COLORECTAL CANCER SCREENING IN A PACIFIC NORTHWEST AMERICAN INDIAN TRIBE

By

Annika G. Maly

A THESIS

Presented to the Department of Public Health and Preventive Medicine
and the Oregon Health & Science University
School of Medicine
in partial fulfillment of
the requirements for the degree of

Master of Public Health

March 2013

Department of Public Health and Preventive Medicine

School of Medicine

Oregon Health & Science University

CERTIFICATE OF APPROVAL

This is to certify that the Master's thesis of

Annika G. Maly

has been approved

Thomas Becker, MD, PhD

Rochelle Fu, MD, PhD

David Lieberman, MD, FACG

TABLE OF CONTENTS

TABLES

ACKNOWLEDGEMENTS

The authors thank the members of Tribe A for their participation in the survey, the Tribe A Department of Health and Human Services and clinic staff, including Jim Sherrill, Steve Kutz, Todd Bratton, and Pamela McCall for their support and mentorship, and the tribal council for facilitating the implementation of the survey. We thank research assistants Hanna Nelson, Anna Kitchin, Ruth Frost, and Amy Ferriel, and Ed Lutz and Hanna Nelson for data entry and editing, as well as Marnie Boardman and Dennis McDermot at the Washington State Department of Health for their data sharing and technical assistance. We also thank the Spirit of EAGLES AIAN Leadership Initiative on Cancer, the Northwest Native American Research Center for Health, and the Oregon Students Learn and Experience Research program for their financial support.

I also want to personally thank Tessa Steel for her commitment to the project and working alongside me for the duration of the project, Dr. Lieberman for his expertise in colorectal cancer screening and for providing his expert opinion during the analysis phase, Dr. Fu for her invaluable help navigating the statistics, and Dr. Becker for presenting this project to me in the Fall of 2008 and facilitating everything that has happened in its wake. It has been a journey.

ABSTRACT

Objectives. Estimates of colorectal cancer (CRC) screening adherence are low among American Indians (AIs). We described the demographics, health status, prevalence of modifiable CRC risk factors, and use of CRC screening modalities in a Pacific Northwest AI Tribe.

Methods. We conducted a survey among Tribe A members using a modified Behavioral Risk Factor Surveillance System (BRFSS) questionnaire. We analyzed demographics, health status, behavioral risk factors, and CRC screening variables. Using proportions from the Washington State 2010 BRFSS we compared the characteristics of Tribe A members living in Washington State to their non-Hispanic White (NHW) counterparts. We used logistic regression to examine factors associated with CRC screening.

Results. A greater proportion of tribal members reported living below the Federal Poverty Level compared to NHWs in Washington State (12% vs 7%, p=0.013). For individuals over age 50 years, a greater proportion of tribal members had poorer self-rated health (27% vs 16%, p=0.006) and were without health insurance (12% vs 6%, p=0.004). The prevalence of obesity was greater in tribal members compared to NHWs (45% vs 25%, p<0.001). A greater proportion of tribal members had a fecal occult blood

test (FOBT) within the past year (20.4% vs 13.4%, p=0.006). No significant differences were observed in the proportion of tribal members who had an FOBT the past year and/or sigmoidoscopy/colonoscopy within the past 5 years (61.3% vs 58.7%, p=0.48). Age 60-69 years and 70+ years (OR 2.61, 95% CI: 1.38-4.95; OR 2.17, 95% CI: 1.05-4.51) and personal provider (OR 3.7, 95% CI: 1.4-9.6) were associated with increased adherence.

Conclusions. Data from the Tribe A BRFSS demonstrate that members are receiving CRC screening in the same proportions as their NHW counterparts despite lower sociodemographic indicators among members. Unique characteristics of the tribe likely contribute to this finding.

INTRODUCTION

Cancer is the second leading cause of death among American Indian and Alaska Native people (AI/AN) behind cardiovascular disease (1). Overall, colorectal cancer (CRC) is the third most common cancer among AI/ANs behind prostate and lung cancer for men and behind breast and lung cancer for women (2, 3). In the most recent Annual Report to the Nation on the Status of Cancer, between 2004-2008 the incidence of CRC decreased among men and women in all racial groups except among AI/ANs (4).

Previously, traditional surveillance methods demonstrated that the incidence of CRC was lower for AI/AN people when compared to all races (5). However, upon closer inspection, significant regional diversity in CRC incidence exists among AI/AN people across the United States (3, 6). Specifically, in the Pacific Northwest, linking Indian Health Service (IHS) records with national cancer registries demonstrated that the incidence of CRC is greater and 1- and 5-year CRC-related survival is lower in Pacific Northwest AI/ANs when compared to non-Hispanic Whites (NHWs) (7, 8). Thus, investigations are needed to understand CRC screening patterns in this region, as well as barriers that are unique to these tribal communities.

Nationwide CRC screening is significantly lower among AI/ANs than NHWs (9). Government Performance and Results Act (GPRA) data indicate improvement in CRC screening adherence in AI/ANs (33%, 37%, 41.7%, 46.1%. in 2009, 2010, 2011, 2012 respectively); however, these numbers are significantly lower than CRC screening adherence percentages in the general population (64.5% in 2010), and are much lower than the Healthy People 2020 target of 70.5% (10, 11). The GPRA reports also provide

the most specific CRC screening data for the Pacific Northwest, which includes Washington, Idaho, and Oregon. In 2011, the percentage of CRC screening adherence among IHS tribal users age 50 years and older was 41.1% (12).

CRC screening behaviors vary regionally and are influenced by a complex set of sociodemographic, health care access, and cultural factors (13-15). Among Northern Plain and Southwest AIs Perdue, *et al.* found an association between cultural identity measures and screening by endoscopy or colonoscopy, and no trend with fecal occult blood tests (FOBT) (13). In a study conducted in Alaska and the Southwest, researchers demonstrated that age greater than 60 years, state of residence, urban residence, higher levels of education, family history of colorectal cancer, former smoking, multiple medical conditions, English language spoken at home, and higher income were factors associated with age-appropriate CRC screening (14). In another study conducted among AIs in North Carolina, self-rated health, non-smoking, and physical activity were associated with CRC screening (15).

Disparities continue to exist in colorectal cancer screening, incidence of CRC cases, and CRC-related mortality in AI/ANs nationwide, including the Pacific Northwest. To date, no published research has addressed factors associated with CRC screening in Pacific Northwest tribes. The Tribe A Behavioral Risk Factor Surveillance System (BRFSS) Project 2009-2010 provides a unique opportunity to investigate the health information of a tribe that has not been previously studied and to gain a better understanding of factors associated with cancer screening behaviors in this at-risk population.

METHODS

Setting. We surveyed members from the Pacific Northwest Tribe A using an adapted CDC BRFSS questionnaire in 2009 and 2010 (Tribe A BRFSS Project 2009-2010). Tribe A is a non-reservation based tribe that recently gained federal recognition and has approximately 3,000 members. Tribe A provides health care to AI/ANs in the Northwest through Direct Care Services, a type of health care model offered through IHS. Seventy-eight (78) percent of the tribe's population lives in Washington state, 14% live in Oregon, and the remainder live across the country. The study was supported by the Northwest Portland Area Indian Health Board (NPAIHB) and Oregon Health and Science University (OHSU). The protocol was approved by Institutional Review Boards at NPAIHB and OHSU, and by tribal leadership. Researchers were committed to following the principles of community-based participatory and involved the Tribe A Health and Human Services department at each step of the project. A community advisory board was developed to evaluate the results and provide feedback for this manuscript.

Data collection. Eligibility included being an enrolled member of Tribe A with a working telephone number and at least 18 years of age. A convenience sample of adults was selected from the tribal roster (N=1,770). A maximum of three calls and one telephone message were attempted. From the tribal roster, 38% of telephone numbers were inaccurate or disconnected. Contact was made with 51% of those with working telephone numbers. The response proportion was 96% among tribal members with a successful personal contact.

Telephone interviews were conducted by trained personnel following a pre-approved script. Interviews ranged between 30-60 minutes in duration. Rights as a

participant and privacy were reviewed before obtaining verbal consent. An information form was sent to participants at the completion of the interview, as well as $5 compensation for their time. Telephone interviews were randomly monitored for quality and adherence to the script, and paper surveys were reviewed by another member of the interview team during the months of active interviewing to address inconsistencies or missed questions. Responses were recorded on a paper copy of the survey that was later entered into a Microsoft Access database. Double data entry was performed and discrepancies were reviewed and recorded.

Questionnaire. We used 13 core sections from the CDC's BRFSS form. Four more modules were created by the tribe or taken from the 2005 Oregon Health Care Survey. Survey format and questions were approved by the NPAIHB and tribal administration. Overall, the questionnaire consisted of 166 questions.

Independent variables. Demographic variables included age, sex, marital status, employment status, education level, and annual household income. Health status variables included self-reported health status, presence of personal provider, health check-up within the past 2 years, usual place of health care, and health insurance status. We identified five behavioral risk factors that have been strongly associated with colorectal cancer including; obesity, smoking, alcohol consumption, lack of physical activity, and consumption of red and processed meat (16-20). All independent variables were included in the multivariate regression model.

Outcome variable. Recent CRC Screening was defined as either FOBT within the past year and/or sigmoidoscopy or colonoscopy within the past 5 years. For the FOBT, participants were asked, "A blood stool test is a test that you can use at home to

determine whether the stool contains blood. How long has it been since your last blood stool test using a home kit?" For sigmoidoscopy/colonoscopy exam, participants were asked, "Sigmoidoscopy and colonoscopy are exams in which a tube is inserted in the rectum to check the bowel for signs of cancer or other health problems. How long has it been since you had your last sigmoidoscopy or colonoscopy?" No data points were missing from the Tribe A BRFSS survey and 3 individuals were dropped from analysis due to history of colon cancer.

Data analysis. For our descriptive analyses we included all tribal members living in Washington State age 18 years and older (N=439). Weighted proportions from the Washington State BRFSS 2010 survey were used to compare the raw proportions from the Tribe A BRFSS survey for demographics, health status variables, behavioral risk factors, and CRC screening modalities. For our regression analysis, we used data from members at least 50 years of age who had complete records for all covariates (N=229). Significance of univariate ratios were assessed with chi-square tests. We assessed variables associated with having been recently screened for CRC using a multiple logistic regression model. All quantitative analysis was conducted using STATA 11.2.

RESULTS

Demographics. Numbers presented in Table 1 are representative of the total surveyed populations and surveyed populations age 50 years and older for Washington State Tribe A members and from the weighted Washington State BRFSS 2010 survey. Of note, a significantly greater proportion of tribal members lived below the Federal Poverty Level in both the overall population (12% vs 7%, p=0.013) and population age 50 years and older (10% vs 4%, p=0.001) when compared to the NHW population. A greater

proportion of tribal members had less than a high school education in both the overall population (12% vs 5%, $p<0.001$) and population over age 50 years (15% vs 4%, $p<0.001$) when compared to NHWs, and a significantly smaller proportion of tribal members had additional years of higher education when compared to NHWs (54% vs 72%, $p<0.001$).

Health status. Descriptive statistics for self-reported health, health care utilization, and health care access among Washington State tribal members and the weighted Washington State BRFSS for NHW participants are shown in Table 2. In both the total population and population age 50 years and older, a greater proportion of tribal members reported to be in fair/poor health compared to their NHW counterparts (20% vs 12%, $p<0.001$; 27% vs 16%, $p=0.006$). A greater proportion of tribal members age 50 years and older reported having no health insurance compared to NHWs in Washington State (12% vs 6%, $p=0.004$).

Behavioral risk factors. Numbers presented in Table 3 are representative of the total surveyed population (N=439) and weighted Washington State BRFSS survey, as well as for the populations aged 50 years and older. The proportion of obese tribal members was significantly greater when compared to the NHWs (38% vs 21%, $p<0.001$). When compared to the NHW population in Washington State, no differences were observed between cigarette smoking (17% vs 15%, $p=0.3$), heavy alcohol drinking (5% vs 6%, $p=0.65$), and physical activity (85% vs 83%, $p=0.36$). Data were not available for meat consumption in the Washington State BRFSS 2010 survey.

CRC screening. The proportions of CRC screening among tribal members and Washington State NHWs are illustrated in Table 4. When compared to the NHW

population in Washington State, a significantly greater proportion of the tribal members had completed FOBT testing within the past year (20.4% vs 13.4%, p=0.006). No significant differences were found in the proportions of those who had received sigmoidoscopy or colonoscopy screening (55.3% Tribe A vs 53.6% NHW, p=0.52), or in the overall recent screening measure (61.3% Tribe A vs 58.7% NHW, p=0.48).

Factors associated with CRC screening. In the final multivariate regression model age and current health care provider were significantly associated with CRC screening ($p<0.05$). For those age 60-69 years, the odds of having been recently screened for CRC were 2.6 times the odds for those age 50-59 years (95% CI: 1.4-4.9, p=0.003). The odds of having been recently screened for CRC were 2.2 times the odds for those age 70 years and older compared to those age 50-59 years (95% CI: 1.1-4.5, p = 0.04). For those who stated they had a personal health care provider, the odds of screening were 3.7 times the odds for those who did not have a stated health provider (95% CI: 1.4-9.6, p=0.007). Other variables tested and not found to be significant were sex, marital status, employment status, education level, annual income level, self-reported health status, recent checkup, health insurance status, place of care, body mass index, alcohol consumption, sedentary lifestyle, and smoking.

DISCUSSION

Using data from the Tribe A BRFSS Project 2009-2010 and Washington State BRFSS 2010 survey, we described the demographics, health status, prevalence of modifiable behavioral risk factors associated with colon cancer, and CRC screening practices among Tribe A members compared to the their NHW counterparts in Washington State. Demographic characteristics demonstrated that members of Tribe A

are generally poorer and have had less educational opportunities than their NHW counterparts. The proportion of members with self-rated fair/poor health was significantly greater among tribal members, and a significantly larger proportion of tribal members age 50 years and older were without health insurance when compared to NHWs in Washington State. While Tribe A was only recently federally recognized and members have been living without formal reservation land, the descriptive statistics for this previously unstudied population show that Tribe A is distinctly different from the NHW population in Washington State.

Colorectal cancer is accepted to be modifiable in some cases with increased incidence in Westernized countries owing to lifestyle factors such as obesity, activity level, diet, and smoking (16, 17, 19-22). A significantly larger proportion of tribal members self-reported BMIs over thirty. However, such findings are consistent with the ratio of obese AI/ANs nationwide to obese NHWs in the U.S. presented in the Centers for Disease Control Summary Health Statistics for 2010 (1.8 among Tribe A vs 1.9 among AI/ANs) (23). Factors that contribute to this difference are likely multifactorial and may include socioeconomic factors, genetic predisposition, and cultural changes in food preparation and exercise routines (24). Researchers have identified one genetic locus that may influence BMI among full-heritage Pima Indians although, no clear genetic link has yet been identified for other American Indian groups (25). Overall, the high prevalence of obesity in Tribe A may put tribal members at increased risk for CRC in the future.

No disparity was found in the percentage of individuals that had been recently screened for CRC between the tribal members and NHW population, and a significantly larger proportion of tribal members had recently been screened with FOBT when

compared to NHWs. These findings were unexpected given the low rates of screening cited in regional data collected by the IHS. Also unexpected was the high percentage of recent CRC screening despite larger proportions of tribal members with lower educational status, living below the Federal Poverty Level, and without health insurance. Several factors within the tribe and biases in the survey methods could be contributing to these findings.

Tribe A participates in a Colon Health Program supported by a consortium of smaller tribes in Washington state. This project has been federally funded through the National Colorectal Cancer Control Program that was launched in 2009. With these funds the tribe has hired a Colon Health Patient Navigator who recruits tribal members for CRC screening through the tribal clinic. FOBT is the primary screening method used by this program, which could explain why a greater proportion of tribal members have had FOBTs. Patient navigators have been shown to increase prevalence of CRC screening adherence in underserved populations (26-29). Unfortunately, we are not able to evaluate the impact of the patient navigator within this tribe, although the effects of this program are likely positive.

Another factor contributing to the high percentage of recent screening among tribal members may be related to our ability to contact members via telephone. Over one third of the tribe was unreachable due to unavailable, disconnected, or incorrect telephone numbers listed in the tribal roster. Individuals without telephones are generally of lower socioeconomic status with less access to health services. Thus, we can assume that tribal members without a telephone number and/or no contact information in the tribal roster are at higher-risk for cancer screening non-adherence and also less likely to be aware of

tribal resources. Thus, this important population may have been missed in our survey due to our recruitment techniques and the availability of tribal members' phone numbers. In turn, our results could be an overestimation of recent cancer screening within the tribe.

In the multiple regression model, factors found to be barriers to recent screening included age 50-59 years and lack of an identified health care provider. Older age and personal provider have previously been associated with adherence to CRC screening (30-33). Persons of younger age may have fewer health issues and lower perceived risk of cancer, thus, less need to see a health provider. Those age 50-59 years may have higher co-pays for preventive screening through their insurance. In a *post hoc* analysis, we considered the effect of Medicare and analyzed screening in age categories 50-54, 55-59, 60-64, 65-69, and over 70 years to investigate if there was an abrupt increase in screening at age 65 years. Screening percentage increased incrementally and without statistical significance in each 5-year category making Medicare an unlikely confounder. With this information the tribe may choose to target CRC screening awareness messages to those age 50-59 years, especially since younger patients are more likely to be diagnosed with late stage CRC (34).

The association between an identified personal provider and recent CRC screening is consistent with evidence demonstrating the importance of provider recommendation with CRC screening adherence (32, 35-37). In a survey of IHS and tribal providers, Haverkamp, *et al*. found that health providers did not always recommend screening beginning at age 50 (37). Thus, recommending screening to average-risk individuals starting at age 50 years must be emphasized among all health providers. The

tribe may also wish to initiate a campaign where every member is encouraged to identify a personal health provider.

In addition to the biases mentioned above, this study has several limitations. The BRFSS questionnaire does not differentiate between sigmoidoscopy and colonoscopy. Thus, we were not able to evaluate adherence to CRC screening according to national guidelines and had to limit our outcome variable to "recent CRC screening". Current guidelines recommend sigmoidoscopy every 5 years and colonoscopy every 10 years (38, 39). In our study recent screening was defined as FOBT within the past year and/or sigmoidoscopy/colonoscopy within the past 5 years, which may have lead to an underestimation of true adherence to screening.

This study is specific to Tribe A people living in Washington State and may not be generalizable to AI/ANs across this region. Forty-three federally designated tribes reside in this area and represent a large diversity of urban, suburban, rural, reservation-based, and non-reservation communities. Although Tribe A has only recently been federally recognized, they share much of the same history as their neighboring tribes and have struggled to support the health needs of their people. From our demographic statistics we see that the people of Tribe A are significantly different from their NHW counterparts and represent a population that is not generally captured by IHS surveillance methods. Since 1989, over ten area tribes have implemented their own internal BRFSS projects. As more tribes participate in these kinds of projects it would be of interest to merge these data to gain a better overall understanding of the region's AI/AN population and their health needs.

CONCLUSIONS

The Tribe A BRFSS Project 2009-2010 was the tribe's first effort to collect general health information about their people. The purpose of this report was to gain a better understanding of the Tribe A population, evaluate the prevalence of modifiable behavioral risk factors associated with colon cancer among tribal members, and identify factors associated with barriers to CRC screening. Tribe A represents a population that is unique from NHWs in Washington State as they have a greater percentage of individuals living below the Federal Poverty Level and members over age 50 years living without health insurance. Despite this difference, we found no disparity in recent CRC screening when compared to NHW people in Washington State, and a higher percentage of recent FOBT screening among tribal members. Such findings may be attributed to the tribe's Colon Health Program and dedicated Health and Human Services staff. Programs to improve screening should be targeted towards those age 50-59 years and those who have few encounters with the health care system. Further studies are needed to evaluate the impact of programs like the Colon Health Program and Patient Navigators, so that funding for these kinds of programs may be continued and adopted by other tribes. Ultimately, investment in such programs will help reduce late stage cancer diagnosis and CRC-related mortality in the Pacific Northwest AI/AN population.

REFERENCES

1. National Center for Health Statistics. Health, United States, 2009: With Special Feature on Medical Technology. Hyattsville, MD: 2010.

2. Edwards BK, Ward E, Kohler BA, Eheman C, Zauber AG, Anderson RN, Jemal A, Schymura MJ, Lansdorp-Vogelaar I, Seeff LC, van Ballegooijen M, Goede SL, Ries LA. Annual report to the nation on the status of cancer, 1975-2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. Cancer. 2010 Feb 1;116(3):544-73.

3. Espey DK, Wu XC, Swan J, Wiggins C, Jim MA, Ward E, Wingo PA, Howe HL, Ries LA, Miller BA, Jemal A, Ahmed F, Cobb N, Kaur JS, Edwards BK. Annual report to the nation on the status of cancer, 1975-2004, featuring cancer in American Indians and Alaska Natives. Cancer. 2007 Nov 15;110(10):2119-52.

4. Eheman C, Henley J, Ballard-Barbash R, Jacobs E, Schymura M, Noone A, Pan L, Anderson R, Fulton J, Kohler B, Jemal A, Ward E, Plescia M, Ries L, Edwards B. Annual report to the nation on the status of cancer, 1975-2008, featuring cancers associated with excess weight and lack of sufficient physical activity. Cancer. 2012;118(9):2338-66.

5. Ries L, Eisner M, Kosary C, Hankey B, Miller B, Clegg L, Mariotto A, Feuer E, Edwards B. SEER Cancer Statistics Review, 1975-2001. Bethesda, MD: National Cancer Institute; 2004 Available from: http://seer.cancer.gov/csr/197_2001.

6. Wiggins CL, Espey DK, Wingo PA, Kaur JS, Wilson RT, Swan J, Miller BA, Jim MA, Kelly JJ, Lanier AP. Cancer among American Indians and Alaska Natives in the United States, 1999-2004. Cancer. 2008;113(5 Suppl):1142-52.

7. Puukka E, Stehr-Green P, Becker TM. Measuring the health status gap for American Indians/Alaska Natives: Getting closer to the truth. Am J Public Health. 2005 May;95(5):838-43.

8. Peterson PS. Colorectal Cancer Survival Among American Indian and Alaska Native People in the Pacific Northwest [Master of Public Health, unpublished thesis]. Portland, Oregon: Oregon Health and Science University; 2011.

9 Steele CB, Cardinez CJ, Richardson LC, Tom-Orme L, Shaw KM. Surveillance for health behaviors of American Indians and Alaska natives-findings from the behavioral risk factor surveillance system, 2000-2006. Cancer. 2008 Sep 1;113(5 Suppl):1131-41.

10. Indian Health Service FY 2011, 2012, 2013 Performance (GPRA) Measures. 2012 Available from: www.ihs.gov/cio/crs/documents/gpra/2011-2013Matrix.pdf.

11. Joseph D, King JB, Miller JW, Richardson LC. Prevalence of colorectal cancer screening among adults--behavioral risk factor surveillance system, United States, 2010. Morbidity and Mortality Weekly Report. 2012;61(2):51-6.

12. Indian Health Service. Quality Reports: Quality of IHS Health Care [Internet]. U.S. Department of Health and Human Services cited January 3 2013]. Available from: http://www.ihs.gov/qualityofcare/index.cfm.

13. Perdue DG, Henderson JA, Garroutte E, Bogart A, Wen Y, Goldberg J, Buchwald D. Culture and colorectal cancer screening on three American Indian reservations. Ethnicity and Disease. 2011;21(3):342-8.

14. Schumacher MC, Slattery ML, Lanier AP, Ma KN, Edwards S, Ferucci ED, Tom-Orme L. Prevalence and predictors of cancer screening among American Indian and Alaska Native people: The EARTH study. Cancer Causes & Control. 2008 Sep;19(7):725-37.
15. Farmer DF, Bell RA, Stark N. Cancer screening among Native Americans in eastern North Carolina. Journal of Health Care for the Poor & Underserved. 2005 Nov;16(4):634-42.
16. World Cancer Research Fund/American Institute for Cancer Research. Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Washington DC: 2007 Available from: http://www.dietandcancerreport.org/cancer_resource_center/downloads/Second_Expert_Report_full.pdf.
17. Wei EK, Colditz GA, Giovannucci EL, Fuchs CS, Rosner BA. Cumulative risk of colon cancer up to age 70 years by risk factor status using data from the nurses' health study. Am J Epidemiol. 2009 Oct 1;170(7):863-72.
18. Tsoi KK, Pau CY, Wu WK, Chan FK, Griffiths S, Sung JJ. Cigarette smoking and the risk of colorectal cancer: A meta-analysis of prospective cohort studies. Clinical Gastroenterology & Hepatology. 2009 Jun;7(6):682,688.e1-5.
19. Jacobs ET, Ahnen DJ, Ashbeck EL, Baron JA, Greenberg ER, Lance P, Lieberman DA, McKeown-Eyssen G, Schatzkin A, Thompson PA, Martinez ME. Association between body mass index and colorectal neoplasia at follow-up colonoscopy: A pooling study. Am J Epidemiol. 2009 Mar 15;169(6):657-66.

20. Knekt P, Hakama M, Jarvinen R, Pukkala E, Heliovaara M. Smoking and risk of colorectal cancer. Br J Cancer. 1998 Jul;78(1):136-9.
21. Kirkegaard H, Johnsen NF, Christensen J, Frederiksen K, Overvad K, Tjonneland A. Association of adherence to lifestyle recommendations and risk of colorectal cancer: A prospective Danish cohort study. BMJ. 2010;341:c5504-12.
22. Tsoi KK, Pau CY, Wu WK, Chan FK, Griffiths S, Sung JJ. Cigarette smoking and the risk of colorectal cancer: A meta-analysis of prospective cohort studies. Clinical Gastroenterology & Hepatology. 2009 Jun;7(6):682,688.e1-5.
23. Barnes P, Adams P, Powell-Griner E. National Health Statistics Reports: Health Characteristics of the American Indian or Alaska Native Adult Population: United States, 2004-2008. U.S. Department of Health and Human Services; 2010. Report No.: 20 Available from: http://www.cdc.gov/nchs/data/ad/ad356.pdf.
24. Halpern P. Obesity and American Indians/Alaska Natives. Washington, D.C.: U.S. Department of Health and Human Services; 2007 Available from: http://aspe.hhs.gov/hsp/07/AI-AN-obesity.
25. Traurig MT, Orczewska J, Oritz D, Bian L, Marinelarena A, Kobes S, Hanson R, Mason C, Knowler W, Bogardus C, Baier L. Evidence for a Role of LPGAT1 in Influencing BMI and Percent Body Fat in Native Americans. Obesity (Silver Spring); 2012.
26. Chen L, Santos S, Jandorf L, Christie J, Castillo A, Winkel G, Itzkowitz S. A program to enhance completion of screening colonoscopy among urban minorities. Clinical Gastroenterology and Hepatology. 2008;6(4):443-50.

27. Jandorf L, Gutierrez Y, Lopez J, Christie J, Itzkowitz S. Use of a patient navigator to increase colorectal cancer screening in an urban neighborhood health clinic. J Urban Health. 2005;82(2):216.
28. Percac-Lima S, Grant R, Green A, Ashburner J, Gamba G, Oo S, Richter J, Atlas S. A culturally tailored navigator program for colorectal cancer screening in a community health center: A randomized, controlled trial. Journal of General Internal Medicine. 2009;24(2):211-7.
29. Stokamer C, Tenner C, Chaudhuri J, Vazques E, Bini E. Randomized controlled trial of the impact of intensive patient education on compliance with fecal occult blood testing. J Gen Intern Med. 2005;20(3):278-82.
30. Carlos R, Underwood W, Fendrick A, Bernstein S. Behavioral associations between prostate and colon cancer screening. J Am Coll Surg. 2005;200(2):216-3.
31. Ioannou G, Chapko M, Dominitz J. Predictors of colorectal cancer screening participation in the United States. Am Coll of Gastroenterology. 2003;98(9):2082-91.
32. Meissner H, Breen N, Klabunde C, Vernon S. Patterns of colorectal cancer screening uptake among men and women in the United States. Cancer Epidemiol Biomarkers Prev. 2006;15(2):389-94.
33. Fisher DA, Dougherty K, Martin C, Galanko j, Provenzale D, Sandler RS. Race and colorectal cancer screening: A population-based study in North Carolina. North Carolina Med J. 2004;65(1):12-5.
34. Campbell R, Ferrante J, Gonzalez E, Roetzheim R, Pal N, Herold A. Predictors of advanced stage colorectal cancer diagnosis: Results of a population-based study. Cancer Detect Prev. 2001;25(5):430-8.

35. Guerra CE, Schwartz JS, Armstrong K, Brown JS, Halbert CH, Shea JA. Barriers of and facilitators to physician recommendation of colorectal cancer screening. Journal of General Internal Medicine. 2007;22(12):1681-8.
36. Klabunde CN, Schneck AP, Davis WW. Barriers to colorectal cancer screening among Medicare consumers. Am.J.Prev.Med. 2006;30(4):313-9.
37. Haverkamp D, Perdue DG, Espey D, Cobb N. A survey of Indian Health Service and tribal health providers' colorectal cancer screening knowledge, perceptions, and practices. Journal of Health Care for the Poor & Underserved. 2011;22(1):243-57.
38. U.S. Preventive Services Task Force. Screening for colorectal cancer: U.S. preventive services task force recommendation statement. Ann Internal Med. 2008 Nov 4 2008;149(9):627-37.
39. Lieberman D. Progress and challenges in colorectal cancer screening and surveillance. Gastroenterology. 2010 Jun 1 2010;138(6):2115-26.

TABLES

TABLE 1. Demographic Characteristics for Tribal Members and Washington State Non-Hispanic Whites, Total Surveyed Populations and Populations Age 50 Years and Older, Tribe BRFSS 2009-2010 and Washington State BRFSS 2010.

	Total Surveyed Population			Surveyed Population, age ≥ 50 years		
	Tribe N (%)	NHW N (weighted %)	P	Tribe N (%)	NHW N (weighted %)	P
Age (years)			< 0.001[++]			
18-29	23 (7)	740 (17)	< 0.008[++]			
30-39	34 (10)	1422 (17)	< 0.008[++]			
40-49	59 (17)	2285 (19)	0.307			0.118
50-59	95 (27)	3909 (20)	0.003[++]	95 (41)	3909 (43)	
60-69	84 (24)	4263 (14)	< 0.008[++]	83 (36)	4263 (30)	
70+	53 (15)	4149 (12)	0.099	51 (22)	4149 (26)	
Sex			0.090			0.730
Male	155 (44)	6589 (49)		105 (46)	4783 (47)	
Female	194 (56)	10179 (51)		124 (54)	7538 (53)	
Marital status			< 0.001[++]			0.360
Married or living with a partner	240 (69)	10135 (66)	0.280	152 (6)	7154 (70)	
Separated or divorced	56 (16)	2837 (11)	0.011[++]	39 (17)	2273 (14)	
Widowed	29 (9)	2241 (5)	0.026	29 (13)	2212 (11)	
Never married or lived with a partner	23 (7)	1517 (18)	< 0.001[++]	8 (4)	653 (5)	
Employment status			< 0.001[++]			0.873
Employed or self-employed	187 (54)	7643 (57)	0.211	104 (45)	4528 (46)	
Out of work	18 (5)	916 (8)	0.023	10 (4)	529 (6)	
Homemaker or student	35 (10)	1316 (12)	0.239	12 (5)	681 (5)	
Retired or unable to work	109 (31)	681 (22)	0.0002[++]	103 (45)	6558 (43)	
Education level			< 0.001[++]			< 0.001[++]
Less than high school	43 (12)	723 (5)	< 0.001[++]	34 (15)	517 (4)	< 0.001[++]
High school graduate	116 (33)	4058 (23)	< 0.001[++]	78 (34)	3043 (22)	< 0.001[++]
Additional years of higher education	189 (54)	11956 (72)	< 0.001[++]	116 (51)	8739 (74)	< 0.001[++]
Household annual income[a]			< 0.001[++]			< 0.001[++]
≤ Federal Poverty Level	35 (12)	852 (7)	0.013[++]	23 (10)	455 (4)	0.001[++]
FPL-200% above FPL	26 (9)	2396 (17)	< 0.001[++]	22 (10)	1535 (12)	0.646
> 200% FPL	238 (78)	11540 (75)	0.056	148 (65)	8708 (83)	0.032

[++] Values that are statistically significant using Bonferroni corrected P-values, α=0.05.

[a] Income data were categorized to closely approximate 2010 Federal Poverty Guidelines

Some categories do not equal to 100% due to rounding and/or exclusion of refused/don't know categories

TABLE 2. Health Status Variables for Tribal Members and Washington State Non-Hispanic Whites, Total Surveyed Populations and Populations Age 50 Years and Older, Tribe BRFSS 2009-2010 and Washington State BRFSS 2010.

	Total Surveyed Population			Surveyed Population, age ≥ 50 years		
	Tribe N (%)	NHW N (weighted %)	P	Tribe N (%)	NHW N (weighted %)	P
Self-reported health status			< 0.001++			< 0.001++
Excellent/very good	167 (48)	8871 (59)	< 0.001++	89 (39)	6106 (53)	< 0.001++
Good	110 (32)	5107 (29)	0.28	78 (34)	3885 (30)	0.256
Fair/poor	71 (20)	2747 (12)	< 0.001++	61 (27)	2291 (16)	0.006++
Personal provider			0.027++			0.471
Yes	300 (86)	14561 (81)	0.013++	205 (89.5)	12000 (91)	
No	49 (14)	2203 (18)	0.014++	24 (10.5)	321 (9)	
Health check-up			0.33			
Within the past 2 years	277 (79)	13580 (77)	0.33	184 (80)	10364 (84)	0.129
2 or more years ago	72 (21)	3180 (23)		45 (20)	1954 (16)	
Usual source of care						
Yes- Tribe A clinic	56 (16)	N/A	N/A	23 (10)	N/A	N/A
Yes-Other tribal health center/Indian Health Services	50 (14)			33 (14)		
Yes-Private office	230 (66)			159 (69)		
Other[a]	10 (3)			8 (3.5)		
Don't need health care advice	3 (1)			6 (3)		
Health insurance status						
No insurance	48 (14)	1336 (12)	0.266	28 (12)	684 (6)	0.004++
Medicaid	22 (6.3)			17 (7)		
Medicare/Medicare-plus	85 (24)			82 (36)		
Employer or family member's employer	160 (46)			80 (35)		
Private plan that you pay yourself	23 (6)			12 (5)		
Other (military)	9 (3)			8 (3.5)		

++ Values that are statistically significant using Bonferroni corrected P-values, α=0.05.

[a] Other sources of care included Veteran's Association, Safety Net Clinics, Naturopathic offices.

TABLE 3. Behavioral Risk Factors Associated with Colorectal Cancer for Tribal Members and Washington State Non-Hispanic Whites, Total Surveyed Populations and Populations Age 50 Years and Older, Tribe BRFSS 2009-2010 and Washington State BRFSS 2010.

	Total Surveyed Population			Surveyed Population, age ≥ 50 years		
	Tribe N (%)	NHW N (weighted %)	P	Tribe N (%)	NHW N (weighted %)	P
Obese[a]	134 (38)	3850 (21)	< 0.001[++]	88 (38)	2899 (23)	< 0.001[++]
Extreme obesity[a]	24 (7)	609 (3)	< 0.001[++]	15 (6.5)	419 (3)	0.05
Former smoker	129 (37)	5639 (27)	< 0.001[++]	102 (45)	4735 (36)	0.02
Current smoker	58 (17)	2215 (15)	0.31	38 (17)	1432 (12)	0.05
Heavy drinking[b]	19 (5)	1008 (6)	0.65	11 (5)	730 (6)	0.77
Physical activity[c]	296 (85)	13460 (83)	0.36	197 (86)	9678 (80)	0.02[++]
Regular consumption of red meat[d]	251 (72)	N/A	N/A	158 (69)	N/A	N/A
Regular consumption of processed meat[d]	175 (50)	N/A	N/A	118 (52)	N/A	N/A

[++] Values that are statistically significant using Bonferroni corrected P-values, α=0.05.

[a] Obesity defined as body mass index 30-39.99 kg/m^2, extreme obesity defined as body mass index ≥ 40 kg/m^2

[b] Heavy drinking defined as >2 alcoholic beverages per day in men and >1 alcoholic beverages per day in women.

[c] Physical activity defined as respondents that report doing any physical activity in the past 30 days.

[d] Regular consumption of red and processed meat defined as a range from daily consumption to consumption multiple times in one week.

TABLE 4. Prevalence of Tribal Members Age 50 Years and Older and Washington State NHW Population Age 50 Years and Older who Report Recent Colorectal Cancer Screening, Tribe BRFSS 2009-2010, Washington State BRFSS 2010.

	Surveyed Population, age ≥ 50 years		
	Tribe N (%)	NHW N (weighted %)	P
Recent FOBT[a]	58 (20.4)	1670 (13.4)	0.006[++]
Recent sigmoidoscopy or colonoscopy[b]	157 (55.3)	6593 (53.6)	0.52
Recent CRC screening[c]	174 (61.3)	7228 (58.7)	0.48

[a] Fecal Occult Blood Test (FOBT) within the past 1 year.
[b] Sigmoidoscopy or colonoscopy screening within the past 5 years.
[c] FOBT within the past 1 year and/or sigmoidoscopy or colonoscopy within the past 5 years.
[++] Values that are statistically significant using Bonferroni corrected P-values, α=0.05.

TABLE 5. Factors Associated with Recent CRC Screening among Tribal Members, Tribe BRFSS 2009-2010.

Independent variable	OR	95% CI	P
Age (years)			
50-59	--	--	--
60-69	2.6	1.4-4.9	0.003
70+	2.2	1.1-4.5	0.04
Current provider			
No	--	--	--
Yes	3.7	1.4-9.6	0.007