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Predictors of Cervical Cancer Screening and Physician Recommendations among Women in the United States using Current Screening Guidelines

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PREDICTORS OF CERVICAL CANCER SCREENING AND PHYSICIAN RECOMMENDATIONS AMONG WOMEN IN THE UNITED STATES USING CURRENT SCREENING GUIDELINES

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Vincy Samuel

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To: Dean Tomás R. Guilarte
R. Stempel College of Public Health and Social Work

This dissertation, written by Vincy Samuel, and entitled Predictors of Cervical Cancer Screening and Physician Recommendations among Women in the United States using Current Screening Guidelines, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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ABSTRACT OF THE DISSERTATION

PREDICTORS OF CERVICAL CANCER SCREENING AND PHYSICIAN RECOMMENDATIONS AMONG WOMEN IN THE UNITED STATES USING CURRENT SCREENING GUIDELINES

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In 2015, there were 257,524 women with cervical cancer (CC) in the United States (U.S.). CC is preventable; screening detects early-stage cancer when treatment is most successful. This study aimed to identify predictors for CC screening adherence among U.S. women, describe predictors for screening adherence by marital status, and examine physician recommendation for CC screening and adherence to those recommendations. Predictors were grouped as demographic, acculturation, access to care, chronic conditions, and health behaviors. Descriptive analyses were performed on a sample of 10,667 women from the 2015 National Health Interview Survey, and multiple logistic regression models determined predictors of CC screening adherence, physician recommendations, and adherence to physician recommendations.

Overall, 81.7% (95%CI=80.7-82.7%) of U.S. women adhered to CC screening guidelines. Adherence declined with increasing age after 39 years old. Never married women (adjusted odds ratio[aOR]=0.67, CI=0.56-0.79) or current smokers (aOR=0.70,

CI=0.59-0.84) had lower odds, while college-educated women had greater odds (aOR=1.38, CI=1.14-1.67) of CC screening adherence.

Among unmarried women, 78.6% adhered to CC screening. Unmarried women who were unemployed (aOR=0.48, CI=0.38-0.62), had no physician visits (aOR=0.58, CI=0.40-0.85), no usual source of care (aOR=0.67, CI=0.50-0.89), never heard of HPV (aOR=0.59, CI=0.46-0.76), never received HPV vaccine (aOR=0.50, CI=0.34-0.75), no birth control use (aOR=0.33, CI=0.23-0.47), no flu shot (aOR=0.62, CI=0.48-0.80), and perceived low breast cancer risk (aOR=0.66, CI=0.47-0.92) had lower odds of adherence.

Among women with a physician, 55.6% received screening recommendations. Race/ethnicity, access to care, HPV knowledge and vaccine receipt, age when first child was born, and flu shot were significant predictors of physician recommendation for CC screening. Significant predictors of adherence to physician recommendation included education, employment, English proficiency, outpatient clinic visits, usual source of care, age when first child was born, birth control, alcohol use, smoking status, flu shot, and health status.

Based on our results, two levels of intervention should be explored. First, targeted interventions are needed for women who are unmarried, have low socio-economic status, and limited access to care to reduce cervical cancer risk. Second, interventions for physicians to increase screening recommendations to all eligible women are needed to improve national screening rates.

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ABBREVIATIONS AND ACRONYMS

ACS	American Cancer Society
AOR	Adjusted Odds Ratio
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
HPV	Human Papillomavirus
NCCC	National Cervical Cancer Coalition
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
ND	No Date
NHIS	National Health Interview Survey
NIH	National Institutes of Health
ODPHP	Office of Disease Prevention and Health Promotion
OR	Odds Ratio
Pap	Papanicolau
SEER	Surveillance, Epidemiology, and End Results Program
US	United States
USPSTF	United States Preventive Services Task Force

CHAPTER I.

INTRODUCTION

Overview

Epidemiology of cervical cancer

Cervical cancer is one of the most preventable cancers. This cancer is the fourth most common cancer among women worldwide, and among the top causes of cancer death. Approximately 85% of cervical cancer cases occur in less-developed regions (International Agency for Research on Cancer, 2016). Previously one of the most common cancers among women in the United States, cervical cancer now ranks number 21 among common types of cancer, with cervical cancer representing only 0.8% of all new cancer cases (National Cancer Institute [NCI], n.d.).

In the United States from 2009 to 2013, the incidence rate of cervical cancer was 7.5 per 100,000 women per year, and the mortality rate was 2.3 per 100,000 women. The lifetime risk of developing cervical cancer was 0.6 percent of women (NCI, n.d.). Hispanic women had the highest incidence of cervical cancer, followed by non-Hispanic Black, White, American Indian/Alaska Native, and Asian/Pacific Islander women. Non-Hispanic Black women had the highest mortality rate, followed by Hispanic, Asian/P etacific Islander, non-Hispanic White, and American Indian/Alaska Native women (Centers for Disease Control and Prevention [CDC], 2015).

Cervical cancer rates also vary by state. In 2012, Arizona, Arkansas, District of Columbia, Florida, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, Texas, and Wisconsin had the highest incidence rates (8.2 to 9.6 per 100,000). Alabama, Arkansas, District of Columbia, Florida, Georgia, Mississippi, Oklahoma, Texas, and West Virginia

had the highest mortality rates (2.8 to 5.3 per 100,000) (CDC, 2014). Variations in incidence and mortality rates by state may be attributed to differences among racial and ethnic populations, differences in populations and health behaviors, differences in medical care, and the influence of aging (U.S. Department of Health and Human Services, 2018).

In 2010, the annualized mean net cost of care for cervical cancer in women under 65 years of age was $54,209 in the initial year after diagnosis and $1,425 between the initial year and the last year of life (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011). Most private insurance companies, public employee health plans, and Medicaid offer coverage and reimbursement for Pap testing (American Cancer Society [ACS], 2016). For women without insurance, programs such as the National Breast and Cervical Cancer Early Detection Program provide access to cervical cancer screening and diagnostic testing for low-income, uninsured, and underserved women (CDC, 2016).

The risk of cervical cancer increases with smoking, positive HIV status, use of oral contraceptives for five or more years, giving birth to three or more children, and having multiple sex partners (CDC, 2015). Cervical cancer is the most common type of human papillomavirus (HPV)- related cancer, and almost all cervical cancers are caused by HPV. HPV infections may clear on its own, but some infections persist and cause cellular changes, which can lead to genital warts or cancers (NCI, 2015).

Prevention

Most cervical cancer cases could be prevented by primary prevention with the HPV vaccination, which is recommended for preteens at 11 to 12 years of age in order to

protect them from being exposed to HPV. The HPV vaccine is recommended for men and women who did not receive or finish the HPV vaccine series until they reach the ages 21 and 26, respectively (CDC, 2015). In 2014, 40.2% of women and 8.2% of men 19 to 26 years of age reported receiving at least one dose of the HPV vaccine (CDC, 2016). Therefore, there is still a large part of the population that has not been fully vaccinated with the HPV vaccine.

Cervical cancer is highly preventable when screening and follow-up recommendations are adhered to (CDC, 2015). Up to 93% of cervical cancer cases can be prevented through screening and HPV vaccination (CDC, 2014). If cervical cancer is diagnosed at an early stage, it is treatable and associated with long term survival (CDC, 2015). Cervical cancer is a slow-growing cancer (National Cervical Cancer Coalition [NCCC], 2016).

Secondary prevention through cervical cancer screening identifies cervical abnormalities. Cervical cancer cases and deaths have decreased over the last 40 years due to women receiving regular Pap tests (CDC, 2015). However, from 2008 to 2010, cervical cancer screening rates declined slightly (Brown et al., 2014). Additionally, the proportion of 18 year-old women who reported ever having a Pap test decreased from approximately 50% in 2000 to 38% in 2010 (Roland et al., 2013). According to the U.S. Preventive Services Task Force, a Pap test is recommended for women between the ages of 21 and 65 years old who have not had a hysterectomy. Recommendations regarding the frequency of cervical cancer screening have changed over the years (ACS, 2018). Since 2012, a Pap test is recommended every three years, as compared to more frequently in the years prior to 2012 (Table 1). Cervical cancer screening is only recommended

every five years if a Pap test and an HPV test are conducted as part of a co-testing algorithm. In 2018, the U.S. Preventive Services Task Force recommended screening with high risk HPV testing alone every five years. These recommendations apply to women who have not received a diagnosis of a high-grade precancerous cervical lesion or cervical cancer, women without in utero exposure to diethylstilbestrol, or women who are HIV negative and not otherwise immunocompromised (U.S. Preventive Services Task Force [USPSTF], 2018).

Table 1: History of recommendations for the early detection of cervical cancer in women without symptoms

Dates	**Test**	**Age**	**Frequency**
Pre 1980	Pap test	Not specified	As part of a regular check-up
1980 - 1987	Pap test	20 and over; under 20 if sexually active	Yearly, but after 2 negative exams 1 year apart, at least every 3 years
	Pelvic exam	20 – 39	Every 3 years
		40 and over	Yearly
1987 - 2002	Pap test	18 & over or sexually active	Yearly, but after 3 consecutive normal exams, less frequently at the discretion of the doctor
	Pelvic exam	18 & over or sexually active	Yearly
2003 - 2012	Pap test	Start 3 years after first vaginal intercourse but no later than 21	Yearly with conventional Pap test or every 2 years with liquid-based Pap test
		30 and over	After 3 normal results in a row, screening can be every 2 to 3 years. An alternative is a Pap test plus HPV DNA testing every 3 years.*
		70 and over	After 3 normal Pap tests in a row within the past 10 years, women may choose to stop screening**
	Pelvic exam	Not specified	Discuss with health care provider

2012 - 2018[1]	Pap test	21 - 29	Every 3 years*
	Pap test plus HPV DNA test	30 - 65	Every 5 years* An alternative is screening with a Pap test alone every 3 years*
		Over 65	A woman should stop screening unless she had a serious cervical pre-cancer or cancer in the last 20 years
2018 - Present	Pap test	21 - 29	Every 3 years*
	Pap test plus HPV DNA test OR hrHPV test	30 - 65	Every 5 years* An alternative is screening with a Pap test alone every 3 years*
		Over 65	A woman should stop screening unless she had a serious cervical pre-cancer or cancer in the last 20 years

*Doctors may suggest a woman be screened more often if she has certain risk factors, such as a history of DES exposure, HIV infection, or a weak immune system
**Women with a history of cervical cancer, DES (diethylstilbestrol) exposure, or who have a weak immune system should continue screening as long as they are in reasonably good health
[1] These guidelines are not meant to apply to women who have been diagnosed with cervical cancer. These women should have follow-up testing as recommended by their healthcare team.

Sources: American Cancer Society (2018). History of ACS recommendations for the early detection of cancer in people without symptoms. Retrieved from https://www.cancer.org/health-care-professionals/american-cancer-society-prevention-early-detection-guidelines/overview/chronological-history-of-acs-recommendations.html.

U.S. Preventive Services Task Force (2018). Final recommendation statement: Cervical Cancer screening. Retrieved from https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/cervical-cancer-screening2.

The five-year observed survival rate decreases as the disease progresses. The five-year survival rate is 93% at stage 0, 93% at stage IA, 80% at stage IB, 63% at stage IIA, 58% at IIB, 35% at stage IIIA, 32% at stage IIIB, 16% at IVA, and 15% at stage IVB. These survival rates can be improved through adherence to follow-up care (ACS, 2016).

Cervical cancer screening provides the best chance of identifying the cancer at an early stage, which is when treatment will be most successful. Prior to becoming cancer, abnormal cervix cell changes occur, which can also be identified through screening (ACS, 2014). Additional tests such as repeat Pap test or co-test, HPV test, colposcopy, biopsy, endocervical sampling, and endometrial sampling may be performed, depending on age and initial Pap test results (American Congress of Obstetricians and Gynecologists, 2016). Treatment during this pre-cancerous change can prevent it from becoming cervical cancer. If the changes in cervical cells are moderate or high-grade, treatment such as loop electrosurgical excision procedure, cryotherapy, laser therapy, or conization may be indicated to prevent cancer. If the pre-cancerous cell changes progress to cervical cancer, tertiary prevention through treatment of invasive cancer would be indicated (ACS, 2014). Follow-up to any abnormal results will allow for appropriate diagnosis and subsequent treatment.

Follow-Up

Although screening is one of the most important elements in the reduction of cervical cancer incidence and mortality, timely follow-up care for abnormal lesions is just as important (Kaplan et al., 2000). Every year in the United States, approximately two to

three million women learn that they have an abnormal Pap result (Hunt, 2002). In order to sufficiently reduce the incidence and mortality of cervical cancer, an abnormal Pap test requires a follow-up visit, diagnosis, and treatment (Yabroff, Kerner, & Mandelblatt, 2000). Therefore, it is necessary to obtain a confirmatory follow-up Pap test if an abnormality is detected. However, many women fail to obtain the necessary follow-up care (Eggleston, Coker, Prabhu, Cordray, & Luchok, 2007). Women who do not receive the appropriate follow-up forfeit the benefits of early treatment (Melnikow, 1999). A delay in follow-up visits increases the risk of developing cervical cancer or being diagnosed with an advanced stage of the disease. If abnormalities are detected early enough and the necessary follow-up visits and treatment are adhered to, there is close to a 100% survival rate. Among women with invasive cervical carcinomas, 13% can be attributed to lack of follow-up after abnormal Pap results (Eggleston et al., 2007). Despite this, approximately 20% to 50% of women with abnormal Pap results do not comply with follow-up care. Consequently, there are still many women who are being diagnosed with and even dying from a preventable disease (Kaplan et al., 2000).

Factors associated with non-adherence to Pap screening guidelines include lack of a usual source of care and health insurance, income and educational status, obesity, smoking, immigrant status, and foreign birth (Nelson, Moser, Gaffey, & Waldron, 2009). Among women with an abnormal Pap smear, those perceived to have low literacy by their physician were more likely to not follow-up (Lindau, Basu, & Leitsch, 2006).

There is great variation in the rates of follow-up across different populations and settings. Approximately 7% to 49% of women with abnormal results do not follow-up with the necessary diagnostic tests (Yabroff et al., 2000). Characteristics associated with

women who do not follow-up after abnormal Pap tests are young age, low socioeconomic status, and minority classification. Minority women have the lowest rates of completing a follow-up (Abercrombie, 2001). Minority women with low income are the least likely to comply with follow-up care (Hunt, 2002). About 80% of low-income women do not adhere to the recommended follow-up treatment (Engelstad et al., 2001). Poverty is the most common factor for not following up after abnormal results (Saslow et al., 2007). Some barriers that these women may face when being told that they need a follow-up exam are their understanding of how abnormal results can affect them, their beliefs about their risk of having cancer, how much they believe that following up can potentially help to prevent cancer and improve their survival, and costs associated with follow-up care. Furthermore, some women may prefer not to hear that something may truly be wrong with them and may opt to not find out (Ell et al., 2002). In a systematic literature review with the outcome as adherence to follow-up after an abnormal Pap test, African American women were not as likely to obtain the appropriate follow-up as compared to other ethnicities (Benard et al., 2005; Eggleston et al., 2007; Engelstad et al., 2005). Inconsistent evidence for associations between race, income, and age and screening has been found (Eggleston et al., 2007).

Research aims and objectives

Aim 1: To describe predictors for cervical cancer screening adherence using current guidelines among a sample of nationally representative women.

Objective 1a: Describe demographic, acculturation, access to health care, and health behavior and knowledge factors associated with cervical cancer screening adherence.

Objective 1b: Describe demographic, acculturation, access to health care, and health behavior and knowledge factors for cervical cancer screening adherence by race/ethnicity.

Aim 2: To assess the association of marital status with cervical cancer screening adherence using current guidelines among a sample of nationally representative women.

Objective 2a: Describe demographic, acculturation, access to health care, and health behavior and knowledge factors for cervical cancer screening adherence among married and unmarried women.

Objective 2b: Describe demographic, acculturation, access to health care, and health behavior and knowledge factors for cervical cancer screening adherence among unmarried women by race/ethnicity.

Aim 3: To explore the gap between physician recommendation of cervical cancer screening and adherence to physician recommendation.

Objective 3a: Explore demographic, acculturation, access to health care, and health behavior and knowledge predictors for physician recommendation.

Objective 3b: Explore demographic, acculturation, access to health care, and health behavior and knowledge predictors for adherence to physician recommendation.

Objective 3c: Explore the reasons for not adhering to cervical cancer screening after physician recommendation.

Public health significance

Many studies on cervical cancer screening focus on specific geographic regions or racial/ethnic groups (Hatcher, Studts, Dignan, Turner, & Schoenberg, 2011; Ji, Chen, Sun, & Liang, 2010; Miranda-Diaz, Betancourt, Ruiz-Candelaria, & Hunter-Mellado, 2016; Paskett et al., 2010; Sadler et al., 2010; Schoenberg, Studts, Hatcher-Keller, Buelt, & Adams, 2013). In addition, few studies use the most current screening guidelines in defining adherence (Watson, Benard, King, Crawford, & Saraiya, 2017; White et al., 2017). This study will add to the literature by using the most current screening guidelines to explore predictors for screening adherence and physician recommendation in a large nationally representative sample of women. The results of this study can then be used in determining which populations to target to improve cervical cancer screening rates.

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CHAPTER II.

LITERATURE REVIEW

Overview

The literature search for this study included a comprehensive review of scientific articles in English language from 2000 to 2017 in the following databases: MEDLINE, PubMed, and CINAHL. Medical subject headings and keywords used included "cervical cancer", "Pap", "cervical cancer screening", "marital status", "unmarried", "never married", "physician recommendation", "doctor recommended", among others and from all years. Reference lists of relevant articles were reviewed to identify additional articles.

Predictors of cervical cancer screening

Demographics

Sociodemographic factors have been shown to be predictors of cervical cancer screening (Miles-Richardson, Allen, Claridy, Booker, & Gerbi, 2017). In analyses of the 2000 National Health Interview Survey, age, education attainment, and health insurance were associated with cervical cancer screening (Meissner, Yabroff, Dodd, Ballard-Barbash, & Berrigan, 2009). Low family income, low educational level, and being unmarried were associated with lower rates of Pap testing (Hewitt, Devesa, & Breen, 2004). Predictors for never having been screened for cervical cancer included Hispanic race, never being married, living below poverty level, fewer than 12 years of education, 65 years of age or older, and unemployment. Some of these predictors changed when analyzing those who had not been screened recently (Calle, Flanders, Thun, & Martin,

1993). In addition, recent studies have shown that being non-Hispanic white reduced the likelihood of cervical cancer screening (Miles-Richardson et al., 2017).

There are racial and ethnic differences in the association of these demographic factors with cervical cancer screening. Hispanic and other race women were more likely (11.1% and 14.7%, respectively) to never have a Pap test than non-Hispanic white women (5.0%) or black women (5.8%) (Chen, Kessler, Mori, & Chauhan, 2012). Among American Indian and Alaska Native women, higher educational level, income, presence of one or more chronic medical conditions, being 25 to 39 years of age, and having been ever married predicted Pap test use (Schumacher et al., 2008). Among Korean American women, correlates of regular Pap testing included knowledge of guidelines, physician recommendation, having health insurance, and having family or friends who also receive Pap tests (Juon, Seung-Less, & Klassen, 2003). Among Vietnamese Americans, being married, having a higher education level, having a female physician, having a respectful physician, requesting a Pap test, and physician recommendation were associated with receipt of a Pap test (Nguyen, McPhee, Nguyen, Lam, & Mock, 2002). Among Thai women in Northern California, physician recommendation, insurance status, and primary language were predictors of Pap testing (Tsui & Tanjasiri, 2008). Similarly, cervical cancer screening patterns have been studied among other subgroups. According to the Health Information National Trends Survey, women with health insurance were more likely to adhere to cervical cancer screening than women without health insurance (Nelson et al., 2009). Among non-Hispanic white and black women, insurance was associated with increased likelihood of receipt of a Pap smear (Hirth, Laz, Rahman, & Berenson, 2016).

Women living in rural areas may face barriers to receiving cervical cancer screening. Among farm women from three states, non-adherence to Pap testing increased with age and decreased with education. Up-to-date Pap testing was positively associated with obtaining a mammogram or breast examination in the past and being married (Carruth, Browning, Reed, Skarke, & Sealey, 2006). Among Appalachian women, those who rarely or never had breast cancer screening were likely to be rarely or never screened for cervical cancer as well (Schoenberg et al., 2013). In two rural Oregon communities, women over 55 years of age with co-morbidities such as arthritis, diabetes mellitus, and hypertension were less likely to be up-to-date for cervical cancer screening as compared to women without chronic conditions (Liu et al., 2014).

Region of residence within the United States has also been shown to be a predictor of cervical cancer screening. Women residing in the West region of the United States were less likely to have had cervical cancer screening, while women residing in the Southern region of the United States were more likely (Miles-Richardson et al., 2017).

Most surveys ask women to select their marital status (Clark et al., 2009). Marital status has been determined to be associated with cancer screening participation, such as for colorectal cancer screening (El-Haddad, Dong, Kallail, Hines, & Ablah, 2015). In addition, marital status impacts cancer outcomes (Aizer et al., 2013). Previous studies have shown that unmarried women were more likely to be diagnosed with a late stage of cervical cancer (Saghari, Ghamsary, Marie-Mitchell, Oda, & Morgan, 2015).

Acculturation

Among recent immigrants, 73% reported having a Pap smear in the previous two years as compared to 89% of U.S. born women. Uninsured U.S. born women were more likely to have a Pap smear than uninsured recent immigrant women (Carrasquillo & Pati, 2004). Among Chinese American immigrants, having insurance or a regular healthcare provider had better odds of Pap test use and adherence (Lee-Lin et al., 2007).

African American women have been shown to be three times more likely to self-report undergoing a current Pap smear than African-born women (Forney-Gorman & Kozhimannil, 2016). Older Chinese American women with more traditional cultural views were less likely to be screened regularly, and those with higher English proficiency were more likely to have received regular Pap tests as compared to women with lower proficiency (Ji et al., 2010). Cultural beliefs about the etiology of cervical cancer affect Pap testing among immigrant women (McMullin, De Alba, Chavez, & Hubbell, 2005).

Access to Care and Utilization

Private health insurance and a usual source of care have been shown to have a bigger impact on cervical cancer screening adherence as compared to being uninsured and having no usual source of care (White et al., 2017 and Watson et al., 2017). At least one doctor's visit in the last year has been demonstrated to be associated with screening adherence (Ashok, Berkowitz, Hawkins, Tangka, & Saraiya, 2012; Nelson et al., 2009).

Chronic Conditions

There has been conflicting findings on the association between chronic diseases and breast, cervical, and colorectal cancer screenings. Some studies have found that chronic conditions such as diabetes are a barrier to cancer screening, while other studies have found that chronic diseases increase the likelihood of cancer screening adherence (Brown, Hossain, & Forrester, 2013; Liu et al., 2014; Lukin et al., 2012). Pap testing compliance among women with and without cardiovascular disease was similar. Myocardial infarction was associated with reduced odds of Pap test compliance (Guo, Hirth, & Berenson, 2015). A study conducted in Oregon found that women with arthritis, diabetes mellitus, and hypertension were less likely to adhere to cervical cancer screening compared with women without chronic conditions (Liu et al., 2014). Among American Indian and Alaska Native women, presence of one or more chronic medical conditions was one of the predictors of Pap test use (Schumacher et al., 2008).

Health Behaviors and Knowledge

It has been found that lifestyle factors and behaviors, including obesity, dietary factors, alcohol intake, physical activity, oral contraceptives, and smoking affect risk of gynecological cancers (Rieck & Fiander, 2006). Health status can include measures such as life expectancy, physical and mental health, self-assessment of health, physical activity and chronic illnesses (Office of Disease Prevention and Health Promotion [ODPHP], 2018). While studies have shown associations between health status and cancer screening, the findings vary. According to the 2000 National Health Interview Survey, health behavior patterns including usual source of care were associated with cervical

cancer screening. Usual source of care was the strongest correlate of Pap testing (Meissner et al., 2009). Among women 18 to 29 years old, usual source of healthcare and current birth control use increased the chances of having a Pap test within the last 12 months (Roland et al., 2013). No primary care provider and lack of usual source of care were associated with lower rates of Pap testing (Hewitt et al., 2004). Adherence to Pap testing is also associated with normal body mass index, being a non-smoker, and no mood disturbance (Nelson et al., 2009).

Some studies have shown an association between higher levels of physical activity and higher rates of cancer screening. In addition, increased physical activity is associated with higher odds of Pap testing among American Indian women (Muus et al., 2012). Women with a normal BMI were more likely to adhere to regular Pap testing compared with obese women (Nelson et al., 2009). Women with BMIs greater than 40 in the United States were less likely to have a Pap test within three years, and women with BMIs >30 were less likely to adhere to physician recommendation for a Pap test (Ferrante, Chen, Crabtree, & Wartenberg, 2007). Non-Hispanic black women with BMIs between 25 and 30 were less likely to receive a Pap smear than black women with BMIs < 25 (Hirth et al., 2016). A systematic review showed an inverse association between obesity and cervical cancer among non-Hispanic white women (Maruthur, Bolen, Brancati, & Clark, 2009). Underweight women, overweight women, and obese women are more likely to delay Pap testing by more than two years compared with women with normal weight (Fontaine, Heo, & Allison, 2001). A higher proportion of obese non-Hispanic white women compared with women of normal weight reported not undergoing Pap testing due to putting it off, being embarrassed, or discomfort. Among women who

did not undergo screening, obese women were just as likely as women with normal weight to receive a physician recommendation for Pap testing (Wee, Phillips, & McCarthy, 2005). Studies have shown that lack of physician recommendation to receive a Pap smear may lead to underutilization of Pap smears (Coughlin, Breslau, Thompson, & Benard, 2005).

History of family cancer has had a positive association with cancer screening in some studies (Bostean, Crespi, & McCarthy, 2013; Carney et al., 2013; Qin, White, Sabatino, & Febo-Vazquez, 2018; Shah et al., 2007). Non-Hispanic white and black women with a family history of cancer were 42% more likely to have had a recent Pap test than those without a family history of cancer, and non-Hispanic black women with a family history of cancer were more likely to have had a recent Pap test than non-Hispanic white women with or without a family history of cancer (Williams, Reiter, Mabiso, Maurer, & Paskett, 2009). In contrast, a population-based study on women in Southeastern United States showed no association between family history of cancer and cervical cancer screening (Bellinger et al., 2013).

Systematic reviews have shown a positive association between education and cervical cancer screening (Damiani et al., 2015), as well as between health literacy and cervical cancer (Kim & Han, 2016). Educational attainment has been shown to have a significant correlation with knowledge of cervical cancer risk factors (Akinlotan et al., 2017). Many studies regarding education, knowledge, and perceptions focus on specific ethnic groups. Korean American women with low education levels and low English proficiency have lower rates of Pap testing than those with high education levels and English proficiency. The most common reason for lack of regular Pap testing among the

Korean American women studied was the belief that it was not necessary if no symptoms were present (Juon et al., 2003). Cancer education has been shown to be an important predictor of cervical cancer screening among uninsured, urban Hispanic women (Buki, Jamison, Anderson, & Cuadra, 2007).

One study found that absolute and comparative risk perceptions were not significant predictors of cervical cancer screening adherence, but risk perception had an indirect effect on screening through cancer worry. As women's risk perception increased, their worry of developing cancer also increased, which was associated with increased screening adherence (Zhao & Nan, 2016). Recent cervical cancer screening has been shown to be associated with knowledge of cancer risk factors and perceptions of cancer survival (Pearlman, Clark, Rakowski, & Ehrich, 1999).

Adherence to Pap testing is associated with normal body mass index, being a non-smoker, no mood disturbance, and being knowledgeable about Pap testing and human papillomavirus infection (Nelson et al., 2009).

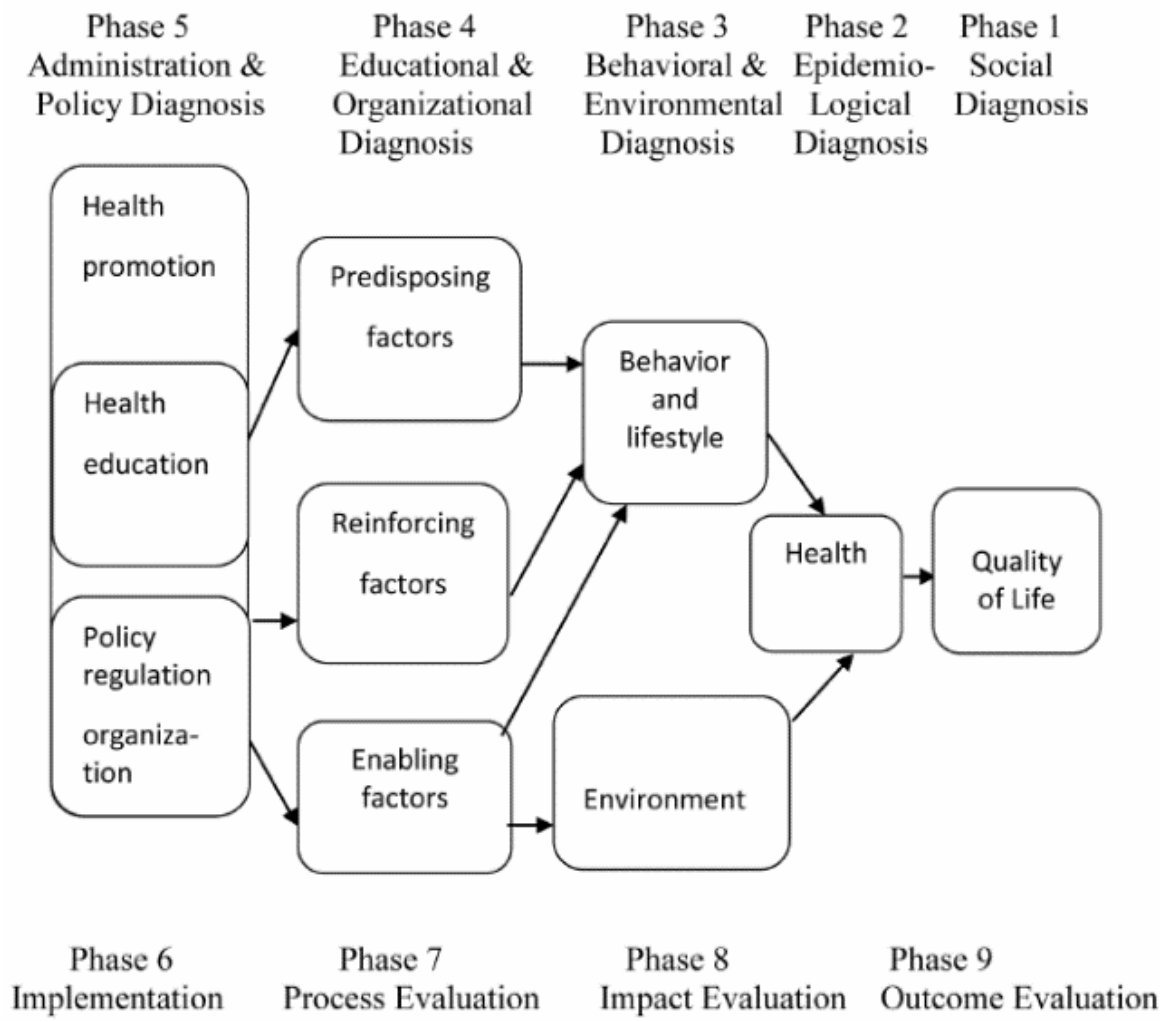
Predictors for never having been screened for cervical cancer are residence in a central city or the Northeast. Some of these predictors change when analyzing those who had not been screened recently (Calle et al., 1993). Among African Americans and Hispanics in three urban public housing communities in Los Angeles, 62% had received cervical cancer screening within the past year, and 29% stated that no health care provider recommended cervical cancer screening to them. Affordability, continuity of care, and physician recommendation predicted adherence to cervical cancer screening (M. Bazargan, S. Bazargan, Farroq, & Baker, 2004).

The PRECEDE-PROCEED Model

The PRECEDE/PROCEED model integrates social, epidemiologic, behavioral, environmental, education, and organizational perspectives of health concerns. PRECEDE stands for predisposing, reinforcing, and enabling constructs in educational/environmental diagnosis and evaluation. PROCEED stands for policy, regulatory, and organization constructs in educational and environmental development. The predisposing, reinforcing, and enabling factors are contributing factors that influence behavioral and environmental change. Predisposing factors include knowledge, attitudes, beliefs, and some sociodemographic characteristics. Enabling factors include cost, transportation, and environmental issues. Reinforcing factors include social support, physician/patient relationship, and peer influence (Hatcher et al., 2011; Ji et al., 2010).

In this study, predisposing, enabling, and reinforcing factors were assessed as predictors of cervical cancer screening. Predisposing factors included age, race/ethnicity, education, chronic conditions, HPV knowledge, age when first child born, perceived risk of breast cancer, and perceived health status (Bautista, Vila, Uso, Tellez, & Zanon, 2006; Chen, Yamada, & Smith, 2014; Palli, Mehta, & Aparasu, 2012; Studts, Tarasenko, & Schoenberg, 2013). Enabling factors included employment status, acculturation, and access to care and utilization (Chen et al., 2014; Palli et al., 2012; Palmer, Midgette, & Dankwa, 2008; Studts et al., 2013). Reinforcing factors included marital status and physician recommendation (Studts et al., 2013).

Figure 1: The PRECEDE/PROCEED Model



Source: McKenzie et al., 2008

Gaps in knowledge about cervical cancer screening among women in the U.S.

First, few studies are available that used recent and robust national data on cervical cancer screening (Miles-Richardson et al., 2017; Watson et al., 2017; White et al., 2017). Many studies explore specific races/ethnicities, geographic regions, age groups, and other demographic characteristics, but they are not generalizable to all U.S. women who fit the criteria for cervical cancer screening (Fedewa, Sauer, DeSantis, Siegel, & Jemal, 2017; Guo et al., 2015; Kepka et al., 2014; Roland et al., 2013). Second, few national studies among United States women used the most current screening guidelines of Pap test only or Pap/HPV co-testing in defining adherence (Watson et al., 2017; White et al., 2017). Finally, limited information is available on cervical cancer screening among unmarried women, physician recommendations for cervical cancer screening, and adherence to physician recommendations (Clark et al., 2009; Coughlin et al., 2005; De Alba & Sweningson, 2006; Hanske et al., 2016; Politi, Clark, Rogers, McGarry, & Sciamanna, 2008).

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CHAPTER III.

METHODOLOGY

Overview

This study used cross-sectional secondary data from the 2015 National Health Interview Survey, a nationally representative survey sample of the civilian noninstitutionalized United States population, to explore predictors of cervical cancer screening among women aged 21 to 65 years and among unmarried women compared to married women. This study also assessed predictors of physician recommendation for cervical cancer screening and adherence to physician recommendation.

Sample and description of data source

The data source for this study was the 2015 National Health Interview Survey (NHIS) (National Center for Health Statistics, CDC, 2017). The National Health Interview Survey is a cross-sectional household interview survey with a multistage area probability design that allows for representative sampling of household and non-institutional group quarters. The sampling plan is a sample of clusters of addresses in primary sampling units, which consist of a county, small group of contiguous counties, or a metropolitan statistical area (CDC, 2018).

The NHIS questionnaire had a core set and supplemental sets of questions. The core questionnaire consisted of household, family, sample adult, and sample child components. The household component consisted of demographic information on all individuals in the household, and the family component collected additional demographic and health information on each family member in the household. One adult and one child

were randomly selected from each family, and the sample adult core and the sample child core questionnaires were used to collect information respectively. The supplemental questions included topics such as Healthy People objectives, cancer screening, complementary and alternative medicine, children's mental health, and healthcare utilization (CDC, 2018). The 2015 National Health Interview Survey contained data for 41,493 households, containing 103,789 persons in 42,288 families. The number of sample children is 12,291, and the number of sample adults is 33,672 (National Center for Health Statistics [NCHS], NHIS, 2015).

The sample for this study consisted of women who were between the ages of 21 and 65. Women who had a hysterectomy or a history of cervical cancer were excluded. The outcome variables were cervical cancer screening adherence, physician recommendation, and adherence to physician recommendation. Cervical cancer screening adherence was defined as having had at least one Pap test during the last 3 years, or for those 30-65 years of age by having had a Pap test and HPV test during the last 5 years. Screening adherence was assessed by the following question: "When did you have your most recent pap test?" "Did you have an HPV test with your most recent pap?"

Demographic, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge variables were chosen based on existing literature and explored as predictors for Pap test adherence. Demographic variables included age, race/ethnicity, marital status, education level, and employment status. Marital status included the following categories: married, widowed, separated, divorced, and never married. Women who reported themselves as widowed, separated, or divorced were

considered to be previously married in this study. Previously married and never married women were then combined to create a variable for unmarried women.

Acculturation was assessed using the geographic region of birth, English proficiency, and period of U.S. residence variables. Access to care variables included insurance type, office visits in past 12 months, and usual source of care. A chronic condition variable combined who had hypertension, high cholesterol, congestive heart failure, heart disease, emphysema, chronic obstructive pulmonary disease, asthma, cancer, or diabetes. Health behaviors and knowledge included BMI level, ever heard of HPV, ever received HPV vaccine, age when first child born, doctor recommended Pap test, birth control use, alcohol drinking status, smoking status, flu shot, risk perception of breast cancer, and reported health status.

This study was reviewed by the Florida International University Office of Research Integrity, and it was determined to be non human subjects research due to the use of publically available de-identified data. Therefore, it did not require further submission and approval of the FIU Institutional Review Board.

Inclusion and exclusion criteria

Sex: This was a categorical variable defined as 1) male and 2) female. Males were excluded from this study.

Age: This was a continuous variable and was recoded into categories of 21 to 29 years, 30 to 39 years, 40 to 49 years, and 50 to 65 years based on previous literature (Watson et al., 2017). Respondents less than 21 years and older than 65 years were excluded from this study based on current screening guidelines (USPSTF, 2016).

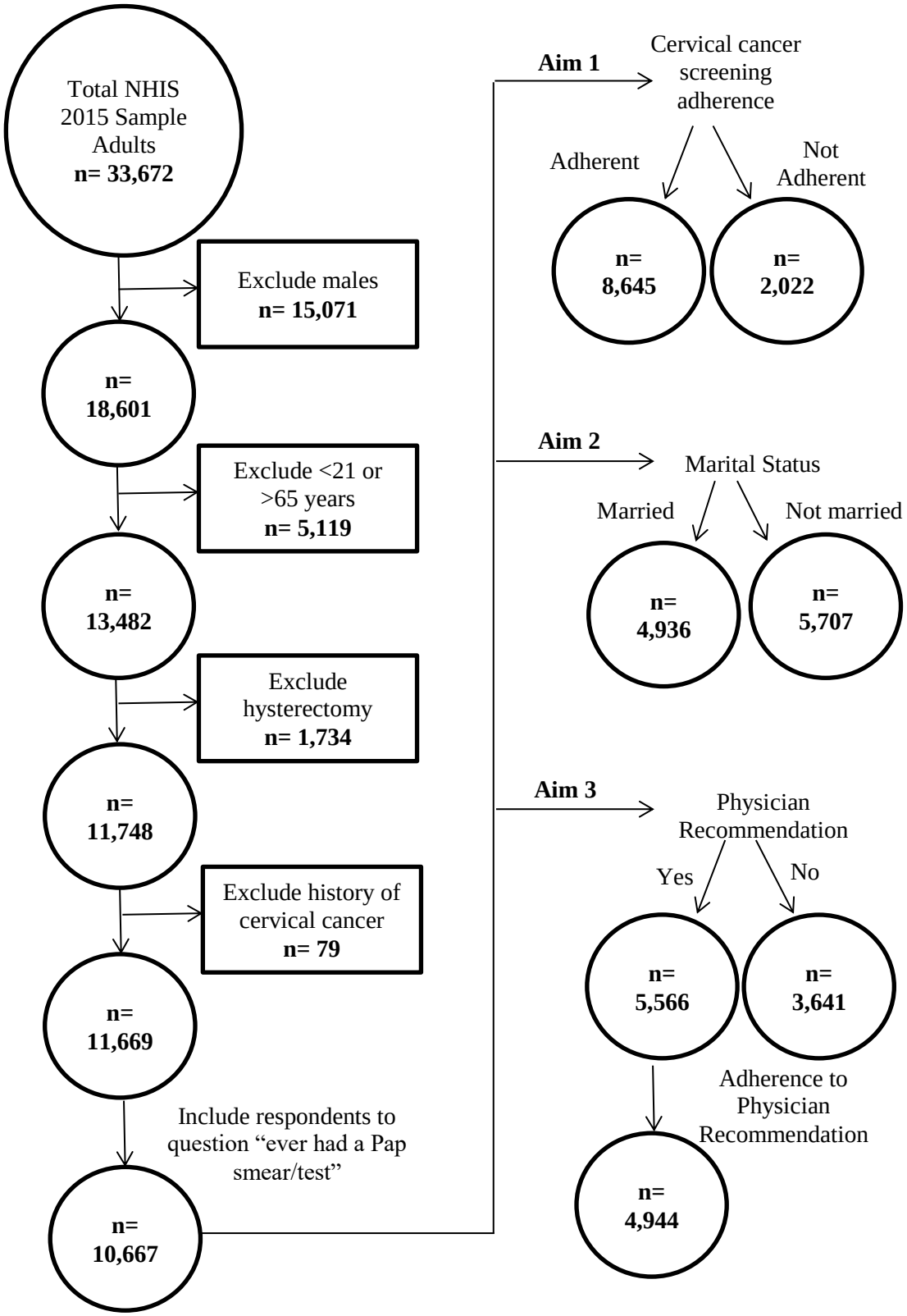
Hysterectomy: Respondents who answered yes to the question "Have you had a hysterectomy?" were excluded from this study based on current screening guidelines (USPSTF, 2016).

Cervical cancer: Respondents who said they were told by a doctor or health professional that they had cervical cancer were excluded to ensure they underwent screening rather than surveillance (Hanske et al., 2016; Politi et al., 2008).

Ever had a Pap smear/test: Respondents who answered the question "Have you ever had a Pap smear or Pap test?" were included in this study.

Among the 33,672 sample adults, 22,003 adults were excluded. Exclusion criteria included being male (n=15,071), being younger than 21 years or older than 65 years old (n=5,119), having had a hysterectomy (n=1,734), and history of cervical cancer (n=79).

Figure 2: Inclusion Criteria, Exclusion Criteria, and Study Aims



Outcome and predictor variables

Cervical cancer screening adherence: The questions for "when did you have your most recent Pap test" were combined to determine whether they had their last Pap test in the last 3 years, in the last 3 to 5 years, or more than 5 years ago. Respondents who answered that they had their last Pap test in the last 3 years, or that they had their last Pap test in the last 3 to 5 years AND answered yes to "did you have an HPV test with your most recent Pap" were considered adherent to cervical cancer screening based on the 2012 U.S. Preventive Services Task Force recommendations (USPSTF, 2016).

Race/Ethnicity: This was a categorical variable defined as 1) Hispanic, 2) non-Hispanic white, 3) non-Hispanic black, 4) Asian, and 5) all other race groups (Watson et al., 2017).

Marital status: This was a categorical variable defined as 1) separated, 2) divorced, 3) married, 4) single/never married, and 5) widowed. Separated and widowed were recoded into one category.

Education level: The highest level of school completed was recoded as less than high school, high school graduate or GED, some college or associate degree, and college graduate (Watson et al., 2017; White et al., 2017).

Employment status: Respondents were asked if they worked for pay at any time in the last calendar year with 1) yes and 2) no as the categories.

Geographic region of birth: This was a categorical variable to determine birthplace. It was recoded into fewer categories: United States, Mexico/Central America/Caribbean/South America, Europe/Russia, Africa, Middle East/Asia, and elsewhere.

English proficiency: Respondents were asked how well they speak English, and the categories were recoded into very well/well and not well/not at all.

Period of U.S. residence: This was a categorical variable, which was recoded as having been born in the United States, living in the United States for 10 years or more , and living in the United States for fewer than 10 years (Watson et al., 2017; White et al., 2017).

Health care coverage: This was a categorical variable defined as 1) private, 2) Medicaid and other public, 3) other coverage, and 4) uninsured (Watson et al., 2017).

Outpatient clinic visits in past 12 months: Total number of office visits in the past 12 months were recoded as none, one, two to three, and four or more.

Usual source of care: The questions "Is there a place that you usually go to when you are sick or need advice about your health" and "what kind of place is it" were combined to create two categories: Has usual source of care and none/hospital emergency department (Watson et al., 2017; White et al., 2017).

Chronic conditions: This variable combined respondents who had ever been told that they have hypertension, high cholesterol, congestive heart failure, heart disease, emphysema, chronic obstructive pulmonary disease, asthma, cancer, or diabetes.

Body mass index (BMI): This was a continuous variable, which was recoded into categories based on CDC guidelines: less than 18.5 (underweight), 18.5-24.9 (normal), 25-29.9 (overweight), 30 or greater (obese) (CDC, 2017b). The equation for BMI is as follows: BMI = [Weight (kg) / [Height (m) squared]].

Ever heard of HPV: This was a categorical variable defined as 1) yes and 2) no.

Ever received HPV shot/vaccine: This was a categorical variable defined as 1) yes and 2) no.

Age when first child born: The questions "have you ever given birth to a live born infant" and "how old were you when your child was born" were combined to create the following categories: Never gave birth, less than 21 years, 21 to 29 years, and 30 years or older.

Physician recommendation: Respondents were asked whether a doctor or other health professional recommended that they have a Pap test or Pap and HPV test in the past 12 months, with categories of 1) yes, 2) no, and 3) did not see a doctor in the last 12 months.

Birth control: This was a categorical variable in which respondents answered yes or no to the question "Are you currently taking birth control pills, birth control implants, birth control shots, or have a birth control patch?"

Alcohol drinking status: This was a categorical variable, which was recoded as lifetime abstainer, former drinker, and current drinker. A lifetime abstainers was defined as consuming fewer than 12 drinks in a lifetime.

Smoking status: This was a categorical variable, which was recoded as never smoker, former smoker, and current smoker.

Flu shot in past 12 months: This was a categorical variable defined as 1) yes and 2) no.

Risk perception of breast cancer: Respondents were asked "Compared to the average women your age, would you say that you are more likely to get breast cancer,

less likely, or about as likely?" The categories were recoded into more likely and less likely/about as likely.

Reported health status: This was a categorical variable defined as 1) excellent, 2) very good, 3) good, 4) fair, and 5) poor. Excellent and very good were recoded into the same category, and fair and poor were recoded into the same category.

Data management and preparation

The public use files were downloaded from the Centers for Disease Control, National Center for Health Statistics (NCHS) website (https://www.cdc.gov/nchs/nhis/nhis_2015_data_release.htm). The 2015 Person, Sample Adult, and Cancer files were merged together to create one dataset.

Statistical analysis

Descriptive analyses were first performed to describe the sample by the selected variables for demographics, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge. The descriptive analyses included the total number in the sample, the percent of the sample that it represented, screening adherence percentages, and crude odds ratio with corresponding 95% confidence interval.

Multiple logistic regression models were used to examine the relationship first between selected variables and the outcomes of interest (cervical cancer screening adherence and physician recommendation), and then analysis was performed by race to determine significant predictors. Backward elimination and stepwise procedures were used for the selection of variables into the model. Multicollinearity was tested for to

ensure predictors were not highly correlated. SAS 7.12 was used to perform the analysis. All analyses included statistical weights to account for the complex survey design, oversampling, post-stratification, and survey nonresponse. Weight, stratum, and cluster variables were used to specify the sample design. SURVEY procedures and statements were used to allow for correct estimation from a complex sample.

Missing

Missing data were coded as ".". Refused, not ascertained, and don't know responses to survey questions were treated as missing data. Missing data were not included in this study. The percentage of missing data for each variable was assessed.

Among the 11,669 eligible women, 1,002 (8.6%) women were coded as "refused" (n=42), "not ascertained" (n=934), or "don't know" (n=26) for the question "Have you ever had a Pap smear or Pap test". "Not ascertained" was used for partially completed interviews where the participant discontinued the interview. The non-respondents were not included in this study, as supported by other studies using the National Health Interview Survey (Blackwell & Clarke, 2016; Blackwell & Clarke, 2018; Clarke, Nahin, Barnes, & Stussman, 2016; Nahin, Barnes, & Stussman, 2016; Ward, Dahlhamer, Galinsky, & Joestl, 2014). The respondents compared to non-respondents were similar when analyzed by age, race/ethnicity, marital status, education level, and employment status, and determined to be randomly missing. The final sample size was 10,667 women.

Weighting

Each person in the NHIS sample has a known non-zero probability of selection, which is reflected in sample weights in order to provide unbiased national estimates. The base weights are adjusted for non-response and post-stratification to create final sampling weights.

Beginning with the 2010 National Health Interview Survey, the National Center for Health Statistics added a nonresponse adjustment for the sample adult weight. The sample adult weight includes design, ratio, non-response, and poststratification adjustments for sample adults. National estimates of all sample adult variables can be made using these weights (NCHS, NHIS, 2015).

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CHAPTER IV.

MANUSCRIPT 1

Predictors of cervical cancer screening among a nationally representative sample of women in the United States using current screening guidelines: 2015 National Health Interview Survey

Abstract

Background: Cervical cancer is one of the most preventable diseases if diagnosed early, but adherence to cervical cancer screening guidelines remains suboptimal. The objective of this study was to identify demographic, acculturation, access to health care and health behavior and knowledge factors associated with adherence to the current cervical cancer screening guidelines, and to determine if these factors differed by race/ethnicity. Methods: The 2015 National Health Interview Survey data were used to analyze cervical cancer screening adherence behavior in a sample of 10,667 women. Demographic, acculturation, access to care and utilization, chronic condition, and health behavior and knowledge variables were analyzed using logistic regression for the entire group and then stratified by race. The outcome of cervical cancer screening adherence was developed based on current guidelines of having a Pap test in the last three years, or co-testing with a Pap test and HPV test in the last five years. Results: Among these women, 81.7% (95% CI 80.7-82.7%) adhered to cervical cancer screening. Screening adherence declined with increasing age after the age of 39 years. Women who were never married (adjusted odds ratio [aOR] 0.67, CI 0.56-0.79) or current smokers (aOR 0.70, CI 0.59-0.84) had lower odds to adhere to cervical cancer screening guidelines. Women with a

college degree had greater odds to adhere to cervical cancer screening guidelines (aOR 1.38, CI 1.14-1.67). Positive health behaviors indicative of visiting a doctor were significantly associated with adhering to cervical cancer screening guidelines.

Conclusion: Enhanced education about the importance of cervical cancer screening and targeted interventions are needed for women aged under 30 and over 40 years, unmarried, unemployed, uninsured women, women with less education, women with no usual source of care, and current smokers.

Background

Previously one of the most common cancers among women in the United States, cervical cancer now ranks as the 21st most common types of cancer (NCI, n.d.). In the United States from 2009 to 2013, the incidence rate of cervical cancer was 7.5 per 100,000 women per year, and the mortality rate was 2.3 deaths per 100,000 women. The risk that a woman will develop cervical cancer during her lifetime is 0.6 percent (NCI, n.d.). Hispanic women had the highest incidence of cervical cancer, followed by non-Hispanic black, white, American Indian/Alaska Native, and Asian/Pacific Islander women. Non-Hispanic black women had the highest mortality rate, followed by Hispanic, Asian/Pacific Islander, non-Hispanic white, and American Indian/Alaska Native women (CDC, 2015).

Cervical cancer is highly preventable when screening and follow-up recommendations are adhered to (CDC, 2015). If cervical cancer is diagnosed at an early stage, it is treatable and associated with long survival (CDC, 2015). The five-year observed survival rate decreases as the disease progresses. The five-year survival rate is

93% at stage 0, 93% at stage IA, 80% at stage IB, 63% at stage IIA, 58% at IIB, 35% at stage IIIA, 32% at stage IIIB, 16% at IVA, and 15% at stage IVB (ACS, 2016). Cervical cancer is a slow-growing cancer, making it one of the most preventable cancers (NCCC, 2016).

Secondary prevention through cervical cancer screening identifies cervical abnormalities. Cervical cancer deaths have decreased by 50% over the last 40 years due to an increase in Pap test utilization (ACS, 2018). However, from 2008 to 2010, cervical cancer screening rates declined slightly (Brown et al., 2014). According to the U.S. Preventive Task Force, a Pap test is recommended for women between the ages of 21 and 65 years of age who have not had a hysterectomy. Recommendations for frequency of cervical cancer screening have changed over the years. Currently, a Pap test is recommended every three years. Cervical cancer screening is only recommended every five years if there is co-testing with the HPV test. These recommendations do not apply to women with a diagnosis of a high-grade precancerous cervical lesion or cervical cancer, women with *in utero* exposure to diethylstilbestrol, women who are HIV infected, or women who are otherwise immunocompromised (USPSTF, 2016).

Many studies on cervical cancer screening focus on specific geographic regions or racial/ethnic groups. While the findings of previous studies have been consistent on the association of demographic factors and cervical cancer screening, there are insufficient results on chronic diseases. In addition, trends for some characteristics will vary over the years and may indicate different populations for further study. Current analysis on robust, national data is warranted to identify or confirm predictors and to explore populations in need of interventions for the prevention of cervical cancer. In 2012, HPV

and Pap co-testing for women over the age of 30 became a part of the cervical cancer screening guidelines. There are two published articles which examined Pap test adherence by sociodemographic characteristics and health care access using NHIS 2015 data. One study examined Pap test within three years and co-testing within three years separately, while the other study combined both options together (White et al., 2017; Watson et al., 2017). This study adds to current literature by taking current screening guidelines into account when determining the characteristics of who gets screened. The characteristics examined will go beyond demographic and health care access to also assess the role of acculturation, chronic conditions, and health behavior and knowledge on screening. The objective of this study was to identify demographic, acculturation, access to health care and health behavior and knowledge factors associated with adherence to the current cervical cancer screening guidelines and to determine if these factors differed by race/ethnicity. Variables were chosen based on existing literature and considered as predisposing, reinforcing, or enabling factors using the PRECEDE/PROCEED model (Hatcher et al., 2011; Ji et al., 2010).

Methods

The data source for this study was the 2015 National Health Interview Survey (NHIS) (National Center for Health Statistics, CDC, 2017). The NHIS is a cross-sectional household interview survey with a multistage area probability design that allowed for representative sampling of household and non-institutional group quarters. The sampling plan was a sample of clusters of addresses in primary sampling units, which consisted of a county, small group of contiguous counties, or a metropolitan

statistical area (CDC, 2018). The 2015 Person, Sample Adult, and Cancer files were merged together.

The sample for this study consisted of women who were between the ages of 21 and 65. Women who had a hysterectomy or a history of cervical cancer were excluded. The outcome variable was cervical cancer screening adherence. Cervical cancer screening adherence was defined by having had at least one Pap test during the last 3 years, or for those 30-65 by having had a Pap test and HPV test during the last 5 years. Screening adherence was assessed by the following question: "When did you have your most recent pap test?" "Did you have an HPV test with your most recent pap?"

Demographic, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge variables were explored as predictors for Pap test adherence. Demographic variables included age, race/ethnicity, marital status, education level, and employment status. Acculturation was assessed using the geographic region of birth, English proficiency, and period of U.S. residence variables. Access to care variables included insurance type, office visits in past 12 months, and usual source of care. A chronic condition variable combined hypertension, high cholesterol, congestive heart failure, heart disease, emphysema, chronic obstructive pulmonary disease, asthma, cancer, or diabetes. Health behaviors and knowledge included BMI level, ever heard of HPV, ever received HPV vaccine, age when first child born, doctor recommended pap test, birth control use, alcohol drinking status, smoking status, flu shot, risk perception of breast cancer, and reported health status.

A multiple logistic regression model was used to examine the relationship first between selected variables and cervical cancer screening adherence, and then analysis

was performed by race to determine significant predictors. Backward elimination and stepwise procedures were used for the selection of variables into the model. Multicollinearity was tested to ensure predictors were not highly correlated. SAS 7.12 was used to perform the analysis. All analyses included statistical weights to account for the complex survey design, oversampling, post-stratification, and survey nonresponse. Weight, stratum, and cluster variables were used to specify the sample design. SAS Proc SURVEY and its statements were used to allow for correct estimation from a complex sample. This study was determined to be non human subjects research due to the use of publically available de-identified data.

Results

The sample consisted of 10,667 women between the ages of 21 and 65 without a hysterectomy or history of cancer, representing 75,830,736 women in the United States. Of these, 81.7% were adherent to cervical cancer screening. Table 1 shows the distribution of characteristics among the sample and the crude odds of adherence for each characteristic. Of all the age groups, women aged 21 to 29 years reported the lowest cervical cancer screening adherence (76.0%). Cervical cancer screening adherence among non-Hispanic black and non-Hispanic white women was higher (84.2% and 83.4%, respectively) than that among women belonging to Hispanic, Asian, and other racial/ethnic groups (77.8%, 72.6%, and 73.1%, respectively). Cervical cancer screening adherence was higher among women who were married (85.5%) as compared to other marital statuses, and who were employed last year (84.5%). Cervical cancer screening adherence increased with higher education.

Cervical cancer screening adherence was higher among women who spoke English well (82.5%) as compared to not well (69.6%). Only 65.1% of women living in the United States for fewer than 10 years reported cervical cancer screening adherence as compared to 78.3% of women in the United States for 10 or more years, and 83.3% of women born in the United States.

Cervical cancer screening adherence was higher among women who had private health insurance (85.6%). Screening adherence increased as the number of outpatient clinic visits in the past 12 months increased, with four or more office visits in the prior year being the highest (88.1%). Women who did not have a usual source of care had a lower percentage of screening adherence (64.9%) as compared to women who did have a usual source of care (84.4%). Women who had at least one chronic condition (83.4%) had higher screening adherence as compared to women with no chronic conditions (80.3%). Women with a BMI of 25-29.9 (overweight) had the highest percentage of screening adherence (82.5%) as compared to all other BMI categories. Women with knowledge of HPV (85.9%) and receipt of the HPV vaccine (89.5%) had higher rates of cervical cancer screening adherence. Screening adherence increased with increasing age of when the first child was born. Women who did not have physician recommendation for a Pap test had lower screening adherence (78.5%) than those who did have physician recommendation (89.3%). Among women using birth control pills, implants or shots, 91.3% adhered to screening guidelines. Current alcohol drinkers (85.5%) and former smokers (86.0%) had the highest rates of screening adherence as compared to those who abstained from alcohol (71.5%) or were never smokers (82.1%). Women who had a flu shot in the past 12 months had a higher rate of screening adherence (88.5%). Women

who perceived themselves to be less likely to get breast cancer as compared to average women had a lower percentage of adherence (81.5%). Screening adherence was higher among women who reported excellent or good health status (82.4%) than among women who reported fair or poor health status (75.3%).

We performed a multivariable analysis to calculate the odds ratios for cervical cancer screening adherence, adjusting for other variables (Table 1.2). Non-Hispanic black women (aOR 2.26, 95% CI 1.83-2.80) and Hispanic women (aOR 1.47, 95% CI 1.16-1.86) had higher odds of cervical cancer screening adherence as compared to non-Hispanic white women. Women between the ages of 30 and 39 had the highest likelihood of adhering to cervical cancer screening (aOR 1.59, 95% CI 1.30-1.94). Screening rates decreased after 39 years of age but were still higher than those among the 21 to 29 year age group. Compared with the youngest age group, those who were 30 to 39 years of age had the highest odds to adhere to cervical cancer screening if non-Hispanic white (aOR 1.71, 95% CI 1.16-2.53) or Hispanic (aOR 1.50, 95% CI 1.01-2.23) but not for non-Hispanic black women (aOR 1.33, 95% CI 0.70-2.50). Women who were never married were least likely to adhere to cervical cancer screening as compared to other marital status (aOR 0.67, 95% CI 0.56-0.79). Among non-Hispanic white and Hispanic women, never married compared to married women had lower odds of getting screened (aOR 0.48, 95% CI 0.35-0.68; and aOR 0.60, 95% CI 0.41-0.87, respectively), but there was no difference among non-Hispanic black women (aOR 0.95, 95% CI 0.53-1.72). Higher odds of cervical cancer screening adherence were associated with being a college graduate (aOR 1.38, 95% CI 1.14-1.67) compared with other education levels, and with having worked last year compared with not having worked last year.

Graduation from college and having worked last year were significantly associated with screening among non-Hispanic white and black women but not for Hispanic women. Lower odds of screening adherence were associated with being born in the Middle East or Asia (aOR 0.62, 95% CI 0.38-0.99), being uninsured (aOR 0.72, 95% CI 0.59-0.88), having no office visits in the past 12 months (AOR 0.54, 95% CI 0.45-0.66), and having no usual source of care or using a hospital emergency department (aOR 0.68, 95% CI 0.57-0.81). Non-Hispanic white (aOR 0.66, 95% CI 0.45-0.97) and Hispanic (aOR 0.59, 95% CI 0.37-0.94) women who were uninsured had lower odds to adhere to cervical cancer screening but were not significantly different than non-Hispanic black women (aOR 0.55, 95% CI 0.28-1.12). Not having a usual source of care was a significant factor only among non-Hispanic white women (aOR 0.64, 95% CI 0.47, 0.87). Women with no office visits in the past 12 months were less likely to adhere to cervical cancer screening among non-Hispanic white (aOR 0.52, 95% CI 0.34, 0.79), non-Hispanic black (aOR 0.50, 95% CI 0.26-0.96), and Hispanic women (aOR 0.46, 95% CI 0.30-0.71).

Higher odds of cervical cancer screening adherence were associated with having heard of HPV, having received an HPV shot, being over 30 years old when the first child was born, physician recommendation for a Pap test, birth control use, and having received a flu shot in the past 12 months. Non-Hispanic white (aOR 0.56, 95% CI 0.35-0.88) and Hispanic (aOR 0.43, 95% CI 0.25-0.76) women who had never received an HPV shot were less likely to adhere to cervical cancer screening but were not significant among non-Hispanic black women (aOR 0.88, 95% CI 0.46-1.70). Women who currently drank alcohol compared with never drinkers had greater odds (aOR 1.50, 95% CI 1.27-1.76) to adhere to cervical cancer screening recommendations; whereas current

smokers had lower odds (aOR 0.70, 95% CI 0.59-0.84) than never smokers. Women who had not heard of HPV, who had never given birth, with no physician recommendation for a Pap test, with no birth control use, and with no flu shot in the last 12 months had lower odds to adhere to cervical cancer screening among non-Hispanic white, non-Hispanic black, and Hispanic women. Alcohol drinking and smoking status and reported health status were only significant among non-Hispanic white women. Lower odds of screening adherence were associated with having reported fair or poor health status (aOR 0.72, 95% CI 0.59-0.88).

Discussion

Recognizing cervical cancer as a highly preventable disease as well as needs for updated national data to determine which groups to target, we assessed 2015 NHIS data to identify predictors of cervical cancer screening as well as racial disparities. In addition, we used the current guidelines of either having a Pap test in the last 3 years or having a Pap test and HPV test in the last 5 years as the outcome. Among women aged 21 to 65 years with no hysterectomy and no history of cervical cancer, 81.7% were adherent to cervical cancer screening guidelines. This translates into 61,922,182 women. However, no group of women examined in this study reached the Healthy People 2020 objective of 93% of women screened. Women currently taking birth control pills, implants, or shots (91.3%) are the closest group to achieving this target. We found a number of factors affected the screening behavior among women, which included race/ethnicity, age, marital status, education, work status, insurance, physician office visits, usual source of care, knowledge of HPV, HPV vaccination, age when first child

born, doctor recommendation, birth control use, alcohol and smoking status, flu shot in the last 12 months, and reported health status.

Racial disparities are important to analyze to understand where additional resources are needed. Stratified by race, differences in associated characteristics with adherence were evident. Overall, non-Hispanic black women were more than twice as likely as non-Hispanic white women to adhere to cervical cancer screening. With non-Hispanic black women having higher incidence and mortality rates for cervical cancer as compared to non-Hispanic white women, other factors, such as follow-up to abnormal pap test results, need to be studied to better understand this disparity. Understanding the significant predictors by race is imperative in providing the appropriate education and interventions to targeted groups.

In addition, recent studies have shown being non-Hispanic white reduced the likelihood of cervical cancer screening (Miles-Richardson et al., 2017). There are racial and ethnic differences in the association of these demographic factors with cervical cancer screening. Hispanic and other race women were more likely (11.1% and 14.7%, respectively) to never have a Pap test than non-Hispanic white women (5.0%) or black women (5.8%) (Chen et al., 2012). Among non-Hispanic white and black women, insurance was associated with increased likelihood of receipt of a Pap smear (Hirth et al., 2016).

Our study found that women who were born in the Middle East or Asia were less likely to adhere to cervical cancer screening guidelines. Studies have shown that foreign born women are less likely to adhere to Pap testing recommendations compared with women born in the United States. There are further differences based on duration of time

spent in the United States and by birthplace (Tsui, Saraiya, Thompson, Dey, & Richardson, 2007). Cultural beliefs about the etiology of cervical cancer affect Pap testing among immigrant women (McMullin et al., 2005).

Our findings on the demographic variables and the percentage of adherence concurred with past research (White et al., 2017; Watson et al., 2017). Sociodemographic factors have been shown to be predictors of cervical cancer screening (Miles-Richardson et al., 2017). According to the 2000 National Health Interview Survey, age, race/ethnicity, education, health insurance, and a usual source of care were associated with cervical cancer screening (Meissner et al., 2009). With the median age of diagnosis of cervical cancer being 49 years, it is interesting to note our finding that the likelihood of screening declines after the age of 39. This indicates a need for enhancing education to women over the age of 40 and to emphasize continued screening. While it is crucial to start screening at the age of 21, it is important to adhere to current screening guidelines even as age increases to find any cervical cell changes at an early stage. Non-Hispanic white women and Hispanic women between the ages of 30 and 39 were most likely to get screened for cervical cancer as compared to other age groups, whereas age was not significant for non-Hispanic black women. This may be a result of cultural beliefs and the age at which such services are deemed to be necessary. In addition, they also may have been screened as part of obstetric care or when obtaining birth control. Women who did not work the previous year were 35% less likely to have adhered to cervical cancer screening guidelines. Women who did not work the previous year may have fewer financial resources for screening such as insurance and transportation, which may have hindered health seeking behaviors. Women without insurance were 28% less

likely to adhere to cervical cancer screening guidelines, similar to women who did not work the previous year. Women who did not work the previous year were significantly associated with nonadherence among non-Hispanic women but not among Hispanic women. Also, lack of insurance was significantly associated with nonadherence among non-Hispanic white women and Hispanic women but not among non-Hispanic black women.

Low family income, low educational level, and being unmarried have been shown to be associated with lower rates of Pap testing (Hewitt et al., 2004). In our study, unmarried categories were differentiated as widowed or separated, divorced, and never married. Women who were never married were the least likely to adhere to cervical cancer screening as compared to the other unmarried categories. One theory is that some women in the never married category may not currently be sexually active, and may erroneously believe they are not at risk for cervical cancer. A recent study found single, separated/divorced, and widowed women are more likely to be diagnosed with cervical cancer at an advanced stage as compared to married women (Ibrahimi & Pinheiro, 2017). This further emphasizes the importance of cervical cancer screening for unmarried women. Non-Hispanic white women and Hispanic women who were never married were least likely to be screened, but this was not a significant predictor for non-Hispanic black women.

Systematic reviews have shown a positive association between education and cervical cancer screening (Damiani et al., 2015), as well as between health literacy and cervical cancer (Kim & Han, 2016). Educational attainment has been shown to have a significant correlation with knowledge of cervical cancer risk factors (Akinlotan et al.,

2017). Many studies regarding education, knowledge, and perceptions focus on specific ethnic groups. The most common reason for lack of regular Pap testing is the belief that it is not necessary if no symptoms are present (Juon et al., 2003). College graduates were 38% more likely to adhere to cervical cancer screening guidelines as compared to a high school graduate. Thus, cervical cancer screening adherence improves with increasing education even past a high school degree. Having a college degree was significantly associated with screening adherence among non-Hispanic women but not among Hispanic women.

Research on the association of chronic conditions and cancer screening has shown varied results. Some studies have found that chronic conditions such as diabetes are a barrier to cancer screening, while other studies have found that chronic diseases increase the likelihood of cancer screening adherence (Brown et al., 2013; Guo et al., 2015; Liu et al., 2014). Some have theorized that the presence of a chronic condition indicates more physician visits, which may increase the likelihood of pursuing other preventive health measures. Here, we found that having a chronic condition such as diabetes had a higher association with cervical cancer screening adherence than not having a chronic condition. One could speculate that having a chronic condition may mean more doctors' visits, which may provide more opportunities for recommending preventive screenings. Physician recommendation for a Pap test is significantly associated with adherence to cervical cancer screening. Women who did not have a Pap test recommended were 46% less likely to adhere to screening guidelines. Even specialists should stay up-to-date on preventive care guidelines to ensure they can provide guidance to their patients, even if the visit is for other reasons.

This study supports the importance of health behaviors and knowledge in adhering to cervical cancer screening guidelines. Women who had heard of HPV and who had an HPV vaccine were more likely to get cervical cancer screening. The number of office visits in the last 12 months had a positive association with cervical cancer screening. Doctor recommendation also influenced more women to get cervical cancer screening. Women who use birth control or have had a flu shot in the last 12 months were more likely to get screened for cervical cancer. All of these findings show that visiting a doctor improves the likelihood of cervical cancer screening. In addition, behaviors indicative of preventive health may make women more likely to pursue cancer screening as well.

Women who are current drinkers were more likely to adhere to cervical cancer screening as compared to lifetime abstainers; whereas women who are current smokers were less likely to adhere to cervical cancer screening as compared to never smokers. A previous cross-sectional study using the Behavioral Risk Factor Surveillance System also found that the odds of current smokers having had a Pap test in the last 3 years was 0.70 as compared to never smokers (MacLaughlan, Lachance, & Gjelsvik, 2011). With smoking being a risk factor for cervical cancer, current smokers should be targeted for interventions to increase their adherence to pap testing and consequently diagnosis at an earlier stage of the disease.

The limitations of this study included self-reported data, which may not accurately capture cervical cancer screening adherence as a result of recall bias, social desirability, and over-reporting of Pap test utilization. Women may also erroneously believe their pelvic exam included a Pap test.

Enhanced education about the importance of cervical cancer screening and targeted interventions are needed for women aged under 30 and over 40 years, unmarried, unemployed, uninsured women, women with less education, women with no usual source of care, and current smokers.

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Table 1.1: Percentage of women with cervical cancer screening adherence by selected characteristics - National Health Interview Survey, United States, 2015 (N=10,667)

Variables	Total	Sample %	% Adherent (weighted)	Crude OR (95% CI)
Total	10,667			
Weighted	75,830,736		81.7	
Demographics				
Age				
21-29 years	2286	21.4	76.0	1.00
30-39 years	2745	25.7	86.7	2.06*** (1.69, 2.51)
40-49 years	2255	21.1	83.2	1.56*** (1.26, 1.93)
50-65 years	3381	31.7	80.9	1.34** (1.12, 1.59)
Race/Ethnicity				
Non-Hispanic white	6068	56.9	83.4	1.00
Hispanic	2140	20.1	77.8	0.70*** (0.59, 0.82)
Non-Hispanic black	1601	15.0	84.2	1.06 (0.88, 1.28)
Asian	704	6.6	72.6	0.53*** (0.42, 0.67)
Other	154	1.4	73.1	0.54* (0.33, 0.89)
Marital Status				
Married	4936	46.4	85.5	1.00
Widowed or Separated	812	7.6	79.0	0.64** (0.49, 0.84)
Divorced	1661	15.6	81.3	0.74** (0.60, 0.91)
Never married	3234	30.4	74.5	0.50*** (0.43, 0.58)

Highest level of school completed				
Less than high school	1238	11.6	69.3	0.72*** (0.58, 0.90)
High school graduate or GED	2184	20.5	75.8	1.00
Some college or associate degree	3496	32.9	81.6	1.42*** (1.17, 1.72)
College graduate	3720	35.0	88.2	2.39*** (1.97, 2.90)
Employed last year				
Yes	7865	73.8	84.5	1.00
No	2795	26.2	73.7	0.51*** (0.45, 0.59)
Acculturation				
Geographic region of birth				
United States	8348	78.3	83.3	1.00
Mexico, C. America, Caribbean, S. America	1392	13.1	77.9	0.70*** (0.58, 0.85)
Europe, Russia	182	1.7	78.0	0.71 (0.46, 1.09)
Africa	113	1.1	70.0	0.47** (0.28, 0.77)
Middle East, Asia	568	5.3	71.1	0.49*** (0.39, 0.63)
Elsewhere	56	0.5	76.4	0.65 (0.28, 1.48)
How well is English spoken				
Very well, well	9838	92.2	82.5	1.00
Not well, not at all	829	7.8	69.6	0.48*** (0.40, 0.59)
Period of U.S. Residence				
U.S. born	8348	78.5	83.3	1.00
In U.S. ≥ 10 years	1818	17.1	78.3	0.72*** (0.61, 0.85)
In U.S. < 10 years	475	4.5	65.1	0.37*** (0.30, 0.47)

Access to Care and Utilization				
Health care coverage				
Private	6751	64.7	85.6	1.00
Medicaid and other public	1859	17.8	78.2	0.60*** (0.51, 0.71)
Other coverage	478	4.6	84.0	0.89 (0.64, 1.23)
Uninsured	1340	12.9	64.0	0.30*** (0.25, 0.36)
Outpatient clinic visits - past 12 months				
None	1587	14.9	56.5	0.32*** (0.26, 0.40)
1	1838	17.3	80.0	1.00
2-3	3018	28.3	86.1	1.55*** (1.26, 1.92)
4+	4209	39.5	88.1	1.85*** (1.53, 2.24)
Usual source of care				
Has usual source	9157	86.4	84.4	1.00
None or hospital emergency department	1441	13.6	64.9	0.34*** (0.29, 0.41)
Chronic Conditions				
No	5735	54.5	80.3	1.00
Yes	4779	45.5	83.4	1.23** (1.07, 1.42)
Health Behaviors and Knowledge				
Body Mass Index				
<18.5	226	2.1	69.4	0.50*** (0.34, 0.75)
18.5-24.9	3913	37.2	81.9	1.00
25-29.9	2724	25.9	82.5	1.05 (0.88, 1.24)
>=30	3666	34.8	81.5	0.98 (0.83, 1.15)
Ever heard of HPV				
Yes	7854	75.5	85.9	1.00
No	2552	24.5	69.0	0.35*** (0.31, 0.41)

Ever received HPV shot/vaccine				
Yes	1173	11.6	89.5	1.00
No	8972	88.4	80.8	0.50*** (0.38, 0.64)
Age when first child born				
Never gave birth	3189	30.1	74.8	1.00
<21 years	2472	23.4	80.5	1.39*** (1.16, 1.65)
21-29 years	3644	34.4	85.8	2.03*** (1.72, 2.38)
>=30 years	1274	12.0	89.7	2.92*** (2.27, 3.75)
Doctor recommended pap test				
Yes	5566	53.3	89.3	1.00
No	4392	42.1	78.5	0.44*** (0.38, 0.51)
Did not see a doctor in the past 12 months	479	4.6	54.7	0.15*** (0.11, 0.19)
Currently taking birth control pills, implants, or shots				
Yes	1877	17.8	91.3	1.00
No	8676	82.2	79.7	0.37*** (0.30, 0.47)
Alcohol drinking status				
Lifetime abstainer	2315	21.8	71.5	1.00
Former drinker	1278	12.0	78.6	1.46*** (1.18, 1.82)
Current drinker	7017	66.1	85.5	2.35*** (2.00, 2.75)
Smoking status				
Never smoker	7222	67.8	82.1	1.00
Former smoker	1719	16.1	86.0	1.34** (1.12, 1.60)
Current smoker	1713	16.1	74.9	0.65*** (0.54, 0.78)

Flu shot past 12 months				
Yes	4310	40.5	88.5	1.00
No	6341	59.5	76.9	0.43*** (0.38, 0.50)
Risk of breast cancer compared to average women				
More likely	1178	11.7	85.7	1.00
Less likely, about as likely	8888	88.3	81.5	0.74** (0.59, 0.92)
Reported health status				
Excellent, very good, or good	9421	88.3	82.4	1.00
Fair or poor	1245	11.7	75.3	0.65*** (0.54, 0.79)

*<0.05, **<0.01, ***<0.001

Table 1.2: Adjusted odds ratios of cervical cancer screening adherence by race - National Health Interview Survey, United States, 2015

Variables	Overall	Non-Hispanic White	Non-Hispanic Black	Hispanic
Total	8,898	4,582	1,219	1,501
Demographics				
Age				
21-29 years	1.00	1.00	1.00	1.00
30-39 years	1.59*** (1.30, 1.94)	1.71** (1.16, 2.53)	1.33 (0.70, 2.50)	1.50* (1.01, 2.23)
40-49 years	1.24 (1.00, 1.54)	0.87 (0.59, 1.29)	1.11 (0.56, 2.22)	1.40 (0.87, 2.25)
50-65 years	0.96 (0.78, 1.19)	0.80 (0.56, 1.14)	1.04 (0.52, 2.07)	1.26 (0.71, 2.23)
Race/Ethnicity				
Non-Hispanic white	1.00	-	-	-
Hispanic	1.47** (1.16, 1.86)	-	-	-
Non-Hispanic black	2.26*** (1.83, 2.80)	-	-	-
Asian	1.16 (0.75, 1.78)	-	-	-
Other	1.11 (0.67, 1.84)	-	-	-
Marital Status				
Married	1.00	1.00	1.00	1.00
Widowed or Separated	0.90 (0.71, 1.15)	0.91 (0.60, 1.38)	0.90 (0.45, 1.81)	1.09 (0.54, 2.22)
Divorced	0.94 (0.77, 1.14)	0.97 (0.68, 1.39)	0.46 (0.21, 1.01)	1.58 (0.87, 2.89)
Never married	0.67*** (0.56, 0.79)	0.48*** (0.35, 0.68)	0.95 (0.53, 1.72)	0.60** (0.41, 0.87)
Highest level of school completed				
Less than high school	1.04 (0.83, 1.29)	0.82 (0.49, 1.37)	0.69 (0.40, 1.19)	0.75 (0.48, 1.16)
High school graduate or GED	1.00	1.00	1.00	1.00
Some college or associate degree	1.11 (0.94, 1.32)	1.02 (0.73, 1.43)	1.58 (0.96, 2.63)	0.96 (0.64, 1.45)
College graduate	1.38*** (1.14, 1.67)	1.61** (1.13, 2.30)	2.46** (1.34, 4.51)	1.33 (0.66, 2.66)

Work last year				
Yes	1.00	1.00	1.00	1.00
No	0.65*** (0.56, 0.75)	0.64** (0.48, 0.84)	0.52** (0.33, 0.81)	0.74 (0.50, 1.10)
Acculturation				
Geographic region of birth				
United States	1.00	1.00	1.00	1.00
Mexico, Central America, Caribbean, South America	1.24 (0.94, 1.64)	-	0.67 (0.29, 1.56)	1.22 (0.79, 1.89)
Europe, Russia	0.72 (0.46, 1.14)	0.56* (0.34, 0.92)	3.02 (0.19, 47.01)	0.24* (0.06, 0.95)
Africa	0.58 (0.31, 1.06)	0.76 (0.12, 4.89)	0.87 (0.37, 2.07)	-
Middle East, Asia	0.62* (0.38, 0.99)	0.47 (0.17, 1.35)	-	-
Elsewhere	1.27 (0.55, 2.93)	0.80 (0.23, 2.78)	0.21 (0.03, 1.77)	-
Access to Care and Utilization				
Health care coverage				
Private	1.00	1.00	1.00	1.00
Medicaid and other public	0.94 (0.77, 1.14)	0.93 (0.65, 1.34)	0.85 (0.52, 1.42)	0.84 (0.54, 1.30)
Other coverage	0.96 (0.71, 1.29)	1.40 (0.85, 2.31)	1.20 (0.55, 2.64)	1.24 (0.54, 2.83)
Uninsured	0.72* (0.59, 0.88)	0.66* (0.45, 0.97)	0.55 (0.28, 1.12)	0.59* (0.37, 0.94)
Outpatient clinic visits - past 12 months				
None	0.54** (0.45, 0.66)	0.52** (0.34, 0.79)	0.50* (0.26, 0.96)	0.46*** (0.30, 0.71)
1	1.00	1.00	1.00	1.00
2-3	1.38*** (1.14, 1.67)	1.41 (1.00, 1.99)	1.90 (0.96, 3.75)	1.06 (0.67, 1.70)
4+	1.74*** (1.44, 2.09)	1.66** (1.21, 2.29)	1.75 (0.99, 3.09)	1.62* (1.02, 2.58)
Usual source of care				
Has usual source	1.00	1.00	1.00	1.00
None or hospital emergency department	0.68*** (0.57, 0.81)	0.64** (0.47, 0.87)	1.10 (0.59, 2.06)	0.98 (0.63, 1.53)

Health Behaviors and Knowledge				
Ever heard of HPV				
Yes	1.00	1.00	1.00	1.00
No	0.56*** (0.49, 0.65)	0.58*** (0.44, 0.76)	0.40*** (0.26, 0.62)	0.54*** (0.38, 0.75)
Ever received HPV shot/vaccine				
Yes	1.00	1.00	1.00	1.00
No	0.64*** (0.50, 0.83)	0.56* (0.35, 0.88)	0.88 (0.46, 1.70)	0.43** (0.25, 0.76)
Age when first child born				
Never gave birth	1.00	1.00	1.00	1.00
<21 years	2.20*** (1.81, 2.67)	1.85** (1.29, 2.65)	2.94*** (1.73, 5.01)	3.54*** (2.17, 5.76)
21-29 years	2.02*** (1.70, 2.40)	1.61** (1.18, 2.20)	1.83* (1.02, 3.27)	3.76*** (2.46, 5.74)
>=30 years	2.56*** (2.00, 3.34)	1.77** (1.16, 2.69)	2.64* (1.05, 6.64)	5.21*** (2.23, 12.17)
Doctor recommended pap test				
Yes	1.00	1.00	1.00	1.00
No	0.54*** (0.47, 0.61)	0.66*** (0.52, 0.84)	0.42*** (0.27, 0.67)	0.50*** (0.34, 0.72)
Did not see a doctor in the past 12 months	0.38*** (0.29, 0.49)	0.51* (0.29, 0.88)	0.27** (0.10, 0.72)	0.47* (0.24, 0.91)
Currently taking birth control pills, implants, or shots				
Yes	1.00	1.00	1.00	1.00
No	0.47*** (0.38, 0.59)	0.50*** (0.35, 0.70)	0.46* (0.23, 0.90)	0.67* (0.46, 0.97)
Alcohol drinking status				
Lifetime abstainer	1.00	1.00	1.00	1.00
Former drinker	1.10 (0.89, 1.37)	1.00 (0.69, 1.46)	1.12 (0.56, 2.26)	1.00 (0.52, 1.90)
Current drinker	1.50* (1.27, 1.76)	1.61** (1.16, 2.23)	0.96 (0.59, 1.57)	1.48 (0.99, 2.20)
Smoking status				
Never smoker	1.00	1.00	1.00	1.00
Former smoker	1.00 (0.82, 1.211)	1.00 (0.74, 1.34)	1.97 (0.89, 4.35)	0.85 (0.41, 1.75)
Current smoker	0.70* (0.59, 0.84)	0.70* (0.51, 0.96)	0.97 (0.54, 1.74)	0.98 (0.59, 1.61)

Flu shot past 12m				
Yes	1.00	1.00	1.00	1.00
No	0.66*** (0.57, 0.76)	0.65*** (0.51, 0.84)	0.57** (0.38, 0.85)	0.65* (0.42, 0.99)
Reported health status				
Excellent, very good, or good	1.00	1.00	1.00	1.00
Fair or poor	0.72** (0.59, 0.88)	0.67* (0.48, 0.96)	0.71 (0.37, 1.35)	1.35 (0.89, 2.07)

*<0.05, **<0.01, ***<0.001

1. There were 1,769 records that could not be used in the analysis due to missing values (24 for missing marital status, 29 for missing education, 7 for missing work status, 8 for missing region of birth, 239 for missing insurance status, 15 for missing number of office visits, 69 for missing usual source of care, 261 for missing HPV knowledge, 522 for receipt of HPV vaccine, 88 for missing maternal age, 230 for missing physician recommendation, 114 for missing birth control use, 57 for missing alcohol use, 13 for missing smoking status, and 16 for missing flu shot).
2. The odds ratios were adjusted for all the factors.

CHAPTER V.

MANUSCRIPT 2

Association of marital status with cervical cancer screening among women aged 21 to 65 years in the United States, 2015 National Health Interview Survey

Abstract

Background: Despite evidence that adherence to screening guidelines decreases mortality, women are still dying from a preventable disease due to underutilization of screening. Studies have found that unmarried women are more likely to have a delayed-stage cervical cancer diagnosis as compared to married women, suggesting underutilization of cervical cancer screening among unmarried women. The primary aim of this study was to examine cervical cancer screening adherence in the United States among unmarried women, including women who were divorced, separated, widowed, or never married. Methods: The 2015 National Health Interview Survey data were used to explore cervical cancer screening adherence behavior in 10,643 women between the ages of 21 and 65 years. Cervical cancer screening adherence was defined as having a Pap test in the last three years, or co-testing with a Pap test and HPV test in the last five years. Previously married and never married women were combined to create a variable for a sample of 5,707 unmarried women. Logistic regression was used, and demographics, acculturation, access to care and utilization, chronic condition, and health behavior and knowledge variables were studied by race. Results: Among unmarried women, 78.6% were adherent. Women aged 30 to 39 years of age had the highest odds of screening adherence (aOR 2.38, CI 1.71-3.31). Women who were not employed last year (aOR 0.48, CI 0.38-

0.62), had no physician office visits (aOR 0.58, CI 0.40-0.85), did not have a usual source of care (aOR 0.67, CI 0.50-0.89), had never heard of HPV (aOR 0.59, CI 0.46-0.76), had never received an HPV shot (aOR 0.50, CI 0.34-0.75), were not currently taking birth control pills (aOR 0.33, CI 0.23-0.47), did not get a flu shot in the past 12 months (aOR 0.62, CI 0.48-0.80), and perceived their risk of breast cancer as less likely or about as likely as the average women (aOR 0.66, CI 0.47-0.92) had a lower odds of screening adherence, regardless of race. Conclusion: Unmarried women had lower rates of cervical cancer screening adherence as compared to married women. Targeted interventions are needed to increase screening among unmarried women, particularly those who are not employed and do not pursue preventive measures such as physician office visits and flu shots.

Background

In 2015, there were approximately 257,524 women with cervical cancer in the United States. In 2018, there are 13,240 estimated new cases of cervical cancer, which is 0.8% of all new cancer cases. There are 4,170 estimated deaths, which represents 0.7% of all cancer deaths. Among women with cervical cancer, 66.2% survive five years after being diagnosed (NCI, 2018).

The United States Preventive Services Task Force recommends cervical cancer screening for women ages 21 to 65 years old. Appropriate screening methods are a Papanicolaou (Pap) smear every 3 years or, for women 30 years of age or older, a Pap smear and human papillomavirus (HPV) co-test every five years (USPSTF, 2016). Despite evidence that adherence to screening guidelines decreases mortality, women are

still developing invasive cervical cancer and dying from a rather preventable disease due to underutilization of screening (Benard et al., 2014). Approximately 81% of United States women are up-to-date on cervical cancer screening, which is short of the Healthy People 2020 goal of 93% (Watson et al., 2017; ODPHP, 2018). Therefore, it continues to be important to identify factors associated with cervical cancer screening adherence.

Marital status has been identified as a factor associated with cervical cancer screening (Chen et al., 2012). Moreover, studies have found that being unmarried is a predictor of delayed-stage cervical cancer diagnosis (Politi et al., 2008; Saghari et al., 2015). This suggests underutilization of cervical cancer screening among unmarried women, which can lead to a greater risk for adverse health outcomes. In 2016, there were over 61 million unmarried adult women in the United States, which includes women who were widowed, divorced, separated, or never married (Census Bureau, 2017). There is limited evidence on the effect of marital status on cervical cancer screening adherence among United States women. In addition, black and Hispanic women have the highest age-adjusted mortality attributed to cervical cancer in the United States (Saghari et al., 2015). The primary aim of this study was to examine cervical cancer screening adherence in the United States among married and unmarried women, including women who were divorced, separated, widowed, or never married. Unmarried women were also stratified by race to better understand screening behaviors.

Methods

We used the 2015 National Health Interview Survey (NHIS) for this study (National Center for Health Statistics, CDC, 2017). The NHIS is a cross-sectional

household interview survey with a multistage area probability design that allows for representative sampling of household and non-institutional group quarters. The sampling plan was a sample of clusters of addresses in primary sampling units, which consist of a county, small group of contiguous counties, or a metropolitan statistical area (CDC, 2018).

The NHIS questionnaire had core and supplemental questions. The core questionnaire consisted of household, family, sample adult, and sample child components. The supplemental questions included topics such as Healthy People objectives, cancer screening, complementary and alternative medicine, children's mental health, and healthcare utilization (CDC, 2018). The 2015 person, sample adult, and cancer files were merged together.

The sample for this study consisted of women who were between the ages of 21 and 65. Women who had a hysterectomy or a history of cervical cancer were excluded. The outcome variable was cervical cancer screening adherence. Cervical cancer screening adherence was defined as having had at least one Pap test during the last 3 years, or for those 30-65 as having had a Pap test and HPV test during the last 5 years. Screening adherence was assessed by the following questions: "When did you have your most recent pap test?" "Did you have an HPV test with your most recent pap?"

Demographic, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge variables were explored as predictors for Pap test adherence among unmarried women. Demographic variables included age, race/ethnicity, marital status, education level, and employment status. Marital status included the following categories: married, widowed, separated, divorced, and never

married. Women who reported themselves as widowed, separated, or divorced were considered to be previously married in this study. Previously married and never married women were then combined to create a variable for unmarried women.

Acculturation was assessed using the geographic region of birth, English proficiency, and period of U.S. residence variables. Access to care variables included insurance type, office visits in past 12 months, and usual source of care. A chronic condition variable combined hypertension, high cholesterol, congestive heart failure, heart disease, emphysema, chronic obstructive pulmonary disease, asthma, cancer, or diabetes. Health behaviors and knowledge included BMI level, ever heard of HPV, ever received HPV vaccine, age when first child born, doctor recommended pap test, birth control use, alcohol drinking status, smoking status, flu shot, risk perception of breast cancer, and reported health status.

Descriptive analyses were first performed. Then, a multiple logistic regression model was used to examine the relationship between selected variables and cervical cancer screening adherence among married and unmarried women, and analysis was then stratified by race to determine significant predictors among unmarried women. Backward elimination and stepwise procedures were used for the selection of variables into the model. Multicollinearity was tested for to ensure predictors were not highly correlated. SAS 7.12 was used to perform the analysis. All analyses included statistical weights to account for the complex survey design, oversampling, post-stratification, and survey nonresponse. Weight, stratum, and cluster variables were used to specify the sample design. SAS Proc SURVEY and its statements were used to allow for correct

estimation from a complex sample. This study was determined to be non human subjects research due to the use of publically available de-identified data.

Results

The sample consisted of 10,643 women between the ages of 21 and 65 without a hysterectomy or history of cancer and who reported their marital status. Table 2.1 shows the distribution of characteristics by marital status among women who adhered to cervical cancer screening guidelines. The highest percentage of married (32.1%) and previously married (49.8%) women were 50 to 65 years old; whereas the highest percentage of never married women was 21 to 29 years old (43.2%). The majority of women had completed some college (29.5% of married women, 36.3% previously married, 35.5% never married) or were college graduates (40.4% of married women, 27.3% previously married, 32.5% never married). More women were employed in the year prior to the study (71.5% of married women, 73.3% previously married, 77.7% never married) as compared to those who were not employed (28.5% of married women, 26.7% previously married, 22.3% never married).

The majority of women spoke English very well or well (90.3% of married women, 93.7% previously married, 94.1% never married) and were born in the United States (73.8% of married women, 80.7% previously married, 83.8% never married). Women with private insurance (74.1% of married women, 56.7% previously married, 56.5% never married), four or more office visits (38.5% of married women, 43.3% previously married, 38.2% never married), and a usual source of care (88.6% of married women, 88.1% previously married, 81.7% never married) had the highest percentages

across all marital statuses. A greater proportion of women did not have chronic conditions among married (56.0%) and never married women (60.6%). For previously married women, a greater proportion had a chronic condition (56.4%).

A higher proportion of women were obese among previously married (38.4%) and unmarried women (37.2%); whereas women with normal body mass index represented the highest proportion among married women (39.9%). Women who had heard of HPV, had not received an HPV shot, had a doctor recommend a Pap test, were not currently taking birth control pills, were current drinkers, were never smokers, had a flu shot in the past 12 months, perceived themselves as less likely at risk for breast cancer, and had an excellent or good self-reported health status represented the majority of respondents with cervical cancer screening adherence across all marital statuses. There was a greater proportion of married (43.6%) and previously married (38.7%) women with their age at the birth of their first child being 21 to 29 years, whereas never married women had a higher proportion if they never gave birth (58.8%).

Women who were previously married or never married were combined for a total of 5,707 unmarried women, representing 33,400,724 women in the United States (Table 2.2). There were 4,936 married women, representing 42,328,266 women. We performed a multivariable analysis to calculate the odds ratios for cervical cancer screening adherence, adjusting for other variables. Age, employment status, number of physician office visits in the past 12 months, usual source of care, HPV knowledge, receipt of HPV vaccine, age when first child was born, birth control use, alcohol drinking status, smoking status, receipt of flu shot in past 12 months, risk perception of breast cancer, and reported health status were significant predictors of cervical cancer screening adherence among

unmarried women. Among those variables, age, employment status, receipt of HPV vaccine, risk perception of breast cancer, and reported health status were not significant in married women. Unmarried women with all races combined and aged 30 to 39 years had the highest odds of screening adherence (aOR 2.38, CI 1.171-3.31), whereas Hispanic women aged 40 to 49 years had the highest odds (aOR 2.44, CI 1.24-4.80) (Table 2.3). Unmarried women who were not employed last year (aOR 0.48, CI 0.38-0.62), had no physician office visits (aOR 0.58, CI 0.40-0.85), and did not have a usual source of care (aOR 0.67, CI 0.50-0.89) had a lower odds of screening adherence, regardless of race.

Among health behavior and knowledge variables, unmarried women who had never heard of HPV (aOR 0.59, CI 0.46-0.76), had never received an HPV shot (aOR 0.50, CI 0.34-0.75), were not currently taking birth control pills (aOR 0.33, CI 0.23, 0.47), did not get a flu shot in the past 12 months (aOR 0.62, CI 0.48, 0.80), and perceived their risk of breast cancer as less likely or about as likely as the average women (aOR 0.66, CI 0.47-0.92) had lower odds of cervical cancer screening adherence, regardless of race. Unmarried women overall (aOR 3.72, CI 2.13-6.49) and unmarried non-Hispanic white women (aOR 3.11, CI 1.64-5.90) who were over 30 years of age had the highest odds of screening adherence as compared to unmarried women who never gave birth, whereas unmarried Hispanic women who were 21 to 29 years of age had the highest odds (aOR 6.37, CI 3.53-11.48). Unmarried women overall (aOR 1.90, CI 1.43-2.51) and non-Hispanic white women (aOR 2.58, CI 1.69, 3.95) who were current drinkers had the highest odds of screening adherence as compared to lifetime abstainers. Unmarried women overall (aOR 0.65, CI 0.48-0.89) and non-Hispanic white women

(aOR 0.52, CI 0.33-0.79) who reported fair or poor health status had lower odds of screening adherence as compared to women who reported excellent or good health status.

Discussion

We assessed predictors for cervical cancer screening among married and unmarried women in the United States. To our knowledge, there are few studies with a similar sample of unmarried women in the United States to compare our results. Overall, 52% of women in this study were unmarried, and 79% of unmarried women adhered to cervical cancer screening guidelines. Our finding of 79% cervical cancer screening adherence among unmarried women was consistent with a study using the Behavioral Risk Factor Surveillance System Survey (Hanske et al., 2016). The proportion of unmarried women adhering to screening guidelines has been shown to be lower when compared to women of all marital status (83%) (White et al., 2017).

Failure to adhere to cervical cancer screening guidelines has been shown to be the primary reason for late-stage diagnosis of cervical cancer (Saghari et al., 2015). It has been suggested that marital status affects the diagnosis and prognosis to cancer. Married women were more likely to be diagnosed at an early stage of cervical cancer as compared to unmarried women (El-Haddad et al., 2015). Single/divorced/widowed and never married women as compared to married women were shown to have the strongest predictors of delayed-stage cervical cancer (Saghari et al., 2015). This suggests that married women are more likely to adhere to screening guidelines as compared to other marital groups. Marriage has also been linked to increased survival among cancer patients (El-Haddad et al., 2015). Marital status has been shown to predict survival

outcome in other cancers, with married patients having a better survival outcome as compared to unmarried patients. Married women may have increased social support, healthier behaviors, and higher income, which in turn may improve outcomes related to cancer therapies and rehabilitation (Wang et al., 2017). Increased financial resources may also lead to reliable transportation (Baine et al., 2011).

Our analysis showed that married, previously married and unmarried women differ with regard to age, race/ethnicity, education level, employment level, geographic region of birth, English language proficiency, period of United States residency, health care coverage, number of physician office visits, having a usual source of care, having a chronic condition, body mass index, HPV knowledge, receipt of HPV vaccination, age when first child was born, birth control use, alcohol drinking status, smoking status, receipt of flu shot in past 12 months, and reported health status.

Unmarried women aged 30 to 39 years of age had the highest odds of screening adherence (aOR 2.38, CI 1.171-3.31), similar to that of women in all marital statuses combined. The strongest predictor was the age the first child was born. One theory could be that, without the social support of a spouse, older maternal age may bring more independence and maturity to make better decisions such as visiting a doctor's office than a younger maternal age. In addition, being pregnant leads to the possibility of more doctor office visits, particularly with a specialist where cervical cancer screening is conducted (Hellquist, Czene, Hjalm, Nystrom, & Jonsson, 2014; Merrill, Fugal, Novilla, & Raphael, 2005).

Previous studies have found employed women are more likely to adhere to cervical cancer screening as compared to unemployed women (Clark et al., 2009).

Unmarried women may be more likely to depend on their employment for financial stability; whereas married women may receive some financial support from their spouse. Unmarried women may benefit from physicians who have evening and weekend appointments for screening (Clark et al., 2009).

The effect of marriage on cervical cancer screening adherence could be explained by spouses monitoring each other's health and promoting healthy behaviors. Married couples may feel responsible for each other's health, leading to encouragement of a healthy lifestyle (El-Haddad et al., 2015). Marriage may influence healthy behaviors, including diet, exercise, and health screenings (Baine et al., 2011). All of these factors are known to promote health. Married couples also have better social support, which improves feelings of happiness, acceptance, and self-efficacy (Baine et al., 2011). Emotional support has been found to increase cancer screening adherence (El-Haddad et al., 2015).

When unmarried women were stratified by race, similar patterns were found for each group as were found for the overall unmarried group. Women who were employed, had more than two office visits, and had a usual source of care had higher odds of adhering to screening. Hispanic women with more than four office visits had three times higher odds of adhering to cervical cancer screening as compared to only one office visit. More office visits may provide more opportunities for patient education.

Limitations of this study included self-reported data, which may not accurately capture cervical cancer screening adherence as a result of recall bias, social desirability, and over-reporting of Pap test utilization. Women may also erroneously believe their pelvic exam included a Pap test. In addition, the NHIS survey is administered to people

with landline telephones. Therefore, the results of this study may be generalizable only to women with a landline telephone. Results from an NHIS survey suggested an increasing trend with Americans who only have wireless telephones (Blumberg & Lake, 2017).

Public health interventions targeting unmarried women are needed to promote cervical cancer screening. Future studies should explore opportunities, such as physician recommendations, to introduce unmarried women to the benefits of adhering to screening recommendation.

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Table 2.1: Characteristics of women by marital status - National Health Interview Survey, United States, 2015 (N=10,643)

Variables	Married	Previously Married	Never Married	P-Value
Total	4,936	2,473	3,234	
Weighted	42,328,266	12,944,074	20,456,650	
Adherence (weighted %)	85.5	80.6	74.5	
Demographics				
Age				
21-29 years	686 (13.9%)	123 (5.0%)	1486 (45.6%)	<0.0001
30-39 years	1415 (28.7%)	449 (18.2%)	875 (27.1%)	
40-49 years	1216 (24.6%)	595 (24.1%)	439 (13.6%)	
50-65 years	1619 (32.8%)	1306 (52.8%)	444 (13.7%)	
Race/Ethnicity				
Non-Hispanic white	3126 (63.3%)	1445 (58.4%)	1483 (45.9%)	<0.0001
Hispanic	988 (20.0%)	461 (18.6%)	688 (21.3%)	
Non-Hispanic black	336 (6.8%)	437 (17.7%)	823 (25.4%)	
Asian	436 (8.8%)	91 (3.7%)	175 (5.4%)	
Other	50 (1.0%)	39 (1.6%)	65 (2.0%)	
Highest level of school completed				
Less than high school	549 (11.1%)	330 (13.4%)	356 (11.0%)	<0.0001
High school graduate or GED	931 (18.9%)	567 (23.0%)	679 (21.0%)	
Some college or associate degree	1454 (29.5%)	894 (36.3%)	1144 (35.5%)	
College graduate	1990 (40.4%)	674 (27.3%)	1048 (32.5%)	
Employed last year				
Yes	3258 (71.5%)	1812 (73.3%)	2511 (77.7%)	<0.0001
No	1405 (28.5%)	660 (26.7%)	721 (22.3%)	

Acculturation				
Geographic region of birth				
United States	3631 (73.6%)	1994 (80.6%)	2704 (83.7%)	<0.0001
Mexico, Central America, Caribbean, South America	711 (14.4%)	324 (13.1%)	355 (11.0%)	
Europe, Russia	99 (2.0%)	46 (1.9%)	37 (1.1%)	
Africa	56 (1.1%)	29 (1.2%)	26 (0.8%)	
Middle East, Asia	399 (8.1%)	71 (2.9%)	98 (3.0%)	
Elsewhere	35 (0.7%)	9 (0.4%)	12 (0.4%)	
How well is English spoken				
Very well, well	4457 (90.3%)	2318 (93.7%)	3042 (94.1%)	0.0012
Not well, not at all	479 (9.7%)	155 (6.3%)	192 (5.9%)	
Period of U.S. Residence				
U.S. born	3631 (73.8%)	1994 (80.7%)	2704 (83.8%)	<0.0001
In U.S. ≥ 10 years	993 (20.2%)	419 (16.9%)	403 (12.5%)	
In U.S. < 10 years	295 (6.0%)	59 (2.4%)	120 (3.7%)	
Access to Care and Utilization				
Health care coverage				
Private	3585 (74.1%)	1346 (56.7%)	1808 (56.5%)	<0.0001
Medicaid and other public	459 (9.5%)	551 (23.2%)	846 (26.5%)	
Other coverage	249 (5.1%)	145 (6.1%)	81 (2.5%)	
Uninsured	543 (11.2%)	331 (13.9%)	463 (14.5%)	
Outpatient clinic visits - past 12 months				
None	688 (14.0%)	351 (14.2%)	544 (16.8%)	0.0006
1	902 (18.3%)	376 (15.2%)	557 (17.2%)	
2-3	1442 (39.2%)	672 (27.2%)	896 (27.7%)	
4+	1899 (38.5%)	1069 (43.3%)	1232 (38.2%)	

Usual source of care				
Has usual source	4344 (88.6%)	2168 (88.1%)	2623 (81.7%)	<0.0001
None or hospital emergency department	558 (11.4%)	292 (11.9%)	589 (18.3%)	
Chronic Conditions				
No	2727 (56.0%)	1056 (43.6%)	1938 (60.6%)	<0.0001
Yes	2144 (44.0%)	1368 (56.4%)	1258 (39.4%)	
Health Behaviors and Knowledge				
Body Mass Index				
<18.5	93 (1.9%)	48 (2.0%)	85 (2.7%)	<0.0001
18.5-24.9	1945 (39.9%)	820 (33.6%)	1139 (35.7%)	
25-29.9	1297 (26.6%)	637 (26.1%)	779 (24.4%)	
>=30	1538 (31.6%)	937 (38.4%)	1187 (37.2%)	
Ever heard of HPV				
Yes	3670 (76.2%)	1693 (71.5%)	2474 (77.4%)	<0.0001
No	1149 (23.8%)	674 (28.5%)	724 (22.6%)	
Ever received HPV shot/vaccine				
Yes	337 (7.2%)	109 (4.7%)	726 (23.3%)	<0.0001
No	4360 (92.8%)	2204 (95.3%)	2386 (76.7%)	
Age when first child born				
Never gave birth	896 (18.3%)	399 (16.3%)	1890 (58.8%)	<0.0001
<21 years	1003 (20.5%)	796 (32.6%)	667 (20.7%)	
21-29 years	2133 (43.6%)	945 (38.7%)	557 (17.3%)	
>=30 years	864 (17.6%)	304 (12.4%)	102 (3.2%)	

Doctor recommended pap test				
Yes	2647 (54.6%)	1318 (54.8%)	1592 (50.4%)	0.2218
No	1984 (40.9%)	979 (40.7)	1415 (44.8%)	
Did not see a doctor in the past 12 months	215 (4.4%)	109 (4.5%)	154 (4.9%)	
Currently taking birth control pills, implants, or shots				
Yes	743 (15.2%)	240 (9.9%)	889 (27.7%)	<0.0001
No	4147 (84.8%)	2194 (90.1%)	2316 (72.3%)	
Alcohol drinking status				
Lifetime abstainer	1199 (24.4%)	463 (18.8%)	648 (20.1%)	<0.0001
Former drinker	559 (11.4%)	422 (17.2%)	293 (9.1%)	
Current drinker	3151 (64.2%)	1574 (64.0%)	2278 (70.8%)	
Smoking status				
Never smoker	3581 (72.6%)	1356 (55.0%)	2270 (70.3%)	<0.0001
Former smoker	832 (16.9%)	490 (19.9%)	390 (12.1%)	
Current smoker	521 (10.6%)	620 (25.1%)	570 (17.6%)	
Flu shot past 12 months				
Yes	2146 (43.5%)	1035 (41.9%)	1121 (34.7%)	<0.0001
No	2786 (56.5%)	1434 (58.1%)	2105 (65.3%)	
Risk of breast cancer compared to average women				
More likely	529 (11.4%)	311 (13.4%)	337 (11.0%)	0.5782
Less likely, about as likely	4122 (88.6%)	2004 (86.6%)	2740 (89.0%)	
Reported health status				
Excellent, very good, or good	4527 (91.7%)	2025 (81.9%)	2847 (88.1%)	<0.0001
Fair or poor	409 (8.3%)	448 (18.1%)	386 (11.9%)	

Table 2.2: Adjusted model of cervical cancer screening adherence by marital status - National Health Interview Survey, United States, 2015

Variables	Married	Unmarried
Total cervical cancer screening adherence	3,684	3,999
Weighted	32,168,699	23,020,201
Adherence (weighted %)	85.5%	78.6%
Demographics		
Age		
21-29 years	1.00	1.00
30-39 years	1.12 (0.74, 1.69)	2.38*** (1.71, 3.31)
40-49 years	0.73 (0.48, 1.13)	2.08*** (1.48, 2.92)
50-65 years	0.80 (0.53, 1.21)	1.59** (1.13, 2.24)
Race/Ethnicity		
Non-Hispanic white	1.00	1.00
Hispanic	1.08 (0.78, 1.48)	0.95 (0.69, 1.31)
Non-Hispanic black	1.40 (0.87, 2.25)	1.74*** (1.28, 2.36)
Asian	0.62* (0.42, 0.90)	0.85 (0.54, 1.35)
Other	0.62 (0.16, 2.49)	0.95 (0.35, 2.55)
Employed last year		
Yes	1.00	1.00
No	0.80 (0.62, 1.03)	0.48*** (0.38, 0.62)

Access to Care and Utilization		
Office visits - past 12 months		
None	0.33*** (0.23, 0.48)	0.58** (0.40, 0.85)
1	1.00	1.00
2-3	1.40* (1.01, 1.93)	1.53* (1.06, 2.22)
4+	1.92*** (1.37, 2.70)	1.76** (1.26, 2.47)
Usual source of care		
Has usual source	1.00	1.00
None or hospital emergency department	0.58** (0.42, 0.81)	0.67** (0.50, 0.89)
Health Behaviors and Knowledge		
Ever heard of HPV		
Yes	1.00	1.00
No	0.43*** (0.33, 0.55)	0.59*** (0.46, 0.76)
Ever received HPV shot/vaccine		
Yes	1.00	1.00
No	0.69 (0.38, 1.26)	0.50*** (0.34, 0.75)
Age when first child born		
Never gave birth	1.00	1.00
<21 years	1.04 (0.72, 1.49)	3.10*** (2.43, 3.95)
21-29 years	1.22 (0.89, 1.68)	2.71*** (2.06, 3.58)
>=30 years	1.64* (1.09, 2.46)	3.72*** (2.13, 6.49)
Currently taking birth control pills, implants, or shots		
Yes	1.00	1.00
No	0.60** (0.42, 0.86)	0.33*** (0.23, 0.47)

Alcohol drinking status		
Lifetime abstainer	1.00	1.00
Former drinker	0.93 (0.63, 1.39)	1.06 (0.74, 1.52)
Current drinker	1.37* (1.02, 1.86)	1.90*** (1.43, 2.51)
Smoking status		
Never smoker	1.00	1.00
Former smoker	0.93 (0.66, 1.3)	1.01 (0.73, 1.40)
Current smoker	0.42*** (0.29, 0.61)	0.75 (0.56, 1.00)
Flu shot past 12 months		
Yes	1.00	1.00
No	0.63*** (0.49, 0.81)	0.62*** (0.48, 0.80)
Risk of breast cancer compared to average women		
More likely	1.00	1.00
Less likely, about as likely	1.14 (0.80, 1.61)	0.66* (0.47, 0.92)
Reported health status		
Excellent, very good, or good	1.00	1.00
Fair or poor	0.82 (0.53, 1.26)	0.65** (0.48, 0.89)

*<0.05, **<0.01, ***<0.001

Table 2.3: Adjusted model of cervical cancer screening adherence by race among unmarried women - National Health Interview Survey, United States, 2015

Variables	Overall	Non-Hispanic White	Non-Hispanic Black	Hispanic
Total	3,999	2,087	1,055	759
Weighted	23,020,201	13,132,995	5,523,866	3,797,076
Adherence (weighted %)	78.6	77.9	83.8	77.5
Demographics				
Age				
21-29 years	1.00	1.00	1.00	1.00
30-39 years	2.38*** (1.71, 3.31)	2.61** (1.46, 4.65)	1.54 (0.74, 3.19)	1.79* (1.08, 2.96)
40-49 years	2.08*** (1.48, 2.92)	1.73* (1.05, 2.84)	1.30 (0.71, 2.40)	2.44* (1.24, 4.80)
50-65 years	1.59** (1.13, 2.24)	1.33 (0.82, 2.15)	0.94 (0.49, 1.77)	1.69 (0.92, 3.11)
Employed last year				
Yes	1.00	1.00	1.00	1.00
No	0.48*** (0.38, 0.62)	0.47*** (0.32, 0.69)	0.43*** (0.27, 0.69)	0.45*** (0.28, 0.71)
Access to Care and Utilization				
Outpatient clinic visits - past 12 months				
None	0.58** (0.40, 0.85)	0.64 (0.36, 1.14)	0.39** (0.19, 0.79)	0.85 (0.47, 1.54)
1	1.00	1.00	1.00	1.00
2-3	1.53* (1.06, 2.22)	1.87** (1.08, 3.23)	1.49 (0.75, 2.96)	1.38 (0.78, 2.45)
4+	1.76** (1.26, 2.47)	1.72** (1.04, 2.83)	1.21 (0.67, 2.16)	2.95*** (1.64, 5.30)
Usual source of care				
Has usual source	1.00	1.00	1.00	1.00
None or hospital emergency department	0.67** (0.50, 0.89)	0.52** (0.35, 0.77)	0.80 (0.48, 1.35)	0.74 (0.42, 1.28)

Health Behaviors and Knowledge				
Ever heard of HPV				
Yes	1.00	1.00	1.00	1.00
No	0.59*** (0.46, 0.76)	0.65* (0.46, 0.93)	0.37*** (0.24, 0.58)	0.55* (0.33, 0.91)
Ever received HPV shot/vaccine				
Yes	1.00	1.00	1.00	1.00
No	0.50*** (0.34, 0.75)	0.51* (0.29, 0.92)	0.72 (0.37, 1.42)	0.41** (0.24, 0.70)
Age when first child born				
Never gave birth	1.00	1.00	1.00	1.00
<21 years	3.10*** (2.43, 3.95)	2.42*** (1.67, 3.52)	2.32*** (1.49, 3.63)	6.24*** (3.67, 10.60)
21-29 years	2.71*** (2.06, 3.58)	2.79*** (1.82, 4.28)	1.43 (0.83, 2.48)	6.37*** (3.53, 11.48)
>=30 years	3.72*** (2.13, 6.49)	3.11*** (1.64, 5.90)	2.61 (0.96, 7.07)	14.88*** (4.42, 50.12)
Currently taking birth control pills, implants, or shots				
Yes	1.00	1.00	1.00	1.00
No	0.33*** (0.23, 0.47)	0.31*** (0.20, 0.49)	0.40* (0.17, 0.94)	0.36*** (0.23, 0.57)
Alcohol drinking status				
Lifetime abstainer	1.00	1.00	1.00	1.00
Former drinker	1.06 (0.74, 1.52)	1.33 (0.80, 2.21)	0.74 (0.38, 1.43)	0.68 (0.35, 1.34)
Current drinker	1.90*** (1.43, 2.51)	2.58*** (1.69, 3.95)	1.10 (0.68, 1.78)	1.50 (0.91, 2.47)
Smoking status				
Never smoker	1.00	1.00	1.00	1.00
Former smoker	1.01 (0.73, 1.40)	1.07 (0.72, 1.58)	1.07 (0.59, 1.92)	0.59 (0.20, 1.68)
Current smoker	0.75 (0.56, 1.00)	0.88 (0.61, 1.28)	0.91 (0.55, 1.49)	0.91 (0.51, 1.63)
Flu shot past 12 months				
Yes	1.00	1.00	1.00	1.00
No	0.62*** (0.48, 0.80)	0.65* (0.46, 0.91)	0.64 (0.41, 1.02)	0.55* (0.32, 0.93)

Risk of breast cancer compared to average women				
More likely	1.00	1.00	1.00	1.00
Less likely, about as likely	0.66* (0.47, 0.92)	0.66* (0.45, 0.98)	0.63 (0.30, 1.31)	0.37** (0.18, 0.78)
Reported health status				
Excellent, very good, or good	1.00	1.00	1.00	1.00
Fair or poor	0.65** (0.48, 0.89)	0.52** (0.33, 0.79)	0.80 (0.49, 1.31)	1.54 (0.80, 2.98)

*<0.05, **<0.01, ***<0.001

CHAPTER VI.

MANUSCRIPT 3

Physician recommendation and patient adherence to cervical cancer screening among women aged 21 to 65 years in the United States, 2015 National Health Interview Survey

Abstract

Background: Physician recommendation has been shown to be a significant predictor of cancer screening. Few studies have investigated differences in patients who receive physician recommendation for cervical cancer screening versus those who adhere to physician recommendations. The current study explores the gap between physician recommendation and patient adherence in a nationally representative sample of women in the United States. Our objective is to determine the proportion of women who received a physician recommendation and proportion of those women who adhered to the physician recommendation. Methods: The data source for this study was the 2015 National Health Interview Survey (NHIS). The sample for this study consisted of women who were between the ages of 21 and 65 who received a physician recommendation for cervical cancer screening. The two outcome variables were receiving a physician recommendation and adherence to the physician recommendation for cervical cancer screening. Demographic, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge variables were explored as predictors for receiving a physician recommendation and adherence to the physician recommendation for cervical cancer screening. A multiple logistic regression model was used to examine the

relationship between select variables and women who received a physician recommendation, and then between the same selected variables and adherence to physician recommendation for cervical cancer screening. Results: Overall, 56% of women with a current physician, reported that cervical cancer screening was recommended to them in the past 12 months. For all respondents, race/ethnicity, health care coverage, outpatient clinic visits, usual source of care, HPV knowledge, receiving an HPV shot, age when first child born, and receiving a flu shot were significant predictors of which respondents received a recommendation for cervical cancer screening. Variables that were significant predictors of adherence to physician recommendation for screening were education level, employment status, English proficiency, outpatient clinic visits, usual source of care, age when first child born, birth control use, alcohol use, smoking status, flu shot, and reported health status. Conclusion: This study suggests that a strategy to further increase cervical cancer screening rates nationally is for physicians to recommend screening to all patients who might benefit. Physician recommendation plays an important role in adherence to cervical cancer screening.

Background

There are an estimated 13,240 new cases of invasive cervical cancer and 4,170 deaths occurring in 2018 (ACS, 2018). Incidence rates of invasive cervical cancer declined from 1975 (14.8 per 100,000) to 2014 (6.9 per 100,000), mainly due to screening. The decline has slowed recently, with the overall incidence from 2005 to 2014 being stable. Similarly, the pace of reduction for mortality rate has slowed, with a decrease of 0.8% per year from 2006 to 2015. The 5-year survival rate for cervical

cancer is 92% when the cancer is diagnosed in a localized stage, but it falls to 57% and 17% when diagnosed in regional and distant-stage, respectively (ACS, 2018).

Physician recommendation has been shown to be a significant predictor of cancer screening. Conversely, the lack of physician recommendation is reported as a reason why patients did not adhere to screening guidelines for cancers, such as colorectal cancer (Coughlin et al., 2005; Hudson et al., 2012; Jibara, Jandorf, Fodera,& DuHamel, 2011; Shokar, Nguyen-Oghalai, & Wu, 2009; D. Wallace, Baltrus, T. Wallace, Blumenthal, & Rust, 2013;).

While physician recommendation has been studied with colorectal cancer and breast cancer, few studies have investigated differences in patients who receive physician recommendation for cervical cancer screening versus those who adhere to physician recommendations. The current study explores the gap between physician recommendation and patient adherence in a nationally representative sample of women in the United States. Our objective is to determine the proportion of women who received a physician recommendation and proportion of those women who adhered to the physician recommendation. This will identify patient populations that could benefit from physician recommendations and further attention to cervical cancer screening, which could increase the number of women who adhere to screening guidelines. For those who did not follow their physician's recommendation, we explored the reasons for not obtaining a Pap test.

Methods

The data source for this study was the 2015 National Health Interview Survey (NHIS) (National Center for Health Statistics, CDC, 2017). The NHIS is a cross-

sectional household interview survey with a multistage area probability design that allows for representative sampling of household and non-institutional group quarters. The sampling plan is a sample of clusters of addresses in primary sampling units, which consist of a county, small group of contiguous counties, or a metropolitan statistical area (CDC, 2018).

The NHIS questionnaire had a core set supplemental sets of questions. The core questionnaire consisted of Household, Family, Sample Adult, and Sample Child components. The supplemental questions included topics such as Healthy People objectives, cancer screening, complementary and alternative medicine, children's mental health, and healthcare utilization (CDC, 2018). The 2015 Person, Sample Adult, and Cancer files were merged together to create one dataset. The sample for this study consisted of women who were between the ages of 21 and 65 who self-reported receiving a physician recommendation for cervical cancer screening. Women who had a hysterectomy or a history of cervical cancer were excluded. The two outcome variables were: receiving a physician recommendation and adherence to the physician recommendation for cervical cancer screening. Cervical cancer screening adherence was defined by having had at least one Pap test during the last 3 years, or for those 30-65 by having had a Pap test and HPV test during the last 5 years. Screening adherence was assessed by the following question: "When did you have your most recent pap test?" "Did you have an HPV test with your most recent pap?"

Demographic, acculturation, access to care and utilization, chronic conditions, and health behaviors and knowledge variables were explored as predictors for Pap test adherence among unmarried women. Demographic variables included age,

race/ethnicity, marital status, education level, and employment status. Acculturation was assessed using the geographic region of birth, English proficiency, and period of U.S. residence variables.

Access to care variables included insurance type, office visits in past 12 months, and usual source of care. A chronic condition variable combined had hypertension, high cholesterol, congestive heart failure, heart disease, emphysema, chronic obstructive pulmonary disease, asthma, cancer, or diabetes. Health behaviors and knowledge included BMI level, ever heard of HPV, ever received HPV vaccine, age when first child born, doctor recommended pap test, birth control use, alcohol drinking status, smoking status, flu shot, risk perception of breast cancer, and reported health status.

A multiple logistic regression model was used to examine the relationship first between selected variables and women who received a physician recommendation, and then between the same selected variables and adherence to physician recommendation for cervical cancer screening. Backward elimination and stepwise procedures were used for the selection of variables into the model. Multicollinearity was tested for to ensure predictors were not highly correlated. SAS 7.12 was used to perform the analysis. All analyses included statistical weights to account for the complex survey design, oversampling, post-stratification, and survey nonresponse. Weight, stratum, and cluster variables were used to specify the sample design. SAS Proc SURVEY and its statements were used to allow for correct estimation from a complex sample. This study was determined to be non human subjects research due to the use of publically available de-identified data.

Results

Overall, 56% of women, who self-reported having a current physician, had cervical cancer screening recommended to them in the past 12 months. Younger age (P=0.0022), being married (P=0.0001), being employed last year (P=0.0294), having private health insurance (P<0.0001), having an outpatient clinic visit (P<0.0001), having a usual source of care (P<0.0001), having no chronic conditions (P<0.0001), heard of HPV (P<0.0001), having received an HPV vaccine dose (P=0.0397), never given birth (P<0.0001), lifetime abstainer of alcohol (P=0.0087), flu shot (P<0.0001), and reporting excellent or good health status (P=0.0083) were significant predictors of receiving a physician recommendation for cervical cancer screening (Table 3.1).

Among patients who self-reported receiving a recommendation for cervical cancer screening, predictors included younger age (P=0.0002), being married (P=0.0002), higher education (P<0.0001), being employed last year (P<0.0001), having private health insurance (P<0.0001), having an outpatient clinic visit (P<0.0001), having a usual source of care (P<0.0001), heard of HPV (P<0.0001), having received an HPV vaccine (P=0.0063), never given birth (P<0.0001), using birth control (P<0.0001), lifetime abstainer of alcohol (P<0.0001), never smoker (P<0.0001), flu shot (P<0.0001), and reporting excellent or good health status (P<0.0001) (Table 1). Race/ethnicity, geographic region of birth, period of residence in the United States, chronic conditions, body mass index, and breast cancer risk perception did not affect whether patients adhered to cervical cancer screening recommendations.

Table 3.2 shows the adjusted odds ratios of receipt of physician recommendation for cervical cancer screening and adherence to the physician recommendation. For all

respondents, race/ethnicity, health care coverage, outpatient clinic visits, usual source of care, HPV knowledge, receiving an HPV shot, age when first child was born, and receiving a flu shot were significant predictors of which respondents received a recommendation for cervical cancer screening. The odds of receiving a recommendation were greater for women having four or more outpatient clinic visits (aOR 1.28, CI 1.11-1.48) and being older than 30 years when the first child was born (aOR 1.85, CI 1.52-2.24), as compared to one office visit and never giving birth, respectively. Respondents who were Hispanic (aOR 0.73, CI 0.59-0.90), not having a usual source of care (aOR 0.75, CI 0.62-0.92), having never heard of HPV (aOR 0.83, CI 0.72-0.95), having never received an HPV shot (aOR 0.76, CI 0.63-0.91), and not having had a flu shot in the past 12 months (aOR 0.83, CI 0.74-0.94) had lower odds of receiving a recommendation. Age, marital status, employment status, chronic conditions, alcohol use, and reporting excellent or good health status were no longer significant predictors of receipt of physician recommendations in multivariable analysis.

Variables that were significant predictors of adherence to physician recommendation for screening were education level, employment status, English proficiency, outpatient clinic visits, usual source of care, age when first child born, birth control use, alcohol use, smoking status, flu shot, and reported health status. The odds of adhering to physician recommendations were greater for women who were college graduates (aOR 1.51, CI 1.03-2.21), having four or more outpatient clinic visits (aOR 1.85, CI 1.26-2.70), being older than 30 years when first child born (aOR 2.87, CI 1.86-4.41), and being current drinkers (aOR 2.87, CI 1.86-4.41). Respondents who were not employed last year (aOR 0.63, CI 0.46-0.87), not having had a usual source of care (aOR

0.64, CI 0.44-0.93), not taking birth control pills (aOR 0.51, CI 0.31-0.83), current smokers (aOR 0.53, CI 0.38-0.73), not having had a flu shot in the past 12 months (aOR 0.52, CI 0.39-0.70), and reporting fair or poor health status (aOR 0.68, CI 0.47-0.99) had lower odds of adhering to physician recommendations.

Among women who received a physician recommendation for cervical cancer screening, 392 women provided a reason for why they have not been screened. The most common reasons included: "Didn't need it or didn't know I needed it" (14.0%, CI 10.3-17.7), no problems (8.7%, CI 6.0-11.5), put it off (11.2%, CI 8.9-13.5), too expensive or no insurance (18.8%, CI 13.4-24.2), too painful or embarrassing (5.5%, CI 3.0-8.1), no reason/never thought about it (34.0%, CI 29.1-38.8) or other (7.8%, CI 5.1-10.5) (Table 3).

Discussion

We found no difference in receipt of physician recommendation and adherence by race ethnicity, but Hispanic ethnicity was associated with lower odds of receiving a physician recommendation. While non-Hispanic black women had lower odds of receiving a physician recommendation as compared to non-Hispanic white women, they had higher odds of adhering to physician recommendations. This study also found that higher education and being employed increases the odds of adhering to physician recommendations for screening.

Women who were born in Mexico, Central America, Caribbean, and South America had the highest odds of receiving a physician recommendation. The physician-patient relationship and subsequent communication regarding cancer screening is

important for patients with language and cultural barriers (Coughlin et al., 2005; Juon et al., 2003; Nguyen et al., 2002). Previous studies have shown that physician recommendation for a Pap test is an important predictor of screening in Hispanic women (Ngueyn et al., 2002; O'Malley et al., 2001).

Insurance type was important for physician recommendation but not in adherence to the recommendation. Education level, employment status, and English proficiency only played roles in adhering to physician recommendation but not in receiving physician recommendation. Physicians may be less likely to recommend cancer screening if the patient does not have insurance or is unable to otherwise pay for services (Wallace et al., 2013).

The number of outpatient clinic visits significantly increased the odds of receiving a physician recommendation and the odds of adhering to the recommendation. Women with co-morbidities may visit their doctor more frequently, which would then be consistent with studies that have reported patients with co-morbidities were more likely to receive recommendations for cancer screening (Wallace et al., 2013).

Among reasons reported by women who did not adhere to cervical cancer screening after a physician recommends it, some stated they did not know they needed it. Some women believe that Pap tests are for women who are younger, sexually active, or pregnant. This may lead them to think that routine screenings are not relevant to them. Communications regarding sexual behavior during a clinic visit have been shown to improve cancer screening rates (Politi et al., 2008).

Evidence has shown patient-provider communication to be a predictor of cancer screening among women (Politi et al., 2008). Positive communications can lead to

changes in health behavior, adherence to medical advice, increased understanding about the importance of screening, and higher satisfaction with care. This may result in increased cancer screening rates (Politi et al., 2008).

The main limitations of this study is self-reported data, which may not accurately capture cervical cancer screening adherence as a result of recall bias, social desirability, and over-reporting of Pap test utilization. Women may also erroneously believe their pelvic exam included a Pap test, or they may not realize they had a Pap test during their pelvic exam. In addition, women may not recall whether their physician provided a recommendation. Self-report does not allow us to explore physician barriers to understand why physicians may have been more likely to recommend or not recommend screening.

This study suggests the physician recommendations may increase cervical cancer screening rates. A strategy to further increase cervical cancer screening rates nationally is for physicians to recommend screening to all patients who might benefit. Physician recommendation plays an important role in adherence to cervical cancer screening. In addition, strategies to address the reasons for non-adherence to cervical cancer screening are needed. One such strategy could be sensitivity training for physicians on delivering cervical cancer screening recommendations and on performing the tests. In addition to recommending cervical cancer screening, physicians should consider communication about sexual health to address any misconceptions about the risk of cervical cancer.

Comprehensive communication that includes cervical cancer screening recommendations and sexual health may have a positive impact on screening adherence. Future research should consider optimal approaches for communication with women to

promote cervical cancer screening. Moreover, the type of physician, such as primary care or gynecologist, providing the recommendation should be examined. In addition, adherence to recommendations received from physicians should be compared to those received from physician extenders, such as nurse practitioners. Some office visits do not include face-to-face interactions with physicians, and instead a physician extender may be the one to conduct the visit.

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Table 3.1: Receipt of and adherence to physician recommendation for cervical cancer screening - National Health Interview Survey, United States, 2015 (N=9,958)

Variables	Received Physician Recommendation				Adherence to Physician Recommendation			
Overall	5,566				4,944			
Weighted	39,610,272				35,367,305			
Demographics	Total	Sample %	% Recommended (weighted)	P-Value	Total	Sample %	% Adherence (weighted)	P-Value
Age								
21-29 years	1132	20.3	52.1	0.0022	1029	20.8	90.5	0.0002
30-39 years	1422	25.5	54.7		1298	26.3	92.6	
40-49 years	1188	21.3	58.1		1070	21.6	88.8	
50-65 years	1824	32.8	58.7		1547	31.3	86.3	
Race/Ethnicity								
Non-Hispanic white	3284	59.0	57.5	0.0536	2898	58.6	89.3	0.4981
Hispanic	1061	19.1	53.5		951	19.2	88.5	
Non-Hispanic black	825	14.8	54.0		751	15.2	91.4	
Asian	327	5.9	54.3		282	5.7	87.8	
Other	69	1.2	45.8		62	1.3	87.3	
Marital Status								
Married	2647	47.6	58.0	0.0001	2395	48.5	91.3	0.0002
Widowed or Separated	420	7.6	55.2		354	7.2	87.0	
Divorced	898	16.2	58.0		785	15.9	86.2	
Never married	1592	28.6	51.3		1403	28.4	86.6	
Highest level of school completed								
Less than high school	619	11.1	56.4	0.7248	507	10.3	79.4	<.0001
High school graduate or GED	1098	19.8	55.4		933	18.9	85.5	
Some college or associate degree	1840	33.1	55.3		1642	33.3	90.0	
College graduate	1996	35.9	57.1		1849	37.5	93.0	

Employed last year								
Yes	4075	73.2	55.2	0.0294	3684	74.5	91.2	<.0001
No	1489	26.8	58.5		1258	25.5	84.1	
Acculturation								
Geographic region of birth								
United States	4425	79.5	56.1	0.9767	3937	79.7	89.8	0.1094
Mexico, C. America, Caribbean, S. America	712	12.8	56.5		642	13.0	88.6	
Europe, Russia	96	1.7	54.2		80	1.6	84.8	
Africa	48	0.9	57.3		44	0.9	89.7	
Middle East, Asia	256	4.6	54.0		221	4.5	87.3	
Elsewhere	26	0.5	57.0		18	0.4	70.4	
How well is English spoken								
Very well, well	5168	92.8	56.1	0.7578	4585	92.7	89.2	0.6699
Not well, not at all	398	7.2	55.3		359	7.3	90.1	
Period of U.S. Residence								
U.S. born	4425	79.6	56.1	0.8828	3937	79.7	89.8	0.167
In U.S. ≥ 10 years	909	16.4	55.4		804	16.3	89.0	
In U.S. < 10 years	223	4.0	56.9		196	4.0	87.0	
Access to Care and Utilization								
Health care coverage								
Private	3568	65.5	56.7	<.0001	3263	67.3	91.7	<.0001
Medicaid and other public	1057	19.4	61.4		923	19.0	86.8	
Other coverage	249	4.6	50.8		207	4.3	86.4	
Uninsured	576	10.6	46.6		458	9.4	77.8	

Outpatient clinic visits – past 12 months								
None	505	9.1	39.8	<.0001	340	6.9	66.7	<.0001
1	904	16.3	52.6		784	15.9	86.4	
2-3	1647	29.6	57.8		1504	30.4	92.0	
4+	2507	45.1	60.6		2316	46.8	92.6	
Usual source of care								
Has usual source	5022	90.7	57.8	<.0001	4533	92.1	90.5	<.0001
None or hospital emergency dept.	515	9.3	42.5		389	7.9	77.8	
Chronic Conditions								
No	2853	53.9	53.6	<.0001	2543	52.2	89.1	0.7198
Yes	2638	49.9	59.3		2333	47.8	89.5	
Health Behaviors and Knowledge								
Body Mass Index								
<18.5	101	1.8	45.4	0.0696	85	1.7	85.8	0.5938
18.5-24.9	2013	36.7	55.0		1792	36.8	89.9	
25-29.9	1444	26.3	56.5		1282	26.3	89.6	
>=30	1926	35.1	57.3		1710	35.1	88.5	
Ever heard of HPV								
Yes	4309	79.0	57.4	<.0001	3906	80.5	90.9	<.0001
No	1145	21.0	51.1		947	19.5	83.5	
Ever received HPV shot/vaccine								
Yes	672	12.7	59.6	0.0397	630	13.4	93.3	0.0063
No	4615	87.3	55.3		4071	86.6	88.8	

Age when first child born								
Never gave birth	1505	27.2	49.8	<.0001	1298	26.4	86.7	0.0014
<21 years	1301	23.5	56.9		1136	23.1	87.8	
21-29 years	1976	35.7	57.9		1781	36.2	90.5	
>=30 years	755	13.6	63.6		706	14.3	92.7	
Currently taking birth control pills, implants, or shots								
Yes	1075	19.4	58.3	0.1488	1010	20.6	95.1	<.0001
No	4455	80.6	55.6		3902	79.4	87.9	
Alcohol drinking status								
Lifetime abstainer	1114	20.1	52.7	0.0087	962	19.5	84.9	<.0001
Former drinker	709	12.8	59.9		599	12.2	84.6	
Current drinker	3717	67.1	56.4		3362	68.3	91.4	
Smoking status								
Never smoker	3743	67.3	55.9	0.9178	3403	68.9	90.8	<.0001
Former smoker	926	16.7	56.4		828	16.8	91.1	
Current smoker	890	16.0	56.5		709	14.4	80.2	
Flu shot past 12 months								
Yes	2477	44.6	60.8	<.0001	2299	46.6	93.4	<.0001
No	3082	55.4	52.6		2639	53.4	85.9	
Risk of breast cancer compared to average women								
More likely	662	7.0	60.0	0.0794	602	12.7	90.6	0.4164
Less likely, about as likely	4651	49.2	56.0		4126	87.3	89.2	
Reported health status								
Excellent, very good, or good	4847	87.1	55.5	0.0083	4346	87.9	90.2	<.0001
Fair or poor	719	12.9	61.1		598	12.1	82.3	

Table 3.2: Adjusted odds ratios of receipt of and adherence to physician recommendation for cervical cancer screening - National Health Interview Survey, United States, 2015

Variables	Received Physician Recommendation	Adherence to Physician Recommendation
Overall	4,797	4,280
Weighted	42,768,435	36,708,797
Demographics	Adjusted Odds Ratio	Adjusted Odds Ratio
Race/Ethnicity		
Non-Hispanic white	1.00	1.00
Hispanic	0.73** (0.59, 0.90)	1.08 (0.72, 1.64)
Non-Hispanic black	0.85 (0.71, 1.01)	1.85** (1.23, 2.79)
Asian	0.98 (0.66, 1.47)	0.93 (0.56, 1.57)
Other	0.61 (0.33, 1.14)	1.13 (0.37, 3.47)
Highest level of school completed	-	
Less than high school		0.64 (0.40, 1.02)
High school graduate or GED		1.00
Some college or associate degree		1.19 (0.84, 1.68)
College graduate		1.51* (1.03, 2.21)
Employed last year	-	
Yes		1.00
No		0.63** (0.46, 0.87)

Acculturation		
Geographic region of birth		-
United States	1.00	
Mexico, C. America, Caribbean, S. America	1.46** (1.16, 1.84)	
Europe, Russia	0.91 (0.58, 1.42)	
Africa	1.35 (0.68, 2.68)	
Middle East, Asia	1.01 (0.66, 1.55)	
Elsewhere	1.09 (0.51, 2.34)	
How well is English spoken	-	
Very well, well		1.00
Not well, not at all		2.36* (1.22, 4.58)
Access to Care and Utilization		
Health care coverage		-
Private	1.00	
Medicaid and other public	1.28** (1.09, 1.49)	
Other coverage	0.76* (0.58, 0.99)	
Uninsured	0.91 (0.74, 1.13)	
Outpatient clinic visits - past 12 months		
None	0.66*** (0.55, 0.80)	0.34*** (0.22, 0.53)
1	1.00	1.00
2-3	1.18* (1.01, 1.38)	1.53* (1.06, 2.21)
4+	1.28** (1.11, 1.48)	1.85** (1.26, 2.70)

Usual source of care		
Has usual source	1.00	1.00
None or hospital emergency department	0.75** (0.62, 0.92)	0.64* (0.44, 0.93)
Health Behaviors and Knowledge		
Ever heard of HPV		
Yes	1.00	1.00
No	0.83** (0.72, 0.95)	0.77 (0.57, 1.04)
Ever received HPV shot/vaccine		-
Yes	1.00	
No	0.76** (0.63, 0.91)	
Age when first child born		
Never gave birth	1.00	1.00
<21 years	1.45*** (1.23, 1.71)	2.69*** (1.79, 4.02)
21-29 years	1.46*** (1.26, 1.68)	2.32*** (1.62, 3.33)
>=30 years	1.85*** (1.52, 2.24)	2.87*** (1.86, 4.41)
Currently taking birth control pills, implants, or shots		
Yes	1.00	1.00
No	0.93 (0.79, 1.08)	0.51** (0.31, 0.83)
Alcohol drinking status	-	
Lifetime abstainer		1.00
Former drinker		1.01 (0.67, 1.52)
Current drinker		1.63** (1.15, 2.31)

Smoking status	-	
Never smoker		1.00
Former smoker		1.06 (0.75, 1.50)
Current smoker		0.53*** (0.38, 0.73)
Flu shot past 12 months		
Yes	1.00	1.00
No	0.83** (0.74, 0.94)	0.52*** (0.39, 0.70)
Reported health status		
Excellent, very good, or good	1.00	1.00
Fair or poor	1.19 (0.97, 1.45)	0.68* (0.47, 0.99)

Table 3.3: Reasons why cervical cancer screening not obtained after physician recommendation

Reasons	Frequency	Weighted Frequency	Sample %	95% Confidence Interval	
No reason/never thought about it	144	898,715	33.97	29.11	38.83
Didn't need it/didn't know needed it	39	369,787	13.98	10.28	17.68
No problems	37	230,950	8.73	5.99	11.47
Put it off	39	296,063	11.19	8.89	13.49
Too expensive, no insurance	73	498,239	18.83	13.43	24.23
Too painful, embarrassing	23	145,887	5.51	2.97	8.06
Other	37	206,079	7.79	5.11	10.47

VII.

CONCLUSION

The purpose of this research was to: Describe predictors for cervical cancer screening adherence using current guidelines among a sample of nationally representative women; assess the association of marital status with cervical cancer screening adherence; and explore the gap between physician recommendation of cervical cancer screening and adherence to physician recommendation.

The results of this study indicate about 1 in 5 women in the United States are not being screened for cervical cancer as recommended. Furthermore, the results suggest that interventions to improve screening should be targeted to women under 30 and over 40 years of age, unmarried women, women who do not work, uninsured women, women with no usual source of care, and current smokers.

Women who were married had increased odds of adherence with cervical cancer screening recommendations compared to women in other marital categories. The findings of this study are important because few studies have explored the effect of marital status on cervical cancer screening adherence in the United States.

Cervical cancer screening rates for unmarried women are lower than those among married women. Unmarried women would benefit from targeted interventions to improve their screening rates. Physicians, regardless of their specialty, who are examining or treating unmarried women should take the opportunity to educate them about screening guidelines.

A strategy to further increase cervical cancer screening rates nationally is for physicians to recommend screening to all patients who might benefit. Physician recommendation plays an important role in adherence to cervical cancer screening. While most studies look at lack of adherence to cervical cancer screening after physician recommendation, our study examines who does follow their physician recommendations for cervical cancer screening. The results of this study will allow physicians and policymakers to target women who are less likely to adhere to cervical cancer screening recommendations.

Limitations

Limitations of this study included self-reported data, which may not accurately capture cervical cancer screening adherence as a result of recall bias, social desirability, and over-reporting of Pap test utilization. Women may also erroneously believe their pelvic exam included a Pap test. Also, women who have multiple doctors' appointments may not recall what occurred at each appointment. Women who know the screening recommendations but chose not to adhere may respond favorably to having received a recent Pap test, even if they did not have one. In addition, self-report does not allow us to explore physician barriers to understand why physicians may have been more likely to recommend or not recommend screening.

Face-to-face interviews are conducted in respondents' homes. Telephone interviews are permitted if follow-ups to complete interviews are needed, the respondent requests a telephone interview, or when road conditions or travel distances are a barrier to to scheduling a visit before the completion date. NHIS asks respondents to provide

residential telephone numbers, to allow recontacting of survey participants. The NHIS survey is administered to people with landline telephones. Therefore, there may be undercoverage due to not being able to reach persons with landline telephones. Results from an NHIS survey suggested an increasing trend with Americans who only have wireless telephones. Even those who have a landline may be difficult to reach due to a wireless telephone being their primary mode of communication (Blumberg & Lake, 2017).

Missing data was not included in this study. Missing data can reduce statistical power, cause bias in parameter estimations, and can reduce the sample's representativeness. However, less than 10% was missing from each variable.

Directions for future research

Despite these limitations, our findings suggest important considerations for cervical cancer screening program planning and further research. Future research should review barriers to screening in more detail. Health promotion programs should consider addressing multiple prevention behaviors simultaneously. For example, our findings consistently showed receiving a flu shot to be a significant predictor of cervical cancer screening. Healthcare providers who administer flu shots may have an opportunity to educate patients of other preventive behaviors.

Public health interventions targeting unmarried women are needed to promote cervical cancer screening. Future studies should explore opportunities, such as physician recommendations, to introduce unmarried women to the benefits of adhering to screening recommendation.

Strategies to address the reasons for non-adherence to cervical cancer screening are needed, such as sensitivity training for physicians on delivering cervical cancer screening recommendations and performing the tests. In addition, open communications about sexual health are needed to address any misconceptions about the risk of cervical cancer. Comprehensive communication that includes cervical cancer screening recommendations and sexual health may have a positive impact on screening adherence. Positive communications can lead to changes in health behavior, adherence to medical advice, increased understanding about the importance of screening, and higher satisfaction with care, which can lead to increased cancer screening rates. Future studies should examine various mechanisms for physician recommendations to determine feasible and cost-effective ways to increase recommendations and adherence to the recommendations.

Future research should also consider self-collected HPV testing for women non-adherent to cervical cancer screening. Some studies have shown participation of under-screened women can be improved by offering HPV self-testing at home. Women have expressed positive acceptance due to the elimination of logistical barriers, such as lack of time or transportation to a health center, and avoidance of psychological barriers, such as embarrassment and stress of undergoing cervical cancer screening (Katz, Zimmermann, Moore, Paskett, & Reiter, 2016; Mao et al., 2017). While it can only be used for testing by clinically validated assays and not cytological analyses, offering self-sampling devices to non-adherent women can increase screening participation (Mistro et al., 2017). Home HPV screening tests may be more widely accepted by both patients and physicians if it does not impact access to a physician to address other health concerns (Mao et al., 2017).

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PUBLICATIONS AND PRESENTATIONS

Samuel V, Marlett N, MacDonald M, Meyer K, Gopal V (2015, May). *Recommended practices for the prevention of healthcare-associated infections in patients with percutaneous endoscopic gastrostomy tubes.* Accepted poster abstract for The Society of Gastroenterology Nurses and Associates 42nd Annual Course.

Samuel V (2013, July). *Shigella flexneri associated with MSM and HIV* . Oral presentation at Florida Department of Health, Bureau of Epidemiology Grand Rounds, Jacksonville, Florida.

Samuel V (2013, March). *Shigella flexneri associated with MSM and HIV* . Oral presentation at Baptist Hospital Infectious Disease Grand Rounds, Jacksonville, Florida.

Samuel V (2012, November). *West Nile virus infection in Duval County: epidemiology and prevention.* Oral presentation at CSX, Jacksonville, Florida.

Samuel V (2012, September). *West Nile virus infection in Duval County, 2012.* Oral presentation at the City of Jacksonville's Mosquito Control, Jacksonville, Florida.

Notes from the field: Tuberculosis cluster associated with homelessness – Duval County, Florida, 2004-2012. (2012, July 20) *MMWR: Morbidity and Mortality Weekly Report, 61* (28), 539-540.

Samuel V, Morgan A, Anil L (2012, February). *A review of West Nile virus disease in Duval County, 2011.* Poster presentation at the University of Florida, Emerging Pathogens Institute Research Day, Gainesville, Florida.

Samuel V, Morgan A, Anil L (2012, January). A review of West Nile virus disease in Duval County, 2011. *Epi Update*, 3-7.

Samuel V, Morgan A, Zaheer S (2011, November). *Incidence of West Nile virus in northeastern Florida.* Oral presentation at the Florida Mosquito Control Association Annual Fall Meeting, Jacksonville, Florida.

Samuel V, Khan H (2011, August). *A modeling strategy for future survival days given a follow-up doubly censored sample of liver cancer patients.* Oral presentation at the 2011 Joint Statistical Meetings, Miami Beach, Florida.