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A randomized trial to increase colonoscopy screening in members of high risk families in the Colorectal Cancer Family Registry and Cancer Genetics Network

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Abstract

Background—Individuals with a strong family history of colorectal cancer (CRC) have significant risk for CRC, though adherence to colonoscopy screening in these groups remains low. This study assessed whether a tailored, telephone counseling intervention can increase adherence to colonoscopy in members of high risk families in a randomized, controlled trial.

Methods—Eligible participants were recruited from two national cancer registries if they had a first-degree relative with CRC under age 60 or multiple affected family members, which included families that met Amsterdam criteria for Hereditary Non-Polyposis Colon Cancer, and if they were due for colonoscopy within 24-months. Participants were randomized to receive a tailored, telephone intervention grounded in behavioral theory or a mailed packet with general information

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about screening. Colonoscopy status was assessed through follow-up surveys and endoscopy reports. Cox-proportional hazards models were used to assess intervention effect.

Results—Of the 632 participants (aged 25–80), 60% were female, the majority were White, non-Hispanic, educated and had health insurance. Colonoscopy adherence increased 11 percentage points in the tailored, telephone intervention group, compared to no significant change in the mailed group. The telephone intervention was associated with a 32% increase in screening adherence compared to the mailed intervention (Hazard Ratio=1.32; $p=0.01$).

Conclusions—A tailored, telephone intervention can effectively increase colonoscopy adherence in high risk persons. This intervention has the potential for broad dissemination to health-care organizations or other high risk populations.

Impact—Increasing adherence to colonoscopy among persons with increased CRC risk could effectively reduce incidence and mortality from this disease.

Keywords

colorectal cancer; colonoscopy; HNPCC; family history; randomized-controlled trial

Introduction

Though widely considered preventable, colorectal cancer (CRC) remains a common and often fatal cancer. More than 140,000 men and women in the U.S. will develop CRC each year, and 50,000 will die from this disease [1]. The lifetime risk for developing CRC is about five percent but a family history of CRC substantially increases this risk; having a first degree relative with CRC increases the risk about two-fold but if the relative has CRC under age 60 or there is more than a single first-degree relative the risk increases three to six fold [2–4]. Moreover, the risk for developing CRC for members of families with genetic predisposition to CRC, specifically Lynch Syndrome, is approximately nine times higher than general population risk [5–8].

A family history of CRC also has a major influence on recommendations for CRC screening. For average risk populations without a family history of CRC, screening is recommended to begin at age 50 with any of several screening tests (annual stool tests, sigmoidoscopy every five years with or without a stool test, or colonoscopy every 10 years) [9,10]. Surveillance increases with family history of CRC. It is currently recommended that first-degree relatives of patients with CRC under age 60 be screened with colonoscopy starting at age 40 or 10 years prior to the earliest CRC diagnosis in the family no less than every five years [9,10]. Because of their markedly increased CRC risk, members of families with Lynch Syndrome are advised to have colonoscopy screening every one to two years starting at age 20–25 or two to five years prior to the earliest CRC if it is diagnosed before age 25 [10]. About three to five percent of the population is thought to fall into one of these high risk groups [3,11] but they represent a disproportionate number of incident CRC and CRC deaths, which magnifies the importance of screening adherence in these families.

Despite the established efficacy of endoscopy screening to reduce CRC incidence and mortality [12–15], adherence to CRC screening remains suboptimal even in these high risk groups [16–20]. The Family Health Promotion Project (FHPP) was a randomized, controlled trial to test the effectiveness of a telephone-based, counseling intervention to increase adherence to colonoscopy screening in members of high risk CRC families. The study design and results from the baseline survey have been described previously [17]. We report here the primary outcome data for FHPP; the effect of the intervention on colonoscopy screening adherence.

Materials and Methods

Trial Design Overview

The FHPP was a multi-center, randomized, controlled trial. Participants at increased risk for CRC as described below were recruited from two national cancer family registries, the Colon Cancer Family Registry (C-CFR) and the Cancer Genetics Network (CGN) between February 2005 and July 2006 [21–22]. Consenting participants completed a baseline survey and were randomized to receive either a tailored, one time telephone-based counseling intervention (tailored telephone intervention) or a mailed packet. Participants were mailed follow-up assessments at 6, 12, and 24 months to assess screening behavior as well as participants' knowledge, attitudes and beliefs about CRC screening and barriers to having screening (ex. cost, no symptoms, busy, fear/anxiety about the test, worry about the prep) [17]. Questions on the baseline and follow up surveys were adapted and validated from previous studies [17, 23–25]. The primary outcome for the study was prevalence of colonoscopy screening in the two groups within the 24-month study period from randomization. This study was approved by the Colorado Multiple Institutional Review Board (IRB #03-858).

Participants

Participants were recruited from eight C-CFR and three CGN registry sites; CGN centers: Universities of Utah (n=61), New Mexico (n=4) and Colorado (n=51); C-CFR centers: Universities of Arizona (n=25), North Carolina (n=16), Minnesota (n=56), Southern California (n=5) and Colorado (n=38), the Cleveland Clinic (n=95), Mayo Clinic (n=95) and The Fred Hutchinson Cancer Research Center (n=185). Eligible participants were unaffected with CRC, at least 21 years of age, English speaking and at increased risk for CRC on the basis of their family history. Two classes of increased risk were defined. Participants from families that met the Amsterdam II criteria for hereditary non-polyposis colorectal cancer (HNPCC): three biological relatives with CRC or other HNPCC-associated cancers with one being a first degree relative of the other two and at least two generations affected, and one cancer diagnosis under 50 years of age [7], were classified as 'HNPCC' participants. We used the term HNPCC for these participants because genetic testing had not been confirmed for these families and the term Lynch Syndrome is typically reserved for families with confirmed mutations in a DNA mismatch repair gene. Participants that had at least one first-degree relative diagnosed with CRC under age 60 or two or more first-degree relatives diagnosed with CRC at any age were defined as 'High Risk'. Eligible participants must have been due for colonoscopy during the 24-month study period according to consensus guidelines for these populations. Because recommended that individuals from HNPCC families have colonoscopy every one to two years, all of these participants would have been due for colonoscopy during the 24 month period and thus eligible. The recommendation for High Risk participants is to have colonoscopy no less than every five years. Thus High Risk participants who had a colonoscopy within the three years prior were excluded, as they would not have been due to have another colonoscopy during the study period.

Recruitment and Randomization

Upon receiving permission to contact participants from their respective registry site, FHPP staff at the University of Colorado Cancer Center contacted participants to recruit them into the study (n=1,068). Of the 1,068 subjects contacted, 156 were deemed ineligible and 280 refused participation for an overall response rate of 69% (632 of 912 eligible) (Figure 1). The 632 consenting participants, representing 533 families, completed the baseline survey and were randomized to receive either the tailored, telephone counseling intervention (N=322) or the general mailed intervention (N=310). Block randomization was employed to

assure equal distribution of participants across intervention groups by recruitment site, CRC risk level (HNPCC vs. High Risk) and by family unit to avoid experimental contamination.

Tailored, Telephone Counseling and Mailed Intervention

The components of the telephone counseling intervention have been described in detail previously [17]. Briefly, the counseling intervention was delivered by trained interviewers using tailored messages based on participants' responses to the baseline survey and motivational interviewing (MI) techniques. The intervention was grounded in several theoretical models to promote behavior change including the Health Belief Model [26–28], the Theory of Planned Behavior [29–31] and the Transtheoretical Model [32–34]. The counseling intervention was conducted using computer-assisted telephone interviewing (CATI) software of the Survey Core of the University of Colorado Cancer Center. Upon establishing telephone contact, the interviewers began the session by eliciting the participants' readiness (stage of change) to have colonoscopy. Based on their response (1- ready, 2- ready but with some reservation, or 3- not ready), the interviewer appropriately engaged the participant in conversation about their perceived risk of CRC, risk-appropriate screening guidelines, the pros and cons of CRC screening, and perceived barriers.. Information from the participant's baseline assessment regarding these factors was incorporated into the interview, which allowed the interviewers to tailor the counseling session to focus on specific barriers and/or information gaps (ex. knowledge of screening intervals specific to their risk level). At the end of the session, the interviewers engaged the participants in developing an individualized action plan that was appropriate based on their readiness to be screened. Action items ranged from talking with their family members about the benefits of screening, to calling their provider to obtain a referral for colonoscopy. The average intervention session lasted between 20 and 30 minutes. Following the telephone counseling session, participants were mailed a summary of the issues discussed including their personalized action plan that was extracted directly from the CATI software. Participants were sent a reminder postcard in the month prior to their colonoscopy due date.

Participants randomized to the *mailed intervention* group were mailed a letter stating the importance of maintaining a healthy lifestyle through exercise, diet and routine screening for reducing risk of cancer and other chronic diseases, and were sent a *Choices for Good Health* brochure, sponsored by the American Cancer Society. Participants were also encouraged to speak with their doctors about options for CRC screening, which may be different given their family history of CRC.

Study Outcome: Colonoscopy screening

The primary outcome of the FHPP was the prevalence of colonoscopic screening at the end of the study period as reported on at least one of the follow-up assessments. Each assessment asked the participant whether (and when) they had had colonoscopy since the time of the previous survey. Participants who reported having had colonoscopy were asked to provide consent to obtain endoscopy and pathology reports to verify screening. Endoscopy reports were obtained for 98% of reported colonoscopies. Concordance between self-reported colonoscopies and endoscopy reports was 100%. Thus, we included all reported colonoscopies including the five (2%) for which we could not obtain endoscopy reports in the analysis.

Statistical Analysis

To assess the effectiveness of randomization, we compared demographic characteristics between intervention groups using repeated measures models to accounts for familial clustering. These models were also used to assess any differences between groups with respect to baseline characteristics related to CRC screening such as past screening history,

knowledge of guidelines, intentions to screen, risk perception and barriers to screening. McNemar's test was used to assess change in the percent of participants who were adherent from baseline to 24 months within study groups [35]. To account for the variability in the length of follow-up due to participant dropout or inability to contact, we employed survival analysis techniques to test our main hypothesis of greater adherence to colonoscopy in the telephone counseling intervention group compared to the mailed intervention group at 24 months. Responses were censored at the time of colonoscopy or at time of the last completed follow-up assessment. Cox proportional hazards methods [36] were used to assess the effectiveness of the telephone intervention while adjusting for any confounding variables identified. Regression parameters in the Cox models were estimated using a robust sandwich covariance matrix estimate to account for the familial clustering [37]. An intent-to-treat approach was used; thus all participants that were randomized were included in the analysis. Possible interaction effects by risk status were assessed. The sample size was established to enable detection of a relative difference in colonoscopy adherence of 15% overall between intervention groups at 24 months with 80% power.

Results

A total of 632 participants were enrolled in the FHPP trial. Of the 322 participants randomized to the telephone intervention, 306 (95%) received the intervention (16 participants could not be reached by phone within the allotted time frame per protocol), and 309 of 310 (>99%) participants in the mailed group received the mailed packet. Retention of participants over 24-months was greater than 90% overall; 87% in the telephone and 94% in the mailed intervention group.

Characteristics of study participants by intervention group are shown in Table 1. Twenty-five percent of participants (N=125) met criteria for HNPCC and 75% (N=467) were classified as High Risk. Approximately 60% of the participants were women, and the majority were age 50 or older, Caucasian and non-Hispanic. The study population was generally well educated, and over 90% had health insurance and a regular primary physician. A higher percentage of participants in the mailed intervention group had at least some college education (p=0.02) but the other demographic variables were balanced between the two intervention groups (Table 1). There were no significant differences between participants who consented compared to those who declined participation with respect to gender, age, race/e ethnicity or risk level.

Despite randomization, comparison of baseline attitudes, beliefs and behaviors related to CRC screening revealed several significant differences between the intervention groups (Table 2). Participants in the mailed group were less likely than those in the telephone intervention group to report barriers to screening (63% vs. 71%, p=0.048) and more likely to be adherent with CRC screening (52% vs. 43%; p=0.04). There was also a trend toward a higher level of knowledge of screening recommendations in the mailed group (54% vs. 47%; p=0.06). Over 70% of participants in both groups reported having at least one previous colonoscopy, but only about 50% said they intended to have a colonoscopy within the next 24 months. Over 80% of all participants recognized that they were at elevated risk for CRC.

In total, 328 participants reported having had a colonoscopy during follow-up. The proportion of participants who were adherent with colonoscopy at 24 months compared to baseline was assessed. In the mailed intervention group, adherence with colonoscopy at baseline was 52.1% and it was slightly lower (49.8%) at 24 months. In the tailored, telephone intervention group, the prevalence of adherence was 43.2% at baseline and increased by 11 percentage points to 54.0%. Eleven participants in the telephone and 10 in the mailed group had colonoscopy within one month of randomization, suggesting these

may have been scheduled prior to randomization. When stratified by risk level, we found that the HNPCC group had greater overall adherence at 24 months compared to the High Risk group but the absolute difference in adherence from baseline to 24 months for the HNPCC and High Risk participants in the telephone intervention group was comparable (about 11 percentage points) [Fig 2]. There was no increase in colonoscopy adherence from baseline for either risk group among participants who received the mailed intervention.

Results from bivariate and multivariate analyses are shown in Table 3. In unadjusted bivariate analysis, using an intent-to-treat approach, the tailored, telephone intervention was associated with a 24% increase in colonoscopy adherence at 24 months (Hazard Ratio = 1.24, $p=0.04$). Baseline factors that were significantly associated with greater adherence included having had a previous colonoscopy, intent to have screening, appropriate CRC risk perception, and knowledge of risk-appropriate screening intervals. Not having a regular doctor was associated with lower adherence as was having one or more perceived barriers to screening. Age, gender, education, insurance status, adherence at baseline, and risk level did not significantly predict adherence. After adjusting for significant covariates in multivariate analysis, we found that the tailored, telephone intervention was associated with a 32% increase in colonoscopy adherence (Hazard Ratio=1.32, $p=0.01$). Previous colonoscopy and intent to have colonoscopy in the next 1–2 years were also associated with increased adherence in the multivariate model.

Discussion

Results from the FHPP trial demonstrate that a tailored, educational and barriers counseling intervention delivered by telephone can effectively increase adherence to colonoscopy screening among members of high-risk CRC families. To our knowledge, this is the first randomized trial to successfully promote colonoscopy screening in high-risk populations that included individuals from HNPCC families. Efforts to increase both initial screening and maintenance of screening adherence in these groups is important both because they have a substantially increased CRC risk and they continue to demonstrate relatively low screening adherence.

In this trial, we found that although over 80% of our participants were aware that they were at increased CRC risk, less than 50% were adherent with recommended screening intervals at enrollment [Table 2], which is consistent with reports from previous studies [16–20,38]. One explanation for the low adherence at baseline in our participants appears to be a lack of knowledge of risk appropriate screening intervals. As previously reported, only 22% of HNPCC and 52% of High Risk participants knew the recommended colonoscopy screening interval based on their family history [17]. Given that a significant number of individuals in the general population are predisposed to CRC due to a strong family history (about 3–5%) [3,11] and the persistent low rates of screening in these groups, interventions that even moderately increase screening have the potential to effectively reduce CRC morbidity and mortality in these families, and in the population at-large.

By chance, the proportion of participants who were adherent with colonoscopy guidelines at baseline (but as required for eligibility, due for their next screening within 24 months) was significantly lower among participants randomized to the telephone intervention than in those in the mailed intervention (43% vs. 52%; $p=0.04$). Nonetheless, our results showed an 11% absolute increase in colonoscopy screening prevalence from baseline to 24 months (43% to 54%, $p<0.004$) among participants who received the telephone counseling intervention compared to essentially no change in adherence among participants randomized to the mailed group (52% vs. 50%, $p=0.56$). The multivariate analysis that accounted for the difference in baseline adherence showed that participants who received the telephone

intervention were 32% more likely to have colonoscopy during follow-up than those in the mailed group.

The counseling intervention appeared to be effective in both the HNPCC and High Risk groups. Adherence to colonoscopy upon completion of the study was somewhat higher in the HNPCC group, which is important given their significant CRC risk, and consistent with previous reports of higher screening prevalence in this population following genetic education and counseling [39–42]. However, the absolute difference in adherence was similar in both risk groups. This is encouraging, as an intervention that increases adherence in both risk groups would have wider applicability. It can be difficult to clinically distinguish the two risk groups without having a complete family history, which is rarely collected in clinical practice [43–46].

There have been few randomized studies of interventions to specifically promote colonoscopy adherence among individuals at increased risk for CRC due to family history, and none to our knowledge, that have included persons from HNPCC families [47]. A study by Manne et al [48] evaluated the effect of three increasingly intense behavioral interventions on CRC screening adherence in siblings of CRC survivors: generic print materials vs. tailored print materials vs. tailored print plus telephone counseling. Results from this study showed that while all three interventions increased adherence, adherence was significantly higher in each of the tailored groups compared to the generic group (25% and 26% vs. 14%, respectively) though there was no difference in adherence between the tailored print and tailored print plus telephone counseling groups. A second, smaller study by Rawl et al [49] that compared the effect of two print interventions (generic vs. tailored) to increase CRC screening among siblings and children of CRC cases similarly demonstrated that both interventions increased adherence (21% and 14% at 12 months), but found no difference in adherence between the tailored and generic print groups. Finally, a trial by Glanz et al [50] tested the effect of using face-to-face risk counseling (vs. general health counseling) to increase screening adherence among siblings of CRC cases. This intensive intervention resulted in a net change in adherence (above the general counseling group) of 13 and 11 percentage points at 4 and 12 months respectively.

Variability across studies with respect to study population, screening outcome, intervention intensity and mode of delivery, make it challenging to directly compare results. For FHPP, we included participants who were adherent at baseline but who were at risk for becoming non-adherent during the study period, whereas other studies specifically excluded these individuals [48–49]. We also limited our outcome to colonoscopy screening, where others have included additional CRC screening modalities [49–50]. In addition, our trial did not include a ‘tailored-print’ arm with which to specifically compare our telephone intervention. Nonetheless, our finding of a net change in adherence of 11 percentage points in our telephone intervention group over that of our control group, is similar to that reported in two previous trials [48, 50]

Taken together, with some exceptions, results from our study and others’ suggest that tailored interventions may be more effective in promoting screening in high risk groups [47–48, 50]. Using tailored messages is particularly relevant when addressing populations of various risk profiles as we had in FHPP, and when attempting to promote both initial screening as well as adherence to recommended screening intervals, which differ depending on risk. It remains unclear as to whether print vs. telephone delivery would be equally effective. The challenge to using a tailored approach in practice is having adequate information about the target population *a priori* such as family history and known barriers, which is often not available. One benefit of using a phone-based approach is the ability to

assess risk, readiness and barriers in real time that can be directly translated into tailored messages.

The FHPP study has many strengths including a prospective, randomized, controlled design, high response and retention rates and validation of self-reported colonoscopies with endoscopy reports. The use of two NCI-funded registries allowed the identification of (HNPCC and High Risk) participants with well characterized and updated family history information available. Having information about risk *a priori* allowed us to tailor the intervention to appropriately address issues of CRC risk and recommended screening intervals. Use of the CATI technology allowed the counseling intervention to be tailored in real time and importantly, to address any persisting barriers to screening. For example, for participants who shared that cost was an issue or that they did not feel that screening was necessary since they did not have symptoms (two of the most common barriers), the interviewers were able to counsel them on how to approach their provider to discuss payment options, and were able to immediately reinforce to participants that screening is most effective for preventing cancer before symptoms arise. These messages were included in the action-plan that was discussed and reiterated in the follow-up letter. Finally, the use of motivational interviewing techniques allowed the interviewers to assess and tailor messages that were appropriate for participants' readiness to undergo screening [17].

Our study also has some limitations. Our participants were also mostly White, affluent, had health insurance, and higher education levels, and were all English-speaking, which may limit generalization of our findings. Similarly, by virtue of their participation in the registries, our participants may be different than other high-risk individuals in that they may be more aware of their risk and the importance of screening, and therefore more motivated to undergo screening. It is possible that participants who had colonoscopy within a month of randomization had scheduled this prior to receiving the intervention. However, this number was small and comparable across groups, thus it is unlikely that this significantly affected our results. Despite the overall large sample size, the smaller size of the HNPCC subset (n=165) limited the power to assess interactions. Finally, randomization did not result in equal distribution of several important variables including baseline adherence to colonoscopy. This may in part have been due to clustering of family members within intervention groups, who may have similar screening practices. This difference attenuated the effect of the intervention in that at 24 months the absolute screening prevalence in the two intervention groups was similar.

In conclusion, the FHPP trial demonstrated that a relatively brief but tailored telephone-based, education and barriers counseling intervention can increase colonoscopy screening in persons at increased risk for CRC due to their family history. As designed, our intervention, which was tailored in real-time by non-medical interviewers, has the potential for broad dissemination into health-care organizations or populations (such as high risk registries) that have the capacity to identify persons at increased risk. Though our intervention effectively increased adherence, there remained a subset of participants who were non-adherent, highlighting the need for continued efforts to identify strategies for improving adherence in these high risk groups. These efforts may start with enhancing systems for identifying persons with familial risk, ensuring that providers are aware of risk appropriate guidelines and enlisting patient navigators to assist patients who face significant barriers to screening. Eliciting patients' barriers, mutually identifying ways to overcome these and developing an action plan for taking next steps, may help to increase screening in these more resistant populations. Analyses are underway to identify specific components from our intervention that were most likely to increase colonoscopy adherence, which will inform the nature and viability of broader dissemination of this intervention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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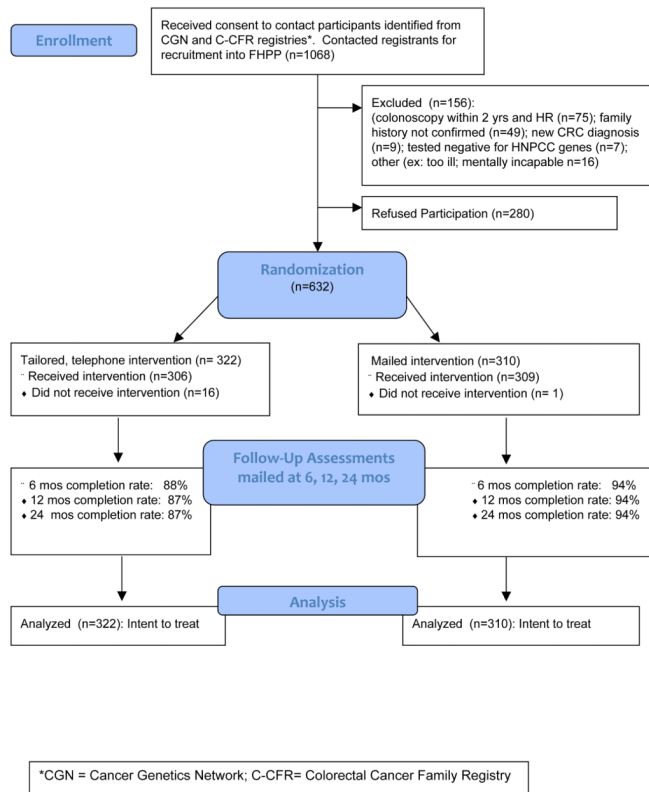


Figure 1.
 CONSORT Flow Diagram for FHPP Trial
 *CGN = Cancer Genetics Network; C-CFR = Colorectal Cancer Family Registry

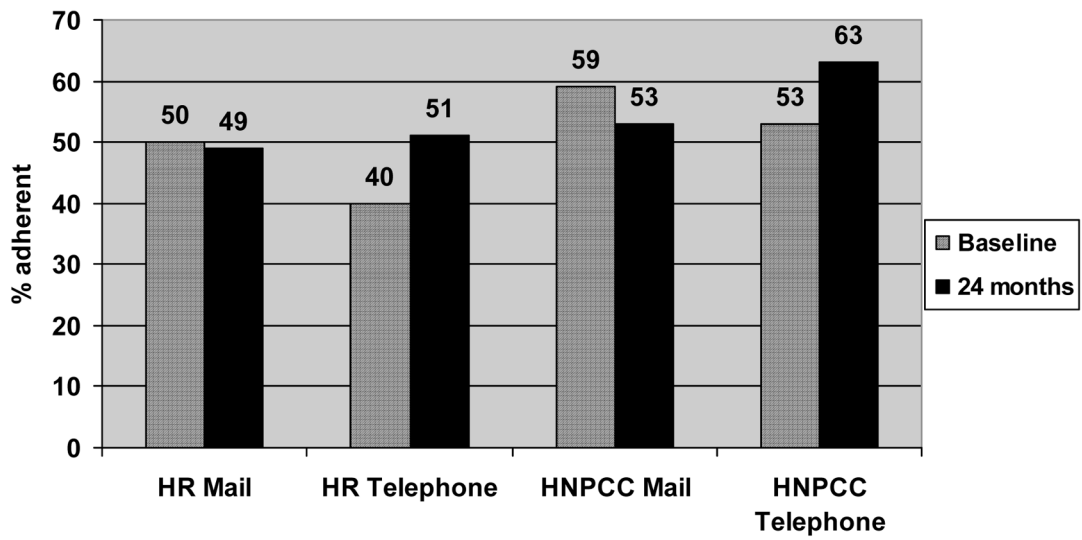


Figure 2. Colonoscopy adherence by risk level (High Risk (HR) vs. Hereditary Non-Polyposis Colon Cancer (HNPCC)) and intervention group at baseline and 24 months

Table 1

Participant Demographics by Intervention Group (N=632)

Characteristic	Intervention Group		p-value for difference
	Tailored Telephone (N=322) N (%)	Mailed (N=310) N (%)	
Gender			
Male	137 (43)	124 (40)	0.40
Age			
< 40	19 (6)	17 (5)	0.50
40 – 49	88 (27)	64 (21)	
50 – 64	132 (41)	140 (45)	
65+	83 (26)	89 (29)	
Race			
African American	7 (2)	4 (1)	0.62
Caucasian	299 (93)	290 (94)	
Other	10 (3)	13 (4)	
Missing	4	3	
Ethnicity			
Hispanic	9 (3)	6 (2)	0.46
Non-Hispanic	307 (95)	298 (96)	
Missing	6	6	
Education			
Post college	59 (18)	58 (19)	0.02
College graduate	81 (25)	94 (30)	
Some college/tech	93 (29)	102 (33)	
High school	72 (22)	49 (16)	
Less than high school	14 (4)	6 (2)	
Missing	3	1	
Risk level			
HNPCC*	81 (25)	84 (27)	0.91
High Risk	241 (75)	226 (73)	
Household Income			
\$70,000 or more	122 (38)	113 (36)	0.51
\$45,000 – \$69,999	81 (25)	78 (25)	
\$30,000 – \$44,999	52 (16)	54 (17)	
\$15,000 – \$29,999	29 (9)	39 (13)	
< \$15,000	16 (5)	12 (4)	
Missing	22	14	

Characteristic	Intervention Group		p-value for difference
	Tailored Telephone (N=322) N (%)	Mailed (N=310) N (%)	
Have Health Insurance			
Yes	310 (96)	293 (95)	0.54
Have regular doctor			
Yes	291 (90)	291 (94)	0.11

* Hereditary non-polyposis colorectal cancer

⁺ Due to rounding and missing data, percentages do not always add to 100%

Table 2

Baseline colorectal cancer (CRC) screening behaviors, knowledge and perceived CRC risk by intervention group (N=632)

Baseline survey question	Intervention Group		p-value for difference
	Tailored Telephone (N=322) N (%)	Mailed (N=310) N (%)	
Ever had colonoscopy	239 (74.2)	238 (76.8)	0.34
Adherent with CRC screening at baseline *	139 (43.2)	161 (51.9)	0.04
Intend to have colonoscopy in next 1–2 years	163 (50.6)	163 (52.6)	0.46
Knowledge of risk-appropriate screening recommendations **	151 (46.9)	166 (53.5)	0.06
Risk perception higher than others without family history	263 (81.7)	253 (81.6)	0.90
Barriers to CRC screening:			
Reported one or more barrier	228 (70.8)	196 (63.4)	0.048
Median # of barriers (range)	2.00 (1–14)	2.00 (1–13)	

* Adherent for participants from Hereditary non-polyposis colorectal cancer (HNPCC) families = colonoscopy within past 2 years and for participants from High Risk families = within past 5 years

** for HNPCC reported recommendation of 'every 1–2 years'; for High Risk reported interval no less frequent than every 5 years

Table 3

Results from bivariate and multivariate analysis to assess the degree of screening compliance by baseline factors and intervention group (N=632)

Subject Characteristic	Bivariate Analysis Hazard Ratio (95% C.I.) (p-value)	Multivariate Analysis [†] Hazard Ratio (95% C.I.) (p-value)
Age (yrs)		
25–39	1.00	-
40–49	0.96 (0.52, 1.76)	
50–64	1.14 (0.64, 2.05)	
65+	1.28 (0.70, 2.33)	
Male gender	0.86 (0.69, 1.08)	-
Education		
No college (vs. some college or more)	1.14 (0.88, 1.48)	-
No doctor	0.54 (0.30, 0.96) (0.02)	-
No insurance	0.55 (0.27, 1.14)	-
Risk group – HNPCC (vs. HR)	1.15 (0.91, 1.45)	-
Ever had colonoscopy	1.74 (1.27, 2.38) (0.0003)	1.47 (1.06, 2.04) (0.02)
Adherent at baseline	1.08 (0.87, 1.34)	-
Plan on having colonoscopy in 1–2 years	2.98 (2.37, 3.75) (<0.0001)	2.90 (2.30, 3.65) (<0.0001)
Risk perception is higher than others without family history	1.73 (1.27, 2.35) (0.0003)	-
Knowledge of risk appropriate recommendations	1.33 (1.07, 1.65) (0.01)	-
Reported barriers to CRC screening Any barrier (yes vs. no)	0.73 (0.58, 0.92) (0.007)	-
Intervention Arm – Intensive	1.24 (1.01, 1.55) (0.04)	1.32 (1.07, 1.64) (0.01)

[†] Adjusted for all variables with significance level of $p < 0.05$ in multivariate model