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What are the effects of colorectal cancer screening interventions among Asian Americans? A meta-analysis

Sophia B. Kim[a] and Minji Kang[b]

[a]Myron B. Thompson School of Social Work, University of Hawaii at Manoa, Honolulu, HI, USA; [b]Center for Gendered Innovations in Science and Technology Researches (GISTeR), Korea Federation of Women's Science & Technology Associations, Seoul, Republic of Korea

ABSTRACT

Objective: Great strides have been made to conduct intervention studies aimed at increasing colorectal cancer (CRC) screening rates that are informed by sound theoretical frameworks and conducted using rigorous methodologies; however, efforts are still gaining wave to understand the efficacy of theory-based interventions among Asian American (AA) population. The purpose of this study was to report the results of a meta-analysis conducted on the effects of CRC screening interventions.

Methods: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were used to evaluate the CRC screening interventions. Literature search was performed on October 2018, and studies published in English and conducted in the United States were eligible for inclusion if they (1) conducted interventions with aims to increase CRC screening rates among AA and (2) utilized a randomized control trial or quasi-experimental study design, (3) reported quantitative screening rates following the intervention, and (4) included a comparison or control group for comparison. No publication year restriction was applied.

Result: In total, 14 Odds Ratio (OR) from 16 studies were included in the meta-analysis. Overall, results indicated that AA participants who received the screening interventions aimed at improving screening were 1.78 times more likely to obtain a CRC screening at post-intervention compared to those in the control or comparison group, OR = 1.78 (1.44, 2.11).

Conclusion: Understanding the efficacy of interventions designed to promote CRC screening among AA population is imperative to decrease CRC burden and mortality. Although research in this area is limited, this review sheds light on important socio-cultural strategies to developing a CRC screening intervention aimed at increasing screening rates among AA. Findings in this review demonstrate that improvement in screening can be achieved through a variety of ways, but the common feature across all the studies was the culturally responsive foundation of their respective interventions.

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CONTACT Sophia B. Kim sophiabk@hawaii.edu

Introduction

According to studies analyzing Surveillance, Epidemiology, and End Results (SEER) registries data, racial/ethnic groups are diagnosed with colorectal cancer (CRC) at a significantly earlier age and at more advanced stages when compared with non-Hispanic White (NHW) (Ellis et al. 2018; Rahman et al. 2015). Particularly for Asian American (AA), CRC continues to burden this heterogeneous population's health. For instance, a study showed that although the adjusted rates of mortality from CRC were slightly lower for AA than NHW, the difference was not as large compared to other cancer types (Thompson et al. 2016). Overall CRC incidence rate has been decreasing over time, however, disparities have remained persistent (Thompson et al. 2016; Ladabaum et al. 2014). Studies show that Japanese males and females have the highest CRC incidence rates (Thompson et al. 2016) when compared to NHW and other AA subgroups (i.e. Chinese, South Asians, Koreans, Filipino, and Vietnamese) (Jin et al. 2015). What is more troubling is that for some Southeast Asians (i.e. Vietnamese, Thai, Cambodian, Hmong, and Laotian), increasing CRC incidence was observed over the period 1990–2014 (Ellis et al. 2018).

There is strong evidence that regular CRC screening is essential for the prevention and early diagnosis of CRC. According to the US Preventive Services Task Force (USPSTF 2015), CRC screening recommendation that received a letter grade 'A' is to begin screening for asymptomatic average-risk adults at age 50–75. Several tests that detect CRC are available and include invasive procedures (i.e. colonoscopy and sigmoidoscopy) and non-invasive procedures: (i.e. CT colonography ['virtual colonoscopy'] and stool-based tests [fecal occult blood test, fecal immunochemical test, and stool DNA test]) (USPSTF 2015). Despite the different screening options, study findings have shown consistently low CRC screening participation (Lee et al. 2011; Liss and Baker 2014; Wong et al. 2005) and survival rates among AA (Lin et al. 2002). A study by Le et al. (2009) further disaggregated the survival differences among Asian subsets using the California Cancer Registry (CCR) which is part of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program and found that colon cancer survival improved for only Chinse and Filipino individuals. Another study's findings showed that Japanese had significantly better survival rates than NHW, while Koreans did not (Trinh et al. 2015). These differences can indicate screening disparities by ethnic subgroup and correspond with findings that showed Koreans as being the most disadvantaged AA subgroup with regards to CRC screening adherence (Lee et al. 2011; Oh and Jacobsen 2014).

Historically, data on AA subgroup's health behavior and health outcomes have been unknown or misunderstood. Inadequate sampling, data collection strategies, and the aggregation of AA subgroups when conducting analyses have resulted in the mis-extrapolation of findings for specific subgroups (Holland and Palaniappan 2012). However, efforts have gone underway to improve accurate data collection. First, it is imperative to recognize that AA as a single category is a tremendously diverse population that is comprised of people: (1) having origins in the Far East, Southeast Asia, or the Indian subcontinent (Office of Minority Health [OMH] 2019) and (2) speaking over 100 languages/dialects (Census 2019). In 2017, AA represented approximately 22.2 million of the US population with Chinese (5 million) being the largest ethnic group, followed by Asian Indian (4.4 million), Filipino (4 million), Vietnamese (2.1 million), Korean (1.9 million), and Japanese

(1.5 million) (Census 2019). Moreover, federal efforts were initiated to improve the collection of AA health data by highlighting the need to disaggregate data by AA ethnic subgroup (Holland and Palaniappan 2012). Since then, significant efforts have been made to understand the determinants of health behavior including CRC screening practice among AA subgroups. Previous studies showed that common reasons for not being screened across local Asian Indian, Chinese, Filipino, Hmong, Japanese, Korean, and Vietnamese American communities included the cultural tradition of not being seen by the doctor until sick (31%), no health insurance (31%), or a perceived lack of need (20%) (Wu et al. 2010). Moreover, a systematic literature review informed by the health belief model examined predictors of CRC screening across multiple AA subgroups and found different determinants influencing screening practice for Chinese, Filipino, Korean, and Japanese Americans (Kim 2017). The review also showed that physician recommendation was a cue to action that increased the odds of screening, and those reporting 'not having problems/symptoms' was an example of a predisposing characteristic that decreased the odds of screening for the aggregate AA (Kim 2017).

In the early 2000s, federal efforts were increased to mitigate AA cancer health disparities. The unique characteristic of AA has been that they are the first racial/ethnic group to experience cancer as the leading cause of death (Chen, Chow, and Nguyen 2018). CRC, in particular, has been reported to be the 2nd leading cause of cancer-related mortality among aggregated AA males and 3rd leading cause of mortality for AA females (Thompson et al. 2016). In 2000, the National Cancer Institute (NCI) funded grant recipients to address community needs for cancer awareness and promote training and research opportunities to racial/ethnic researchers (Chen, Chow, and Nguyen 2018). Asian American Network of Cancer Awareness Research and Training (AANCART), a center devoted to reducing AA cancer health disparities was one of the recipients. Through their initiatives, evidence-based culturally specific materials were developed to increase screening knowledge and to reduce cancer disparities using community-based participatory education, training, and research (Chen, Chow, and Nguyen 2018). Given the burden CRC continues to have among the AA population, researchers and community partners developed interventions targeted to specific subgroups. Culturally appropriate and language-specific education and support were identified as important inclusions in an intervention with aims to increase screening rates across cancer types (Chen, Chow, and Nguyen 2018; Wu et al. 2010; Hou, Sealy, and Kabiru 2011; Yoo et al. 2015). A study examining a community-based CRC awareness program in Michigan also aimed to improve screening by increasing knowledge and by removing 'cultural and financial barriers' among a predominantly Chinese sample (76.5%) (Wu et al. 2010). Findings showed that using community-based approaches and language-specific education increased knowledge about CRC, the importance of screening, and the eventual proceeding to screen among 70% of those who participated in the program (Wu et al. 2010). A pilot study aimed at improving awareness, knowledge, and willingness to undergo CRC screening among Koreans further echoed that interventions should be linguistically and culturally customized to the population to reduce CRC morbidity and mortality (Kim et al. 2019). Moreover, it was stressed that the intervention should be delivered by trusted community leaders to support the wellbeing of participants (Kim et al. 2019).

Although great strides have been made to conduct studies informed by sound theoretical frameworks and with rigorous methodologies, efforts are still gaining wave to

understand the efficacy of theory-based interventions designed to promote CRC screening among AA population (Carney et al. 2014). Examining the efficacy of CRC screening interventions is imperative in reducing the higher rate of late-stage diagnosis experienced in this population. As such, the primary purpose of this study was to report the results of a meta-analysis conducted on the overall effects of CRC screening intervention among AA. The efficacy of interventions will be examined stratified by study design (randomized controlled trial [RCT] or quasi-experimental [QE] study), AA subgroups, and whether the studies were an AANCART study (yes or no).

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al. 2009) were used to evaluate the CRC screening interventions.

Search strategy

Both reviewers independently conducted the search and screened each title and abstract identified in the searches and then compared for agreement. The article's full text was reviewed if either reviewer judged the title and abstract to be eligible for this meta-analysis. The literature search was performed on October 2018, and studies published in English and conducted in the United States were eligible for inclusion if they (1) conducted interventions with aims to increase CRC screening rates among AA and (2) utilized a RCT or QE study design, (3) reported quantitative screening rates following the intervention, and (4) included a comparison or control group for comparison. The following databases were used for our searches: PubMed, Web of Science, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Social Services Abstracts. The search was conducted using the search string: 'colorectal cancer screening' AND 'interventions' AND 'Asian Americans' and no publication year restriction was applied to optimize search results. The search through PubMed, Web of Science, CINAHL, and Social Services Abstracts yielded 185, 64, 13, and 17 articles, respectively. References of relevant studies were examined to identify additional articles, and three articles were identified. Upon screening the study abstracts and removing duplicate studies and studies that did not meet the inclusion criteria, 23 articles were reviewed in its entirety. In total, 14 articles fit the established criteria and were included in the analysis (Figure 1).

Data extraction

Data extraction was undertaken by the first author and then reviewed by the second author. Data were extracted based on the study, sample, and intervention characteristics. Study characteristics included the following codes: study design reported as RCT or QE and community based participatory research (CBPR) if the approach was utilized, sample size for intervention group(s) and control/comparison groups, and outcome measures reported as CRC screening rates post-intervention for both intervention and control/comparison groups. Sample characteristics included AA subgroup and mean age. Finally, intervention characteristics included the theoretical framework in parenthesis and brief intervention description (Table 1).

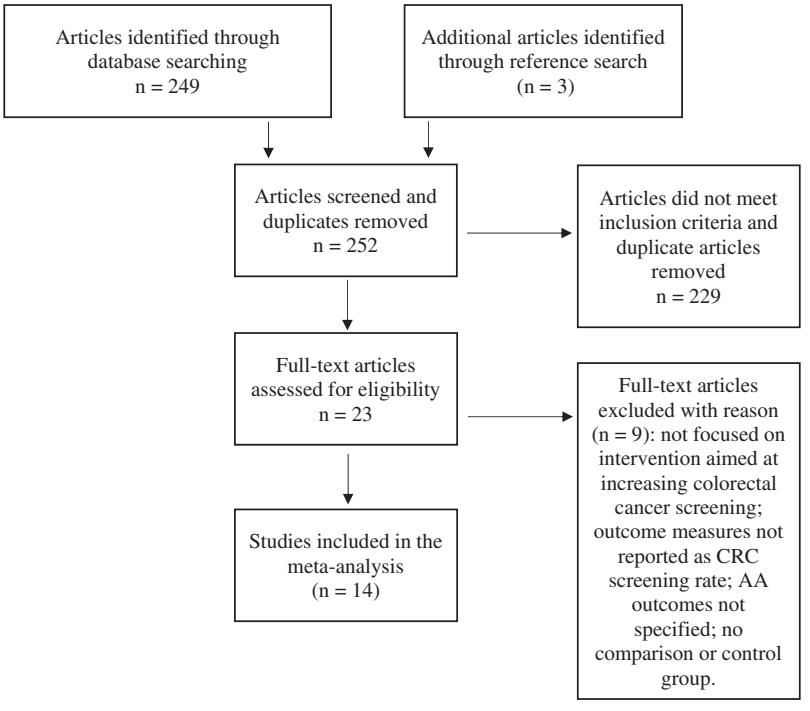

Figure 1. Preferred reporting items for systematic reviews and meta analysis (PRISMA) flowchart. Flow diagram for the inclusion and exclusion of studies.

Data were also collated to further showcase the details of each studies' interventions. Data were extracted by the following codes: study design: RCT or QE and CBPR (if applicable), whether the study was an AANCART study (yes or no), intervention delivery personnel, and specific components of the experimental intervention (Table 2).

Risk of bias assessment

The first author assessed the initial risk of bias and the second author independently checked after. Only RCT studies ($n = 11$) were assessed for the following components based on the Cochrane risk of bias tools and the PRISMA guidelines: (1) random sequence generation (selection bias), (2) blinding participants and personnel (performance bias), (3) blinding of outcome assessment (detection bias), (4) incomplete outcome data (attrition bias), and (5) selective outcome reporting (reporting bias). The assessment of the risk is summarized in Table 3.

A funnel plot asymmetry test was performed to assess for potential publication bias. Funnel plot is considered appropriate to use if there is a minimum of 10 studies included in the meta-analysis (Sterne et al. 2011). The points connected by the diagonal forming the 'funnel' indicates the 95% pseudo-confidence intervals of study effect estimates (log odds ratio) by the precision of estimates (log of the standard error of the odds ratio) (Figure 2).

Data analysis

Odds ratio (OR) reported from individual studies were used in the meta-analysis. If studies only reported quantitative screening rates (i.e. frequencies) following the intervention, OR

Table 1. Study characteristics of CRC interventions for AA.

Study	Study location	Study design	(Theoretical framework) Intervention description	N_I N_C	AA subgroup	Age	Intervention group screened %	Control/ comparison group screened %
Tu et al. (2006)	Metropolitan Seattle, WA	RCT	(NA) Health educator intervention	105 105	CA	50-64: 59.1% 65+: 40.9%	69.5%	27.6%
Wang et al. (2018)	Metropolitan Washington DC and Philadelphia and New York City area	RCT	(SCT) Physician-focused intervention	246 233	CA	50-64: 74% 65+: 26%	24.4%	17.7%
Nguyen et al. (2017)	San Francisco, CA	RCT CBPR	(TTM) LHW intervention	360 365	CA	Mean: 62.2	Ever had FOBT screening: 82.5% Sig/C: 47.2% Ever had any screening: 88.3% UTD screening: 78.1%	70.7% 47.2% 79.5% 64.1%
Jo et al. (2017)	Los Angeles, CA	RCT CBPR	(SCT TTM) LHW intervention	184 164	KA	Mean 61.4	Ever had FOBT: 35.3% Ever had sig/c: 54.3% Ever had any CRC: 64.1% UTD CRC: 53.8%	29.9% 47.6% 57.3% 50%
Ma et al. (2009)	Not mentioned	QE CBPR	(SCT HBM) LHW intervention	84 83	KA	Intervention: 62.5 Control: 63.9	77.4%	10.8%
Tong et al. (2017)	Sacramento, CA	RCT CBPR	(SCT TTM) LHW intervention	161 168	H	50-64: 73.3% 65-75: 26.7%	Ever had FOBT: 79.5% Ever had sig/c: 36% Ever had any CRC: 83.2% UTD: 57.1%	70.8% 17.9% 75% 43.5%

Cuaresma et al. (2018)	Honolulu County, Hawai'i	RCT CBPR	(SCT TTM) LHW intervention	128 176	FA	50-64: 57% 65-75: 43%	Ever had any CRC: 80% Ever had FOBT: 78% Ever had sig/c: 63% UTD: 74%	74% 62% 51% 60%
Maxwell et al. (2010)	Not mentioned	RCT	(Health Behavior Framework) LHW intervention	202 (w/ FOBT); 183 (w/out FOBT) 163	FA	Mean 61	Intervention w/ FOBT: 30% Intervention w/out FOBT: 25%	9%
Maxwell et al. (2016)	Los Angeles & Orange County areas, CA	RCT	(Racial Ethnic Approaches to Community Health 2010 Model of Change) Community Health Advisor intervention	423 250	FA	Mean 59.3	52.7%	48.8%
Nguyen et al. (2015)	Santa Clara County, CA	RCT	(Pathway Framework and Innovations Theory) LHW intervention	320 320	VA	Intervention 50-66: 67.8% 65-74: 32.2% Control: 75%, 25%	Ever had CRC: 56%	19%
Walsh et al. (2010)	Santa Clara County, CA	RCT	(TTM) Intervention A: FOBT + brochure Intervention B: FOBT + brochure+ counseling	339 (A) 341 (B) 113	VA	Mean Intervention (A): 61 Intervention (B): 61 Control: 61	UTD CRC: 86.2% (A); 91.4% (B) UTD FOBT: 65.3% (A); 78.5% (B)	76.3% 58.1%
Nguyen et al. (2010)	Alameda or Santa Clara Counties, CA & Harris County, TX	QE	(Pathway Framework) Public education and provider intervention	NA NA	VA	NA	Ever had FOBT: 71% Ever had sig/c: 65%	50% 47%
Tu et al. (2014)	Metropolitan area of Seattle, WA	QE	(Innovations Decisions Process) Medical assistants intervention	449 304	VA	Intervention 50-64: 75% 65+: 25% Control 75%, 25%	FOBT: 16% sigmoidoscopy: 1% colonoscopy: 34% UTD: 45%	9% 1% 30% 38%
Potter et al. (2011)	San Francisco, CA	RCT	(General model of the Determinants of Behavioral Change) FLU-FOBT program	80 72	AA	NA	FOBT: 33.8% Any CRC: 45.5%	21.7% 35.6%

Notes: CA = Chinese Americans, CBPR = community based participatory research, CRC = colorectal cancer, FA = Filipino Americans, FOBT = fecal occult blood test, H = Hmong, KA = Korean Americans, LHW = lay health worker, NA = information not reported in study, sig/c = sigmoidoscopy/colonoscopy, UTD = up to date, VA = Vietnamese American.

Table 2. Intervention details.

Study	Study design	AANCART study	Intervention delivery personnel	Intervention description
Tu et al. (2006)	RCT	No	Health educator: bicultural CA w/ work history as medical assistant	Clinic-based program CRC screening education: motivational video, bilingual information pamphlet, FOBT kit (3 cards in stamped envelope) with instructions in Chinese
Wang et al. (2018)	Cluster 2-arm RCT (PC*P* = cluster units)	No	PCP	PCP-focused intervention Improve PCP communication to counter patients' barriers/ challenges: printed communication guide, 2 structured in-office training sessions with simulated patients, desk style flip chart (summarizing key points from guide), FOBT instruction sheets, and local free/low cost test informational sheet.
Nguyen et al. (2017)	Cluster RCT (LHW = cluster units) CBPR approach	Yes	LHW	LHW + print Two LHW outreach session and two follow up phone calls combined with brochure (training manual, bilingual brochure + flipchart, telephone call guide, 1 page guide to find free/low cost CRC screening) vs. Print material alone
Jo et al. (2017)	Two-arm cluster RCT (LHW = cluster units) CBPR approach	Yes	LHW	Two LHW educational sessions describing CRC, screening, and barriers to screen and two follow-up phone calls combined with brochure. vs. Print material: two lectures on nutrition and physical activity by professional health educators, CRC brochure, and two follow-up call
Ma et al. (2009)	Two group quasi-experimental design with baseline and post intervention assessment with 12 month follow-up. CBPR approach	No	Bilingual health educators	Church-based program Small group CRC education sessions in Korean discussing CRC incdience, risks, and mortality. Cues to action and strategies to overcome barriers also provided.
Tong et al. (2017)	Two-arm cluster RCT (LHW = cluster units) CBPR approach	Yes	LHW	CRC education/flipchart: knowledge, risks, screening risks/benefits, list of local available services, and follow up phone calls.
Cuaresma et al. (2018)	Two-arm cluster RCT (LHW = cluster units) CBPR approach	Yes	LHW	CRC education/flipchart: screening needs/benefits; brochure
Maxwell et al. (2010)	Three-arm RCT	No	Trained health professional (usually a nurse)	Small group CRC education session, print take-home materials, reminder letter, a letter to the physician, and a free FOBT kit vs. Same as experimental intervention BUT no free FOBT kit
Maxwell et al. (2016)	Two-arm RCT	No	CHA	Small group CRC education sessions, print materials, and FOBT kits. Implementation trial with two

(*Continued*)

Table 2. Continued.

Study	Study design	AANCART study	Intervention delivery personnel	Intervention description
				strategies: (1) basic – training offered to CHA on recommended screenings, access to screening info and tests; and (2) enhanced – same as basic with the inclusion of activities to engage organizations' leaders.
Nguyen et al. (2015)	Cluster RCT	No	LHW	Small group CRC education sessions using flip chart: CRC disease prognosis, screening, and where to go for screening; follow up and navigational services (e.g. phone call reminders referrals to free/low-cost screening options, assistance with making appointments.)
Walsh et al. (2010)	Three-arm RCT	Yes	CHA	Telephone counseling, culturally tailored brochures, and a customized FOBT kit (3 cards for stool collection, stamped envelope, a lab slip, and a letter from PCP emphasizing CRC screening). vs. Mailed FOBT kit and culturally tailored brochures.
Nguyen et al. (2010)	Two group pre/post test QE	No	PCP (for one major component of intervention)	Public education component: media campaign on CRC screening and a hotline; and provider component continuing medical education seminars and distribution of patient counseling materials, reminder items, provider training newsletters and DVDs.
Tu et al. (2014)	Two group pre/post test QE	No	MA	Adapted EBI: using MA as intervention agent: implemented orders for FOBT and provided patients with instructions.
Potter et al. (2011)	RCT	No	Nurse	Nurses provided with aids (e.g. visual aids explaining FOBT, simple multilingual written instructions, video instructions, and stamped envelopes for completing and returning the FOBT kits) when providing FOBT to patients who receive flu vaccinations and elgible for screening.

Notes: AANCART = Asian American Network for Cancer Awareness, Research, and Training, QE = quasi-experiment, CA = Chinese American, RCT = randomized control trial, CBPR = community based participatory research, LHW = lay health worker, CHA = community health advisor, MA = medical assistants, CRC = colorectal cancer screening, PCP = primary care physicians, FOBT = fecal occult blood test.

was then calculated. Odds ratio (OR) were computed based on sample size and screening rates and weighted based on their variance estimates. Meta-analysis techniques were used to calculate the pooled effect sizes of interventions aimed at increasing CRC screening among AA with 95% confidence intervals across 14 studies. With consideration of the heterogeneity between intervention characteristics, random effect model was used. Heterogeneity among the studies was evaluated using Cochran's Q and I^2 statistics and a weight was allotted to each study based on the inverse variance. I^2 reflects the percentage

Table 3. Assessment of risk bias for RCT studies.

Study	Random sequence generation (selection bias)	Blinding participants and personnel (performance bias)	Blinding outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Tu et al. (2006)	L	L	L	L	L
Wang et al. (2018)	L	H	L	H	L
Nguyen et al. (2017)	L	L	L	L	L
Jo et al. (2017)	L	L	L	L	L
Tong et al. (2017)	L	L	L	L	L
Cuaresma et al. (2018)	L	L	L	L	L
Maxwell et al. (2010)	L	L	L	L	L
Maxwell et al. (2016)	L	L	L	L	L
Nguyen et al. (2015)	L	H	U	L	L
Walsh et al. (2010)	L	L	U	L	L
Potter et al. (2011)	U	H	H	U	L

Note: L = low risk of bias, H = high risk of bias, U = unclear risk of bias.

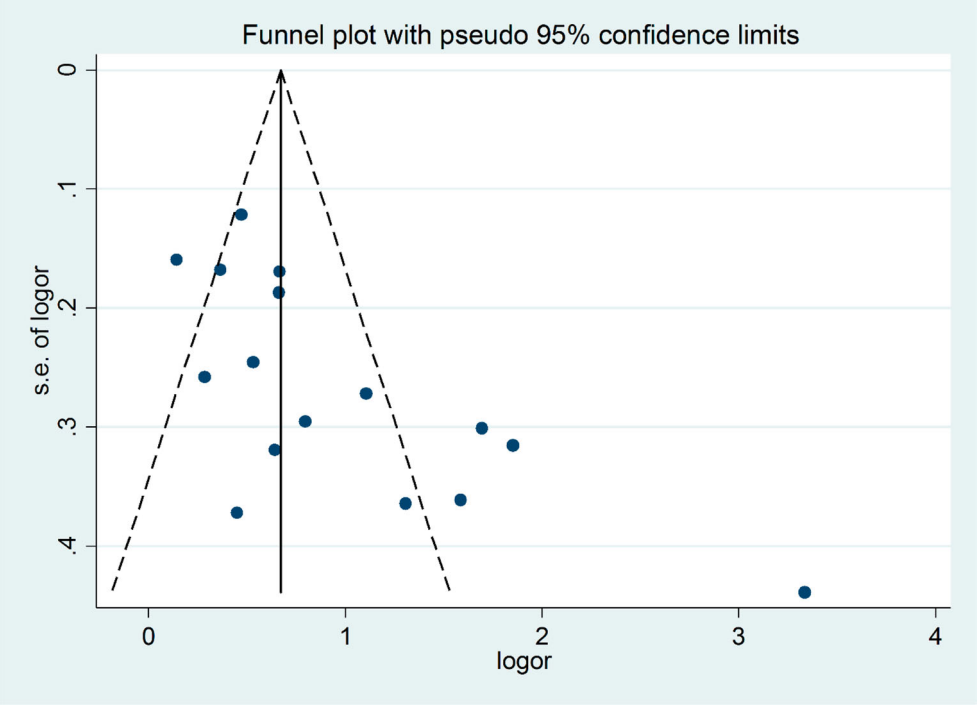

Figure 2. Funnel plot of all studies with 95% pseudo-confidence intervals of study effect estimates (log odds ratio) by the precision of estimates (log of the standard error of the odds ratio).

of total heterogeneity across all studies and is calculated using Cochran's Q as 100% × (Q – degrees of freedom)/Q. A I^2 value of 0% indicates no observed heterogeneity, 25% as low, 50% as moderate, and 75% as high heterogeneity (Higgins et al. 2003; Melsen et al. 2013; Valentine, Pigott, and Rothstein 2010). All analyses were performed using Stata software (version 10.1: StataCorp., College Station, TX, USA) and p-values were set at 0.05 to indicate statistical significance.

Results

A total of 14 CRC screening intervention studies yielded 16 OR values that were included in the meta-analysis because two studies (Maxwell et al. 2010; Walsh et al. 2010) examined two experimental intervention arms. The majority of the studies used a two-arm RCT design with a control group, and three studies (Ma et al. 2009; Nguyen et al. 2010; and Tu et al. 2014) utilized a QE with comparison group design. True to its study design, the aforementioned QE studies did not use random assignment to create their comparison groups. CBPR approach was explicitly verbalized across five studies (Tong et al. 2017; Ma et al. 2009; Nguyen et al. 2017; Jo et al. 2017; Cuaresma et al. 2018). Across all 14 studies, the sample size ranged from 60 to 680 participants. Studies included in the meta-analysis provided 16 effect sizes across a total of 3605 participants receiving the intervention aimed at improving screening. All but one study (Potter et al. 2011) provided outcome measures for a specific AA subgroup: Chinese (Tu et al. 2006; Wang et al. 2018; Nguyen et al. 2017), Korean (Ma et al. 2009; Jo et al. 2017), Hmong (Tong et al. 2017), Filipino (Cuaresma et al. 2018; Maxwell et al. 2010; Maxwell et al. 2016), and Vietnamese (Nguyen et al. 2015; Walsh et al. 2010; Nguyen et al. 2010; Tu et al. 2014). Eleven out of the 14 studies were conducted in the Western region (i.e. California, Washington, and Hawai'i) of the United States. The study's characteristics are described in Table 1 and elaborated further in Table 2.

All 14 studies used an intervention that was culturally responsive to their respective participants' race/ethnicity. This was demonstrated primarily through the use of culturally and/or linguistically appropriate education materials delivered by ethnically concordant personnel. One study stressed the use of culturally responsive venues (i.e. Korean churches) in particular for delivering linguistically sensitive CRC material to their target population (Ma et al. 2009). Additionally, all but one study (Tu et al. 2006) examined interventions that were theoretically informed with the following frameworks being the most commonly used: transtheoretical model of change (TTM) (Walsh et al. 2010; Tong et al. 2017; Nguyen et al. 2017; Jo et al. 2017; Cuaresma et al. 2018) and social cognitive theory (SCT) (Tong et al. 2017; Wang et al. 2018; Jo et al. 2017; Ma et al. 2009; Cuaresma et al. 2018).

Characteristics of the interventions being tested varied with regards to the intervention delivery personnel and intervention components. Five studies used lay health workers (LHW) to deliver their experimental intervention, with OR ranging between 1.6 (Jo et al. 2017) and 5.45 (Nguyen et al. 2015). Nearly all of the LHW interventions were AANCART studies. Seven studies used other professional health workers (i.e. health educator, community health advisor, medical assistants, nurses) to deliver their intervention, and finally, two studies were physician-focused interventions (Wang et al. 2018; Nguyen et al. 2010) with aims to support patient-centered CRC education and screening

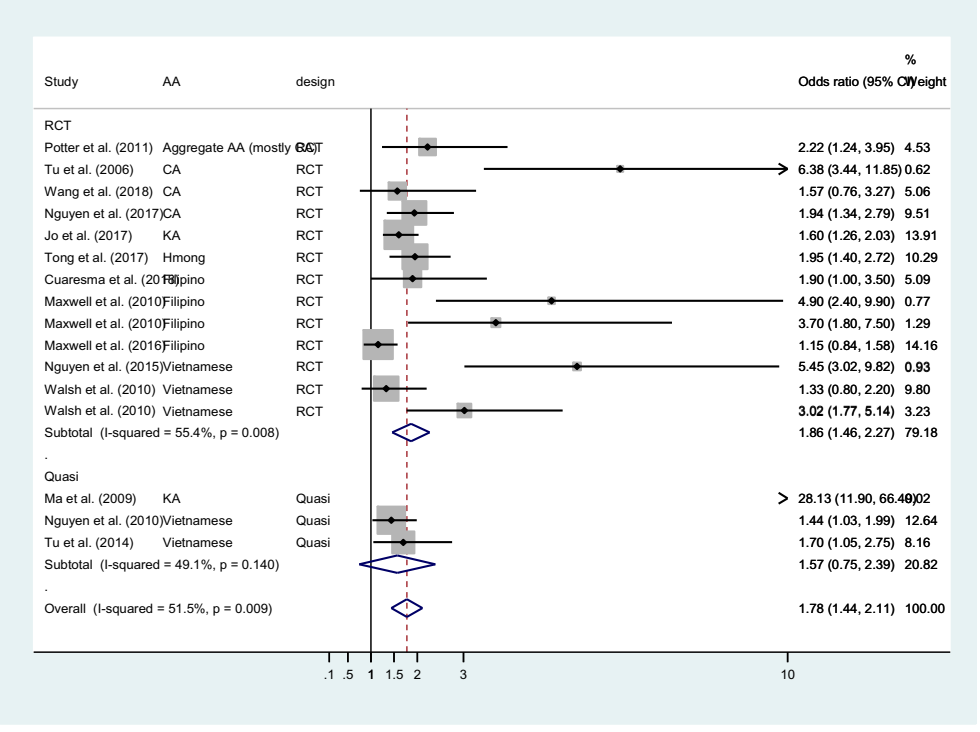

Figure 3. Meta-analytic results of the effects of colorectal cancer screening interventions among AA by study design.

recommendations. The experimental interventions were all multifaceted interventions and included various mechanisms to support patient's CRC education and screening behavior (i.e. small educational group sessions, brochures, videos/DVDs, etc.), address their psychosocial needs, and to reduce logistic/financial barriers (i.e. offering free FOBT kits, list of free/low-cost screening facilities, and reminder calls/letters).

Overall, results indicated that AA participants who received the experimental screening interventions aimed at improving screening were 1.78 times more likely to obtain a CRC screening at post-intervention compared to the control or comparison group, OR = 1.78 (1.44, 2.11) ($I^2 = 51.5\%$, $p = .009$) (Figure 3). All but three studies (Wang et al. 2018; Maxwell et al. 2016; Walsh et al. 2010), indicated statistically significant positive effects from the experimental interventions with the study effect size range between OR = 1.44 and OR = 28.13. When the analysis was stratified by study design type, RCT and QE, only the RCT designs were statistically significant OR = 1.86 (1.46, 2.27) versus QE designs OR = 1.57 (0.75, 2.39).

Intervention efficacy was also examined by AA subgroup, but only for Chinese American (CA), Filipino American (FA), and Vietnamese American (VA) because there was a minimum of at least three studies for each subgroup. For VA, interventions aimed at improving screening were 1.76 times more likely to obtain screening at post-intervention than the non-experimental intervention group OR = 1.76 (1.14, 2.39) ($I^2 = 53.9\%$, $p = .070$) (Figure 4). The results for CA and FA were not statistically significant, OR = 2.15 (0.88, 3.41) and OR = 2.06 (0.83, 3.28), respectively.

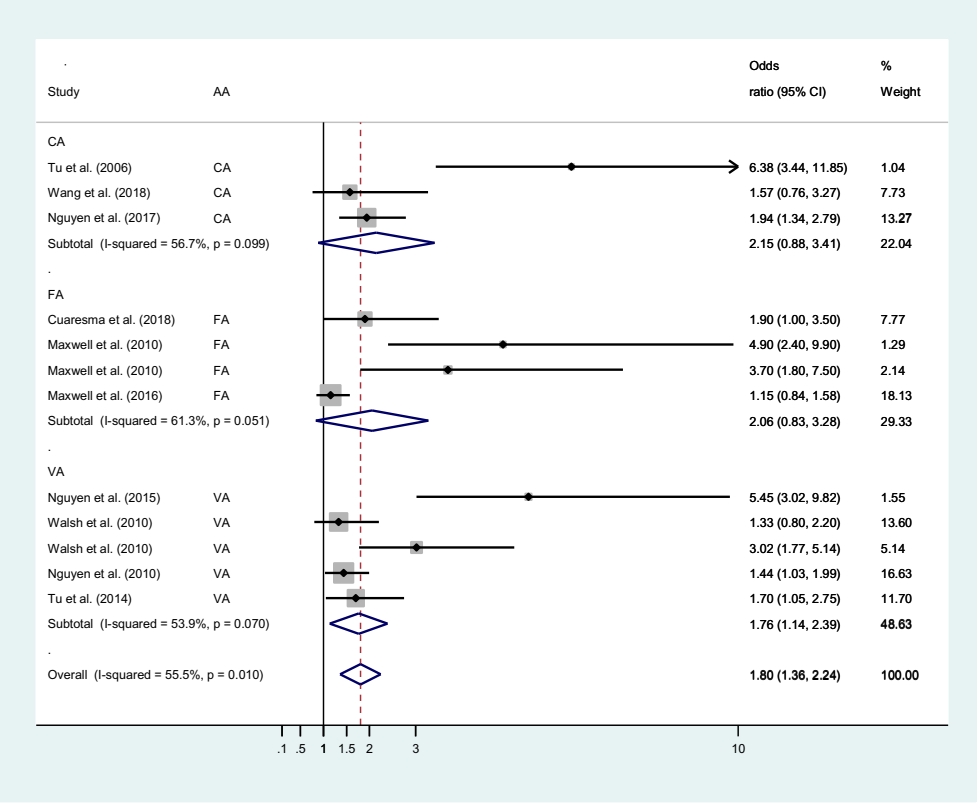

Figure 4. Meta-analytic results of the effects of colorectal cancer screening interventions among AA by ethnic subgroup.

Finally, intervention efficacy was examined by whether the study was an AANCART study. For AANCART studies, the experimental interventions were 1.71 times more likely to obtain screening at post-intervention compared to the non-experimental intervention group OR = 1.71 (1.45, 1.98) ($I^2 = 0.0\%$, $p = .447$) (Figure 5).

Discussion

In total, 16 ORs from 14 studies were included in the meta-analysis and nearly all of the studies were assessed to be generally well-conducted with low bias concerns. Overall, the experimental interventions in this meta-analysis were effective in improving CRC screening behavior with a moderate level of heterogeneity existing between interventions. When stratified by AA subgroup, VA was the only group that had statistically significant results with a moderate level of heterogeneity existing between interventions. Not surprisingly, AANCART studies were very homogenous between interventions and were effective in improving CRC screening behavior. Findings in this review showed that improvement in screening can be achieved through a variety of ways, but the common feature across all the studies was the culturally responsive and theoretically-informed foundation of their respective interventions. In this review, five articles were attributed to AANCART's

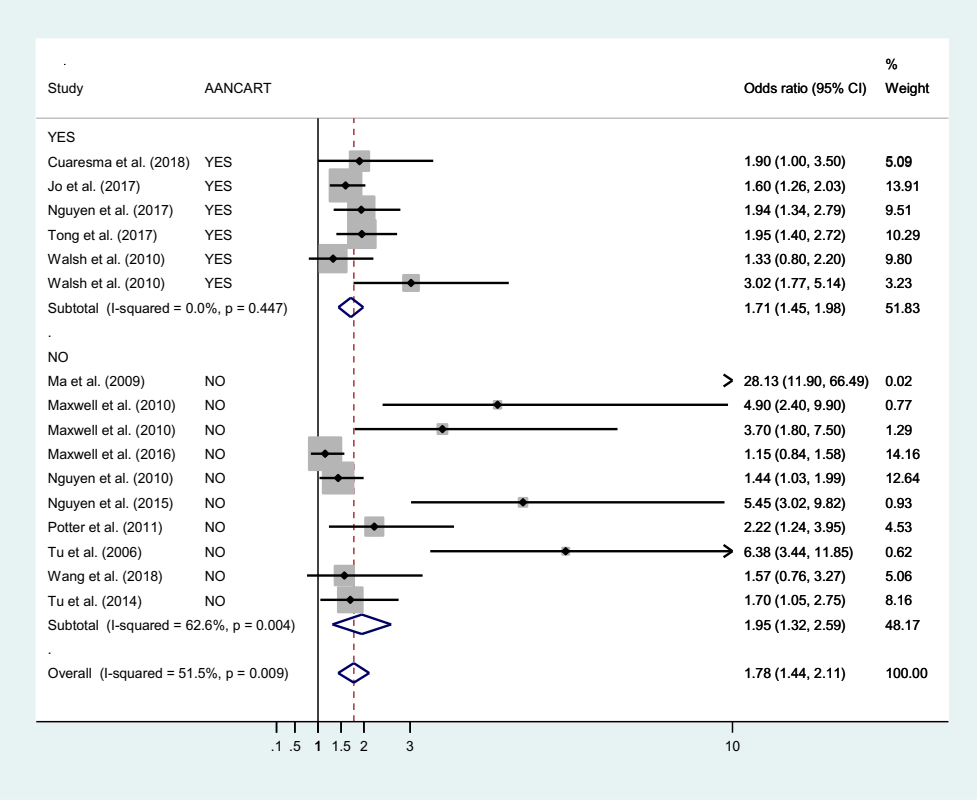

Figure 5. Meta-analytic results of the effects of colorectal cancer screening interventions among AA by AANCART study (yes vs. no).

efforts to reduce CRC disparities in AA communities (Nguyen et al. 2017; Jo et al. 2017; Tong et al. 2017; Cuaresma et al. 2018; Walsh et al. 2010). With CBPR rooted in their empirical approach, AANCART emphasized education, training, and research and is reported to be the first to 'complete rigorously designed community-informed interventions for AA' (Chen, Chow, and Nguyen 2018, 1533). Moreover, their culturally responsive educational aids which centered around LHW-led educational sessions, flip charts, and brochures were integrated in intervention efforts with significantly positive results.

A study using a CBPR two-group QE design with baseline and post-intervention assessment among Korean Americans church members (Ma et al. 2009) deserves further discussion due to its higher prevalence for CRC screening compared to the comparison group. The experimental intervention group received culturally appropriate cancer education program that included bilingual counseling on CRC risk awareness and other psychosocial barriers in addition to patient navigation assistance (i.e. one-on-one small group assistance, screening reminder, arranging appointments with clinical partners, registration and other paperwork, language translation, medical results facilitation, and transportation). This study showed significantly higher screening rates in the intervention group (77.4%) compared with the control group (10.8%), $p < 0.001$. Moreover, 98% of the intervention group's participants' screening was reported to be verified with their respective physician's office.

The authors of this study attributed their findings to their multifaceted culturally responsive intervention. Additionally, they stressed the importance of removing barriers to health messaging, acquiring support from church leaders, and family member's support to participant's screening efforts. This finding corroborates with Han et al. (2011) study which showed that access-enhancing interventions followed by community education were most beneficial in increasing cancer screening among ethnic minority women. Access to healthcare has been further reinforced as an important predictor for AA CRC screening (Jun and Nan 2018), and specifically, for Korean American screening for CRC (Kim 2017). Additionally, the inclusion of church venues as effective intervention delivery sites for Koreans' health information was highlighted in Hou, Sealy, and Kabiru (2011) review. These findings are important reminders to identify AA subgroup's unique socio-cultural needs and modes of reception for cancer screening information.

Two pilot studies were excluded from this review because they did not include a comparison group in their empirical investigation (Wang et al., 2014; Nguyen et al. 2010). However, both studies offer notable suggestions to improve outreach efforts for hard to reach populations. Wang et al. (2014) study was the only accessed study to use a traditional medicine provider to deliver the CRC screening education. Incorporating traditional providers into health promotion programs was argued to be a useful way to improve outreach efforts for Chinese Americans (Wang et al., 2014). In their study limitations, the authors further stressed the need for researchers to use robust study designs when aiming to unravel the role of traditional providers in Westernized health promotion programs. Nguyen et al. (2010) study found an increase in post-intervention CRC screening rates among their Chinese American sample as well. The authors of this study highlighted the use of lay health worker-led outreach when working with ethnic populations due to their natural cultural and linguistic competency. This study also utilized existing social networks to announce the intervention aimed at increasing cancer screening. By creating the norm that cancer screening is an acceptable content for communication, health-related outreach can be enhanced (Nguyen et al. 2010).

Understanding the efficacy of interventions designed to promote CRC screening among AA population is imperative to decrease CRC burden and mortality among AA. This review sheds light on important socio-cultural strategies when developing a CRC screening intervention aimed at increasing screening rates among AA. Findings in this review corroborated with findings from a systematic literature review that showed that cancer screenings among AA can be increased using multi-component through community-based and LHW strategies (Hou, Sealy, and Kabiru 2011). It will also be essential to continue the use of robust methodologies and theoretically informed interventions in CRC prevention and early intervention studies. With respect to the efforts to disaggregate AA population's CRC screening practice and outcomes, tailored intervention approaches for each AA subgroup should be investigated to understand how the inclusion of specific emphasis and foci in intervention efforts affects each subgroup's screening behavior.

Limitations

Our findings are limited to the AA who were included in this review due to the inclusion criteria that were in place. For instance, four databases were examined for the literature search and it is possible that relevant studies could have been missed. Internal validity

issues also include each study's sampling procedures. For example, one article did not include AA ethnic-specific results, but instead, the aggregated AA group in addition to other race/ethnic groups. Empirical studies should continue to disaggregate the diverse AA population and report disaggregated cancer measures. As many of the studies used multi-component interventions, future studies should also consider using dismantling or factorial designs to conduct within-study comparisons of specific intervention components. Finally, upon visual inspection of this review's funnel plot, there was significant asymmetry with only one study being markedly different from the other studies (Egger's test $p = 0.016$). These limitations highlight the need for ongoing efforts to examine the effectiveness of interventions aimed at improving CRC screening among AA ethnic groups. This review strongly supports the call for ongoing culturally-anchored and linguistically tailored interventions to promote health behavior such as CRC screening among AA populations.

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References

Carney, P. A., F. Lee-Lin, S. Mongoue-Tchokote, M. Mori, H. Leung, C. Lau, D. Le, and D. A. Lieberman. 2014. "Improving Colorectal Cancer Screening in Asian Americans." *Cancer* 120: 1702–1712. doi:10.1002/cncr.28640.

Census.gov. 2019. "Asian/Pacific American Heritage Month: May 2019. Washington, DC: United States Census Bureau, U.S. Department of Commerce: 2019." Available from https://www.census.gov/newsroom/facts-for-features/2019/asian-american-pacific-islander.html.

Chen, M. S., E. A. Chow, and T. T. Nguyen. 2018. "The Asian American Network for Cancer Awareness, Research, and Training (AANCART)'s Contributions Toward Reducing Asian American Cancer Health Disparities, 2000-2017." *Cancer* 124: 1527–1534. doi:10.1002/cncr.31103.

Cuaresma, C. F., A. U. Sy, T. T. Nguyen, R. C. S. Ho, G. L. Gildengorin, J. Y. Tsoh, A. M. Jo, E. K. Tong, M. Kagawa-Singer, and S. L. Stewart. 2018. "Results of a Lay Health Education Intervention to Increase Colorectal Cancer Screening among Filipino Americans: A Cluster Randomized Controlled Trial." *Cancer* 124: 1535–1542. doi:10.1002/cncr.31116.

Ellis, L., R. Abrahao, M. McKinley, J. Yang, M. Somsouk, L. Le Marchand, I. Cheng, S. Lin Gomez, and S. Shariff-Marco. 2018. "Colorectal Cancer Incidence Trends by Age, Stage, and Racial/Ethnic Group in California, 1990-2014." *Cancer Epidemiology Biomarkers Prevention* 27 (9): 1011–1018. doi:10.1158/1055-9965.EPI-18-0030.

Han, H., J. Kim, J. Lee, H. K. Hedlin, H. Song, Y. Song, and M. T. Kim. 2011. "Interventions That Increase Use of Pap Tests among Ethnic Minority Women: A Meta-Analysis." *Psycho-Oncology* 20: 341–351.

Higgins, J. P., S. G. Thompson, J. J. Deeks, and D. G. Altman. 2003. "Measuring Inconsistency in Meta-Analyses." *British Medical Journal* 327: 557–560.

Holland, A. T., and L. P. Palaniappan. 2012. "Problems with the Collection and Interpretation of Asian American Health Data: Omission, Aggregation, and Extrapolation." *Annals Epidemiology* 22 (6): 397–405. doi:10.1016/j.annepidem.2012.04.001.

Hou, S. I., D. A. Sealy, and C. W. Kabiru. 2011. "Closing the Disparity Gap: Cancer Screening Interventions among Asians – A Systematic Literature Review." *Asian Pacific Journal of Cancer Prevention* 12: 3133–3139.

Jin, H., P. S. Pinheiro, J. Xu, and A. Amei. 2015. "Cancer Incidence among Asian American Populations in the United States, 2009-2011." *Cancer Epidemiology* 138 (9): 2136–2145.

Jo, A. M., T. T. Nguyen, S. Stewart, M. J. Sung, G. Gildengorin, J. Y. Tsoh, E. K. Tong, et al. 2017. "Lay Health Educators and Print Materials for the Promotion of Colorectal Câncer Screening among Korean Americans: A Randomized Comparative Effectiveness Study." *Cancer* 123: 2705–2715. doi:10.1002/cncr.30568.

Jun, J., and X. Nan. 2018. "Determinants of Câncer Screening Disparities among Asian Americans: A Systematic Review of Public Health Surveys." *Journal of Cancer Education* 33 (4): 757–768.

Kim, S. B. 2017. "Unraveling the Determinants to Colorectal Cancer Screening among Asian Americans: A Systematic Literature Review." *Journal of Racial and Ethnic Health Disparities* 5 (4): 683–699. doi:10.1007/s40615-017-0413-6.

Kim, S., A. Yeon, E. Cho, M. Shahid, and J. Kim. 2019. "Effectiveness of a Tailored Colorectal Cancer Educational Seminar in Enhancing the Awareness, Knowledge, and Behavior of Korean Americans Living in the Los Angeles Koreatown Area." *Diversity and Equality in Health and Care* 16 (1): 1–8. doi:10.21767/2049-5471.10000185.

Ladabaum, U., C. A. Clarke, D. J. Press, A. Mannalithara, P. A. Myer, I. Cheng, and S. L. Gomez. 2014. "Colorectal Cancer Incidence in Asian Populations in California: Effect of Nativity and Neighborhood-Level Factors." *American Journal of Gastroenterol* 109 (4): 579–588. doi:10.1038/ajg.2013.488.

Le, H., A. Ziogas, T. H. Taylor, S. M. Lipkin, and J. A. Zell. 2009. "Survival of Distinct Asian Groups among Colorectal Câncer Cases in California." *Cancer* 115 (2): 259–270. doi:10.1002/cncr.24034.

Lee, H. Y., M. Lundquist, E. Ju, X. Luo, and A. Townsend. 2011. "Colorectal Cancer Screening Disparities in Asian Americans and Pacific Islanders: Which Groups Are Most Vulnerable?" *Ethnic Health* 16 (6): 501–508. doi:10.1080/13557858.2011.575219.

Lin, S. S., C. A. Clarke, A. W. Prehn, S. L. Glaser, D. W. West, and C. D. O'Malley. 2002. "Survival Differences among Asian Subpopulations in the United States After Prostate, Colorectal, Breast, and Cervical Carcinomas." *Cancer* 94 (4): 1175–1182.

Liss, D. T., and D. W. Baker. 2014. "Understanding Current Racial/Ethnic Disparities in Colorectal Cancer Screening in the United States: The Contribution of Socioeconomic Status and Access to Care." *American Journal of Prevention Medicine* 46 (3): 228–236. doi:10.1016/j.amepre.2013.10.023.

Ma, G. X., S. Shive, Y. Tan, W. Gao, J. Rhee, M. Park, J. Kim, and J. I. Toubbeh. 2009. "Community-based Colorectal Cancer Intervention in Underserved Korean Americans." *Cancer Epidemiology* 33: 381–386. doi:10.1016/j.caep.2009.10.001.

Maxwell, A. E., R. Bastani, L. L. Danao, C. Antonio, G. M. Garcia, and C. M. Crespi. 2010. "Results of a Community-Based Randomized Trial to Increase Colorectal Cancer Screening among Filipino Americans." *American Journal of Public Health* 100 (11): 2228–2234. doi:10.2105/AJPH.2009.176230.

Maxwell, A. E., L. L. Danao, R. T. Cayetano, C. M. Crespi, and R. Bastani. 2016. "Implementation of an Evidence-Based Intervention to Promote Colorectal Cancer Screening in Community Organizations: A Cluster Randomized Trial." *Translational Behavior Medicine* 6: 295–305. doi:10.1007/s13142-015-0349-5.

Melsen, W. G., M. C. J. Bootsma, M. M. Rovers, and M. J. M. Bonten. 2013. "The Effects of Clinical and Statistical Heterogeneity on the Predictive Values of Results from Meta-Analyses." *Clinical Microbiology and Infection* 20 (2): 123–129. doi:10.1111/1469-0691.12494.

Moher, D., A. Liberati, J. Tetzlaff, D. G. Altman, and the PRISMA Group 2009. "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement." *Annals of Internal Medicine* 151 (4): 264–269.

Nguyen, T. T., M. B. Love, C. Liang, L. Fung, T. Nguyen, C. Wong, G. Gildengorin, and K. Woo. 2010. "A Pilot Study of Lay Health Worker Outreach and Colorectal Cancer Screening among Chinese Americans." *Journal of Cancer Education* 25: 405–412.

Nguyen, B. H., S. J. McPhee, S. L. Stewart, and H. T. Doan. 2010. "Effectiveness of a Controlled Trial to Promote Colorectal Cancer Screening in Vietnamese Americans." *American Journal of Public Health* 100 (5): 870–876. doi:10.2105/AJPH.2009.166231.

Nguyen, B. H., S. L. Stewart, T. T. Nguyen, N. Bui-Tong, and S. J. McPhee. 2015. "Effectiveness of Lay Health Worker Outreach in Reducing Disparities in Colorectal Cancer Screening in Vietnamese Americans." *American Journal of Public Health* 105 (10): 2083–2089. doi:10.2105/AJPH.2015.302713.

Nguyen, T. T., J. Y. Tsoh, K. Woo, S. L. Stewart, G. M. Le, A. Burke, G. Gildengorin, et al. 2017. "Colorectal Cancer Screening and Chinese Americans: Efficacy of Lay Health Worker Outreach and Print Materials." *American Journal of Prevention Medicine* 52 (3): 67–76. doi:10.1016/j.amepre.2016.10.003.

Oh, K., and K. Jacobsen. 2014. "Colorectal Cancer Screening among Korean Americans: A Systematic Review." *Journal of Community Health* 39 (2): 193–200. doi:10.1007/s10900-013-9758-x.

Potter, M. B., J. M. E. Walsh, T. M. Yu, G. Gildengorin, L. W. Green, and S. J. McPhee. 2011. "The Effectiveness of the Flu-Fobt Program in Primary Care: A Randomized Trail." *American Journal of Preventive Medicine* 41 (1): 9–16.

Rahman, R., C. Schmaltz, C. S. Jackson, E. J. Simoes, J. Jackson-Thompson, and J. A. Ibdah. 2015. "Increased Risk for Colorectal Cancer Under Age 50 in Racial and Ethnic Minorities Living in the United States." *Cancer Medicine* 4 (12): 1863–1870. doi:10.1002/cam4.560.

Sterne, J. A. C., A. J. Sutton, J. P. A. Loannidis, N. Terrin, D. R. Jones, J. Lau, J. Carpenter, et al. 2011. "Recommendations for Examining and Interpreting Funnel Plot Asymmetry in Meta-Analyses of Randomized Controlled Trials." *BMJ* 342: 1–8.

Thompson, C. A., S. L. Gomez, K. G. Hastings, K. Kapphahn, P. Yu, S. Shariff-Marco, A. S. Bhatt, et al. 2016. "The Burden of Cancer in Asian Americans: A Report of National Mortality Trends by Asian Ethnicity." *Cancer Epidemiology Biomarkers Prevention* 25 (10): 1371–1381. doi:10.1158/10559965.EPI-16-0167.

Tong, E. K., T. T. Nguyen, P. Lo, S. Stewart, G. Gildengorin, J. Y. Tsoh, A. Jo, et al. 2017. "Lay Health Educator Education Increases Colorectal Cancer Screening among Hmong Americans: A Clustered Randomized Controlled Trail." *Cancer* 123 (1): 98–106. doi:10.1002/cncr.30265.

Trinh, Q., P. L. Nguyen, J. J. Leow, D. Dalela, G. F. Chao, B. A. Mahal, M. Nayak, M. Schmid, T. K. Choueiri, and A. A. Aizer. 2015. "Cancer Specific Mortality of Asian Americans Diagnosed with Cancer: A Nationwide Population-Based Assessment." *Journal of the National Cancer Institute* 107 (6): 1–8. doi:10.1093/jnci/djv054.

Tu, S., A. Chun, Y. Yasui, A. Kuniyuki, M. Yip, V. Taylor, and R. Bastani. 2014. "Adaptation of an Evidence-Based Intervention to Promote Colorectal Cancer Screening: A Quasi-Experimental Study." *Implementation Science* 9: 2–8. doi:10.1186/1748-5908-9-85.

Tu, S., V. Taylor, Y. Yasui, A. Chun, M. Yip, E. Acorda, L. Li, and R. Bastani. 2006. "Promoting Culturally Appropriate Colorectal Cancer Screening Through a Health Educator." *Cancer* 107 (5): 959–966. doi:10.1002/cncr.22091.

U.S. Department of Health and Human Services. Offices of Minority Health. 2019. Profile: Asian Americans. Available from https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=3&lvlid=63.

US Preventive Services Task Force. 2015. "Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement." *JAMA*, doi:10.1001/jama.2016.5989.

Valentine, J. C., T. D. Pigott, and H. R. Rothstein. 2010. "How Many Studies do You Need? A Primer on Statistical Power for Meta-Analysis." *Journal of Educational and Behavioral Statistics* 35 (2): 215–247. doi:10.3102/1076998609346961.

Walsh, J. M. E., R. Salazar, T. T. Nguyen, C. Kaplan, L. Nguyen, J. Hwang, S. J. McPhee, and R. J. Pasick. 2010. "Health Colon, Health Life: A Novel Colorectal Cancer Screening Intervention." *American Journal of Preventive Medicine* 39 (1): 1–14. doi:10.1016/j.amepre.2010.02.020.

Wang, J., A. Burke, J. Y. Tsoh, G. M. Le, S. Stewart, G. Gildengorin, C. Wong, E. Chow, K. Woo, and T. T. Nguyen. 2014. "Engaging Traditional Medicine Providers in Colorectal Cancer Screening Education in a Chinese American Community: A Pilot Study." *Preventing Chronic Disease* 11 (217): 1–10.

Wang, J. H., G. X. Ma, W. Liang, Y. Tan, K. H. Makambi, R. Dong, S. W. Vernon, S. Tu, and J. S. Mandelblatt. 2018. "Physician Intervention and Chinese Americans' Colorectal Cancer Screening." *American Journal of Health Behavior* 42 (1): 13–26. doi:10.5993/AJHB.42.1.2.

Wong, S. T., G. Gildengorin, T. Nguyen, and J. Mock. 2005. "Disparities in Colorectal Cancer Screening Rates among Asian Americans and non-Latino Whites." *Cancer* 104 (12): 2940–2947. doi:10.1002/cncr.21521.

Wu, T., J. Y. Kao, H. F. Hsieh, Y. Y. Tang, J. Chen, J. Lee, and D. Oakley. 2010. "Effective Colorectal Cancer Education for Asian Americans: A Michigan Program." *Journal of Cancer Education* 25: 146–152. doi:10.1007/s13187-009-0009-x.

Yoo, G. J., E. Musselman, Y. Lee, and D. Y. Melichar. 2015. "Addressing Health Disparities among Older Asian Americans: Data and Diversity." *Journal of the American Society on Aging* 38 (4): 74–81.