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Longitudinal predictors of colorectal cancer screening among participants in a randomized controlled trial☆,☆☆

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ABSTRACT

Objective: Few studies use longitudinal data to identify predictors of colorectal cancer screening (CRCS). We examined predictors of (1) initial CRCS during the first year of a randomized trial, and (2) repeat CRCS during the second year of the trial among those that completed FOBT in Year 1.

Methods: The sample comprised 1247 participants of the Systems of Support to Increase Colorectal Cancer Screening (SOS) Trial (Group Health Cooperative, August 2008 to November 2011). Potential predictors of CRCS were identified with logistic regression and included sociodemographics, health history, and validated scales of psychosocial constructs.

Results: Prior CRCS (OR 2.64, 95% CI 1.99–3.52) and intervention group (Automated: OR 2.06 95% CI 1.43–2.95; Assisted: OR 4.03, 95% CI 2.69–6.03; Navigated: OR 5.64, 95% CI 3.74–8.49) were predictors of CRCS completion at Year 1. For repeat CRCS at Year 2, prior CRCS at baseline (OR 1.97, 95% CI 1.25–3.11), intervention group (Automated: OR 9.27, 95% CI 4.56–18.82; Assisted: OR 11.17, 95% CI 5.44–22.94; Navigated: OR 13.10, 95% CI 6.33–27.08), and self-efficacy (OR 1.32, 95% CI 1.00–1.73) were significant predictors.

Conclusion: Self-efficacy and prior CRCS are important predictors of future screening behavior. CRCS completion increased when access barriers were removed through interventions.

Introduction

Colorectal cancer (CRC) is the second most commonly diagnosed and leading cause of cancer death in the U.S. (Siegel et al., 2013). Despite the evidence that colorectal cancer screening (CRCS) with the fecal occult blood test (FOBT), colonoscopy, and/or sigmoidoscopy decreases CRC incidence and mortality (Zauber et al., 2008), screening rates remain below target levels (Centers for Disease Control, Prevention (CDC), 2012).

Interventions that promote the uptake of CRCS must address modifiable determinants or predictors of screening behavior. However, most of the literature is cross-sectional studies of correlates of past screening. Few studies use longitudinal data to examine prospective predictors of CRCS (McQueen et al., 2007). Relying on results from cross-sectional studies when designing interventions may overlook important factors because there may be differences in correlates and predictors of cancer screening behaviors (Bastani et al., 1996; McQueen et al., 2007). For example, a study comparing cross-sectional and prospective predictors of mammography found a number of important variables related to future screening (i.e., predictors) that were not associated with past screening (i.e., correlates) (Bastani et al., 1996). Many of the significant predictors were psychosocial or attitudinal variables. Similarly, for CRCS, a study of initiation and maintenance revealed that there were differences in correlates and predictors (McQueen et al., 2007). The results of these studies call into question the usefulness of targeting or tailoring interventions based on cross-sectional data. A better understanding of the prospective predictors of CRCS may inform development of interventions that target those behaviors.

There also has been limited research on repeat CRCS. Although a number of trials to evaluate the efficacy of CRCS have reported rates of repeat screening (Hardcastle et al., 1986, 1989, 1996; Mandel et al., 1999), very few studies have examined psychosocial predictors of regular screening. Studies of repeat FOBT conducted in community settings

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report completion rates between 14 and 54% among persons who had previously completed an FOBT on schedule (Fenton et al., 2010; Gellad et al., 2011; Liss et al., 2013; Myers et al., 1993). Receipt of a prior preventive health examination, younger age, lesser comorbidity, and a greater number of physician visits were significantly associated with repeat CRCS (Fenton et al., 2010; Liss et al., 2013; Myers et al., 1993). We found only one study that examined social cognitive factors in relation to repeat CRCS (Duncan et al., 2014). On-schedule screening is particularly important for FOBT because its effectiveness may be reduced when patients do not adhere to a regular schedule (Hardcastle et al., 1986, 1989, 1996; Mandel et al., 1999).

To address these gaps in the literature, we conducted a secondary analysis of data from a randomized trial to increase CRCS in adults (Green et al., 2013) and examined prospective predictors of (1) CRCS completion during the first year of the trial, and (2) repeat, on-schedule CRCS during the second year of the trial among those that completed an FOBT in Year 1.

Methods

This research was conducted as part of the Systems of Support to Increase Colorectal Cancer Screening (SOS) Trial (clinicaltrials.gov registration number NCT00697047). Details of the study design (Green et al., 2010), recruitment (Green et al., 2012), and findings (Green et al., 2013) have been reported. Briefly, the trial compared the effectiveness of stepped increments of centralized interventions to increase CRCS and was delivered through 21 medical centers of Group Health Cooperative, a large nonprofit integrated healthcare delivery system in Washington State. Participants were recruited between August 2008 and November 2009.

The interventions targeted constructs from the Preventive Health Model (Myers et al., 1994). Trial participants were randomized to usual care or one of three intervention groups: automated mailed interventions (automated), mailed interventions plus medical assistant telephone support (assisted), or both automated and assisted interventions plus nurse navigation (navigated). The usual care group received preventive services as part of routine care. Intervention participants received FOBT Hemoccult SENSA® cards, simplified instructions, and a postage-paid envelope for returning them. Interventions were repeated in Year 2 for those due for screening (i.e., completed FOBT or were not screened in Year 1). Compared with the usual care group, participants in the intervention groups were more likely to be current for CRCS in both trial years with significant increases by intervention intensity (usual care, 26.3%; automated, 50.8%; assisted, 57.5%; and navigated, 64.7%) (Green et al., 2013).

We extend the findings of the trial by examining predictors of CRCS in a subsample of participants who completed a supplementary baseline survey that included measures of behavioral and psychosocial constructs. Approximately 30% ($n = 1364$) of participants randomized to the trial ($n = 4664$) were randomly selected to complete the survey. The sample for this analysis consisted of 1247 study participants that responded to the survey (91.4% response rate).

Measures

Outcome variables

Two binary dependent variables assessing screening completion were examined: (1) CRCS completion during the first year of the study, and (2) repeat, on-schedule CRCS during the second year of the study among those that completed an FOBT in Year 1. Screening completion included completion of FOBT, sigmoidoscopy, or colonoscopy. Electronic Health Record (EHR) or claims data were used to assess screening completion.

Predictor variables

Sociodemographic, health history, and psychosocial variables were examined as predictors of both screening outcomes. Variables were obtained from automated data (e.g., EHR and claims data) and patient self-reported data on the survey. Sociodemographic variables included age, sex, race/ethnicity, marital status, education, employment, and insurance type.

Health history variables included family history of CRC (first-degree relative), smoking status, overall self-rated health, comorbidity, continuity of care, CRCS test preference (no test preference vs. preference for colonoscopy/sigmoidoscopy/FOBT), physician recommendation for CRCS, and prior CRCS at baseline. The Johns Hopkins Adjusted Clinical Group case-mix system measured comorbidity based on age, gender, and the number and types of ICD-9 diagnostic codes during 12 months prior to randomization (Starfield et al., 1991; Weiner et al., 1991). Patient comorbidity was defined based on expected resource utilization needs and classified as low, moderate, or high (Green et al., 2010). Continuity of care was evaluated using the Usual Provider Continuity Index, calculated as the proportion of primary care visits to a patient's most frequently visited physician (Breslau and Reeb, 1975).

The survey contained 33 items that measured five psychosocial constructs: pros, cons, self-efficacy, social influence, and cancer worry (Green et al., 2010; Myers et al., 1994). Items and scales were adapted from those used in other CRCS trials (Vernon et al., 2011; Tilley et al., 1999) and were validated in diverse settings (McQueen et al., 2008; Murphy et al., 2013; Rawl et al., 2001; Ritvo et al., 2008; Tiro et al., 2005). Pros measured positive aspects of CRCS (7 items, $\alpha = 0.83$), and cons measured negative aspects (10 items, $\alpha = 0.86$). Self-efficacy assessed confidence in performing aspects of CRCS (10 items, $\alpha = 0.93$). Social influence measured norms of friends, family, and physicians related to CRCS (3 items, $\alpha = 0.61$). Cancer worry measured perceived consequences of completing CRCS (3 items, $\alpha = 0.68$). All items were measured on a five-point scale ranging from "strongly disagree" (1) to "strongly agree" (5). Scores were set to missing if participants did not answer more than four items for 10-item scales, three items for the 7-item pros scale, and two items for 3-item scales. Scale scores were standardized by dividing the total scale score by the number of items answered.

Statistical analysis

Pearson chi-square or Fisher exact tests were used to compare categorical characteristics of screeners and nonscreeners, and Student's t-tests or Wilcoxon rank-sum tests were used to compare continuous characteristics. Variables with a p-value less than 0.25 in univariable analysis were included in a multivariable logistic regression model (Hosmer et al., 2013) with CRCS completion at Year 1 and repeat CRCS at Year 2 as the dependent variables. Intervention group assignment (usual care, automated, assisted, or navigated) was retained in all analyses.

Because the intervention had a statistically significant effect in the primary outcomes analysis (Green et al., 2013), we conducted exploratory analyses to examine whether the intervention moderated the association of screening with baseline predictors. We used a conservative approach and included variables with $p < 0.10$ in univariable analysis. To test for moderation, we fit multivariable logistic models that included main effects terms for the individual intervention groups, the predictor of interest, and the interaction term between the predictor variable and the combined intervention groups (usual care vs. any intervention). This method allowed the association between the predictor and screening outcomes to differ between the usual care group and combined intervention groups. An interaction term with $p < 0.05$ suggested the association differed between the usual care and combined intervention groups. Continuous variables were centered by subtracting the mean from each observation before being included in the regression models.

No variable had more than 1% missing data. Chi-square tests ($p < 0.05$) indicated that respondents with incomplete data ($n = 199$, 16%) were more likely to be older (≥65 years), retired, have prior CRCS at baseline, have Medicare or basic health insurance, and have lower scores on the social influence scale; however, there was no statistically significant difference in screening completion between participants with complete versus incomplete data. Participants with missing data on any of the variables included in a multivariable model were excluded.

Statistical analyses were conducted using Stata/SE 13.0 (College Station, TX).

Results

Any screening at year 1

Of 1247 participants who completed the survey, 765 (61%) completed CRCS at the end of Year 1 (Fig. 1). The majority of the screened participants completed FOBT (84%) vs. endoscopy (17%).

Univariable analysis (Table 1) showed that older age, race/ethnicity, more years of formal education, Medicare insurance, family history of CRC, no history of smoking, higher health rating, prior CRCS at baseline, physician recommendation for CRCS, test preference, higher self-efficacy, greater pros, fewer cons, more social influence, plans to be