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Validity of the Process of Change for Colorectal Cancer Screening Among African Americans

Katherine DuHamel, Ph.D.,

Department of Psychiatry and Behavioral Sciences, Memorial Sloan-Kettering Cancer Center, 641 Lexington Avenue, 7th Floor, New York, NY 10022, USA. Department of Oncological Sciences, Mount Sinai School of Medicine, One Gustave L. Levy Place, Box 1130, New York, NY 10029, USA

Yuelin Li, Ph.D.,

Department of Psychiatry and Behavioral Sciences, Memorial Sloan-Kettering Cancer Center, 641 Lexington Avenue, 7th Floor, New York, NY 10022, USA

William Rakowski, Ph.D.,

Department of Community Health & Program in Public Health, Brown University, 121 South Main Street, 2nd floor, Providence, RI 02912, USA

Parisa Samimi, B.A., and

Department of Psychiatry and Behavioral Sciences, Memorial Sloan-Kettering Cancer Center, 641 Lexington Avenue, 7th Floor, New York, NY 10022, USA

Lina Jandorf, M.A.

Department of Oncological Sciences, Mount Sinai School of Medicine, One Gustave L. Levy Place, Box 1130, New York, NY 10029, USA

Katherine DuHamel: duhamelk@mskcc.org; Yuelin Li: liy12@mskcc.org; William Rakowski: william_rakowski@brown.edu; Parisa Samimi: samimi.parisa@gmail.com; Lina Jandorf: lina.jandorf@mssm.edu

Abstract

Background—Process of change (POC) is a construct of the transtheoretical model that proposes to promote healthy behaviors.

Purpose—African Americans participate in colorectal cancer (CRC) screening less often than whites, while disease onset is younger, and incidence and mortality from CRC are higher.

Methods—POC items for CRC screening were administered to 158 African Americans, the majority of whom were female (75.9%) and were not employed (85.4%). Confirmatory factor analysis was used to validate four factors reflecting the POC sub-domains.

Results—Support of the factor validity of the POC with internal consistency of standardized alpha for the four factors was found. A logistic regression showed predictive validity in predicting current screening stage for two of the four sub-domains.

Conclusion—These data support the application of the POC to prediction of CRC screening intention among African Americans.

Keywords

Transtheoretical model; Process of change; Colorectal cancer; Screening; Validity

Introduction

In the USA, colorectal cancer (CRC) is the second most common cause of cancer death and the third most commonly diagnosed cancer among men and women [1]. Because survival is highly associated with the stage of cancer at the time of diagnosis, detecting CRC in its early stages is crucial. For those who have early-stage disease, the 5-year survival rate is 91.0% and 70.0% with regional disease. Furthermore, among those with metastatic/distant disease, only 11.3% survive five or more years [2]. Screening, along with the removal of polyps, has been proven to significantly decrease mortality [3]. Indeed, CRC has come to the foreground as a preventable cancer, with effective screening methods widely available. Despite the benefits of early detection of precancerous or cancerous cells, CRC screening remains low in the USA. Recent 2008 guidelines (a joint guideline from the American Cancer Society, the US Multi-Society Task Forces on Colorectal Cancer, and the American College of Radiology) recommend seven potential screening tests [3]. However, the authors of those guidelines concluded that structural screening tests which detect precancerous polyps and identify cancer, such as flexible sigmoidoscopy (FS) and colonoscopy, should be used [3]. Furthermore, the American College of Gastroenterology has designated colonoscopy as the “preferred strategy” based on research that suggests that FS in combination with fecal occult blood tests (FOBT) will unfortunately fail to detect advanced neoplasia in 25% of persons with the disease [4, 5]. However, the superiority of colonoscopy versus other methods of screening is currently under debate and as recently noted by Neugut and Lebwohl, the promise of colonoscopy should not be overstated without further data [6].

Although clinical research has demonstrated that CRC incidence and mortality can be reduced through appropriate screening, followed by relatively simple surgical procedures to remove polyps, and recent changes to reimbursement policies have been made, less than 60% of men and women in the USA who are at average risk for CRC undergo screening [7]. A low rate of CRC screening is particularly troubling for African Americans. The incidence rates of CRC in African American men and women are 72.6 and 55.0 per 100,000, respectively, while for white men and women, it is 60.4 and 44.0. In addition, African American mortality rates for CRC are higher, with an 83% 5-year survival rate, compared with whites with a 91% survival rate [8–12].

Growing evidence suggests that standard one-size-fits-all interventions are not sensitive to the diverse levels of motivation, depths of knowledge, or readiness to adopt a health behavior [13–15]. Interventions to increase a health behavior that present standard information in a single idiom and format do not ensure a match between what is presented and what the individual needs or can use. Interventions must be designed so that they can match the level of a person’s motivation/readiness to change.

Matching an intervention to the person’s stage of readiness for adopting a behavior is a critical premise of the trans-theoretical model (TTM) [16–18]. The TTM proposes that individuals move through a series of stages of deliberation and action in the process of deciding whether or not to adopt a particular preventive health behavior. Individuals in each stage have a distinct set of issues that determine whether or not they will adopt or maintain that behavior. Additionally, the model seeks to identify strategies used in each stage that will positively influence movement to the next stage (termed process-of-change [POC]). The TTM proposes that progress towards beginning and maintaining a positive health behavior

or stage of change is due in part to the POC. Three POC subscales were initially developed for breast cancer screening via mammography: commitment to screening, which represents a behavioral and attitudinal interest in having regular mammograms; information sharing and communication, representing seeking out information about mammography and talking about the procedure with others; and thinking beyond oneself, placing mammography in a context broader than one's own direct experience with, or reasons for, screening. In addition, as an indication of the woman's interaction with the health care system, a fourth POC representing a tendency to avoid the health care system was proposed [19, 20]. Rakowski and colleagues found support for the behavioral type processing clustering on a single component (commitment to screening), while the informational and experiential processes formed two other processes (information acquisition and thinking beyond oneself). They noted that although it is a limited set of processes, the POC for mammography are consistent with the informational and behavioral type processes for smoking cessation [21]. In a recent study by Pruitt and colleagues, the construct validity of the POC for mammography was supported as the a priori correlated four-factor model structure of the scale was confirmed with a large ($n=2,909$) sample of female veterans [19].

Constructs of the TTM (stage of change, cons/barriers, and pros/promoters and POC) have more recently been applied to CRC screening. In a specific example regarding FS, Brenes and Paskett found that women in the precontemplation and contemplation stages had significantly fewer positive beliefs (pros) and more negative beliefs/barriers (cons) about FS than women in the action/maintenance stage [22]. Rawl and colleagues [23] found that receipt of print materials tailored on benefits/pros and barriers/cons, as well as perceived susceptibility and self-efficacy, were associated with increased forward movement of stage of adoption as compared to the receipt of the non-tailored American Cancer Society brochure entitled, Colon Testing Can Save Your Life [24]. However, neither of these studies included the POC. Manne and colleagues [25] adapted Rakowski and colleagues' measures for mammography to CRC [20], resulting in three CRC specific POC subscales (factors): (a) commitment to screening, (b) information sharing and communication, and (c) thinking beyond oneself. Similar to mammography, they also included a fourth POC sub-scale: (d) avoidance of the health care system. They found that for siblings of individuals with early onset CRC, who are at higher risk for CRC due to having a family member diagnosed with CRC before age 56, two of the POC were correlated with CRC screening compliance, such that participants who were compliant had a higher commitment to screening and were less avoidant of the health care system [25]. They also found that those individuals in the later stages of adoption of screening had a higher commitment to screening. In a prior study conducted with low-income African Americans at average risk for CRC, our group found support for a relation of one of the POCs subscales, thinking beyond oneself, to adherence to CRC screening with FS [26]. However, that earlier study did not include screening colonoscopy and the POC construct validity was not tested. As noted by Spencer and colleagues [27], each TTM construct needs to be tested and validated within specific forms of cancer screening, as its application to one form of behavior/screening may be different from another form. The TTM also needs to be tested and validated among different ethnic/racial groups.

The reviewed research suggests that a print intervention which addresses the TTM constructs, including the POC, may increase colonoscopy adherence among African Americans. However, to facilitate the testing of such an intervention, the validity of the POC measures' score interpretation for CRC among African Americans needs to be established. As noted by the American Educational Research Association, measures need to include the rationale and evidence for the specific scores and score combinations (i.e., internal structure of the test) [28]. In the traditional nomenclature, this is called factorial validity and is one aspect of construct validity [29]. If the POC has good factorial validity among African

Americans at average risk for CRC, confirmatory factor analysis should result in the four proposed factors reflective of the four POC scales previously reported (Fig. 1). Based on prior research with the POC, the first hypothesis of the present study is that a first-order, four-factor structure will provide a better fit than either a single global factor or a four-factor structure with one higher, second-order factor in a sample of low-income African Americans who have never undergone screening colonoscopy. Another aspect of validity is predictive validity [29]. If the POC constructs have predictive validity, they will also be associated with stage of change. Thus, the second hypothesis of the present study is that the POC factors will be associated with stage of change.

Methods

Participants

Data for the present study were derived from the baseline assessment of a parent randomized clinical trial to enhance the stage of adoption for CRC screening in African Americans [30] as their CRC screening rates are low, indicating a need for intervention. The study was approved by the Institutional Review Board at both Mount Sinai Hospital and North General Hospital in New York City for recruitment in their internal medicine clinics. Participants were recruited from July 1, 2005 to February 29, 2008. Eligible patients included African American men and women over the age of 50, who were asymptomatic for gastrointestinal symptoms, needed CRC screening, and had a primary care physician (PCP). Participants who needed screening were defined as: (1) not having either a FOBT or FS within the last 5 years and (2) not having a colonoscopy within the last 10 years (all based on current American Cancer Society's CRC screening guidelines).

Out of the 237 individuals who were approached about the study, 67% agreed to participate. Seventy-seven individuals declined participation for various reasons, including reluctance to answer questions, the burden of too many medical tests, seeing no benefit to the study, and concern over protected health information. One person did sign the consent, but did not complete the interview, resulting in 159 participants. A more detailed description of the methods can be found in Christie and colleagues [30].

As one participant did not complete the POC measure of the survey, their data were not available, leaving 158 participants' data eligible for analysis for the present study. Baseline characteristics of these 158 participants are summarized in Table 1. Among the seven self-reported racial categories, the most endorsed category was Black/African American (87%). In addition, 85% of the study participants reported that they were unemployed. At the time of the study's initial interview, respondent's mean age was 56.95 (SD=7.03, range=50–91).

Procedures

As reviewed by Christie and colleagues [30], staff determined eligibility for CRC screening through chart review before each clinic visit. The clinic staff then gave informational flyers to the eligible patients. If the patient was interested in participating in the study, consent was obtained by a trained Research Assistant. The 45-min baseline interview was conducted immediately before the patient's visit with their primary care physician. Participants received \$20.00 after completing the study interview.

For the overall trial, the PCP recommended screening colonoscopy to the participant and gave the patient a sealed envelope containing information about CRC screening, specifically colonoscopy, during the participant's scheduled appointment. Therefore, the primary CRC screening indicator was the participant's stage of change prior to any intervention.

Analytic Strategy—Confirmatory factor analysis (CFA) was applied to fit the data to three alternative models: (1) a priori correlated four-factor model [19, 20], (2) a model with four first-order factors plus one second-order factor, and (3) a model with a single first-order factor. Figure 1 shows three model diagrams, with the top diagram showing the least restrictive model 3. Model 3 postulates that all POC 21 items are mapped onto one single underlying dimension. Model 2 adds four additional underlying dimensions to model 3. Thus, model 2 is considered “nested” within model 3 [31]. Finally, model 1 drops the second-order dimension in model 2. Model 1 is thus nested within model 2.

Modeling was carried out using SAS v9.1 PROC CALIS procedure. Model fit was evaluated by the following statistics, including the chi-square goodness of fit, the non-normed fit index (NFI) [32], and the comparative fit index (CFI) [33]. Additional fit indices included the root-mean-square error of approximation (RMSEA) [34] and the root-mean-square residual (RMR). Generally, we followed recommendations in the literature that NFI and CFI values greater than 0.90 are taken to indicate good fit, as is a RMSEA less than 0.08 and a RMR less than or equal to 0.05 [35]. However, we did not simply apply these absolute model fit criteria rigidly because they may be of limited practical usefulness due partly to constraints in our relatively modest sample size. We also considered the relative magnitude of the model fit statistics in evaluating the merits of the alternative models.

The chi-square difference test was used to compare the relative fit of nested models [31]. Generally, we compared the chi-square statistics between a more restrictive model and a less restrictive model (e.g., model 2 versus model 3). Typically, a more restrictive model such as our model 2 consumes more degrees of freedom because of the additional model parameters. Thus, our model 2 is not preferred over model 3 unless the additional model parameters improve model fit significantly. This can be tested formally by comparing the difference of the chi-square statistics between models 2 and 3. Moreover, because the alternative models were tested using model maximum likelihood, Akaike’s information criterion (AIC) provides another index of relative fit of nested models (smaller AIC indicates better fit). In addition, the modified Bonferroni procedure [36] was used because it is superior to that of the conventional Bonferroni adjustment. In the modified Bonferroni procedure, the overall type-I error rate remains at 0.05, while reduces the chance of an overly conservative conventional Bonferroni test.

Measures

Stage of Adoption—Stages of adoption define a person’s current behavior, as well as monitor any intentions to change or continue the behavior. Participants were assessed on their readiness to undergo CRC screening via colonoscopy. Questions specific to each stage of change provide feedback on the participant’s behaviors, intention to undergo CRC screening via colonoscopy, and physician recommendations for the screening. The TTM [16, 20] delineates five stages of adoption: precontemplation, contemplation, preparation, action, and maintenance. In addition, people can relapse from a more advanced stage to a stage earlier on the continuum. Rakowski and colleagues [20] had adapted the stages of adoption and the processes of change for breast cancer screening, specifically mammography and for CRC [25]. In the present study, all participants never had a colonoscopy (part of the eligibility requirements) and were asked if they ever thought about having a colonoscopy (yes or no) and if so what were their plans (i.e., decided against it, thought about it but not in the past year, thinking about having a colonoscopy sometime within the next year, plan to have it within the next month, or already had a colonoscopy appointment scheduled). Precontemplation is defined as a person who is not considering CRC screening whether they are aware or unaware of the process. Contemplation is defined as a person considering screening within the coming year, and preparation is defined as a

person with an appointment scheduled for CRC screening. Participants were categorized into those who were in precontemplation ($n=66$), and those who were in contemplation/preparation ($n=92$). Based on the TTM, those who are in precontemplation (who are not considering CRC screening) are hypothesized to be lower on the POC factors as compared to those in contemplation and preparation (those who are considering screening within the coming year and/or who have an appointment scheduled for CRC screening).

Processes of Change—Four POC factors assessed participant's use of strategies for behavior change, based on the original version by Rakowski and colleagues for breast cancer screening via mammography [20] (for the first three factors: "commitment to screening," "information acquisition," and "thinking beyond oneself"), plus a fourth factor ("avoids contact with health care") examined by both Rakowski and colleagues and Manne and colleagues [20, 25]. The items used in assessing the first three factors are consistent with the items in Rakowski [20] (p. 91, Table V). The items for the fourth factor are the same as those reported by Manne and colleagues [25]. The statements are listed in Table 2. Three of these POC factors are specific to CRC screening behavior and include: commitment to screening (six items, $\alpha=0.77$, e.g., "I make plans so that I have enough time for a colorectal cancer test"); information sharing and communication (six items, $\alpha=0.66$, e.g., "I can talk to at least one other person about colorectal cancer tests"); and thinking beyond oneself (five items, $\alpha=0.61$, e.g., "I sometimes think of ways that could get more people to have colorectal cancer tests"). The fourth, avoids contact with the health care system (four items, $\alpha=0.62$), measures a person's general propensity to avoid contact with the health care system [20] by using, for example, home remedies or self-care, rather than refer to health care providers (e.g., "When I am sick, I try to cure myself rather than go to the doctor"). Participants rated each of the POC items on a five point scale (1 = strongly disagree, 2 = moderately disagree, 3 = undecided, 4 = moderately agree, 5 = strongly agree). One item in the avoids contact with the health care system subscale was recorded ("I keep a record so that I know when to plan my next visit to the doctor") before items were entered into the CFA.

To examine whether or not skewed raw responses affected model selection, we conducted CFA using both the raw response data and square-root transformed data and found no discernible differences in the fit statistics we sought. We opted to report the analyses based on raw data because the subscales derived from the raw data are more readily interpretable than the square-root transformed scores.

Results

Table 3 summarizes the descriptive statistics (means, standard deviations, and measures of skewness and kurtosis) and pairwise Pearson correlation coefficients, calculated from the raw responses of the 21 items (item 21 is reverse coded). To boost clarity of data presentation, items were grouped by the underlying factors in our best fitting model described below. Overall, the pattern of pairwise correlation coefficients did not depart considerably from expected. For example, item 2 "I'm disappointed with myself if I know I am late in having a CRC test," belonging to the construct of commitment to screening was best correlated with another item of the same construct, item 14 "I know I will feel better about myself if I have a CRC test." However, responses to individual items were not normally distributed, as was indicated in the skewness and kurtosis measures.

Investigation of Models of POC

Table 4 summarizes the fit indices for the three alternative models. Overall, among the three alternative models, model 1 (a priori 4-factor model) showed fit indices closest to the criteria

of good model fit (CFI=0.78; NFI=0.76, AIC=-7.36, RMSEA=0.08, RMR=0.09). These fit indices were superior in comparison with the fit indices of model 3 (single common factor model, CFI=0.64, NFI=0.60, AIC=133.40, RMSEA=0.10, RMR=0.10) and model 2 (second-order model, CFI=0.61, NFI=0.57, AIC=110.64, RMSEA=0.10, RMR=0.16).

The chi-square difference tests using the modified Bonferroni procedure also indicated the superiority of the four independent factor model by contrasting the chi-square differences in the single-factor model ($\chi^2_{[df=3]}=124.01, p < 0.0001$) and the second-order model ($\chi^2_{[df=4]}=148.77, p < 0.0001$). Based on the a priori 4-factor model, the underlying factor domains were labeled as “Commitment to Regular Screening,” “Information Sharing and Communication,” “Thinking beyond Oneself,” and “Avoids Contact with the Health Care System.”

Table 5 shows that the standardized factor loadings range from 0.11 (“Keep Record” on factor 4) to 0.88 (“Home Remedies” on factor 4) in these domains, with most of the standardized factor loadings greater than 0.40. The correlations among the first three factors ranged from 0.47 to 0.92. The fourth factor was negatively correlated with the first three at -0.38, -0.28, and -0.17, respectively (expected due to the directional wording and coding of the items).

Construct Validity of the POC

We found support of factor validity of the a priori 4-factor model (i.e., RMSEA=0.08, RMR=0.09, and CFI=0.785). Internal consistency by Cronbach’s alpha, although not strong (generally, an alpha of 0.70 is considered to be strong), supported the four-factor model, with standardized alpha for the four domains at 0.77, 0.66, 0.61, and 0.62, respectively.

Predictive Validity

We calculated subscale scores by averaging item responses within each factor. Thus, each subscale score is mapped onto a 1 to 5 scale. The POC subscale scores were associated with stage of change/readiness for undergoing colonoscopy such that those who were in the preparation/contemplation stages were higher on subscale scores representing commitment to regular screening, information sharing, and communication and thinking beyond oneself compared to those in the precontemplation stage and were lower on avoiding the health care system. Table 6 also illustrates the significant Wilcoxon rank sum tests supporting the predictive validity of four POC subscales.

Based on the findings in Table 6 that all four individual POC subscale scores were significantly different between stages of precontemplation versus preparation/contemplation, we further investigated the influence of subscale scores for all four POC domains simultaneously. Because the four subscale scores were correlated, a subset of the subscale scores might show a particularly strong association on the stages of change outcome. We used a logistic regression to examine the influence of the four subscale scores on the probability of reaching the stage of preparation/contemplation, controlling for age, education (HS graduate or GED versus higher), and income (\$10,000–\$14,999 versus higher). Table 7 shows that when controlling for other factors, education was a statistically significant predictor of stage (OR=0.332, 95% CI=1.39–0.796). Moreover, after controlling for age, sex, education, and income, two of the four subscale scores showed strong influence on preparation/contemplation: “Thinking Beyond Oneself” (OR=2.026, 95% CI=1.169–3.510) and “Avoid Contact with the Health Care System” (OR=0.543, CI=0.375–0.786).

Relations of Sociodemographic Variables with POC

We further investigated the associations of sociodemographic variables with POC subscale scores. The sociodemographic factors analyzed were age, gender, education level, employment status, income, and marital status. Age was dichotomized into 50–64 versus 65+ based on results in prior research that those who were 65 years and older had higher rates of CRC screening as compared with those who were 50 to 64 [37]. Univariate analysis did not find significance for any of the sociodemographic factors with regards to POC (results not shown).

Discussion

CRC screening is an effective way to reduce the incidence and mortality of CRC. African Americans participate in CRC screening less often than whites, while disease onset is younger, and incidence and mortality rates from CRC are higher [8–12]. The TTM has been used to promote behavior change and to inform interventions to increase CRC screening. A critical component of the TTM is the POC; however, the factor validity of the POC for CRC screening among African Americans has not been investigated. The first hypothesis of the present study is that a first-order four-factor structure will provide a better fit than either a single global factor or a four-factor structure with one higher, second-order factor in a sample of low-income African Americans who have never undergone screening colonoscopy.

Confirmatory factor analysis supports the first study hypotheses and provides support for the validity of the four factors reflecting the POC sub-domains among 158 African Americans at average risk for CRC. Support of factor validity of the POC with internal consistency of standardized alpha for the four factors was found. A logistic regression showed predictive validity in predicting current screening stage for two of the four sub-domains. These data support the application of the POC to CRC screening intent among African Americans at average risk for CRC and support the use of this measure in the design and assessment of interventions to increase CRC screening.

Three types of models were examined for goodness of fit with the POC items: a single global factor model (implying a unidimensional latent construct), a four-factor structure with one second-order factor (implying a second-order common dimension affecting four independent domains), and a first-order four-factor structure (implying a multidimensional latent construct with four correlated domains). Although all three models demonstrated significance, the first-order four-factor structure was found to be superior because of better overall model fit as shown in several fit indices and smaller residual errors. The main implication is that POC items map onto a psychological construct with four correlated underlying dimensions/factors.

The second study hypothesis, that the POC factors will be associated with stage of change, was supported in that all four POC subscales were significantly different between stages of precontemplation versus preparation/contemplation. Because the four factors were correlated, logistic regression examined the influence of the four factors' scores on the probability of being in the preparation/contemplation stage and "Thinking Beyond Oneself" and "Avoids Contact with the Health Care System" were found to be significant. These data suggest that if an intervention seeks to increase intention for CRC screening, those in precontemplation (a person who is not considering CRC screening whether they are aware or unaware of the process) may be encouraged to move toward the stage of contemplation (a person considering screening within the coming year) and/or preparation (a person with an appointment scheduled for CRC screening) if these POC factors are addressed. The multivariate logistic regression model also shows that preparation/contemplation is affected

more by “Thinking Beyond Oneself” and “Avoids Contact with the Health Care System” after the influences of “Commitment to Regular Screening” and “Information Sharing and Communication” have been accounted for. Efforts to boost regular CRC screening may be more efficacious if the intervention emphasizes the altruistic and familial aspects of screening (e.g., you are doing it not only to protect yourself, but also to protect your family and other loved ones) and helps to eliminate avoidance barriers (e.g., streamlining the process of making and keeping an appointment; a patient navigator who provides person-to-person guidance).

The study results are consistent with the findings of Manne and colleagues [25] that CRC screening compliance is associated with less health care avoidance. Additionally, the results also extend their findings with high risk individuals (siblings of CRC patients) to African Americans at average risk for CRC who are at early and preparatory stages of intention to undergoing CRC screening.

This study did not provide support for any associations between the POC items and age, gender, education level, employment status, income, and marital status. However, the results did indicate that education was associated with stage, such that those individuals with a high school degree or less were more likely to be in precontemplation, suggesting interventions may need to underscore the importance of screening in messages that take into consideration factors such as health literacy, numeracy, and ease of conversation with health care providers. The objective is to facilitate information acquisition, recall, and likelihood to schedule an appointment. Tangible reminder prompts may also be an asset. Prior studies investigating the association of TTM constructs and sociodemographic constructs have presented mixed results. In applying the TTM to female and male perpetrators of intimate partner violence, Babcock and colleagues [38] found that POC strategies were related to stage of change with individuals in more advanced stages of change using more behavioral and experimental strategies to become nonviolent. This finding supports the importance of the relation of POC strategies and stage of change in other populations. The researchers also found that men at more advanced stages reported using more social liberation strategies (e.g., increasing awareness or nonviolent alternative behavior) whereas women at more advanced stages used less social liberation as a behavioral strategy. Although their study did not address the factor validity of the POC score interpretations, it suggests that intervention studies may need to examine whether different POC strategies are related to stage of change based on gender. POC factors also need to be tested for validity across all stages of change for CRC screening. Pruitt and colleagues [19] have found that POC items do demonstrate construct validity across all stages of change with mammography.

Clinical Implications

Past research has demonstrated that health promotion interventions, which are tailored or targeted to the population of interest, are more effective than standard or non-tailored/non-targeted interventions [13–15]. Interventions based on the TTM can be created through a greater understanding of the application of POC strategies to CRC screening, via colonoscopy, for African Americans. Using the focus group findings from the referenced parent study, Freeman and colleagues [39] tailored CRC screening brochures to the African American population by utilizing the TTM components, including the POC. For example, the educational materials emphasized commitment to screening and thinking beyond oneself. Such adapted interventions could help increase CRC screening among African Americans, decreasing the significant burden of CRC incidence and mortality within this population. Such interventions should also consider the significant barriers rooted within the health care system, such as health care policies and economic constraints, which may stand in the way of low-income African Americans participation in cancer prevention and early detection services. In addition to system barriers, intrapersonal barriers to completing CRC

screening, such as fear, pain, and embarrassment as well as lack of knowledge, cancer fatalism, and medical mistrust, need to be considered [40–42].

Study Limitations, Strengths, and Areas for Future Research

Study limitations point to additional areas in need of future research. For example, the study was conducted with a relatively homogenous group of participants in regards to sociodemographic characteristics (e.g., low-income and -education levels) and geography (urban NYC). There was also a 67% response rate that may impact the generalizability of the findings. There may be slight, or even vast, differences between African Americans in different parts of the USA and certainly across the world. Measurement issues may be substantially different in populations with different socioeconomic positions, gender, age, and ethnicity. Research that accounts for greater geographic and sociodemographic diversity is needed to examine this possibility. In addition, this study had too small of a sample size to accurately investigate the effects of gender on the POC items. Studies using a larger sample size would allow for accurate analysis of whether factor validity is affected based on sociodemographic characteristics such as gender, as well as if the associations of POC strategies and stage of change vary based on sociodemographic factors.

Manne and colleagues [25] developed the POC items for CRC screening research; however, in this study, the items were slightly different (as reviewed above) and are consistent with the items developed for mammography. For example, Rakowski and colleagues' [20] research with mammography used six items for commitment to screening like the present study, in contrast to Manne and colleagues' four-item measure. Both Rakowski and colleagues and Manne and colleagues reported an alpha of 0.80 for commitment to screening in contrast to that of 0.77 in the present study. Thus, the Cronbach alphas for the POC items in this study were slightly lower than the alphas in previous studies, although they were adequate. The alphas in the present study are a study limitation and suggest that further item development may be needed. In addition, with a larger sample the alphas may have a narrower confidence interval that would indicate more precisely what their true magnitude may be.

Despite the study limitations, this study addresses an understudied area—the validation of TTM measures among different cancer screening procedures and among different ethnic/racial groups. In this first study addressing the construct validity of the POC strategies among African Americans, support for the application of this measure with African Americans was found. This study adds to the research applying POC to CRC screening and supports the use of the POC among African Americans at average risk for CRC (in contrast to predominately white siblings at-risk for CRC in Manne and colleagues' study). These results support the use of this measure in research with African Americans and in intervention trials designed to increase CRC screening among African Americans.

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Fig. 1.
Process-of-change item cluster models

Table 1

Demographic information of participants

Characteristic	Total sample (n=158)	
	Frequency	Percentage (%)
Age		
50–64	140	88.6
65+	18	11.4
Gender		
Male	38	24.1
Female	120	75.9
Marital status		
Married/partner	36	22.8
Divorced/separated	50	31.7
Never married	53	33.5
Widowed	19	12.0
Race ^a		
Black/African American	137	86.7
Black/African	4	2.5
Black—West Indian/Caribbean	10	6.3
Black—Other	9	5.7
American Indian or Alaskan native	7	4.4
White	0	0
Other ^b	2	1.3
Education level in years		
High school grad or less	93	58.9
More than high school	65	41.1
Employment		
Yes	23	14.6
No	135	85.4
Income		
Less than \$10,000	73	46.2
More than \$10,000	85	52.0
Insurance ^a		
Medicaid	109	69.0
Medicare	33	20.9
Employer-provided insurance	17	10.8
Do not have health insurance	3	1.9

^aNumbers do not total 158 due to participant's ability to indicate more than one race and more than one type of insurance

^bTwo participants wrote in Central American and Human

Table 2

Index of processes of change

Process-of-change index	Statement wording
A. Commitment to regular screening	
Item 2	I am disappointed with myself if I know I am late in having a colorectal cancer test.
3	I think about how much these tests help a person's health.
7	If the doctor or health professional said I did not need a colorectal cancer test, I would ask again at another visit.
10	I make plans so that I have enough time for a colorectal cancer test.
14	I know I will feel better about myself if I have a colorectal cancer test.
15	I try to have colorectal cancer tests regularly.
B. Information sharing and communication	
16	If I have questions about colorectal cancer tests, I try to get answers.
4	If a friend plans to have a colorectal cancer test, I would say it is a good idea.
8	Having regular colorectal cancer tests shows that you are keeping up to date with changes in health care.
9	I know that even if a colorectal cancer test finds nothing, I am much better off than if I did not have one.
12	I can talk with at least one other person about colorectal cancer tests.
17	If I hear something bad about colorectal cancer tests, I try to get the facts and decide for myself.
C. Thinking beyond oneself	
1	I am disappointed if my doctor or health professional does not remind me to have a colorectal cancer test.
5	I talk about colorectal cancer tests with my friends.
6	I sometimes think of ways that could get more people to have colorectal cancer tests.
11	I think I could come up with some ideas that could get doctors or other health care professionals to recommend colorectal cancer tests more often.
13	People will be pleased if I have a colorectal cancer test.
D. Avoids Contact with the Health Care System	
18	When I am sick, I try to cure myself rather than go to the doctor.
19	I rely more on home remedies than on doctors.
20	If I feel well, I do not go to the doctor for a regular check-up.
21 [reversed]	I keep a record so that I know when to plan my next visit to the doctor.

Table 3

Descriptive statistics of process-of-change items and pairwise Pearson correlations ($n=158$)

POC factors and items	M	SD	Skew	Kurt	Corr	2	3	7	10	14	15	4	8	9	12	16	17	1	5	6	11	13	18	19	20	21rev	
Commitment to regular screening																											
2. Disappointed with self	3.87	1.33	-0.99	-0.33	0.42	-																					
3. Test help health	4.54	0.89	-2.5	6.69	0.51	0.306	-																				
7. Ask again	3.84	1.48	-0.99	-0.52	0.48	0.342	0.283	-																			
10. Enough time	4.25	1.08	-1.5	1.52	0.57	0.269	0.515	0.333	-																		
14. Feel better	4.66	0.80	-3.0	9.88	0.63	0.452	0.483	0.441	0.466	-																	
15. Tests regularly	3.33	1.46	-0.33	-1.2	0.42	0.184	0.285	0.302	0.441	0.323	-																
Information sharing and communication																											
4. Encouraging friend	4.57	0.83	-2.6	7.63	0.38	0.312	0.325	0.238	0.447	0.321	0.185	-															
8. Up-to-date	4.62	0.85	-2.8	8.00	0.44	0.255	0.189	0.351	0.195	0.275	0.045	0.218	-														
9. If tested better off	4.64	0.78	-2.8	8.75	0.52	0.407	0.439	0.378	0.454	0.652	0.232	0.356	0.482	-													
12. Talk with others	4.46	1.19	-2.2	3.35	0.20	0.133	0.062	0.163	0.108	0.258	-0.003	0.097	0.135	0.219	-												
16. Questions answers	4.47	0.86	-2.0	3.90	0.37	0.228	0.284	0.281	0.417	0.360	0.255	0.149	0.322	0.354	0.126	-											
17. Get the facts	4.50	0.89	-2.2	4.99	0.37	0.310	0.197	0.232	0.165	0.168	0.034	0.402	0.260	0.186	0.090	0.255	-										
Thinking beyond oneself																											
1. Disappointment doctor	3.43	1.50	-0.47	-1.3	0.15	0.470	0.170	0.277	0.239	0.287	-0.010	0.129	0.124	0.258	0.068	0.104	0.190	-									
5. Talk with friends	2.91	1.54	0.02	-1.5	0.34	0.022	0.155	0.265	0.233	0.180	0.452	0.132	0.118	0.125	-0.035	0.187	0.025	-0.026	-								
6. Getting people tested	2.73	1.47	0.17	-1.4	0.53	0.116	0.189	0.368	0.195	0.176	0.390	0.130	0.133	0.104	-0.073	0.134	0.044	0.035	0.521	-							
11. Ideas recommend	3.24	1.30	-0.26	-0.93	0.48	0.223	0.257	0.358	0.191	0.231	0.328	0.161	0.118	0.185	-0.034	0.199	0.180	0.224	0.218	0.526	-						
13. People pleased	4.07	1.23	-1.2	0.35	0.35	0.309	0.264	0.344	0.212	0.270	0.168	0.142	0.233	0.344	0.188	0.263	0.119	0.230	0.199	0.244	0.248	-					
Avoids contact with health care system																											
18. Self-cure	2.56	1.73	0.46	-1.6	0.53	-0.154	-0.168	-0.054	-0.267	-0.206	-0.224	-0.094	-0.020	-0.109	-0.028	-0.116	-0.070	-0.064	-0.016	-0.119	-0.105	0.036	-				
19. Home remedies	2.25	1.50	0.79	-0.94	0.55	-0.121	-0.210	-0.125	-0.359	-0.219	-0.213	-0.144	-0.131	-0.199	0.008	-0.187	-0.092	-0.070	-0.163	-0.126	-0.024	-0.023	0.635	-			
20. Feel well no doctor	2.41	1.62	0.57	-1.4	0.46	-0.118	-0.122	-0.169	-0.135	0.103	-0.108	-0.097	-0.124	-0.125	-0.110	-0.132	-0.193	-0.182	-0.092	-0.045	-0.013	-0.152	0.390	0.382	-		
21. [rev] Keep record	1.91	1.38	1.4	0.37	0.14	-0.079	-0.109	-0.080	-0.061	-0.093	-0.076	-0.053	0.067	-0.002	0.085	-0.085	-0.225	-0.070	-0.107	-0.079	-0.104	-0.105	0.060	0.082	0.209	-	

Table 4

Goodness of fit for process-of-change models ($n=158$)

Model	χ^2	p	df	RMSEA	RMR	NFI	CFI
Model 3: single common factor	488.63	<0.0001	189	0.0896	0.0954	0.5985	0.6386
Model 2: second order + 4	513.40	<0.0001	190	0.1041	0.1610	0.5689	0.6100
Model 1: a priori 4- factor model	364.63	<0.0001	186	0.0782	0.0895	0.7568	0.7846

The model χ^2 statistics differences offered a more formal test between nested models (lower χ^2 statistics indicates better model fit). Model 1 was deemed the best fitting model among the three alternative models because it was associated with the lowest χ^2 of 364.63. Model 1 had a statistically significantly lower χ^2 statistic than that of model 3 ($\chi^2_{diff}=124$, $df=3$, $p<0.001$). Model 1 also had a statistically significantly lower χ^2 than that of model 2 ($\chi^2_{diff}=148.77$, $df=4$, $p<0.001$)

Table 5

Standardized factor loadings and factor correlations

Process-of-change index	Statement	Factor 1: Commitment	Factor 2: Information	Factor 3: Beyond	Factor 4: Avoid
A. Commitment to regular screening					
	Disappointment Myself	0.54 (–) ^a			
	Tests Help Health	0.62 (0.15)			
	Ask Again	0.60 (0.15)			
	Enough Time	0.68 (0.15)			
	Feel Better	0.75 (0.15)			
	Tests Regularly	0.48 (0.15)			
B. Information sharing and communication					
	Questions Answers		0.51 (0.16)		
	Encouraging Friend		0.51 (0.16)		
	Up-To-Date		0.79 (0.16)		
	If Tested Better Off		0.26 (0.16)		
	Talk with Others		0.54 (–)		
	Get the Facts		0.36 (0.16)		
C. Thinking beyond oneself					
	Disappointment Doctor			0.50 (–)	
	Talk with Friends			0.51 (0.17)	
	Getting People Tested			0.70 (0.17)	
	Ideas Recommend			0.67 (0.17)	
	People Pleased			0.47 (0.17)	
D. Avoids contact with the health care system					
	Self-Cure				0.60 (–)
	Home Remedies				0.88 (0.23)
	Feel Well No Doctor				0.43 (0.16)
	Keep Record				0.11 (0.16)
Factor Correlations (with standard errors)					
	Factor 1: Commitment	1.0 (0.049)	0.92 (0.047)	0.69 (0.041)	–0.38 (0.035)
	Factor 2: Information		1.0 (0.049)	0.47 (0.038)	–0.28 (0.034)

Process-of-change index	Statement	Factor 1: Commitment	Factor 2: Information	Factor 3: Beyond	Factor 4: Avoid
	Factor 3: Beyond			1.0 (0.049)	-0.17 (0.033)
	Factor 4: Avoid				1.0 (0.049)

^aStandardized factor coefficients and the standard errors of the coefficients. Entries marked with (–) were constrained at a raw factor coefficient of 1.0 and thus, yielded no standard error estimates

Table 6

Average factor scores of the four domains

	Precontemplation <i>n</i> =66	Preparation/contemplation <i>n</i> =92	<i>p</i> value ^a
Commitment ^b	3.78 (0.96)	4.30 (0.57)	0.0008
Information	4.44 (0.51)	4.61 (0.56)	0.0062
Beyond	2.95 (0.89)	3.51 (0.80)	0.0002
Avoid	2.72 (1.03)	1.96 (1.00)	0.0001
Age	57.69 (7.84)	56.50 (6.40)	0.28
Sex (Female)	79%	74%	0.45
Education ^c	63%	75%	0.09
Income ^d	33%	36%	0.69

Data are means and standard deviations unless otherwise noted

^a *p* values for continuous variables are based on a two-sided Wilcoxon rank sum test between two independent samples; *p* values for dichotomous variables are based on a chi-square test

^b Each factor is scored on the scale of a lowest possible score of 1.0 and a highest possible score of 5.0

^c HS graduate or GED versus higher

^d \$10,000–\$14,999 versus higher

Table 7

Logistic regression of preparation/contemplation versus precontemplation as a function of the respondent's characteristics and the four domains of processes of change

	Coefficient	Odds ratio	95% CI of OR	<i>p</i> values ^a
Intercept	−1.05	–	–	–
Age	−0.01	0.987	0.939–1.038	0.622
Sex (Female)	−0.03	0.936	0.382–2.293	0.884
Education ^b	−0.55	0.332	0.139–0.796	0.013
Income ^c	−0.21	0.656	0.285–1.508	0.321
Commitment	0.69	1.997	0.969–4.116	0.061
Information	−0.38	0.684	0.299–1.569	0.370
Beyond	0.71	2.026	1.169–3.510	0.012
Avoid	−0.61	0.543	0.375–0.786	0.001

^a *p* values calculated from the Wald chi-square statistic

^b HS graduate or GED versus higher

^c \$10,000–\$14,999 versus higher