Colorectal Cancer Screening: Low Health Literacy and Limited English Proficiency Among Asians and Whites in California

TETINE SENTELL
Office of Public Health Studies, University of Hawai‘i, Honolulu, Hawai‘i, USA

KATHRYN L. BRAUN
Office of Public Health Studies, University of Hawai‘i, and the ‘Imi Hale Native Hawaiian Cancer Network, Honolulu, Hawai‘i, USA

JAMES DAVIS
Biostatistics Core, John A. Burns School of Medicine, University of Hawai‘i, Honolulu, Hawai‘i, USA

TERRY DAVIS
Section of General Medicine, School of Medicine, Louisiana State University Health Sciences Center, Shreveport, Louisiana, USA

The authors examined the relationship between low health literacy (LHL), limited English proficiency (LEP), and meeting current U.S. Preventive Service Task Force colorectal cancer (CRC) screening guidelines for Asians and Whites in California. For 1,478 Asian and 14,410 White respondents 50–75 years of age in the 2007 California Health Interview Survey, the authors examined meeting CRC screening guidelines using multivariable logistic models by LEP and LHL separately and in combination. Analyses were run with the full sample, then separately for Whites and Asians controlling for demographics and insurance. For those with LEP, patient-provider language concordance and CRC screening was examined. Overall, respondents with LEP and LHL were the least likely to meet CRC screening guidelines (36%) followed by LEP-only (45%), LHL-only (51%), and those with neither LHL nor LEP (59%), a hierarchy that remained significant in multivariable models. For Whites, LHL-only was associated with screening, whereas LEP-only and LEP and LHL were significant for Asians. Having a language concordant provider was not significantly

© Tetine Sentell, Kathryn L. Braun, James Davis, and Terry Davis
This study was supported by National Cancer Institute grants no. 1R03CA158419 and U54CA153459. Biostatistical support was also partially supported by grants from the National Institute on Minority Health and Health Disparities U54MD007584 and G12MD007601 from the National Institutes of Health.

Address correspondence to Tetine Sentell, Office of Public Health Studies, University of Hawai‘i, 1960 East-West Road, Biomed, D-104, Honolulu, HI 96822, USA. E-mail: tsentell@hawaii.edu
Cancer Screening, Health Literacy, and English Proficiency

Cancer is a leading cause of death in Asian Americans (Centers for Disease Control and Prevention, 2008). This is an increasing public health problem given that the Asian American population has almost doubled in the past 10 years and continues to grow largely because of immigration patterns (U.S. Census Bureau, 2002, 2009). Immigration to the United States is associated with increasing cancer risk for Asians (Gomez et al., 2010), indicating that cancer morbidity and mortality are likely to rise in this group. Colorectal cancer (CRC), a largely preventable cancer, is the second-leading cause of cancer for Asian American/Pacific Islander men and the third among Asian American/Pacific Islander women (McCracken et al., 2007). CRC is highly treatable with early detection, which can significantly reduce morbidity and mortality. Yet, Asian Americans have some of the lowest CRC screening rates in the United States (Etzioni et al., 2004; Wong, Gildengorin, Nguyen, & Mock, 2005).

CRC screening places particularly high demands on individuals, including scheduling beyond a regular doctors’ appointment, independent test preparation, and/or complex completion instructions (Arnold et al., 2012; Vernon & Meissner, 2008). Screening rates may thus be strongly affected by low health literacy (LHL). Although the relationship between cancer screening and LHL specifically among Asian Americans is not well studied, LHL has been associated with less cancer knowledge, negative attitudes toward cancer screening, lower self-efficacy, and less likelihood of completing screening in other racial/ethnic groups (Bennett et al., 1998; Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011; Davis, Williams, Marin, Parker, & Glass, 2002; Davis et al., 2001; Dolan et al., 2004; Dwyer, Mulvaney, Dietrich, & Rothman, 2007; Lindau et al., 2002; Miller, Brownlee, McCoy, & Pingone, 2007; Peterson, Guerra, Dominguez, & Shea, 2005).

Individuals with limited English proficiency (LEP) face additional barriers in understanding and accessing health information and services (Jacobs, Karavolos, Rathouz, Ferris, & Powell, 2005; Tu et al., 2008). Although LHL and LEP are related, they represent distinct health communication barriers (Leyva, Sharif, & Ozuah, 2005; Sudore et al., 2009). As one study of health literacy among LEP Spanish speakers concluded, one should not assume that “Spanish-speaking Latino parents who are comfortable speaking English will understand a prescription label written in English, or that Latino parents who speak Spanish will understand drug information written in Spanish” (Leyva et al., 2005, p. 56). Even in a state such as California, which has strong and innovative language access policies (Perkins & Youdleman, 2008; Snowden, Masland, Peng, Wei-Mien Lou, & Wallace, 2011), significant gaps exist by English proficiency in health outcomes (Kim et al., 2011), cancer screening (Johnson-Kozlow, Roussos, Rovniak, & Hovell, 2009) and access to linguistically appropriate health information (Hadler, Chen, Gonzalez, & Roby, 2013; Tanjasiri et al., 2004).

LEP is common in many Asian American populations. For example, approximately 60% of Chinese, Korean, and Vietnamese speakers have LEP (U.S. Census Bureau, 2003). LEP may escalate the health-related consequences of LHL generally and in Asian populations specifically. Previous work has found that individuals with both LEP and LHL are at particular risk for poor health (Sentell & Braun, 2012). The relationships among cancer screening, LEP, and LHL are unknown.

Patient-provider language concordance has been found to predict both access to health care and health status, without fully mitigating all language-based health
disparities (August, Nguyen, Ngo-Metzger, Sorkin, 2011; Wilson, Chen, Grumbach, Wang, & Fernandez, 2005). Findings regarding language concordance and CRC screening specifically are mixed. Eamranond and colleagues found that LEP individuals in patient-provider language-concordant relationships had higher rates of CRC screening compared with individuals in language-discordant relationships (Eamranond, Davis, Phillips, & Wee, 2011). However, Linsky and colleagues found that LEP individuals with language concordant providers had lower screening prevalence than those with a language-discordant provider (Linsky, McIntosh, Cabral, & Kazis, 2011). The relationships among language, health literacy, and provider language concordance are similarly complex and understudied (Sudore et al., 2009).

 Particularly among Asian Americans who have notable cancer screening and mortality disparities, it is important to consider the distinct relationships between LHL and LEP in CRC screening. These findings could play a role in designing effective interventions, along with furthering our understanding of distinct predictors of CRC screening. The purpose of this study was to examine the relationships among LHL, LEP, and CRC screening for Asian Americans and Whites. For those with LEP, we also examined the role of patient-provider language concordance to investigate whether this factor might play a role in mitigating CRC screening disparities.

**Method**

The 2007 California Health Interview Survey (CHIS; CHIS, 2010a) public-use data file was used in this analysis. The CHIS is a random digit dialing telephone survey administered by the University of California, Los Angeles, Center for Health Policy Research. The CHIS is a representative sample of California, home to 4 out of every 10 Asian Americans in the United States (U.S. Census Bureau, 2002). The CHIS specifically oversamples underrepresented ethnic/racial groups, including Asians (CHIS, 2010b). Along with Spanish, the 2007 CHIS was administered in Mandarin, Cantonese, Korean, and Vietnamese, allowing participation by Asian American individuals with LEP (CHIS, 2010b).

**CRC Screening**

In the 2007 CHIS, compliance with colorectal screening guidelines was obtained for all participants 50–75 years of age based on a series of cancer screening methods (i.e., having a fecal occult blood test in the past year, a flexible sigmoidoscopy or double-contrast barium enema in the past 5 years, or a colonoscopy in the past 10 years), per the U.S. Preventive Services Task Force’s guidelines (U.S. Preventive Services Task Force, 2003, 2008, 2009). Meeting colorectal cancer screening guidelines was defined as **yes** for this variable if timing of the test was as recommended.

Respondents who reported a CRC test were asked whether they completed the test as a result of a problem. Individuals who took the test for diagnostic purposes \(n = 3,425\) were excluded from this study because of the concern that their utilization may be subject to different factors.

**Race/Ethnicity**

Race/ethnicity was self-reported and defined as Asian (including Chinese, Filipino, Japanese, Korean, Vietnamese, and other Asian American) or White.
**LHL**

We assessed health literacy using two questions:

1. “When you get written information at a doctor’s office, would you say that it is very easy, somewhat easy, somewhat difficult, or very difficult to understand?”
2. “When you read the instructions on a prescription bottle, would you say that it is very easy, somewhat easy, somewhat difficult, or very difficult to understand?”

*LHL* was defined as responding that (a) written information at the doctor’s office is “somewhat” or “very difficult” to understand or (b) instructions on a prescription bottle are “somewhat difficult” or “very difficult” to understand (Health Research for Action, 2009; Sentell, 2012; Sentell & Braun, 2012). In these two questions, there was no indication that the language of written materials or prescription drugs had to be English. Thus, a non-English speaker could be answering this question regarding in-language materials. Individuals who reported both not getting written information and not using prescription medicine (*n* = 166) were excluded because their health literacy could not be determined.

**LEP**

Respondents who spoke any languages at home besides English were asked, “Since you speak a language other than English at home, we are interested in your own opinion of how well you speak English. Would you say you speak English very well, well, not well, not at all.” *LEP* is defined as self-reporting speaking English “not well” and “not at all.” This LEP variable is considered a superior measure for language barriers in health (Flores, Abreu, & Tomany-Korman, 2005), has strong face validity, and is standard in many studies (Cordasco, Ponce, Gatchell, Traudt, & Escarce, 2011; Ponce, Hays, & Cunningham, 2006).

**LHL and LEP**

On the basis of previous research that found distinct relationships with health status for combinations of LHL and LEP (Sentell & Braun, 2012), we compared four possible combinations of LEP and LHL to CRC screening: (1) individuals with both LEP and LHL, (2) individuals with LEP-only, (3) individuals with LHL only, and (4) individuals with neither LEP nor LHL. Group 4, those with neither LEP nor LHL, served as the reference group.

**Sample**

As described earlier, we included only individuals who were White or Asian, 50–75 years of age, who did not take a CRC test for a diagnostic purpose, and who were not missing health literacy assessment. The final, unweighted sample size was 15,888 individuals, including 14,410 Whites and 1,478 Asians.

**Statistical Methods**

All data were analyzed in Stata 12 (Stata Corp., 2011) using appropriate weighting methods to both correct for the complex sample design and to provide population-level
We first compared descriptive statistics for Whites and Asians overall using Chi-square analyses. We then considered meeting CRC screening guidelines by the four LHL and LEP combinations using chi-square and then multivariable analyses. We performed these analyses overall with the full sample, then separately for Whites and Asians. In these subgroup analyses, we dropped any LEP or LHL combination group with a sample size \(<45\) because these lacked sufficient \((\leq 79\%)\) power to find a 20% screening difference in CRC screening for that group compared with the reference group (neither LEP nor LHL). The 20% difference (specifically 60% vs. 40%) was based on previous research of CRC screening by English proficiency (Diaz et al., 2012) and among Asians (Lee, Lundquist, Ju, Luo, & Townsend, 2011).

In multivariable models, control variables were age (continuous 50–75 years), sex, education (less than high school, high school graduate, college graduate, more than college), poverty (\(\leq 100\%\) of the federal poverty level vs. not), living in a rural area (vs. not), current insurance (vs. none), being born in the United States (vs. elsewhere), and marital status (married vs. other). These variables are associated with health literacy and self-reported health status in other studies (Berkman et al., 2011). Age is presented dichotomously as middle age (50–64 years) and older age (65–75 years) in the descriptive tables for ease of interpretation.

For those with LEP, we also considered language concordance. The language concordance variable was defined based on previous work with the CHIS (August et al., 2011). The two groups possible for this variable were (a) other-language concordant (patients and providers spoke the same non-English language) or (b) language discordant (patient did not share a language with their provider).

To test the importance of the language concordance variable to our study findings, we first considered whether language concordance had a significant relationship with CRC screening in bivariate models for those with LEP (overall, Whites, and Asians). Only groups with a significant relationship for language concordance and CRC screening in bivariate models would include this variable in final multivariable models to investigate whether language concordance affected the relationship between LEP and/or LHL to CRC screening.

**Results**

**Descriptive Results**

Table 1 shows the demographic and CRC screening comparisons of Asians and Whites, revealing significantly lower CRC screening for Asians (51.1%) compared with Whites (57.7%). Distinct relationships with health communication variables also were seen. Overall, 21.2% Asians reported LHL compared with 11.2% of Whites. For LEP, 33.5% of Asians reported this, compared with 1% of Whites. Considered together, 13.8% of Asians reported both LEP and LHL, compared with <1% of Whites. Asians and Whites also varied significantly for all control variables, including education, age, U.S. nativity, and insurance.

**CRC Screening**

Overall, respondents with LEP and LHL were the least likely to meet CRC screening guidelines (36%) followed by LEP-only (45%), LHL-only (51%), and those with neither LHL nor LEP (59%) (design-corrected chi-square: 14.27; \(p < .001\)).
Multivariable models are shown in Table 2. For the full sample, the hierarchy seen earlier in CRC screening by LEP and LHL combinations remained significant even when controlling for associated factors. Compared with the reference group (individuals with neither LEP nor LHL), having both LEP and LHL was associated with lowest odds of timely CRC screening (OR: 0.52; 95% CI [0.31, 0.98]), followed by those with...
LEP-only (OR: 0.60; 95% CI [0.40, 0.91]) and those with LHL-only (OR: 0.77; 95% CI [0.65, 0.91]).

The analyses for Asians and Whites are separately shown in Table 2. In the multivariable model for Whites, the key health communication variable predicting CRC screening was LHL-only (OR: 0.78; 95% CI [0.64, 0.93]). LEP-only was not significant for Whites. (The group with both LHL and LEP was not included in the White analyses due to the small sample size: <45.) However, among Asians, LEP was a critical

|                          | Total OR (95% CI) | White OR (95% CI) | Asian OR (95% CI) |
|--------------------------|------------------|------------------|------------------|
| LHL and LEP              | 0.52 (0.31–0.89) | N/A              | 0.50 (0.28–0.89) |
| LEP only                 | 0.60 (0.40–0.91) | 0.53 (0.20–1.39) | 0.62 (0.38–0.99) |
| LHL only                 | 0.77 (0.65–0.91) | 0.78 (0.64–0.93) | 0.71 (0.39–1.28) |
| Neither                  | Reference        | Reference        | Reference        |
| Education                |                  |                  |                  |
| Less than high school    | 0.62 (0.48–0.81) | 0.61 (0.47–0.81) | 0.66 (0.31–1.43) |
| High school graduate     | 0.67 (0.59–0.76) | 0.66 (0.58–0.75) | 0.73 (0.46–1.14) |
| College graduate         | 0.76 (0.66–0.88) | 0.74 (0.64–0.86) | 0.89 (0.57–1.39) |
| More than college degree | Reference        | Reference        | Reference        |
| Other control variables  |                  |                  |                  |
| Age                      | 1.06 (1.05–1.07) | 1.06 (1.05–1.07) | 1.04 (1.02–1.07) |
| Born in the United States| 1.05 (0.84–1.30) | 1.05 (0.81–1.37) | 1.02 (0.63–1.65) |
| Female                   | 0.86 (0.77–0.95) | 0.82 (0.73–0.91) | 1.08 (0.78–1.50) |
| ≤ 100% federal poverty level | 0.65 (0.49–0.86) | 0.65 (0.46–0.91) | 0.67 (0.39–1.14) |
| Rural                    | 0.85 (0.76–0.95) | 0.87 (0.77–0.98) | 0.52 (0.27–1.02) |
| Insured                  | 3.77 (2.98–4.76) | 3.90 (2.98–5.11) | 3.33 (2.08–5.33) |
| Married                  | 1.24 (1.10–1.39) | 1.26 (1.12–1.43) | 1.03 (0.74–1.44) |
| Race/ethnicity           |                  |                  |                  |
| Chinese                  | 0.92 (0.68–1.25) | —                | 0.88 (0.51–1.53) |
| Filipino                 | 0.75 (0.51–1.12) | —                | 0.68 (0.35–1.30) |
| Korean                   | 1.25 (0.81–1.94) | —                | 1.10 (0.57–2.11) |
| Vietnamese               | 1.43 (0.83–2.46) | —                | 1.28 (0.59–2.80) |
| Other Asian              | 0.76 (0.44–1.30) | —                | 0.73 (0.39–1.37) |
| Japanese                 | 1.02 (0.67–1.55) | —                | Reference        |
| White                    | Reference        | —                | —                |

Note. LEP = Limited English proficiency; LHL = low health literacy; N/A = variable could not be included due to insufficient cases for analysis.
variable. For Asians, having both LEP and LHL was associated with having lower likelihood of cancer screening (OR: 0.50; 95% CI [0.28, 0.89]), as was LEP-only to a slightly less degree (OR: 0.62; 95% CI [0.38, 0.99]). LHL-only was not a statistically significant variable among Asians in multivariate analyses.

Among the control variables, health insurance was the strongest variable across all multivariate analyses (OR > 3.00 across all groups). Other significant control variables associated with meeting CRC screening recommendations in the full sample were older age, higher education, being male, living above poverty, living in a nonrural area, and being married.

Role of Doctor-Patient Language Concordance

Among the 539 individuals in the sample with LEP, 54.5% had a language-concordant provider (Table 1). Specifically, 25% of Whites with LEP had a language concordant provider compared with 58% of Asians with LEP. However, in bivariate analysis, language concordance was not significantly associated with timely CRC screening overall or specifically for Whites or Asians. Thus, we did not include this variable in further analyses.

Discussion

This study has three key findings. First, LHL was associated with CRC screening overall. However, to fully understand CRC screening disparities, our findings emphasizes that it is also important to consider English proficiency. Considering health literacy along with LEP in CRC screening was particularly important for Asians, a group with substantial numbers (34%) reporting LEP.

Second, we note that those with both LEP and LHL were particularly vulnerable groups for cancer screening disparities. In unadjusted models, only 39% of those with LEP and LHL met CRC screening guidelines, compared with 59% of those with neither health communication disadvantage. Even in fully adjusted models, CRC screening rates were significantly lower for those with both LEP and LHL overall and among Asians. This issue is also particularly important among Asians, as almost 14% reported both LEP and LHL, indicating significant self-reported health communication challenges and likely vulnerability to cancer screening disparities in this group.

However, it is important to note that not all individuals with LEP reported LHL. Those with LEP and/or LHL may not realize, or wish to admit, their own challenges (Parikh, Parker, Nurss, Baker, & Williams, 1996). These individuals may comprise another particularly vulnerable group for cancer screening disparities, although one that cannot be identified with self-reported health literacy measurement used in this study.

Last, this study found that language concordant providers do not appear to play a strong role in CRC screening among those with LEP. Previous research has found that language-concordant providers can reduce confusion about health information among those with LEP, though they do not fully mitigate language barriers (Wilson et al., 2005). This suggests that language concordant providers are not sufficient to resolve language-based disparities in cancer screening.

This speaks to the importance of also considering other interventions, including tailoring and disseminating education materials and messages to different cultural and language groups. Tips on developing effective cancer education materials for consumers are available in the literature (Kulukulualani, Braun, & Tsark, 2008) and online (National Cancer Institute, 2008; Susan G. Komen Foundation, 2007), including
checklists and protocol for pretesting early versions of educational pieces. Low reading level text and congruent and clear graphics are essential for individuals with LEP and LHL. Other research has found that interpreters are effective in increasing cancer screening in Asian and Pacific Islander populations with LEP (Dang et al., 2010).

California has strong linguistic access policies, such as mandating that certain health materials and language assistance services be provided in a non-English language when a particular linguistic group surpasses a county percentage threshold (Perkins & Youdleman, 2008; Snowden et al., 2011). However, access to both in-language materials and programs in California vary across factors such as geography and racial/ethnic subgroup (Tanjasiri et al., 2004; Zargarzadeh & Law, 2011), and existing language assistance regulation have not resolved all communication barriers (Hadler et al., 2013). Furthermore, some individuals may also access in-language health education materials independently. For example, educational materials on colorectal cancer are available in some Asian languages (including Chinese, Hindi, Hmong, Khmer, Korean, Ilocano, Tagalog, and Vietnamese) through a website maintained by the Asian American Network for Cancer Awareness, Research, and Training (http://www.aancart.org/apicem-web-tool). Because there is no CHIS question asking if non-English speakers received linguistically appropriate health information from their providers or on their own, we could not test these issues in this analysis. We think that the relationship between LEP and LHL in cancer screening generally is important to consider, yet it is likely that specific relationships between LHL and LEP in CRC screening may vary by contextual factors (particularly interacting with demographic characteristics). While specifying these multilevel relationships are beyond the scope of the present study, future research should consider these issues in order to design the most effective interventions.

Outside of language, known barriers to CRC screening include diet restrictions associated with the guaiac-based fecal occult blood test, multiday sampling usually associated with both the guaiac and immunochemical fecal occult blood test, and diet restrictions and cleansing requirements associated with sigmoidoscopy and colonoscopy. LHL may add comprehension challenges to these instructions. LEP and LHL together may further compromise comprehension of and adherence to CRC screening procedures.

Another known barrier to CRC screening is lack of insurance, a particularly important and significant predictor of CRC screening compliance in this study. It is hoped that the Affordable Care Act will reduce the number of Americans without health insurance, mitigating this barrier. Also, health care facilities are now being monitored on CRC screening rates through the Healthcare Effectiveness Data and Information Set, a tool used by more than 90% of America’s health plans to measure performance on important dimensions of care and service. Ideally, this change will help motivate health care organizations to increase adherence to CRC screening among all Americans, including those with LEP and LHL.

Limitations

This study has many strengths, including a population-based sample with both substantial numbers with LEP and a large Asian sample. However, this study does have some limitations.

The 2007 CHIS health literacy items are not standardized in-person measures, which is a limitation for direct comparison with other studies. Also, health literacy is
self-reported. Despite these limitations, there is strong justification for the use of these health literacy items. First, they are similar to items with known validity in health literacy measurement (Chew, Bradley, & Boyko, 2004; Chew et al., 2008) and have been used previously (Health Research for Action, 2009; Sentell, 2012; Sentell & Braun, 2012). Second, they have strong face validity as direct measures of health communication challenges. Third, to our knowledge, no other US, population-based study includes health literacy and cancer screening data for those who are LEP and speak multiple Asian languages. Fourth, only with findings of disparities in these factors are there likely to be justification for adding more detailed health literacy measures into population-based health surveys, including those with substantial Asian American samples. As these efforts are expensive, it is important to use rich existing data sources to consider if there is sufficient justification for the costly undertaking of such in-person health literacy measures.

Our other items are self-reported as well. Respondents may not be fully aware of their English proficiency or their cancer screening history. Furthermore, racial/ethnic groups respond differently to self-reported items (Kandula, Lauderdale, & Baker, 2007). The CHIS data also lack some variables (health beliefs and previous cancer history) that have been associated with cancer screening in previous research (Breslau, 2010; McCracken et al., 2007; Maxwell, Crespi, Antonio, & Lu, 2010). Also, because our health literacy measure does not distinguish between difficulty reading materials in the patient’s native tongue versus difficulty reading English, as discussed above, it is possible that some of the health literacy barriers for LEP patients could be overcome by having materials available in the patient’s native tongue.

The American Asian label encompasses at least 50 ethnic groups with distinct cultures and languages, which may have distinct relationships to cancer screening and associated factors (McCracken et al., 2007). However, as other researchers have found, small numbers of Asians in population-based samples often require combining American Asian groups for statistical analysis (Ghosh, 2003), an approach which we followed to assure adequate power for our analyses of LEP and LHL. Future research with larger sample sizes of Asian subgroups should consider how LEP and LHL might differentially impact diverse Asian subgroups. The small sample sizes of our LEP populations, particularly in Whites, may also have impacted our analyses, including the language concordance analyses. Future work including larger sample sizes would be useful for this topic as well.

Last, these findings are based on California data. Our findings may not be fully relevant to Asian American populations in other states. They also may apply differently to non-Asian American LEP populations in California or elsewhere, including Latinos. Asians and other racial/ethnic groups may have unique pathways to cancer screening in California, particularly in light of the innovative language polices there. Yet, even in California data, we found significant disparities. Only 42% of those with LEP overall received CRC cancer screening, compared with 58% of those with English proficiency. Also, only 51% of Asians received screening compared with 58% of Whites. We might expect disparities to be larger in states with less access to Asian language materials and less innovative linguistic policies.

Conclusions
This study confirms that health literacy is associated with CRC screening in a large population-based sample. We also provide insight to significant health communication
predictors for CRC screening among Asian Americans generally, a group with notable cancer screening and mortality disparities. Unlike race/ethnicity and many other factors associated with cancer disparities, health literacy is amenable to direct intervention at the individual, patient/provider, and systems levels and may be a fruitful focus for intervention. However, this study also confirms that English proficiency is a critical health communication variable to consider along with health literacy in understanding CRC screening disparities. Further research should consider which health literacy and language-based policies and interventions might explain and/or mitigate these differences. We note that provider language concordance does not appear to either explain or mitigate CRC screening disparities in the groups studied. Future research should also consider the role of health communication barriers on other points along the cancer care continuum in which health disparities are perpetuated and might be decreased. The role of language and health literacy should also be considered for other racial/ethnic groups and in screening for other cancers, including those with screening tests that place fewer health literacy demands on individuals. Overall, it appears that addressing health communication factors, such as language and health literacy, will be important to addressing critical cancer screening disparities in the United States.

References
Arnold, C. L., Rademaker, A., Platt, D. J., Liu, D., Esparza, J., & Davis T. C. (2012). Literacy barriers to colorectal cancer screening in community clinics. Journal of Health Communication, 17(Suppl. 3), 252–264.
August, K. J., Nguyen, H., Ngo-Metzger, Q., & Sorkin, D. H. (2011). Language concordance and patient–physician communication regarding mental health needs. Journal of the American Geriatric Society, 59, 2356–2362. doi: 10.1111/j.1532-5415.2011.03717.x
Bennett, C. L., Ferreira, M. R., Davis, T. C., Kaplan, J., Weinberger, M., Kuzel, T., … Sartor, O. (1998). Relation between literacy, race, and state of presentation among low-income patients with prostate cancer. Journal of Clinical Oncology, 16, 3101–3104.
Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: an updated systematic review. Annals of Internal Medicine, 19, 97–107. doi: 10.1059/0003-4819-155-2-201107190-00005
Breslau, E. S., Jeffery, D. D., Davis, W. W., Moser, R. P., McNeel, T. S., & Hawley, S. (2010). Cancer screening practices among racially and ethnically diverse breast cancer survivors: Results from the 2001 and 2003 California Health Interview Survey. Journal of Cancer Survivors, 4, 1–14.
California Health Interview Survey. (CHIS). (2010a). About the California Health Interview Survey. UCLA Center for Health Policy Research. Retrieved from http://www.chis.ucla.edu/about.html
California Health Interview Survey. (CHIS). (2010b). CHIS 2007 Sample Design. UCLA Center for Health Policy Research. Retrieved from http://www.chis.ucla.edu/pdf/sample_desc_2007.pdf
California Health Interview Survey. (CHIS). (2011). About the California Health Interview Survey. Survey design and methods: CHIS data quality. Retrieved from http://www.chis.ucla.edu/dataquality.html
Centers for Disease Control and Prevention. (2008). 10 leading causes of death; Asian American and Pacific Islander population, US, 2006. Leading causes of death by race/ethnicity. Health, US, 2008. Table 30. Retrieved from http://www.cdc.gov/omhd/populations/AsianAM/AsianAm.htm
Chew, L. D., Bradley, K. A., & Boyko, E. J. (2004). Brief questions to identify patients with inadequate health literacy. Family Medicine, 36, 588–594.
Cancer Screening, Health Literacy, and English Proficiency

Chew, L. D., Griffin, J. M., Partin, M. R., Noorbaloochi, S., Grill, J. P., Snyder, A., … Vanryn, M. (2008). Validation of screening questions for limited health literacy in a large VA outpatient population. *Journal of General Internal Medicine, 23*, 561–566.

Cordasco, K. M., Ponce, N. A., Gatchell, M. S., Traubt, B., & Escare, J. J. (2011). English language proficiency and geographical proximity to a safety net clinic as a predictor of health care access. *Journal of Immigrant and Minority Health, 13*, 260–267.

Dang, J., Lee, J., Tran, J. H., Kagawa-Singer, M., Foo, M. A., Nguyen, T. U., … Tanjasiri, S. P. (2010). The role of medical interpretation on breast and cervical cancer screening among Asian American and Pacific Islander women. *Journal of Cancer Education, 25*, 253–262. doi: 10.1007/s13187-010-0074-1

Davis, T. C., Dolan, N. C., Ferreira, M. R., Tomori, C., Green, K. W., Sipler, A. M., & Bennett, C. L. (2001). The role of inadequate health literacy skills in colorectal cancer screening. *Cancer Investigation, 19*, 193–200.

Davis, T. C., Williams, M. V., Marin, E., Parker, R. M., & Glass, J. (2002). Health literacy and cancer communication. *CA: A Cancer Journal for Clinicians, 52*, 134.

Diaz, J. A., Roberts, M. B., Clarke, J. G., Simmons, E. M., Goldman, R. E., & Rakowski, W. (2013). Colorectal cancer screening: Language is a greater barrier for Latino men than Latino women. *Journal of Immigrant and Minority Health, 15*, 472–475. doi: 10.1007/s10903-012-9667-6

Dolan, N. C., Ferreira, M. R., Davis, T. C., Fitzgibbon, M. L., Rademaker, A., Lui, D., … Bennett, C. L. (2004). Colorectal cancer screening knowledge, attitudes, and beliefs among veterans: Does literacy make a difference? *Journal of Clinical Oncology, 22*, 2617–2622.

Eamranond, P. P., Davis, R. B., Phillips, R. S., & Wee, C. C. (2011). Patient–physician language concordance and primary care screening among Spanish-speaking patients. *Medical Care, 49*, 668–672. doi: 10.1097/MLR.0b013e318215d803

Etzioni, D. A., Ponce, N. A., Babey, S. H., Spencer, B. A., Brown, E. R., Ko, C. Y., … Klabunde, C. N. (2004). A population-based study of colorectal cancer test use: Results from the 2001 California Health Interview Survey. *Cancer, 101*, S125–S131.

Flores, G., Abreu, M., & Tomany-Korman, S. C. (2005). Limited English proficiency, primary language at home, and disparities in children's health care: How language barriers are measured matters. *Public Health Reports, 120*, 418–430.

Ghosh, C. (2003). Healthy People 2010 and Asian Americans/Pacific Islanders: Defining a baseline of information. *American Journal of Public Health, 93*, 2093–2098.

Gomez, S. L., Quach, T., Horn-Ross, P. L., Pham, J. T., Cockburn, M., Chang, E. T., … Clarke, C. A. (2010). Hidden breast cancer disparities in Asian women: Disaggregating incidence rates by ethnicity and migrant status. *American Journal of Public Health, 100*(Suppl. 1), S125–S131.

Guerra, C. E., Dominguez, F., & Shea, J. A. (2005). Literacy and knowledge, attitudes, and behavior around colorectal cancer screening. *Journal of Health Communication, 10*, 651–663.

Hadler, M. W., Chen, X., Gonzalez, E., & Roby, D. H. (2013). Limited English proficient HMO enrollees remain vulnerable to communication barriers despite language assistance regulations. Policy Brief, UCLA Center for Health Policy Research (PB2013-1).

Health Research for Action. (2009). *Investigating the intersection between health literacy and health plan efficiency*. University of California, Berkeley. Retrieved from http://www.opa.ca.gov/about/consumer_information/files/pdf/full-report-health-care-access(HRA).pdf

Jacobs, E. A., Karavolos, K., Rathouz, P. J., Ferris, T. G., & Powell, L. H. (2005). Limited English proficiency and breast and cervical cancer screening in a multiethnic population. *American Journal of Public Health, 95*, 1410–1416.

Johnson-Kozlow, M., Roussos, S., Rovniak, L., & Hovell, M. (2009). Colorectal cancer test use among Californians of Mexican origin: Influence of language barriers. *Ethnicity & Disease, 19*, 315–322.

Kandula, N. R., Lauderdale, D. S., & Baker, D. W. (2007). Differences in self-reported health among Asians, Latinos, and non-Hispanic Whites: The role of language and nativity. *Annals of Epidemiology, 17*, 191–198.
Kim, G., Worley, C. B., Allen, R. S., Vinson, L., Crowther, M. R., Parmelee, P., Chiriboga, D. A. (2011). Vulnerability of older Latino and Asian immigrants with limited English proficiency. *Journal of the American Geriatric Society, 59*, 1246–1252. doi: 10.1111/j.1532-5415.2011.03483.x

Kulukulualani, M., Braun, K. L., & Tsark, J. (2008). Using a four-step protocol to develop and test culturally targeted cancer education brochures. *Health Promotion Practice, 9*, 344–355.

Lee, H. Y., Lundquist, M., Ju, E., Luo, X., & Townsend, A. (2011). Colorectal cancer screening disparities in Asian Americans and Pacific Islanders: Which groups are most vulnerable? *Ethnicity & Health, 16*, 501–518. doi: 10.1080/13557858.2011.575219

Leyva, M., Sharif, I., & Ozuah, P. O. (2005). Health literacy among Spanish-speaking Latino parents with limited English proficiency. *Ambulatory Pediatrics, 5*, 56–59.

Lindau, S. T., Tomori, C., Lyons, T., Langseth, L., Bennett, C. L., & Garcia, P. (2002). The association of health literacy with cervical cancer prevention knowledge and health behaviors in a multiethnic cohort of women. *American Journal Obstetrics and Gynecology, 186*, 938–943.

Linsky, A., McIntosh, N., Cabral, H., & Kazis, L. E. (2011). Patient–provider language concordance and colorectal cancer screening. *Journal of General Internal Medicine, 26*, 142–147. doi: 10.1007/s11606-010-1512-9

Maxwell, A. E., Crespi, C. M., Antonio, C. M., & Lu, P. (2010). Explaining disparities in colorectal cancer screening among five Asian ethnic groups: A population-based study in California. *BMC Cancer, 10*(1), 214.

McCracken, M., Olsen, M., Chen, M. S., Jemal, A., Thun, M., Cokkinides, V., … Ward, E. (2007). Cancer incidence, mortality, and associated risk factors among Asian Americans of Chinese, Filipino, Vietnamese, Korean, and Japanese Ethnicities. *CA: A Cancer Journal for Clinicians, 57*, 190–205.

Miller, D. P., Brownlee, C. D., McCoy, T. P., & Pingone, M. P. (2007). The effect of health literacy on knowledge and receipt of colorectal cancer screening: A survey study. *BMC Family Practice, 8*, 16.

National Cancer Institute. (2008). *Making health communication programs work*. Retrieved from http://www.cancer.gov/cancertopics/cancerlibrary/pinkbook

Parikh, N. S., Parker, R. M., Nurss, J. R., Baker, D. W., & Williams, M. V. (1996). Shame and health literacy: The unspoken connection. *Patient Education & Counseling, 27*, 33–39.

Perkins, J., & Youdelman, M. (2008). *Summary of state law requirements addressing language needs in health care*. 2008. National Health Law Program. Retrieved from http://sites.lawhelp.org/documents/383231nhelp.lep.state.law.chart.final.pdf

Peterson, N. B., Dwyer, K. A., Mulvaney, S. A., Dietrich, M. S., & Rothman, R. L. (2007). The influence of health literacy on colorectal cancer screening knowledge, beliefs, and behaviors. *Journal of the National Medical Association, 99*, 1105–1112.

Ponce, N. A., Hays, R. D., & Cunningham, W. E. (2006). Linguistic disparities in health care access and health status among older adults. *Journal of General Internal Medicine, 21*, 786–791.

Sentell, T. (2012). Implications for reform: Survey of California adults suggests low health literacy predicts likelihood of being uninsured. *Health Affairs, 31*, 1039–1048. doi: 10.1377/hlthaff.2011.0954

Sentell, T., & Braun, K. L. (2012). Low health literacy, limited English proficiency, and health status in Asians, Latinos, and other racial/ethnic groups in California. *Journal of Health Communication, 17*(Suppl. 3), 82–99. doi: 10.1080/10810730.2012.712621

Snowden, L. R., Masland, M. C., Peng, C. J., Wei-Mien Lou, C., & Wallace, N. T. (2011). Limited English proficient Asian Americans: Threshold language policy and access to mental health treatment. *Social Science & Medicine, 72*, 230–237.

StataCorp. (2011). *Stata Statistical Software: Release 12*. College Station, TX: Author.

Sudore, R. L., Landefeld, C. S., Pérez-Stable, E. J., Bibbins-Domingo, K., Williams, B. A., & Schillinger, D. (2009). Unraveling the relationship between literacy, language proficiency,
and patient–physician communication. *Patient Education & Counseling, 75*, 398–402. doi: 10.1016/j.pec.2009.02.019

Susan G. Komen Breast Cancer Foundation. (2007). *Asians or Pacific Islanders: Developing effective cancer education print materials*. Dallas, TX: Author. Retrieved from http://ww5.komen.org/uploadedfiles/Content_Binaries/Asian.pdf

Tanjasiri, S. P., Tran, J. H., Kagawa-Singer, M., Foo, M. A., Foong, H. L., Lee, S. W., … Wang, J. S. (2004). Exploring access to cancer control services for Asian-American and Pacific Islander communities in Southern California. *Ethnicity & Disease, 14*(Suppl. 1), S14–S19.

Tu, S.-P., Yip, M.-P., Chun, A., Choe, J., Bastani, R., & Taylor, V. (2008). Development of intervention materials for individuals with limited English proficiency: Lessons learned from “Colorectal Cancer Screening in Chinese Americans”. *Medical Care, 46*(Suppl. 1), S51–S61.

U.S. Census Bureau. (2002). *The Asian population: 2000. Census 2000 brief*. Retrieved from http://www.census.gov/prod2002pubs/c2kbr01-16.pdf

U.S. Census Bureau. (2003). *Language use and English speaking ability: 2000*. Washington, DC: U.S. Department of Commerce.

U.S. Census Bureau. (2009). *Census Bureau estimates nearly half of children under age 5 are minorities: Estimates find nation’s population growing older, more diverse*. Retrieved from http://www.census.gov/newsroom/releases/archives/population/cb09-75.html

U.S. Preventive Services Task Force. (2003). *Screening for cervical cancer*. Retrieved from http://www.ahrq.gov/clinic/uspstf/uspsccerv.htm

U.S. Preventive Services Task Force. (2008). *Screening for colorectal cancer*. Retrieved from http://www.ahrq.gov/clinic/uspstf/uspscol.htm

U.S. Preventive Services Task Force. (2009). *Screening for breast cancer recommendations*. Retrieved from http://www.ahrq.gov/clinic/uspstf/uspsbrca.htm

Vernon, S., & Meissner, H. (2008). Evaluating approaches to increase uptake of colorectal cancer screening: Lessons learned from pilot studies in diverse primary care settings. *Medical Care, 46*, S97–S102.

Wilson, E., Chen, A. H., Grumbach, K., Wang, F., & Fernandez, A. (2005). Effects of limited English proficiency and physician language on health care comprehension. *Journal of General Internal Medicine, 20*, 800–806.

Wong, S. T., Gildengorin, G., Nguyen, T., & Mock, J. (2005). Disparities in colorectal cancer screening rates among Asian Americans and non-Latino Whites. *Cancer, 104*(12 Suppl.), 2940–2947.

Zargarzadeh, A. H., & Law, A. V. (2011). Access to multilingual prescription labels and verbal translation services in California. *Research in Social and Administrative Pharmacy, 7*, 338–346. doi: 10.1016/j.sapharm.2010.08.001