RESEARCH ARTICLE

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Andersen's Behavioral Model to Identify Correlates of Cervical Cancer Knowledge among American Indian Women

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Abstract

Objective: Using the Andersen's behavioral model of health services use as a framework, this study aims to examine factors (predisposing, needs, and enabling) related to American Indian (AI) women's cervical cancer knowledge. **Methods:** Andersen's behavioral model of health services was used to examine factors predisposing, needs, and enabling related to AI women's cervical cancer knowledge. A sample of 259 AI women residing in the Northern Plains was recruited using a convenience sampling strategy. Cervical cancer knowledge was measured using guidelines from the American Cancer Society. Three predisposing factors, six enabling factors, and four need factors were observed. **Result:** The mean score of knowledge was 9.11 out of 13. Higher cancer knowledge was associated with 3 enabling factors (higher education, higher HPV knowledge, and use of TV/radio to gain health literacy) and one needs factor (experience in hospitalization). **Conclusion:** Our findings indicate that culturally sensitive educational interventions, especially those using media, to increase cervical cancer knowledge are needed among AI women.

Keywords: American Indian female- Andersen's behavioral model- cervical cancer knowledge- HPV- Northern plains

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Introduction

Cervical cancer is highly treatable with early screening and detection. Cancer, in general, is the leading cause of death among American Indian (AI) women (National Center for Health Statistics, 2021). In recent trends reported by the National Cancer Institute (2021) AI women had higher incidence and mortality rates per 100,000 persons with 7.7 and 2.2, respectively than non-Hispanic White women with 6.7 and 2.0, respectively. Furthermore, AI women experience disparities in cancer incidence and mortality rates, which vary by tribe and region (Becker et al., 2008; White et al., 2014). When regional differences were observed, the incidence rates nearly doubled for Northern Plains (12.0 vs. 6.3), Alaska (10.9 vs. 6.8), Southern Plains (13.8 vs. 8.5), and Pacific Coast (13.8 vs. 6.9) (Melkonian et al., 2020). In South Dakota, the cervical cancer mortality rate among AI women is 79% higher than White women and 500% higher than the national average, resulting in a severe public health issue (Espey et al., 2014; Pandhi et al., 2011; Schmidt-Grimminger et al., 2013; Wienski, 2017). Because AI women tend to experience a higher prevalence of late-stage diagnosis, a lower survival rate, and a rapidly increasing incidence rate, it is critical to increase the cervical cancer knowledge of this population (Espey et al., 2005; Rogers and Petereit, 2011).

Studies report a marginal level of cervical cancer knowledge among AI women. In a study conducted with AI women in Canada, O'Brien and associates (2009) reported that Cree First Nations women had inadequate information about cervical cancer knowledge and cancer screening. A systematic review on facilitators and barriers to cervical cancer knowledge and screening found a lack of awareness of disease progression and human papillomavirus (HPV) to be cited in many studies (Sethi et al., 2021).

Previous studies report common predictors to knowledge related to cervical cancer, such as Pap smear or HPV. For example, one study assessing the effectiveness of cervical cancer education programs among AI women found that a higher level of Pap smear knowledge was associated with high educational level and income (Dignan et al., 1998). Another study on HPV knowledge, one of the leading infections causing cervical cancer, found that African Americans had lower knowledge than Whites, and those with less educational levels had lower knowledge than those with more education (Hughes et al., 2009).

Other studies specifically on cervical cancer knowledge found similar predictors. For example, studies conducted in Sub-Saharan Africa found younger age, no birthing

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experience, low educational level, not being employed, low wealth levels, not having health insurance, far distance to health facility, rural residency, and not using radio or TV to be predictors of low cervical cancer knowledge (Kangmennaang et al., 2018; Moodley et al., 2020). Another study found rural residency and lower socioeconomic status among female medical university students in rural India to be associated with lower knowledge (Patel et al., 2021).

Cervical cancer screening literacy, or knowledge in cervical cancer screening guidelines, is found to be related to cervical cancer screening behaviors among AI women (Kolahdooz et al., 2014; Lee et al., 2020; O'Brien et al., 2009). Thus, increasing knowledge about cervical cancer and screening guidelines is a significant factor in promoting screening behavior. Indeed, AI women have two barriers to receiving cervical cancer screening: they have less knowledge of cancer screening and are less likely to have a particular place to receive medical care than their White counterparts (Espey et al., 2014; Kolahdooz et al., 2014).

The theoretical framework used for this study was Andersen's behavioral model of health services. Some studies have applied this model on cancer related knowledge (Beltran et al., 2016; Lee et al., 2018; An et al., 2020). This model provides a relatively comprehensive guideline for conceptualizing the relationships between multiple explanatory factors (i.e., predisposing, enabling, and need factors) associated with health knowledge. Andersen's behavioral model of health has been widely applied in studies on cancer screening behavior (Andersen, 1995). A systematic review of the model found that age, marital status, gender/sex, education, and ethnicity were used as predisposing factors (Babitsch et al., 2012). This same review found commonly used variables for enabling factors were income, health insurance, and having a primary care provider, while need factors included health status (Babitsch et al., 2012).

Moreover, the model has been applied to various racial/ethnic minority populations, including the AI populations (Andersen et al., 2014; Babitsch et al., 2012; Roh et al., 2016). Some commonly found predisposing factors were age and gender, while income, education, and having a primary care physician were enabling factors (Jin et al., 2019b). Common needs factors included health status (Jin et al., 2019b), colorectal cancer screening adherence (Jin et al., 2019a), health literacy (Lee et al., 2015; Khuu et al., 2018), use of health service (Surood et al., 2010), and cancer literacy (Lee et al., 2014). Specifically, a study among AI women reported age, educational attainment, annual health checkups, awareness of mammograms, greater self-efficacy of colorectal cancer, and family and personal cancer history as predictors of mammogram uptake (Lee et al., 2020) and colorectal screening adherence (Roh et al., 2016).

With 574 federally recognized AI tribes in the U.S. (U.S. Department of the Interior Indian Affairs, 2023) and the heterogeneity across tribes, it is critical to conduct regional investigations to consider unique tribal and cultural differences. Northern Plains AI women appear to differ from other region's AI women in their cervical cancer knowledge. Moreover, little research has investigated AI women's cancer knowledge with appropriate theoretical models that may guide more systematic intervention efforts. Therefore, this study aimed to use the Andersen's behavioral model of health services as a framework to examine factors, predisposing, needs, and enabling related to AI women's cervical cancer knowledge.

Materials and Methods

Sample and Data Collection

After approval from the lead author's institutional review board, a survey was conducted in rural areas with AI women between September 2013 and May 2014. The research team used a survey research design with convenience sampling to examine factors correlated with cervical cancer knowledge among AI women residing in the Northern Plains. Participants were recruited from multiple locations: local AI churches, other religious organizations, senior housing facilities, senior centers, an annual Indian art market, and three powwows in South Dakota.

Although 269 AI women participated in the study, 10 participants were excluded due to missing data, yielding an analytic sample of 259. The study used a self-administered questionnaire; however, trained interviewers were available for anyone who asked for assistance in reading and understanding the questions (four participants required such assistance). The questionnaire took about 30 minutes to complete, and participants were offered $10 cash for their time.

Measures and Variables

Dependent variable

Cervical cancer knowledge

In order to measure cervical cancer knowledge, the research team modified 13 questions into a scale by following the guidelines from the American Cancer Society (American Cancer Society, 2021a; 2021b; Betancourt et al., 2010). Answers were coded in a binary format (1 = yes, 0 = no), ranging from 0 to 13. Higher scores indicated higher cervical cancer knowledge. Examples of the modified questions for the scale include: "I believe Pap test can help detect cervical cancer earlier"; "Human papilloma virus infection can cause cervical cancer"; and "Having several miscarriages can increase the risk of getting cervical cancer". Cronbach's alpha of this scale was .73 in this study.

Independent variables

Predisposing Factors

Three demographic characteristics were collected to reflect predisposing factors, including age (in years, a continuous variable); marital status (1 = married, 0 = other); and religion (1 = yes, 0 = no).

Enabling Factors

This study included six variables as enabling factors: 1) monthly household income (ranged from 1 = less than $999 to 4 = $3,000 or over); 2) education (ranged

from 1 = no high school diploma/GED to 4 = graduate or over); 3) appropriate methods for improving cancer health literacy: TV/radio (1 = yes, 0 = no); 4) awareness of Pap test (1 = yes, 0 = no); 5) health benefits regarding cancer screening; and 6) knowledge of HPV. This study employed one subscale (of the six subscales) of the Health Belief Model (HBM) constructs to measure health benefits regarding cancer screening (Glanz et al., 2008). The perceived health benefits subscale consists of 5 items with a 5-point Likert scale (from "1 = strongly disagree" to "5 = strongly agree"). The total scores ranged from 5 to 25. Higher scores indicated greater levels of perceived health benefits towards cancer screening. Examples of items from the subscale include: "When I participated in cancer screening, I feel good about myself" and "Participating in cancer screening will allow me to detect cancer early". The coefficient of reliability was a = .82 in this study. This study used a nominal scale (1 = yes, 0 = no) with ten items regarding the knowledge of HPV to measure HPV knowledge (Buchwald et al., 2013). The total scores ranged from 0 to 10, and higher scores indicated more knowledge of HPV. Examples of items from the scale include: "HPV can cause cervical cancer" and "HPV is spread by sexual contact." Cronbach's alpha of this scale was .75 in this study.

Need Factors

This study used four variables to represent need factors: 1) personal cancer experience (1 = yes, 0 = no), "Has the doctor ever told you that you had cancer of any kind?"; 2) family cancer experience (1 = yes, 0 = no), "Have any of your family ever had cancer of any kind?"; 3) hospitalization (1 = yes, 0 = no), "Have you ever been hospitalized for last year?"; and 4) treatment without hospitalization (1 = yes, 0 = no), "Did you have treatment from hospitals or clinics, health centers, for the last three months without hospitalization?".

Data Analysis

Three different data analysis methods were used in this study. First, the descriptive statistics method was used to understand participants' socio-demographic characteristics. Second, a bivariate Spearman correlation matrix was employed to understand basic correlations among the main study variables. Third, the hierarchical multivariate regression method explored significant predictors influencing cervical cancer knowledge among the 259 AI women (Mertler and Vannatta, 2005). In addition, the regression analysis identified the specific amount of variance (R^2) for three different hierarchical steps (George and Mallery, 2016) in the continuous dependent variable, cervical cancer knowledge. No multicollinearity problems were observed among all independent variables since the variance inflation factor scores were greater than 1.04 (Mertler and Vannatta, 2005). The IBM Statistical Package for the Social Sciences Program (SPSS version 28) was used for all the data analysis.

Results

Table 1 summarizes the socio-demographic characteristics of participants. The age of 259 AI women ranged from 18 to 65 years, with a mean age of about 42 years (SD = 13.38). Greater portions of participants were married (31%) or never married (38%). The majority of participants (89%) had a religious affiliation. Slightly more than 39% of participants' monthly household income was less than $999, and about 21% reported not having a high school diploma/GED. About 39% of participants answered that TV/radio was an appropriate method for health literacy, while about 61% answered that it was not. Slightly over 95% indicated awareness of the Pap test. A large portion of participants, about 71%, had a family cancer history, while only 17% reported a personal cancer history. Almost 80% of participants experienced hospitalization in the previous year, while 39% reported receiving treatment without hospitalization. The mean score for health benefits was 17.78 (SD = 3.87; Range = 5 to 25), indicating that participants moderately agreed that taking a cancer screening will benefit their health. The mean score for HPV knowledge was 6.15 (SD = 1.90; Range = 0 to 10), indicating that participants had moderate HPV knowledge (Rashwan, Lubis, and Ni, 2009). Also, participants answered 64.8% of questions about HPV correctly. Finally, the mean score for cervical cancer knowledge was 9.11 (SD = 2.12; Range = 2 to 13), indicating that around 70% of answers for questions about cervical cancer knowledge were correct.

The bivariate correlations among the main study variables are presented in Table 2. The main results indicated that cervical cancer knowledge was positively and significantly associated with monthly household income ($r = 0.18$, $p \leq 0.01$), education ($r = 0.27$, $p \leq 0.01$), and knowledge of HPV ($r = 0.32$, $p \leq 0.01$). However, there was a negative association between cervical cancer knowledge and hospitalization ($r = -0.15$, $p \leq 0.05$).

In Table 3, the hierarchical multivariate regression results show the impact of predisposing, enabling, and need factors. In Step 1, findings indicated that predisposing variables explained 0.5% of the variance (R^2) in cervical cancer knowledge. None of the predisposing factors were significant to cervical cancer knowledge. In Step 2, predisposing and enabling variables accounted for 21% of the variance (R^2), increasing about 20.5% from Step 1 (adjusted $R^2 = 18\%$). Education ($B = 0.64$, $SE = 0.18$, $p \leq 0.001$) and knowledge of HPV ($B = 0.29$, $SE = 0.07$, $p \leq 0.001$) were significant factors to cervical cancer knowledge in Step 2. In the final step, predisposing, enabling, and need factors accounted for 24% of the variance (R^2), which increased about 3.5% from Step 2 (adjusted $R^2 = 19\%$). Final results in Step 3 revealed that education was significantly associated with a higher level of cervical cancer knowledge ($B = 0.58$, $SE = 0.18$, $p \leq 0.01$). People who answered that TV/radio were appropriate methods for health literacy were significantly related to a higher level of cervical cancer knowledge ($B = 0.55$, $SE = 0.27$, $p \leq 0.05$). A higher level of HPV knowledge was significantly associated with a higher level of cervical cancer knowledge ($B = 0.31$, $SE = 0.07$,

Table 1. Socio-Demographics of Participants (in Percent or Mean, N = 259).

		n	%
Age	Ranged from 18 to 65	M=42.30 (SD=13.38)	
	18-30	59	22.8
	31-50	117	44.8
	51-65	84	32.4
Marital status	Married	80	31
	Never married (single)	99	38.4
	Divorced	41	15.9
	Other	38	14.7
Religion	None	29	11.4
	Native American church	54	21.3
	Traditional tribal spirituality	85	33.5
	Protestant	33	13
	Other	53	20.8
Monthly household income	Less than $999	99	39.1
	$1,000-$1,999	65	25.7
	$2,000-$2,999	54	21.4
	$3,000 and over	35	13.8
Education	No high school diploma/GED	53	20.6
	High school diploma/GED	149	58
	Bachelor's degree	35	13.6
	Graduate or over	20	7.8
Method of health literacy: TV/radio	Yes	100	38.6
	No	159	61.4
Awareness of Pap test	Yes	243	95.3
	No	12	4.7
Individual cancer experience	Yes	44	17
	No	215	83
Family cancer experience	Yes	184	71.3
	No	74	28.7
Hospitalization	Yes	53	20.7
	No	203	79.3
Treatment without hospitalization	Yes	100	38.8
	No	158	61.2
Health benefits	Ranged from 5 to 25	M=17.78 (SD=3.87)	
Knowledge of human papillomavirus	Ranged from 0 to 10	M=6.15 (SD=1.90)	
Cervical cancer knowledge	Ranged from 2 to 13	M=9.11 (SD=2.12)	

$p \leq 0.001$). Participant hospitalization was negatively and significantly related to their cervical cancer knowledge ($B = -0.73$, $SE = 0.36$, $p \leq .05$). However, age, married, religion, monthly household income, health benefits, awareness of Pap test, and need factors (personal cancer experience, family cancer experience, and treatment without hospitalization) were not significantly related to cervical cancer knowledge among this sample.

Discussion

This study observed factors related to AI women's cervical cancer knowledge by adopting Andersen's behavioral model of health services use as a theoretical guide.

Similar to previous literature on cancer screening adherence, education was significantly associated with higher knowledge (Kolahdooz et al., 2014; Lee et al., 2020). A possible explanation is that highly educated individuals may better understand cancer knowledge than their counterparts. Also, another enabling factor associated with cervical cancer knowledge was a higher level of HPV knowledge. Since HPV infection is one of the highest contributing factors to cervical cancer (Center for Disease Control and Prevention, 2020), those already aware of HPV may likely be aware of cervical cancer. Moreover, those who reported TV/radio as appropriate methods for health literacy had higher cervical cancer knowledge.

Table 2. Correlations among Main Study Variables (N = 259)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Cervical cancer knowledge													
Age	-0.04												
Married	0.04	0.18**											
Religion	0.02	0.11	0.02										
Monthly household income	0.18**	0.07	0.25**	-0.03									
Education	0.27**	-0.08	0.06	-0.05	0.39**								
Methods for health literacy: TV/radio	0.12	0.05	-0.08	0.03	-0.02	0.05							
Health benefits	0.07	0.15*	-0.03	0.11	-0.01	-0.05	0.08						
Awareness of Pap test	0.07	0.16*	0.11	0.04	0.12	0.03	0.14*	0.06					
Knowledge of human papillomavirus	0.32**	-0.09	-0.07	0.01	0.13	0.01	0.06	0.14*	0.04				
Individual cancer experience	-0.07	0.12	0.05	0	0.04	0.02	0.02	0	-0.05	0.04			
Family cancer experience	0.08	0.13*	0.02	0.02	0.1	0.05	-0.01	0.11	0.19**	0.04	0.01*		
Hospitalization	-0.15*	0.06	-0.06	0.05	-0.1	-0.20**	-0.03	0.06	-0.11	0	0.28**	-0.07	
Treatment without hospitalization	0	0.18**	-0.06	-0.04	-0.02	-0.03	-0.01	0.08	0.03	-0.07	0.18**	0.08	0.27**

Note. *p ≤ .05, ** p ≤ .01, *** p ≤ .001

A systematic review on cancer screening knowledge among an Indigenous population found that using media advertisements on cancer improved knowledge about cancer (Kolahdooz et al., 2014), indicating that media can be an excellent tool to distribute cancer information. Thus, an education program is highly needed among the AI community. Finally, this study found a negative association with participant hospitalization. A plausible explanation could be that historical oppression, discrimination, and culturally insensitive or inadequate services during hospitalizations may have caused mistrust in Western medical services (Gone and Trimble, 2012; Burnette, 2014), leading to a decrease in opportunities to obtain cancer-related knowledge. Hence, a culturally tailored education program is necessary.

Limitations

Some limitations to the present study should be noted. First, given its nonprobability sampling strategies, the present study focused on volunteer samples of three

Table 3. Hierarchical Regression Model for Cervical Cancer Knowledge (N = 259)

		Cervical cancer knowledge β[1] (SE[2])		
		Step 1	Step 2	Step 3
Predisposing	Age	-0.011 (0.011)	-0.007 (0.010)	–0.009 (0.011)
	Married	0.134 (0.323)	0.165 (0.304)	0.201 (0.306)
	Religion	-0.029 (0.440)	-0.008 (0.402)	0.040 (0.401)
Enabling	Monthly household income		0.077 (0.069)	0.072 (0.069)
	Education		0.638 (0.183)***	0.577 (0.184)**
	Methods for health literacy: TV/radio		0.498 (0.268)	0.552 (0.268)*
	Health benefits		0.063 (0.036)	0.060 (0.036)
	Awareness of Pap test		-0.360 (0.707)	-0.637 (0.713)
	Knowledge of human papillomavirus		0.294 (0.070)***	0.308 (0.070)***
Need	Personal cancer experience			-0.325 (0.375)
	Family cancer experience			0.245 (0.309)
	Hospitalization			-0.727 (0.362)*
	Treatment without hospitalization			0.421 (0.286)
F test (*d.f.* = 13)		0.332	6.062***	4.822***
R^2		0.005	0.21	0.238
Adjusted R^2		-0.009	0.176	0.188

Notes. *p ≤ .05, **p ≤ .01, ***p ≤ .001; [1], Unstandardized Beta coefficients; [2], Standard errors

community-dwelling AI women. As such, findings are only suggestive, and their non-representative nature presents some limits on the generalizability of this study's findings. Second, these data were based on a cross-sectional survey that hinders the researchers from identifying the causal directions of these associations. Additional exploration with a longitudinal study would help to draw causal inferences. Third, while this study successfully examined, an understudied area among rural AI women am hard-to-reach population, particular characteristics of the participants from this region may have influenced responses to our questions; and such characteristics may have changed since 2014. Therefore, similar research conducted in other parts of the U.S. and/or in more recent years may produce different results. Fourth, selection bias might have affected findings in several ways. Participants might have been more willing to discuss cervical cancer knowledge than AI women who did not choose to participate. Future studies should include a more representative sample and diverse tribal groups because cancer care may vary significantly by tribal affiliation, regional location, and rural/urban contexts. Fifth, all of the data were based on self-report, and participants could have provided answers they considered to be socially desirable. Finally, Andersen's model does not include non-Western conceptualizations of health or preference for traditional healing modalities over biomedical treatments, which are relevant for many AIs (Beals et al., 2005; Hartmann and Gone, 2012).

Implications for Health Research and Practice

Despite these limitations, this study's findings add to the limited body of literature providing critical information for promoting cervical cancer literacy among AI women. To our knowledge, this is the first study to examine factors associated with cervical cancer knowledge among AI women in the Northern Plains. Our findings suggest the importance of examining Andersen's model as a meaningful conceptualization and framework for developing effective prevention and intervention strategies targeting AI women. AI women that were highly educated, had higher access to resources for health literacies such as TV/radio, greater knowledge of HPV, and less hospitalization experience had greater cervical cancer knowledge. To develop a more comprehensive intervention to improve cervical cancer knowledge in AI women, research topics should assess a broader spectrum of Andersen's model constructs, including susceptibility, severity, cues to action, and self-efficacy.

Moreover, health professionals working to reduce the disproportionate cervical cancer burden among AI women should work to promote cervical cancer literacy and health service use by targeting the population with associated factors found in our study. For example, as indicated by a systematic review (Kolahdooz et al., 2014), TV/radio can be an educational platform to approaching AI women on cervical cancer knowledge distribution. Other interventional studies using community-based participatory research and tribal community members to conduct the education workshops showed significant increase in cervical cancer knowledge before and after the education was given to AI (Christopher et al., 2008; Subrahmanian et al., 2011). Public health efforts should also be directed toward enhancing motivation in the importance and promotion of cervical cancer knowledge and eliminating perceived barriers to cervical cancer screening. For example, Turquoise Tuesday (third Tuesday on January) is a national cervical cancer awareness day for AI women and Congress has appointed January as the Cervical Health Awareness Month (National Indian Council on Aging, 2020). In cooperation with the American Indian Cancer Foundation which hosts events to promote screening and educate the AI community, more efforts should be directed towards community-wide campaign and education events via offline and online.

Author Contribution Statement

Dr. Soonhee Roh contributed to conception, design, and collection of data. Dr. Hee Yun Lee contributed to conception and design. Dr. Jung Sim Jun contributed to conception and data analysis. Dr. Yeon-Shim Lee contributed to conception, design, and collection of data. Rong Won Cho contributed to data analysis.

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Ethical Declaration

This study was approved by the University of South Dakota Institutional Review Board

Data Availability (if apply to your research)

Data is not available for the public.

Study Registration

Not applicable

Conflict of Interest

All authors declare that they have no potential competing interest.

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