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Andersen's Behavioral Model to Identify Correlates of Breast Cancer Screening Behaviors among Indigenous Women

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Abstract

This study examined predictive models of utilization of mammograms among Indigenous women adapting Andersen's behavioral model. Using a sample of 285 Indigenous women residing in South Dakota, nested logistic regression analyses were conducted to assess predisposing (age and marital status), need (personal and family cancer history), and enabling factors (education, monthly household income, mammogram screening awareness, breast cancer knowledge, self-rated health, and cultural practice to breast cancer screening). Results indicated that only 55.5% of participants reported having had a breast cancer screening within the past 2 years. After controlling for predisposing and need factors, higher education, greater awareness of mammogram, and higher utilization of traditional Native American approaches were significant predictors of mammogram uptake. The results provide important implications for intervention strategies aimed at improving breast cancer screening and service use among Indigenous women.

Keywords

Indigenous women; breast cancer screening; cancer awareness; mammogram

In the United States (U.S.), Indigenous populations, American Indians (AI) and Alaska Natives (AN) experience the greatest health disparities of any racial/ethnic groups (Mitchell, 2012). An estimated over 5.2 million Indigenous populations reside in the U.S., representing over 573 federally recognized tribes, each with unique cultures, its own language, diverse historical context, and cultural beliefs and practices (National Congress of American Indians, 2019). Despite variability, many live in geographically remote areas where access to health care and service is limited. Prevalence of preventable diseases and conditions, such as

cancer, diabetes, chronic liver disease, and heart disease, tends to be high among Indigenous populations (Indian Health Service [IHS], 2018; Mitchell, 2012).

Particularly among Indigenous women, breast cancer has emerged as the most frequently diagnosed cancer and the second leading cause of cancer mortality (American Cancer Society [ACS], 2017b; Daley et al., 2012; Filippi et al., 2013; White, Richardson, Li, Ekwueme, & Kaur, 2014). Despite the substantial decrements in incidence and mortality rates for breast cancer among the general U.S. populations since 1999, these rates have remained unchanged for Indigenous women (Eheman et al., 2012; White et al., 2014). Furthermore, mammography screening rates are low among this population, with about 59.7% of Indigenous women aged 40 and older reporting having had a mammogram in the past 2 years compared to 68% for white women in 2008 (ACS, 2011). These low screening rates heightened the cancer risk for Indigenous women, such as late-stage of breast cancer and poorer treatment outcomes (White et al., 2014). Numerous barriers have been identified as reasons for late-stage diagnosis of breast cancer, including poverty, less education, lack of access to health care, low compliance to breast cancer screening, lack of transportation, historical trauma, fatalism, fear of mammograms and possible results, past negative experiences with the medical system, cultural considerations, and mistrust issues (Daley et al., 2012; Eberth, Huber, & Rene, 2010; Guadagnolo et al., 2009; Schumacher et al., 2008; Tolma, Stoner, Li, Kim, & Engelman, 2014).

Cancer screening has been shown to be effective in detecting cancer at early stages and preventing overall cancer-related mortalities (Wu & Ronis, 2009). Given Indigenous women's high cancer mortality rate and high prevalence of late-stage diagnosis, it is critical to increase the cancer screening rates of this population. However, little is known about the factors that contribute to receipt of breast cancer screening among this population. Moreover, little research has investigated Indigenous women's cancer screening behaviors with appropriate theoretical models that may guide more systematic intervention efforts.

This study aimed to fill this gap by examining breast cancer screening rates and its associated factors to inform future intervention strategies to enhance breast cancer screening in Indigenous women. We incorporated Andersen's (1973, 1995) behavioral model of health service utilization, which has been successfully applied to studies on cancer screening behavior (Lee, Yang, Lee, & Ghebre, 2015). It provides a relatively comprehensive guideline for conceptualizing the relationships between multiple explanatory factors (i.e., predisposing, enabling, and need factors) associated with utilization of health services. It has been applied to Indigenous populations, and indicates which factors may facilitate or hinder the decision to utilize health care for various racial/ethnic minority populations (Andersen, Davidson, & Baumeister, 2014; Roh et al., 2017).

Literature review

Breast cancer prevalence and disparities among indigenous women

Approximately 252,710 new cases of invasive breast cancer and 40,610 breast cancer deaths are expected to occur among U.S. women in 2017 (ACS, 2017b). Indigenous women have historically had some of the lowest breast cancer rates in the nation. Although incidence

rates have remained lower than those for non-Hispanic white women, they have risen over the last 50 years and have surpassed some other ethnic groups, which is concerning (ACS, 2011). Incidence rates among Indigenous women are the third highest at 91.7/100,000 women from 2002 to 2006 (ACS, 2011). Non-Hispanic white women experience the highest incidence rates at 123.5/100,000 women. African-American women experience the second highest rates at 113.0/100,000 women. Mortality rates for Indigenous women are 14.2/100,000 compared to 33.0/100,000 for African-American women and 23.9/100,000 for Non-Hispanic white women (ACS, 2011). Yet, mortality rates have declined among all racial/ethnic groups except Indigenous women in recent years (Stewart, King, Thompson, Friedman, & Wingo, 2004). Five-year survival rates for Indigenous women are the second lowest at 84.0%, followed by African-American women at 77.3%. A primary reason for the low survival rates of Indigenous women is the late stage when diagnosis is made. Indeed, 44% of breast cancer cases among Indigenous women are diagnosed at the stages of regional or distant metastasis (Smith-Bindman et al., 2006), compared to 36% for non-Hispanic white women and 47% for African-American women (Horner et al., 2009).

Cancer incidence and mortality by region

Cancer incidence varies by geographic region. In the Northern Plains, Indigenous women have a higher cancer incidence rates (538.1 per 100,000 population) than do non-Hispanic white women (464.8 per 100,000 population). Northern Plains' Indigenous women also have the highest and second highest cancer incidence rates within the Indigenous population in the U.S. (Espey et al., 2008). Moreover, Northern Plains' Indigenous populations have the highest cancer mortality rate among the Indigenous populations nationally (275.5 per 100,000) and a higher rate than for all races combined in the U.S. (200.9 per 100,000) (Espey, Paisano, & Cobb, 2005). Northern Plains' Indigenous women, when compared with their non-Hispanic white counterparts in the region and in the U.S., have an elevated risk of developing and/or dying from breast cancer (Becker et al., 2008; Espey et al., 2005; Wingo et al., 2008). Furthermore, Indigenous women in the Northern Plains and other regions are more likely to be diagnosed with advanced stage III and IV breast cancer than are non-Hispanic white women (Becker et al., 2008; Espey et al., 2005; Rogers & Petereit, 2005; Wingo et al., 2008). Therefore, Indigenous women's health issues have reached crisis levels (Schmidt-Grimminger et al., 2011), raising a nationwide call to arms to improve the quality of cancer screenings and outcomes.

Contributing factors of breast cancer disparities among indigenous women

Breast cancer remains a major public health problem and many risk factors for breast cancer have been identified. Established risk factors include a woman's age, own or familial history of breast cancer, genetic configuration, pregnancies and reproductive treatment, Type II diabetes, consumption of alcohol, and exposure to ionizing radiation, lack of exercise, overweight or obese, and smoking (ACS, 2017b). In addition, other research reports that breast cancer tends to be diagnosed at younger ages and later stages for Indigenous women (Roubidoux, 2012; White et al., 2014). For example, about 30% of Indigenous women with breast cancer are diagnosed at age <50 years, substantially higher proportion than for non-Hispanic white women, of whom fewer (19%) are diagnosed at age <50 years (Wingo et al., 2008).

Theoretical framework: Andersen's behavioral model of health service utilization

We used Andersen's (1973, 1995) behavioral model of health service utilization as our theoretical framework. Andersen's model has been widely used as a guideline for examining health service use and extensively applied to studies of diverse racial/ethnic populations, including Indigenous populations (e.g., Lee et al., 2015; Roh, Burnette, Lee, Lee, & Goins, 2016). The model posits that people's use of health services (e.g., cancer screening) is a function of three influential factors for service use: (1) predisposing factors (i.e., predisposition to use health services), (2) need factors (i.e., need for care), and (3) enabling factors.

Predisposing factors reflect propensity to use services that are independent of personal circumstances and experiences that may cause the need for service use. Exogenous factors, such as sociodemographic characteristics (e.g., age, sex, and marital status) have been suggested as predisposing factors that contribute to health status and health service use (Andersen & Newman, 1973). Thus, we include age and marital status in the current study. For mammography, behavioral patterns by age are inconsistent, but most studies find that younger participants were less likely to undergo mammography than are older participants, with part of this being due to this test being offered to women after 40 years of age (Coughlin, Uhler, & Blackman, 1999; Schumacher et al., 2008; Tanjasiri & Sablan-Santos, 2001). However, mixed results have been found, with McDonald and Trenholm (2010) reporting no association between age and mammography screening.

Need factors would include an individual's perceived or clinically evaluated needs, functional capacity, symptoms, and general state of health. We, therefore, included personal cancer history and family cancer history in our need factors. Some studies indicated that participants with a positive family history of breast cancer were more likely to receive mammography (Gonzales, Ton, Garroute, Goldberg, & Buchwald, 2010; Tolma et al., 2014). In addition, a personal history of cancer was correlated with receipt of cancer screening (Roh et al., 2016). Having a personal history of cancer would understandably increase one's cancer screening awareness and the importance of early detection to prevent future occurrences.

Enabling factors are those that explain differences in the resources available to the individual, which may affect health service utilization. Enabling factors can encompass family and community resources and accessibility of those resources. When applied to health and breast cancer knowledge, these can be understood to be factors that assist or hinder people's understanding of health information and services and their ability to follow health directions and recommendations. Increased awareness of screening and the importance of knowledge of mammography screening have been found to be associated with greater receipt of cancer screening (Kolahdooz et al., 2014; Tolma et al., 2014). Research has shown that Indigenous populations have less knowledge of cancer screening and are less likely to have a particular place to receive medical care compared with their white counterparts (Kolahdooz et al., 2014; Tolma et al., 2014). Moreover, access to screening, knowledge about cancer and screening, educational attainment, and perceived need for screening have been found predictive of knowledge, attitudes, and behaviors among Indigenous communities worldwide (Kolahdooz et al., 2014). In previous studies, years of

education and higher income status are closely related to higher cancer screening rates (Howard, Sentell, & Gazmararian, 2006; Kolahdooz et al., 2014; Lee & Choi, 2012), and an individual's self-perception of general health also plays an important role in predicting health service use (Mojtabai, Olfson, & Mechanic, 2002).

Culture-related factors associated with breast cancer screening were of particular interest in the present study. Culture plays a key role in shaping one's beliefs about health, wellness, and healing (Lee, Moon, & Gomez, 2014). With regard to Indigenous culture, health is not the absence of disease, but a state of harmony with ourselves (e.g., mind, body, and spirit), with others, and with our surroundings or creation (Baines, 2012). Traditional healing predates biomedical treatments in Indigenous cultures and is an important element of family, community, and spiritual life (Gurley et al., 2001; Hohl et al., 2016). Native healers/medicine people are common in Indigenous communities (Baines, 2012; Buchwald, Beals, & Manson, 2000; Ferucci et al., 2008; Fortney et al., 2012; Greensky et al., 2014; Kolahdooz et al., 2014) and do not necessarily compete with Western medical services (Baines, 2012), with these services often complementing each other. The use of traditional healers is an important aspect of Indigenous culture, encompassing a broad range of interrelated health behaviors including individual and group ceremonies, use of herbal remedies, and contact with specialized traditional healers. Although specific types of practices vary widely between tribal communities, there tends to be a pervasive emphasis on the spirituality and well-being of the individual (Baines, 2012). Although current evidence is limited, some studies suggest that Indigenous patients frequently seek assistance from traditional healers for pain complaints, such as arthritis, abdominal pain, chest pain, chronic pain, cancer pain, and mental health problems (Baines, 2012; Buchwald et al., 2000; Ferucci et al., 2008; Greensky et al., 2014; Kim & Kwok, 1998). The impact of traditional Native approaches on mammography screening has not been clear and study results are inconsistent. Some studies show that women who are more traditional are more likely to get a screening mammogram (Coughlin et al., 1999; Giuliano, Papenfuss, de Guernsey de Zapien, Tilousi, & Nuvayestewa, 1998), whereas others do not (Canales & Geller, 2004; Canales, Rakowski, & Howard, 2007; Tolma et al., 2014). Given such findings, the current study expected that correlates of high breast cancer screening would include the following as enabling factors: income, education, self-rated health, mammogram awareness, breast cancer knowledge, and cultural practice, such as utilization of traditional Native American approaches and lack of crisis orientation.

The purpose of the current study was to examine breast cancer screening rates and the contribution of predisposing, health needs, and enabling factors to mammography uptake among Indigenous women residing in South Dakota. To our knowledge, this investigation is one of the few to date to examine factors associated with mammogram use in a large sample of Indigenous women living in rural South Dakota.

Based on the Andersen's model and the review of prior literature, the following hypotheses were tested in this study:

1. The predisposing factors (age and marital status) would be associated with receipt of breast cancer screening among Indigenous women.

2. The need factors (personal as well as family cancer history) would be associated with receipt of breast cancer screening among Indigenous women.
3. The enabling factors (education, monthly household income, self-rated health, mammogram awareness, breast cancer knowledge, and cultural practice of breast cancer screening) would be associated with receipt of breast cancer screening among Indigenous women.

Method

Participants and data collection

We used a survey research design with convenience sampling to examine factors associated with receipt of breast cancer screening among Indigenous women residing in South Dakota. After approval from the Institutional Review Board (IRB) of the principal investigator (PI) (i.e., second author), data collection occurred between September 2013 and May 2014. Clinical breast exam (CBE) is recommended every three years for women ages 20 years and older, and yearly for women ages 40 years and older (ACS, 2017b). Therefore, this study focused on adult Indigenous women in general. Eligibility criteria for participants included: (a) being female; (b) being 18 years or older; (c) living in South Dakota at the time of study; and (d) identifying as an Indigenous woman. To ensure a large sample with a wide age range, participants were recruited through several different localities including Indigenous churches (whose members were predominantly Indigenous people), other religious organizations, senior centers and housing facilities, an annual Indian art market, and three powwows in Brookings, Vermillion, and Sioux Falls, South Dakota.

Data was collected with a self-administered survey consisting of more than 100 items. Prior to data collection, the PI explained the purpose and procedures of the study, the kinds of questions that would be asked, issues related to the confidentiality of data, and the participants' benefits and risks. Interested, eligible participants gave informed written consent. Trained interviewers were available for participants who had questions or needed assistance; only two participants required such assistance. The questionnaire took approximately 30 minutes to complete. Participants received compensation of \$10 cash for their time. A total of 287 Indigenous women participated in the study. After excluding two cases in which the participants failed to complete the study questionnaire, the final sample consisted of 285 Indigenous women.

Measures

Dependent variable: receipt of breast cancer screening—To measure receipt of breast cancer screening, respondents were asked whether they had ever had a mammogram. Responses included “*never*,” “*less than 1 year*,” “*over 1 year but less than 2 years*,” and “*over 2 years*.” The dependent variable was dichotomized into “*no, never* (coded as 0)” or “*yes, less than 1 year/over 1 year but less than 2 years/over 2 years* (coded as 1).”

Independent variables

Predisposing factors: Sociodemographic characteristics were collected to reflect predisposing factors, including age (*in years*) and marital status (*never married* = 0, *married*

= 1, *divorced* = 3, *widowed* = 4, and *others* = 5). Marital status was dichotomized into “*married* (coded as 1)” or “*others* (coded as 0).”

Need factors: The following two questions were used to represent need factors: (1) personal history of cancer, “Has the doctor ever told you that you had cancer of any kind?” and (2) family history of cancer, “Has any of your family (parents, grandparents, siblings, or close relatives) ever had cancer of any kind?” Responses to both items were coded 1 for “*yes*” and 0 for “*no*.”

Enabling factors: We included six variables as enabling factors: (1) education (*no high school diploma/General Educational Development (GED)* = 0, *high school diploma/GED* = 1, *bachelor degree* = 2, *graduate degree* = 3); (2) monthly household income (*less than \$999* = 1, *\$1,000-\$1,999* = 2, *\$2,000-\$2,999* = 3, *more than \$3,000* = 4); (3) general awareness of mammogram (for example, “Have you ever heard of mammogram screening?”; *yes* = 1, *no* = 0); (4) self-rated health (*poor* = 1, *fair* = 2, *good* = 3, *excellent* = 4); (5) knowledge of breast cancer; and (6) cultural practice of breast cancer screening.

To measure knowledge of breast cancer, we used a 10-item index adapted from the American Cancer Society breast cancer guidelines (ACS, 2017b, 2017b) and other studies (Akhtari-Zavare, Latiff, Juni, Said, & Ismail, 2015; Smith et al., 2003) with “*true* (coded as 1)” or “*false* (coded as 0)” statements. This index included five breast screening guidelines (for example, “Yearly mammograms are recommended starting at age 40 and continuing for as long as a woman is in good health”) and five breast cancer risk factors (for example, “A woman with cancer in one breast has a 3- to 4-fold increased risk of developing a new cancer in the other breast or in another part of the same breast”). The scoring key for “correct” answers has the scores ranging from 0 to 10. Higher scores indicated higher breast cancer knowledge.

Cultural practice of breast cancer screening was assessed adopting the Tang’s cultural barriers scale (Tang, Solomon, & McCracken, 2000) that measures factors affecting breast cancer screening among Indigenous women. We selected two domains: “lack of crisis orientation” (4 items) and “utilization of traditional Native American approaches” (3 items). Example questions from each domain include: “It is better to detect health problems early through screening efforts than discover something later and have to treat it” and “I believe that traditional Native American approach is very effective in treating health problems.” Items were measured on a 4-point Likert scale ranging from “*strongly disagree* (coded as 1)” to “*strongly agree* (coded as 4)” (Tang et al., 2000). For the “lack of crisis orientation” variable, we reversed the scales of the items. For both cultural practice variables, higher scores indicated greater endorsement of the cultural practice and belief. Internal consistency was .78 for “lack of crisis orientation” and .86 for “utilization of traditional Native American approaches” in the current study.

Data analysis

This study employed three data analysis methods. First, chi-square test or t-test were used to understand the differences of study variables to receipt of breast cancer screening. Second, bivariate Spearman correlations were used to demonstrate the basic associations among

study variables. Third, this study employed nested logistic regression analysis to understand correlates of receipt of breast cancer screening in the sample of this study. Predisposing factors (age and marital status) constituted the first set of correlates, need factors (personal and family cancer history) were the second set of correlates, and enabling factors (education, monthly household income, mammogram awareness, self-rated health, knowledge of breast cancer, and cultural practice [lack of crisis orientation and utilization of traditional Native American approaches]) were added in the third step. No multicollinearity problems were observed among the independent variables since variance inflation factor scores were all greater than 1.10 (Mertler & Vannatta, 2002). This study used IBM SPSS Statistics version 23 for data analyses (IBM Corp., 2014).

Results

Sociodemographic characteristics and breast cancer screening rates

The sample consisted of 285 Indigenous women. Table 1 presented sociodemographic characteristics and the breast cancer screening rates by time frame. In terms of total sociodemographic characteristics, the age of participants ranged from 18 to 89 years, with a mean of 44.6 ($\pm SD = 15.09$) years and over 31% were married. About 17% reported personal cancer history and over 72% reported family cancer history. About 80% of participants had at least a high school diploma/GED. Over 56% of participants had health insurance and approximately 37% earned less than \$999 per month. Over 67% reported good or excellent health condition. Over 94% had heard about mammogram screenings. The mean score of breast cancer knowledge was 7.52 ($\pm SD = 1.97$), ranging from 1 to 10, indicating that the participants selected on average about 75% of correct answers. The mean score of lack of crisis orientation was 7.24 ($\pm SD = 2.09$), ranging from 4 to 15, explaining that participants were more likely to disagree about the importance of cancer prevention. The mean score of utilization of traditional Native American approaches was 8.05 ($\pm SD = 2.32$), ranging from 3 to 12, indicating that participants would be more likely to disagree with using western American medicine.

The results of chi-square test or t-test analyses presented the differences of study variables associated with receipt of breast cancer screening. Significant differences were found in age, marital status, personal cancer history, family cancer history, education, health insurance, and mammogram awareness. Participants with more aged, married or others (divorced, widowed, or separated), personal cancer history, family cancer history, greater than high school diploma/GED, health insurance, and mammogram awareness were significantly more likely to have breast cancer screening than their counterparts. However, there were no significant differences found in monthly household income, self-rated health, breast cancer knowledge, lack of crisis orientation, and utilization of Native American approaches. Overall, about 55.5% of participants reported having had a breast cancer screening within the past 2 years, whereas 21.0% never had a mammogram test.

Bivariate correlations among study variables

As presented in Table 2, there were significant correlations of age ($r = .50, p = .001$), personal cancer history ($r = .14, p = .05$), family cancer history ($r = .21, p = .001$), monthly

household income ($r = .17, p = .01$), mammogram awareness ($r = .28, p = .001$), and self-rated health ($r = -.15, p = .05$) with receipt of breast cancer screening. In addition, mammogram awareness was significantly correlated with family cancer history ($r = .16, p = .01$). Breast cancer knowledge was significantly related to personal cancer history ($r = -.12, p = .05$), education ($r = .19, p = .01$) and mammogram awareness ($r = .13, p = .05$).

Nested logistic regression

Table 3 displays the results of nested logistic regression analyses. The good fit of models of this study was tested using the Hosmer and Lemeshow, indicating that the p-values of three Steps ($\chi^2 = 12.011$ in Step 1, $\chi^2 = 14.477$ in Step 2, and $\chi^2 = 7.571$ in Step 3) were greater than the established cutoff ($p = .05$; Hosmer & Lemeshow, 2013). This study used the odds ratios to explain the strengths of associations of independent variables with receipt of breast cancer screening. Among predisposing variables, age was a significant predictor of receipt of breast cancer screening in all Steps. In Step 2 and Step 3, family cancer history was a significant factor to receipt of breast cancer screening.

In Step 3, in terms of predisposing factors, participants with older age were over one time higher than those with younger age to take a breast cancer screening (odds ratio [OR] = 1.116, $p = .001$). In terms of need factors, participants with family cancer history were over two and half times higher than those with no prior history of family cancer to take a breast cancer screening (OR = 2.742, $p = .05$). In terms of enabling factors, participants who had a high school diploma/GED were over 13 times (OR = 13.203, $p = .01$) or participants who had a bachelor degree were over six and half times (OR = 6.750, $p = .01$) higher than those who did not to take a breast cancer screening. Participants who heard about mammogram were over 36 times higher than those who have not heard about mammogram to take a breast cancer screening (OR = 36.250, $p = .01$). Participants with the high level of utilization of traditional Native American medicines were about 1.3 times higher than those with the low level of utilization of traditional Native American approaches to take a breast cancer screening (OR = 1.294, $p = .05$).

Discussion

The present study focused on Indigenous women who have shouldered a disproportionate share of breast cancer burden, but largely been ignored in the cancer literature. Responding to the priority placed on reducing cancer disparities, this study assessed the current rates of breast cancer screening and predictive models of mammography uptake, using a sample of 285 Indigenous women living in rural South Dakota. An application of the Andersen's behavioral health model examined the contribution of three potential predictors: predisposing (age and marital status), need (personal and family cancer history), and enabling factors (education, monthly household income, mammogram awareness, self-rated health, breast cancer knowledge, and cultural practice [lack of crisis orientation and utilization of traditional Native American approaches]).

Our data provided several key findings that could inform future cancer intervention strategies to improve cancer disparities in Indigenous women. First, the data highlighted a relatively low pattern of breast cancer screening among the rural sample of Indigenous

women, especially when recent screening was considered, that suggested a critical need for geographically targeted cancer intervention efforts (Becker et al., 2008; Roh et al., 2018; White et al., 2014). Overall, about 55.5% of participants reported having had a breast cancer screening within the past 2 years, whereas 21.0% never had a mammogram test. Although studies of Indigenous women and breast cancer screening are limited and vary by region, our findings were lower than another study, in which 66.39% of Indigenous women reported having undergone a mammogram test within the last 2 years in California (Eberth et al., 2010). Our results still do not meet the *Healthy People 2020*'s objective of 81.1% between age 50 and 74 years old of American women receiving breast cancer screenings (U.S. Department of Health and Human Services, 2013, 2017).

Second, our results supported Andersen's behavioral model of health service utilization, in that mammography uptake was explained by predisposing (age), need (family cancer history), as well as enabling factors (education, mammogram awareness, and utilization of traditional Native American approaches). Consistent with previous studies with general populations (Andersen et al., 2014; Lee et al., 2015), the present study suggested some utility of Andersen's model in explaining Indigenous women's health care utilization, particularly in the context of breast cancer screening behaviors. The results, however, revealed that not all predisposing, need, and enabling factors were related to mammography screening among these women. Clearly more research is needed to precisely understand the array of predictor variables that influence mammography utilization among Indigenous women. Further examinations of and modifications to Andersen's behavioral model seem warranted if it is to be used to explain mammography uptake among Indigenous women.

Predisposing factors

With respect to the predisposing factors, age was a significant predictor of mammogram use, indicating that older Indigenous women were more likely to receive mammogram screening. This finding is in accordance with a previous study that showed a positive association between age and mammography among Chamorro women in southern California (Tanasiri & Sablan-Santos, 2001). Studies suggest that with the recommended age for getting a mammogram being 40, Indigenous women below these ages may not see the need to receive mammography screening and could perceive themselves as at low risk for the disease (Filippi et al., 2013). Another predisposing factor, marital status, was not significantly associated with mammogram use, which is a striking contrast to other studies (Mishra, Luce, & Hubbell, 2001; Tanasiri & Sablan-Santos, 2001). These divergent findings may be attributed to differences in populations, samples, and measures, limiting our ability to compare findings across studies. One possible explanation for the present study's lack of findings on marital status lies with the greater representation of women in non-married categories in the current sample.

Need factors

Of need factors, only cancer history of family members was associated with mammogram use. Given that family history of breast cancer is a risk factor (ACS, 2017b), cancer screening tests play a pivotal role in reducing mortality related to breast cancer. With the increasing prevalence of cancer among Indigenous people, knowledge of family health

history has become an important component of prevention. Our findings, therefore, have important clinical implications. Health professionals need to consider cultural factors when collecting family medical history from Indigenous patients. For example, while most Americans understand family as biogenetically determined, in many Indigenous cultures, the concept of “family” can be quite broad, including fictive, non-blood related kin. In certain tribes, however, the notion of family may be quite narrow, limited to either matrilineal or patrilineal blood-related relatives. Therefore, the diversity of ways in which family can be understood among Indigenous populations underscores the need for culturally informed educational interventions that emphasize the significance of family history for certain hereditary cancers, as well as the importance of sharing personal health history with family members. Likewise, the increased risk of developing hereditary cancers for individuals with family history calls for culturally competent health professionals. Understanding and using kinship terms that are specific to individual tribes during the collection of medical histories can help to ensure comprehensive information on all biologically related kin (Gonzales et al., 2010).

Enabling factors

Of enabling factors, consistent with previous literature, educational attainment was a significant predictor of mammography uptake (Coughlin et al., 1999; Kollahdooz et al., 2014; Mishra et al., 2001). Several prior studies documented that Indigenous individuals with at least 12 years of education were likely to be screened for mammography (Coughlin et al., 1999; Kollahdooz et al., 2014; Mishra et al., 2001). It is plausible that highly educated individuals are likely to obtain multiple sources of cancer-related information. Consequently, they may be more informed of the recommended preventive measures as well as consequences related to cancer (Walsh et al., 2010). Another enabling factor, increased mammogram awareness, was significantly associated with receipt of breast cancer screening (Balajadia, Wenzel, Huh, Sweningson, & Hubbell, 2008; Kollahdooz et al., 2014). Thus, educating health professionals and Indigenous community members about the importance of breast cancer screening is highly needed.

One of the most interesting findings of the present study was that the high level of utilization of traditional Native American approaches was a significant predictor of mammogram use. According to Canales (2004), taking care of self was a primary factor influencing health care decisions among Indigenous women. According to Canales (2004), the properties of taking care of self included health promoting behaviors, such as knowing one’s family history, balancing the mind, body, and spirit, understanding the body, and integrating traditional tribal practices. In other words, enhanced engagement with tribal traditions promote one’s connection with oneself and others, or being “in-tune,” which may contribute to women being proactive and responsive to their bodies and their health needs. These study results were consistent with findings from previous studies (Coe et al., 2004; Giuliano et al., 1998; Risendal, Roe, DeZapien, Papenfuss, & Giuliano, 1999). For example, Giuliano et al. (1998) reported that attendance at cultural ceremonies and use of the Hopi language were associated with increased participation in biennial mammography. Belief systems may vary among tribal women, depending on the respective tribal perceptions and beliefs and level of acculturation to western cultural beliefs.

In contrast to our findings, other researchers have found evidence suggesting that traditionality may hinder participation in cancer screening (Canales et al., 2007; Solomon & Gottlieb, 1999; Yost et al., 2017). For example, Canales et al. (2007), in their study with 115 Indigenous women in Vermont, reported an inverse relationship between traditionality (e.g., traditional Indian healer use) and mammogram screening. Women who were more likely to attend spiritual ceremonies, to follow the Indian way of life, to seek guidance from a traditional healer, and to participate in traditional health practices were less likely to have a mammogram. This may, in part, be a result of the history of mistrust of Western medical services due to historical oppression, and receiving poor, inconsistent, culturally irrelevant, or ineffective services (Burnette, 2015a; Gone & Trimble, 2012). In times of great discrimination, it may have been part of survival to avoid Western systems that have been oppressive or inadequate (Burnette, 2015b; Gone & Trimble, 2012). These conflicting results suggest that it is important for health providers to initially assess if a woman is seeking guidance from a traditional healer and then determine the influence of the healer on past cancer screening behavior as well as on future screening intention. Utilization of traditional Native American approaches is a complex concept, with varying interpretations that are difficult to measure quantitatively. Additional future studies as well as qualitative analyses are necessary to further elucidate the concept of traditional Native American approaches and its relationship to breast cancer screening.

We did not find evidence of self-rated health. The lack of findings on self-rated health could have resulted from assessing health status solely through subjective health perceptions. Physical health can be more precisely measured with multiple indicators of health, including biological markers of physical symptoms, pains, and disease.

Limitations and implications

A few limitations to this study should be noted. First, the cross-sectional design and convenient sampling of participants limit the generalizability of our findings; the findings may be limited in scope to the general locale of Brookings, Vermillion and Sioux Falls, South Dakota from which the sample was drawn. Second, Indigenous identity was self-identified, it is, thus, possible that some participants might not be considered Indigenous if verification through tribal membership were used to identify the sample. Third, selection biases might have affected the findings in several ways. Those who participated in the study might have been more willing to discuss breast cancer screening behaviors than those who did not participate. They also might have held more positive views about breast cancer screening. Studies with more representative samples of Indigenous women from different Tribes and rural and urban contexts will provide a fuller picture of breast cancer screening, thereby advancing breast cancer knowledge. Fourth, this study adopted 17 items about cultural practice to mammography from Tang and colleagues' study (Tang et al., 2000). The original questions were developed for Chinese American populations, so there is a possibility that the responses from our Indigenous women's sample may have been shaped by cultural aspects unaccounted for in the original item formulation. Development of ethnic-relevant and culture-specific instruments for the assessment of cultural practices is needed for further research. Lastly, we used a sample of Indigenous women ages 18 years or older based on the CBE recommendation and our intent to be more inclusive of women with at

higher than average risk (Susan G. Komen, 2018 available at <https://ww5.komen.org/BreastCancer/BreastCancerScreeningForWomenAtHigherRisk.html>). Mammogram guidelines have changed over time, and vary from one professional organization to another with ongoing debates, but ACS(2017b) recommends annual or biennial screening mammography to begin at age 40 (or younger if having a cancer history or genetic tendency). It was important to sample a broader age range to assess whether these recommendations were being followed in practice. Subsequent work is necessary to establish age-specific analyses in order to increase relevance for specific age groups.

Despite these limitations, this study's findings suggest several implications. First, over 72% reported family cancer history in our study. It is critical that public health education and community interventions focus on Indigenous women, as their breast cancer screening rates have been shown to be substantially lower than that of non-Hispanic whites and other U.S. racial/ethnic groups, despite their higher rates of family cancer history. Indigenous women who are less educated and younger are particularly vulnerable to low breast cancer screening, so special attention should be given to this population. Second, considering that a high cultural practice score or use of traditional Native American approaches, older age, higher level of education, history of family cancer, and greater awareness of mammogram were associated with breast cancer screening, health professionals are encouraged to assess a woman's level of traditional beliefs and practices and its possible influence on screening participation and future screening intention. This is especially relevant for primary care providers who care for the majority of poor and underserved women nationally and globally. In addition, the integration of cultural, spiritual, and traditional knowledge and practices into health care can help to build a foundation for healing and prevention for Indigenous women. The development of a cancer screening assessment tool that incorporates cultural language and beliefs of the respective tribe may be more accepted by the Indigenous community. A tool that is culturally adaptive for Indigenous women and communities could also lessen the stigma or fear about breast cancer screening, thus decrease the high incidence of breast cancer and provide awareness to all Indigenous women and help build traditional healthcare interventions. Lastly, partnerships with IHS providers, healthcare agencies, diverse social and community support networks, and traditional healers could provide an integrated model of healthcare for Indigenous women and be a promising form of healthcare delivery (Lee, Burnette, Liddell, & Roh, 2018).

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Table 1.Sociodemographic characteristics of breast cancer screening (in percent or mean, $N = 285$).

		Breast Cancer Screening		χ^2/t -tests
		No	Yes	
Age	Ranged from 18 to 89 ($SD = 15.09$) <i>Mean</i>	34.2	49.9	-9.50***
Marital status	Never married	57.6	24.6	36.42***
	Married	25.0	33.3	
	Divorced	9.8	21.9	
	Widowed	0.0	12.0	
	Others (separated, etc.)	7.6	8.2	
Personal cancer history	Yes	9.7	20.8	5.37*
	No	90.3	79.2	
Family cancer history	Yes	59.1	78.6	11.53***
	No	40.9	21.4	
Education	Lower than high school diploma/GED	9.6	7.5	11.99*
	High school diploma/GED	52.9	33.9	
	Greater than high school diploma/GED	37.5	58.6	
Health insurance	Yes	55.2	68.5	4.30*
	No	44.8	31.5	
Monthly household income	Less than \$999	45.2	33.0	7.71
	\$1,000-\$1,999	29.0	25.6	
	\$2,000-\$2,999	17.2	22.7	
	More than \$3,000	8.6	18.8	
Self-rated health	Poor	3.3	0.0	5.24
	Fair	12.2	17.8	
	Good	45.6	49.7	
	Excellent	38.9	32.7	
Mammogram awareness	Yes	85.3	98.9	21.86***
	No	14.7	1.1	
Breast cancer knowledge	Ranged from 1 to 10 ($SD = 2.0$) <i>Mean</i>	7.5	7.6	-0.34
Cultural practice: Lack of crisis orientation	Ranged from 4 to 15 ($SD = 2.1$) <i>Mean</i>	7.4	7.2	.63
Cultural practice: Utilization of traditional Native American approach	Ranged from 3 to 12 ($SD = 2.3$) <i>Mean</i>	8.0	8.1	-0.09
Receipt of Mammogram	Never	21.0		
	Less than 1 year	35.9		
	Over 1 year but less than 2 years	19.6		
	Over 2 years	21.5		

 $p < .05$ **
 $p < .01$

 p .001.

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Table 2.Correlations among study variables ($N = 285$).

	1	2	3	4	5	6	7	8	9	10	11
1. Breast cancer screening											
2. Age	.50***										
3. Married	.09	.14*									
4. Personal cancer history	.14*	.07	.05								
5. Family cancer history	.21***	.14*	.04	.13*							
6. Education	-.09	-.04	.01	.01	.08						
7. Monthly household income	.17**	.12*	.25***	.04	.13*	.43***					
8. Mammogram awareness	.28***	.10	.03	-.01	.16**	.05	.11				
9. Breast cancer knowledge	.01	-.08	.05	-.12*	.03	.19**	.08	.13*			
10. Self-rated health	-.15*	-.19**	-.05	-.15*	-.11	.09	.11	-.03	.09		
11. Cultural practice: Lack of crisis orientation	-.02	.03	.01*	-.08	-.20**	-.18**	-.19**	-.19*	-.09	-.06	
12. Cultural practice: Utilization of traditional Native American approach	-.00	-.04	-.03	-.11	.03	.04	.06	-.05	-.09	.07	.13*

* $p < .05$ ** $p < .01$ *** $p < .001$.

Table 3.

Nested logistic regression model for taking breast cancer screening ($N = 285$).

	Breast Cancer Screening					
	Step 1		Step 2		Step 3	
	$\beta^1 (SE^2)$	$Exp(\beta^3)$	$\beta^1 (SE^2)$	$Exp(\beta^3)$	$\beta^1 (SE^2)$	$Exp(\beta^3)$
Predisposing factors						
Age	.103(.017)***	1.108	.105(.018)***	1.110	.109(.020)***	1.116
Married	.135(.417)*	1.144	.120(.431)	1.128	-.369(.522)	.691
Need factors						
Personal cancer history			-.041(.545)	.960	.265(.661)	1.304
Family cancer history			1.134(.426)**	3.107	1.009(.508)*	2.742
Enabling factors						
Education (vs. no high school diploma/GED)						
High school diploma/GED					2.581(.956)**	13.203
Bachelor degree					1.910(.716)**	6.750
Graduate degree					1.366(.920)	3.919
Monthly household income					.157(.128)	1.169
Mammogram awareness					3.590(1.207)**	36.250
Breast cancer knowledge					.136(.137)	1.146
Self-rated health					-.352(.330)	.704
Cultural practice: Lack of crisis orientation					-.230(.137)	.795
Cultural practice: Utilization of traditional Native American approach					.258(.107)*	1.294
<i>Model Chi-square (d.f. = 13)</i>	56.160***		63.423***		92.888***	
<i>Hosmer and Lemeshow Test Chi-square</i>	12.011		14.477		7.571	

* $p < .05$

** $p < .01$

*** $p < .001$

¹ Unstandardized Beta coefficients

² Standard errors

³ Odds ratios.