebook posts, and learned new information about CRC risk and the prevention of CRC.

Efficacy of #CRCFree

The measured modifiable risk factors for CRC (dietary pattern, physical activity, obesity, and screening status) were assessed at baseline and at post-intervention, using paired t-tests to examine differences from baseline to post-intervention (Table 2). Analyses revealed a statistically significant difference between the mean HEI scores at baseline and post-intervention ($p < .001$). The mean HEI score increased by nearly 9 points, from 49.9 ± 9.9 at baseline to 58.6 ± 12.1 at post-intervention. Furthermore, the results from the paired t-test analysis examining DII scores showed that the mean DII score significantly changed from baseline to post-intervention ($p = .002$), decreasing from 2.8 ± 1.1 at baseline to 1.6 ± 1.7 at post-intervention. No statistically significant changes were seen in physical activity or BMI. At completion of the #CRCFree study, 2 participants reported completing a colonoscopy since study enrollment.

Acceptability of #CRCFree

All focus group participants reported that they found the Facebook posts to be useful. The posts were educational and served to motivate them with healthy behavioral cues. One participant stated: “Seeing messages on colorectal cancer, I took everything to heart, started eating healthy, it really got me thinking.” Another participant agreed, saying: “I have lost 25 pounds. I got motivation about eating healthy and I started [eating] stuff I have never eaten before.”

Frequency and timing of Facebook posts.—Participants liked the frequency of the #CRCFree Facebook posts. The participants appreciated the ability to access #CRCFree at their convenience. Participants expressed that due to busy daily schedules and employment they often did not access posts immediately, but enjoyed being able to view posts retrospectively. One participant stated: “I am not on Facebook every day. I work all day, very busy, I check them later. If they hit me, I will read it.” Another participant described her experience related to time constraints in accessing Facebook posts. She reported that on occasion the posts got lost among other Facebook notifications, but said that she tried to go back to #CRCFree to check posts when she was able. Participants preferred Facebook posts occurring during evening hours and on the weekends. Participants felt that they would be better able to view the posts if they were posted after working hours. One participant stated: “I prefer to check later at night after work, when I am sitting and relaxing.”

Facebook group physical activity contests.—Participants enjoyed the Fitbit challenges and indicated that they were more active as a result of wearing the Fitbit device.

Most participants took part in the challenges and posted pictures of their daily steps to Facebook as part of the challenge. Many participants noted that the activity challenges motivated them to increase their physical activity. One participant stated: “I work at a job where I can’t get much steps, I work in medical records. Wearing the Fitbit and doing the contest helped me to be more conscious.” Another participant in the focus group stated: “The Fitbit motivated me to walk. There was a competition between me and my wife.” This was a common theme among participants, who reported that wearing a Fitbit encouraged them to participate in “step challenges” outside of the study intervention.

DISCUSSION

This study provides several important findings that may be useful in informing future research regarding CRC risk reduction in rural Appalachians. Rural Appalachians are at increased risk for CRC due to a number of factors including physical inactivity, poor diets, and low rates of CRC screening, which was demonstrated in this rural Appalachian Kentucky study population. However, with culturally appropriate CRC screening behaviors and risk reduction strategies, such as those introduced in this innovative social media-based intervention, CRC risk may be reduced for this at-risk population. This intervention aimed to decrease CRC risk in a rural Kentucky Appalachian population by addressing modifiable behavioral risk factors including physical activity, diet, and CRC screening.

To date, there have been several studies that have addressed cancer screening using different platforms, but few have used social media to address screening in addition to addressing other behavioral risk factors as demonstrated in this study. In this study, we focused on examining the applicability, feasibility, efficacy, and acceptability of a Facebook-based intervention to decrease multiple CRC risk factors in a sample of rural Appalachian adults aged 50 years. We analyzed both quantitative and qualitative data. Previously, Brittain et al³³ examined the reach and use of a Facebook page dedicated to raising CRC awareness in older women. Although the study addressed the acceptability and feasibility of a Facebook group, data were limited to Facebook group interactions and metrics, and only included women aged 45–65 years.³³ Our analyses, albeit in a smaller sample (N = 301 vs N = 56), included data addressing applicability and preliminary feasibility, in addition to acceptability of this type of intervention platform.

Our findings provide preliminary support for the applicability and feasibility of a Facebook-based risk factor modification intervention in this population. Participants reported enjoying using Facebook to receive information about reducing CRC risk, and reported frequent use of social media. These findings are supported by research that reports that older adults use social media sites and seek out health information on the Internet and social media websites. Some studies have used social media platforms, including Twitter and Facebook, and have found that many populations, like the participants in our study, are open to using social media to discuss and learn about cancer screening and prevention.^{33,34} It also has been demonstrated that older adults use social media websites to find cancer screening information.³⁵ These studies have had varied populations, including older women, older adults, and general social media users.^{33–35} These samples have been multi-ethnic and focused on different types of cancer screening and prevention,³⁵ providing evidence that

using social media in CRC prevention efforts is acceptable to many different populations, including rural Appalachian older adults.

Our study pilot-tests an outcomes-based intervention using social media. Whereas several studies have examined social media platforms to provide education about CRC screening and prevention, few studies have used social media to conduct interventions with measurable risk factor outcomes, particularly in older adults. Many studies utilizing social media have been conducted in young adults and have focused on diseases that are relevant to that age group, such as obesity.³⁶ Due to the small sample size in this study, results of this study are not statistically powered to describe the efficacy of this intervention. However, the statistically significant changes seen in the HEI and DII scores from pre-intervention to post-intervention shows promising movement in the direction of efficacy and provide a foundation for future studies, which should be statistically powered to be able to address to the efficacy of this type of intervention.

Another important finding from this study was the pattern of use of social media and electronic devices in this population. Appalachian older adults not only use electronic devices, but access social media regularly, making social media-based interventions a simple way to integrate health promotion into their daily routines. During post-intervention focus groups, participants reported that they enjoyed being a part of the #CRCFree Facebook group, and felt that they learned how to decrease their CRC risk. Participants stated that they would be receptive to future social-media based health promotion efforts. Participants reported physical activity goal setting, diet changes, and community support that occurred as a result of participating in this study. Participants discussed enjoying learning new information, particularly about healthy diet modifications. Participants were also eager to discuss ways to improve this intervention for future use, such as Facebook posts occurring at night and on weekends instead of during working hours. These findings are consistent with other studies that demonstrate the acceptability of technology-based intervention in older adults, including use of motivational text messaging and social media.³⁷ For example, Stellefson et al³⁷ found social media to be an acceptable method to provide educational resources to underserved populations with chronic obstructive pulmonary disease. Rural samples such as ours may be hard to reach due to geographical location. Acceptability of social media-based in rural populations provides support for the use of similar interventions in the future, and provides investigators with a cost-effective method by which to access these populations.

Strengths of this study include the novel and innovative approach of using social media as the platform to conduct an intervention aimed at changing health behaviors, as well as incorporating digital modalities such as Fitbit into data collection. Additionally, supporting social media with CHWs in this study helped to ensure culturally appropriate and tailored participant recruitment efforts and participant engagement throughout the 12-week #CRCFree intervention. CHWs also helped to ensure Facebook posts were relevant, timely and tailored for the communities of interest. Similar to our study, Mendoza et al³⁸ and Mirolposki et al¹⁹ tested a 10-week intervention and a 12-week randomized control trial respectively to test the effectiveness of physical activity among young cancer survivors by using Fitbit and Facebook to promote social support and adherence. These studies illustrate

the feasibility and acceptability of social media interventions mixed with digital modalities to improve health and quality of living. Our study shows that when used in tandem, Facebook messaging and Fitbit step tracking encouraged participants to be more physically active.

There are important limitations to this study to note. The small sample size prevents us from being able to statistically address the efficacy of this intervention. Promising changes were seen in dietary patterns and this provides a foundation for future efforts. Second, issues with Fitbit devices may have impacted the ability to track participants' physical activity accurately. Not regularly downloading data from the Fitbit device created missing data for some participants, as Fitbit devices are only able to store 21 days of physical activity data. Strategies to address regular downloading of the data would be important to consider in future studies. Additionally, the use of Fitbit device during this study was limited by the short battery life of the devices. For some participants, Fitbit batteries failed during the intervention, losing data until the battery was replaced. We recommend that future studies provide replacement batteries and instructions on how to replace batteries initially, as to avoid data loss during the study period. Another limitation of this project is that we used purposive sampling to recruit participants with known access to a mobile phone and the Internet for them to be able to participate in an Internet-based intervention. Whereas Internet accessibility is nearly ubiquitous, this does limit the generalizability of our findings to other Appalachian Kentuckians without Internet.

Social media platforms, such as Facebook, and other technology-based interventions may help bridge the digital health divide that exists in rural and underserved regions. According to the US Census Bureau, household Internet broadband use in rural areas rose from 2% to 61% between 2000 and 2015.³⁹ However, an urban-rural gap persists in Internet broadband use due to older average age, higher poverty rates, and lower education levels in rural areas, all factors associated with diminished broadband use.³⁹ State policies that increase Internet access and mobile device availability for rural populations can allow researchers to develop innovative interventions aimed at disseminating health promotion and disease prevention information to these communities. Community and social networks such as those present in this study support the acceptability and feasibility of social media-based interventions as opportune to educating and motivating Appalachian adults on CRC risk. Although this study focused on rural Appalachian Kentucky older adults with access to Internet and mobile devices, it is important to explore how social media platforms have empowered rural communities to become self-advocates associated with reduced risk of CRC and improved health outcomes.

Our findings provide promising preliminary data to support using a Facebook-based intervention in rural Appalachian older adults to decrease CRC risk. Few studies have attempted to use social media platforms with a rural older adult population. However, this population has demonstrated a need for health promotion regarding modifiable risk factors for CRC, as well as participant receptiveness to using social media as an intervention platform. Additionally, social media websites provide an accessible, cost-effective method for investigators to reach and intervene to improve the health of vulnerable populations.

Acknowledgements

We acknowledge Dr. Fran Feltner, DNP, RN, and the University of Kentucky Center for Excellence in Rural Health. This research was supported by the University of Kentucky Markey Cancer Center, Lexington, Kentucky. This publication was supported by the University of Kentucky College of Nursing DREAM Center. The content is solely the responsibility of the authors and does not necessarily represent the official views of the CON or the DREAM Center. Additionally, this project was supported by the NIH National Center for Advancing Translational Sciences through grant number UL1TR001998. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Human Subjects Approval Statement

Prior to start of the study, the study procedures, instruments, and materials were reviewed and approved by the University of Kentucky Institutional Review Board (Protocol Number 16–0413-P2H). All participants of this study provided written informed consent prior to engagement in any study activities.

References

1. Appalachian Regional Commission. The Appalachian region. Available at: https://www.arc.gov/appalachian_region/TheAppalachianRegion.asp. Accessed February 6, 2020.
2. Creating a Culture of Health in Appalachia. Disparities and bright spots: health disparities key findings. Available at: <https://healthinappalachia.org/disparities-report/key-findings/>. Accessed February 6, 2020.
3. US Department of Health and Human Services, US Centers for Disease Control and Prevention, and National Cancer Institute. US Cancer Statistics Data Visualizations Tool, based on November 2018 submission data (1999–2016) 2019. Available at: www.cdc.gov/cancer/dataviz. Accessed December 6, 2019.
4. American Cancer Society. Colorectal Cancer Facts & Figures 2017–2019. Available at: <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/colorectal-cancer-facts-and-figures/colorectal-cancer-facts-and-figures-2017-2019.pdf>. Accessed December 6, 2019.
5. Wilson RJ, Ryerson AB, Singh SD, King JB. Cancer incidence in Appalachia, 2004–2011. *Cancer Epidemiol Biomarkers Prev*. 2016;25(2):250–258. [PubMed: 26819264]
6. Kentucky Cancer Registry. Age-adjusted cancer mortality rates in Kentucky. Available at: <http://cancer-rates.info/ky>. Accessed February 20, 2020.
7. Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *JAMA*. 2016;315(23):2564–2575. [PubMed: 27304597]
8. Wolf AMD, Fontham ETH, Church TR, et al. Colorectal cancer screening for average-risk adults: 2018 guideline update from the American Cancer Society. *CA Cancer J Clin*. 2018;68(4):250–281. [PubMed: 29846947]
9. Kentucky Department for Public Health and the US Centers for Disease Control and Prevention. Kentucky Behavioral Risk Factor Survey. Available at: <https://chfs.ky.gov/agencies/dph/dpqi/cdpb/Kentucky%20BRFSS%20Data%20Reports/2018%20KyBRFS%20Annual%20Report.pdf>. Accessed December 6, 2019.
10. Berkowitz Z, Zhang X, Richards TB, et al. Multilevel small-area estimation of colorectal cancer screening in the United States. *Cancer Epidemiol Biomarkers Prev*. 2018;27(3):245–253. [PubMed: 29500250]
11. US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Healthy People 2020. Available at: https://www.healthypeople.gov/node/4054/data_details#revision_history_header. Accessed December 6, 2019.
12. Marshall JL, Thomas L, Lane NM, et al. Creating a Culture of Health in Appalachia: Disparities and Bright Spots. Washington, DC: Appalachian Regional Commission. 2017;193–201.
13. Hoogland AI, Hoogland CE, Bardach SH, et al. Health behaviors in rural Appalachia. *South Med J*. 2019;112(8):444–449. [PubMed: 31375842]

14. Hendren S, Winters P, Humiston S, et al. Randomized, controlled trial of a multimodal intervention to improve cancer screening rates in a safety-net primary care practice. *J Gen Intern Med*. 2014;29(1):41–49. [PubMed: 23818159]
15. Jones AR, Moser DK, Hatcher J. Using text messages to promote health in African-Americans: #HeartHealthyandCancerFree. *Ethn Health*. 2018;23(3):307–320 [PubMed: 27897049]
16. Nimmons K, Beaudoin C, St. John J, et al. The outcome evaluation of a CHW cancer prevention intervention: testing individual and multilevel predictors among Hispanics living along the Texas-Mexico border. *J Cancer Educ*. 2017;32(1):183–189. [PubMed: 26462478]
17. Boyd DM, Ellison NB. Social network sites: definition, history, and scholarship. *J Comput Mediat Commun*. 2007;13(1):210–230.
18. Pew Research Center. Social media fact sheet. Available at: <http://www.pewinternet.org/fact-sheet/social-media/>. Accessed July 17, 2017.
19. Miropolsky EM, Baker KS, Abbey-Lambertz M, et al. Participant perceptions on a Fitbit and Facebook intervention for young adult cancer survivors: a qualitative study. *J Adolesc Young Adult Oncol*. 2020 Jan 13. doi: 10.1089/jayao.2019.0072. [Epub ahead of print]
20. Kashian N, Jacobson S. Factors of engagement and patient-reported outcomes in a stage IV breast cancer Facebook group. *Health Commun* 2020;35(1):75–82. [PubMed: 30351185]
21. Bender JL, Jimenez-Marroquin MC, Jadad AR. Seeking support on Facebook: a content analysis of breast cancer groups. *J Med Internet Res*. 2011;13(1):e16. [PubMed: 21371990]
22. Kernot J, Olds T, Lewis LK, Maher C. Effectiveness of a Facebook-delivered physical activity intervention for post-partum women: a randomized controlled trial protocol. *BMC Public Health*. 2013;13:518. [PubMed: 23714411]
23. Harris P, Taylor R, Thielke R, et al. Research electronic data capture (REDCap) — a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform X*. 2009;42(2):377–381.
24. Imboden MT, Nelson MB, Kaminsky LA, Montoye AH. Comparison of four Fitbit and Jawbone activity monitors with a research-grade ActiGraph accelerometer for estimating physical activity and energy expenditure. *Br J Sports Med*. 2018;52(13):844–850. [PubMed: 28483930]
25. US Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Questionnaire. Atlanta, GA: CDC; 2001. Available at: <https://www.cdc.gov/brfss/questionnaires/index.htm>. Accessed March 28, 2020.
26. Viocare. Vioscreen Food Frequency Questionnaire. Available at: <https://www.viocare.com/vioscreen.html>. Accessed July 17, 2019.
27. Kristal AR, Kolar AS, Fisher JL, et al. Evaluation of web-based, self-administered, graphical food frequency questionnaire. *J Acad Nutr Diet*. 2014;14(4):613–621. [PubMed: 24462267]
28. Guenther PM, Casavale KO, Reedy J, et al. Update of the Healthy Eating Index: HEI-2010. *J Acad Nutr Diet*. 2013;113(4):569–580. [PubMed: 23415502]
29. Guenther PM, Kirkpatrick SI, Reedy J, et al. The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. *J Nutr*. 2014;144(3):399–407. [PubMed: 24453128]
30. Tabung FK, Steck SE, Ma Y, et al. The association between Dietary Inflammatory Index and risk of colorectal cancer among postmenopausal women: results from the Women’s Health Initiative. *Cancer Causes Control*. 2015;26(3):399–408. [PubMed: 25549833]
31. Shivappa N, Steck SE, Hurley TG, et al. Designing and developing a literature-derived, population-based dietary inflammatory index. *Public Health Nutr*. 2014;17(8):1689–1696. [PubMed: 23941862]
32. IBM Corporation. SPSS for Macintosh. Version 23. Armonk, NY: IBM Corporation; 2015.
33. Brittain K, Pennings Kamp KJ, Salaysay Z. Colorectal cancer awareness for women via Facebook: a pilot study. *Gastroenterol Nurs*. 2018;41(1):14–18. [PubMed: 29373351]
34. Xu S, Markson C, Costello KL, et al. Leveraging social media to promote public health knowledge: example of cancer awareness via Twitter. *JMIR Public Health Surveill*. 2016;2(1):e17. [PubMed: 27227152]

35. Lumpkins CY, Mabachi N, Lee J, et al. A prescription for internet access: appealing to middle-aged and older racial and ethnic minorities through social network sites to combat colorectal cancer. *Health Commun.* 2017;32(7):916–920. [PubMed: 27435103]
36. Prout Parks E, Moore RH, Li Z, et al. Assessing the feasibility of a social media to promote weight management engagement in adolescents with severe obesity: pilot study. *JMIR Res Protoc.* 2018;7(3):e52. [PubMed: 29555623]
37. Stelfefon M, Chaney B, Chaney D, et al. Engaging community stakeholders to evaluate the design, usability, and acceptability of a chronic obstructive pulmonary disease social media resource center. *JMIR Res Protoc.* 2015;4(1):e17. [PubMed: 25630449]
38. Mendoza JA, Baker KS, Moreno MA, et al. A Fitbit and Facebook mHealth intervention for promoting physical activity among adolescent and young adult childhood cancer survivors: a pilot study. *Pediatr Blood Cancer.* 2017; 64(12):e26660.
39. US Department of Agriculture. Rural America at a glance. Available at: <https://www.ers.usda.gov/webdocs/publications/85740/eib-182.pdf?v=43054>. Accessed February 6, 2020.

Table 1

Sociodemographic Characteristics of #CRCFree Sample

	Total Sample (N = 56)	Less FB Engagement (N = 34)	More FB Engagement (N = 22)	p value
Age ± SD (years)	58 ± 6	58 ± 6	57 ± 5	.186
Female	37 (66%)	20 (59%)	17 (78%)	.248
Caucasian	56 (100%)	34 (100%)	22 (100%)	-
Educational Level				
Less than high school	13 (23%)	9 (27%)	4 (18%)	.254
High school/GED	28 (50%)	14 (41%)	14 (64%)	
College	15 (27%)	11 (32%)	4 (18%)	
Income				
Do not have enough to make ends meet	15 (27%)	7 (21%)	8 (36%)	.227
Have enough/ more than enough to make ends meet	41 (73%)	27 (79%)	14 (64%)	
Marital Status				
Single	7 (12%)	4 (12%)	3 (14%)	.453
Married/Partnered	38 (68%)	25 (73%)	13 (59%)	
Divorced/Separated	4 (7%)	1 (3%)	3 (14%)	
Widowed	7 (12%)	4 (12%)	3 (14%)	
Employment Status				
Employed full/part time outside of the home	19 (34%)	11 (32%)	8 (36%)	.090
Retired/Unemployed/Sick Leave	24 (43%)	18 (53%)	6 (28%)	
Homemaker	13 (23%)	5 (15%)	8 (36%)	
CRC Screening (All that apply)				
Have you ever had a colonoscopy? (yes)	8 (14%)	7 (21%)	1 (4%)	.130
Have you ever had a blood stool test? (yes)	9 (16%)	8 (24%)	1 (4%)	.074
Smoking status (current smoker)	9 (16%)	7 (21%)	2 (9%)	.458
Electronic Device Use (All that apply)				
Tablet	25 (45%)	19 (56%)	6 (27%)	.054
Mobile phone	39 (70%)	24 (71%)	15 (68%)	1.0
Laptop computer	18 (32%)	8 (24%)	10 (45%)	.142
Desktop computer	12 (21%)	9 (27%)	3 (14%)	.329

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

	Total Sample (N = 56)	Less FB Engagement (N = 34)	More FB Engagement (N = 22)	p value
In a typical day, how likely are you to use social media?				
Slightly/Moderately likely	7 (13%)	6 (18%)	1 (5%)	.226
Very/Extremely likely	49 (87%)	28 (82%)	21 (95%)	

Note.

Values reported as either mean ± SD or N (%)

FB = Facebook

Table 2

Pre-Intervention to Post-Intervention Changes in CRC Risk Factors (N = 56)

	Pre-Intervention Mean \pm SD	Post-Intervention Mean \pm SD	Pre-Post Intervention Change Mean (CI)	p value
Healthy Eating Index	49.9 \pm 9.9	58.6 \pm 12.1	8.8 (5.1, 12.6)	< .001
Dietary Inflammatory Index	2.8 \pm 1.1	1.6 \pm 1.7	-0.9 (-1.4, -0.3)	.002
Physical Activity (steps per day)	2007.1 \pm 2495.6	1974.5 \pm 2619.2	-33.0 (-698.5, 633.3)	.922
Body Mass Index	32.2 \pm 6.9	32.2 \pm 6.9	0.0	-