EXAMINING FACTORS ASSOCIATED WITH UTILIZATION OF MAMMOGRAPHY SCREENING FOR WOMEN OF AGE 40 – 74 YEARS IN WASHINGTON STATE

By

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The members of the Committee appointed to examine the thesis of ABHISHEK SAVANT find it satisfactory and recommend that it be accepted.

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ABSTRACT

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Objective

The aim of this study is to determine whether race has a statistically significant association with the utilization of mammography screening for women age 40-74 years in Washington State.

Methods

The study analyzes the responses of 9,335 women age 40-74 years who participated in the 2006 Behavioral Risk factor Surveillance System survey. Bivariate analysis determines which predisposing, enabling, and need factors have a statistically significant association with utilization of mammography screening. Multivariate logistic regression modeling examines the statistically significant association between race and utilization of mammography screening after controlling for other factors.

Results

The results of the bivariate analysis state no statistically significant difference between White and Non-White women in the utilization of mammography screening in the past two years. The multivariate logistic regression analysis states that race is not a statistically significant predictor of mammography use after controlling for all other predisposing, enabling, and need factors. However, women of younger age, lower income, without health insurance, without access to a healthcare provider, who have not had a physical breast exam, and have poor or fair perceived health status are less likely to utilize mammography screening.

Conclusion

These results underscore the need for continued efforts to provide mammography screening services to women with low socioeconomic status, without health insurance, and without access to a healthcare provider in Washington State. Successful approaches to increase breast cancer screening among women include community education interventions and low cost mammography screening services.

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DEDICATION

This thesis is dedicated to my parents, Amol and Smita, who have supported me all the way since the beginning of my studies. Finally, this thesis is dedicated to all those who believe in the richness of learning.

CHAPTER ONE

INTRODUCTION / SIGNIFICANCE OF STUDY

The first section of this chapter introduces the current status of mammography screening utilization, the importance of mammography screening, the objectives of the study, and the study hypothesis. The chapter then discusses mammography screening guidelines. Finally, the chapter presents a statement of the problem and hypothesis.

Introduction and Purpose of the Study

Breast cancer is the most commonly diagnosed cancer and second leading cause of cancer deaths among women in the United States (Bandi, Boone, Brinton, Buchert, Calle, Cokkinides, et al., 2007). The annual age-adjusted breast cancer incidence and mortality rates for women in the United States are 125.3 per 100,000 lives and 25.5 per 100,000 lives respectively for the period of 2000-2004 (American Cancer Society, 2007). The incidence and mortality rates per 100,000 are age-adjusted to the 2000 United States standard population (American Cancer Society, 2007).

The annual age-adjusted breast cancer (2000 United States standard population) incidence rate per 100,000 for women in the United States as per race is 132.5 for White (Non-Hispanic), 118.3 for African-American (Non-Hispanic), 89.3 for Hispanic/Latina, 69.8 for American Indian/Alaska Native, and 89.0 for Asians for the period of 2000-2004 (American Cancer Society, 2007). The annual age-adjusted breast cancer (2000 United States standard population) mortality rate per 100,000 for women in the United States as per race is 25.0 for White (Non-Hispanic), 33.8 for African-American (Non-Hispanic), 16.1 for Hispanic/Latina, 13.9 for American Indian/Alaska Native, and 12.6 for Asians for the period of 2000-2004

(American Cancer Society, 2007). In 2006, the prevalence of mammography screening as per percentage of women age 40 years and older, utilizing mammography screening within the past two years is 61.2% (American Cancer Society).

The percentage of women aged 40 years and older who report a mammogram within the past two years increased from 29% in 1987 to 70% in 2000 (Feuer & Wun, 2007). This mammography screening percentage for women aged 40 years and older has flattened from 2000 to 2003 ranging from 76.4% to 75.2% respectively (Feuer & Wun, 2007). In 2005, 66.5% of women reported having a recent mammogram, which is 4 percentage points lower than 2000 levels (Feuer & Wun). Some of the sharpest declines in the prevalence of mammography screening are among women who previously reported high mammography screening rates such as women between age 50 and 64 years and women in higher socioeconomic levels (Feuer & Wun). In 2005, the prevalence of mammography screening as percentage of women age 40 years and older who report a mammogram within the past year as per race is 52.9% for White (Non-Hispanic), 49.9% for African-American (Non-Hispanic), 41.7% for Hispanic/Latina, 46.9% for American Indian/Alaska Native, and 37.9% for Asians (Bandi et al., 2007).

Secondary prevention methods are part of an important strategy to control or lower mortality rates of breast cancer. Mammography screening, as a primary breast cancer screening mechanism, results in a 30% reduction in breast cancer mortality over a 10-year period (Shapiro, 1989). Mammography screening is one of the most effective secondary prevention methods used for the early detection of cancerous growth in the breast (Bandi et al, 2007; Saslow, Boetes, Burke, Harms, Leach, Lehman, et al., 2007).

Randomized clinical trial programs were conducted to compare breast cancer mortality among users and non-users of mammography screening, and in the population before and after

the introduction of mammography screening guidelines in 1989 (Smith, Saslow, Sawyer, Burke, Costanza, Evans, et al., 2003). The incidence-based mortality ratio comparing 1990 to 1996 with 1985 to 1986 shows a 50% reduction in the rate of breast cancer deaths (OR = 0.50, 95% CI 0.38 to 0.66) (Smith et al., 2003). The results prove that the breast cancer mortality reductions are attributable to introduction of mammography screening guidelines of United States Preventive Services Task Force (USPSTF) (Smith, et al.).

A similar randomized clinical study conducted by the American Society of Clinical Oncology states that each additional surveillance mammogram is associated with a 0.69-fold decrease in the odds of breast cancer mortality (Lash, Fox, Buist, Wei, Filed, Frost, et al., 2007). Results of the study verify that the receipt of mammography screening reduces the rate of breast cancer mortality in women above age 40 years diagnosed with early-stage disease (Lash et al., 2007). Identical clinical randomized trials were conducted in Sweden and Italy that projected the same results (Smith, et al., 2003). All 50 states and the District of Columbia have mandated the coverage of breast cancer screening services among the private and public insurers in compliance with the Center of Disease Control and Prevention (CDC) guidelines (Bandi et al., 2007).

Purpose

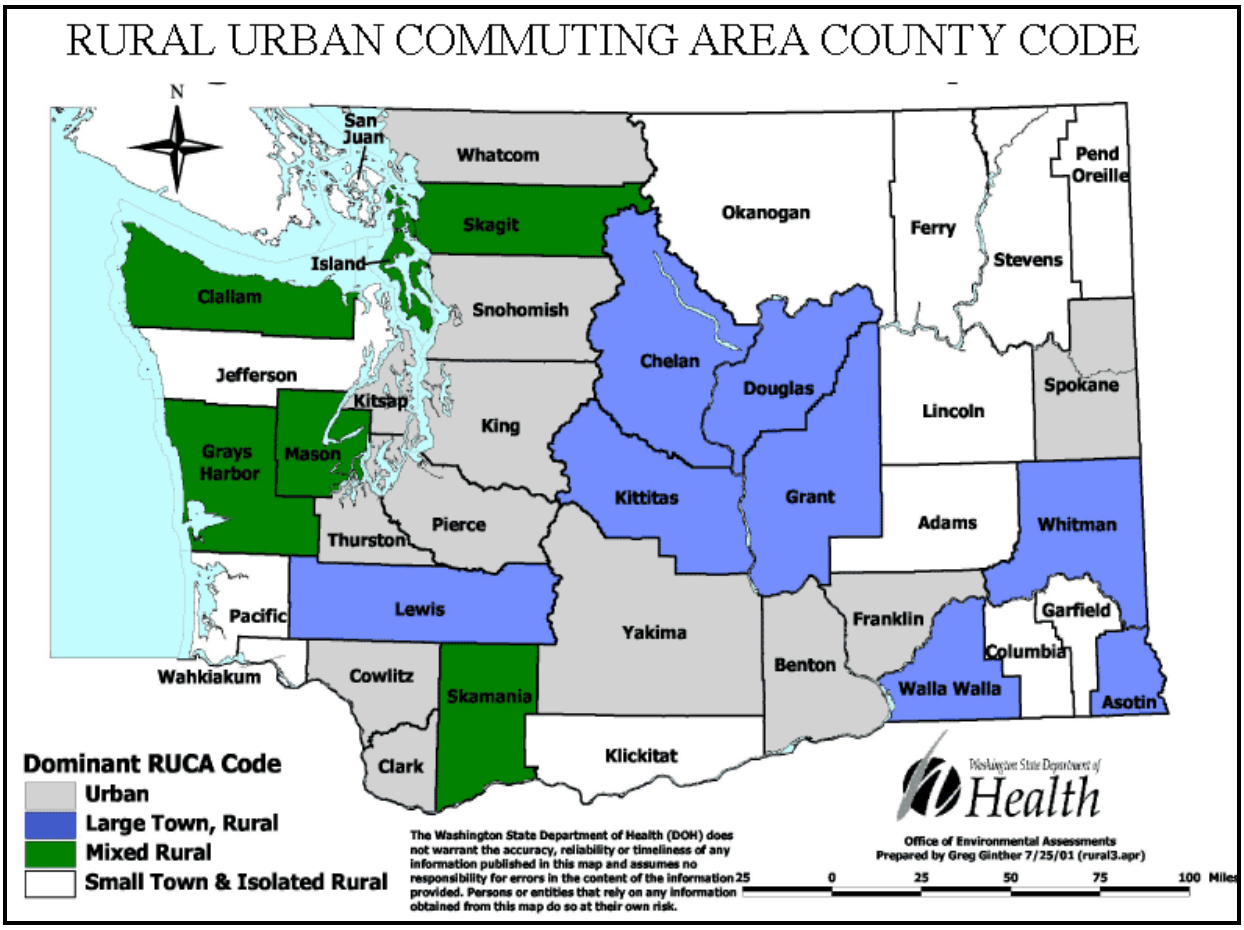
The purpose of this research is to determine the current prevalence of mammography screening by race among women age 40-74 years in Washington State after controlling for all other factors.

Significance and Hypothesis of the Study

The annual age-adjusted breast cancer incidence and mortality rates for women in Washington State are 142.2 per 100,000 lives and 23.8 per 100,000 lives respectively for the period of 2000-2004. The incidence and mortality rates per 100,000 are age adjusted to the 2000 United States standard population (Cokkinides, Bandi, Siegel, Ward, &Thun, 2008). The annual age-adjusted incidence rate of breast cancer for women is the highest in Washington State (Cokkinides et al., 2008).

The annual age-adjusted (2000 United States standard population) breast cancer incidence per 100,000 women in Washington state as per race is 172.6 for White, 150.7 for African-American, 136.7 for American Indian/Alaska Native, and 126.1 for Asians for period 2001-2005 (Washington State Cancer Registry, 2003-2005). The annual age-adjusted (2000 United States standard population) breast cancer mortality rate per 100,000 women in Washington state as per race is 24.0 for White, 26.7 for African-American, 28.7 for American Indian/Alaska Native, and 14.5 for Asians for period 2001-2005 (Washington State Cancer Registry, 2003-2005). In 2006, the prevalence of mammography screening for Washington State as percentage of women aged 40 years and older, utilizing mammography screening within the past two years is 59.9% (Cokkinides et al., 2008). Figure 1 presents the Rural Urban Commuting Area code for Washington State (Grinther, 2001). Table 1 summarizes the age-adjusted incidence rate of breast cancer per 100,000 women for all counties in Washington State (Washington State Cancer Registry).

Figure 1. **Rural urban commuting area county code**



From "Guidelines for Using Rural-Urban Classification Systems for Public Health Assessment" by G. Grinther, 2001, p. 5. Copyright 2001 by the Washington State Department of Health.

Table 1. **Age-adjusted incidence rate of breast cancer per 100,000 women in Washington State (Washington State Cancer Registry, 2003-2005)**

Counties	Sum of Population	Sum of Observations	Sum of age-adjusted rate of breast cancer per 100,000 women
Adams	8,196	12	158.7
Asotin	10,850	21	148.6
Benton	77,854	132	168
Chelan	34,366	50	128.2
Clallam	33,358	101	199.1
Clark	192,462	299	157.6
Columbia	2,098	8	269.1
Cowlitz	48,073	91	162.5
Douglas	17,217	26	140.4
Ferry	3,526	5	135.8
Franklin	27,237	26	111.8
Garfield	1,210	3	142.1
Grant	38,171	44	116.9
Grays Harbor	34,812	62	141.1
Island	37,400	78	172
Jefferson	13,642	35	167.3
King	899,954	1690	178.6
Kitsap	117,814	221	176.1
Kittitas	18,038	25	138.9
Klickitat	9,690	17	149.2
Lewis	35,724	64	145.9
Lincoln	5,105	8	101.7
Mason	24,619	60	179.7
Okanogan	19,834	28	117.7
Pacific	10,616	19	115

From "Age-adjusted incidence rate of breast cancer per 100,000 women." Copyright 2008 by the Washington State Cancer Registry, 2003-2005.

NOTE: Age adjusted to 2000 United States standard population

Table 1. **Age-adjusted incidence rate of breast cancer per 100,000 women in Washington State (Washington State Cancer Registry, 2003-2005) (*Continued)***

Counties	Sum of Population	Sum of Observations	Sum of age-adjusted rate of breast cancer per 100,000 women
Pend Oreille	5,945	7	94.5
Pierce	374,044	629	166.8
San Juan	7,739	16	132.7
Skagit	54,887	104	157.8
Skamania	5,011	8	159.2
Snohomish	322,641	565	177.8
Spokane	220,081	405	167
Stevens	20,474	34	143.3
Thurston	111,724	218	176
Wahkiakum	1,914	4	144.9
Walla Walla	27,813	48	142.9
Whatcom	89,988	170	181.3
Whitman	20,580	20	125.2
Yakima	113,971	146	130.4

From "Age-adjusted incidence rate of breast cancer per 100,000 women." Copyright 2008 by the Washington State Cancer Registry, 2003-2005.

NOTE: Age adjusted to 2000 United States standard population

Substantial reduction in breast cancer mortality rates is possible if the tumor is discovered at an early stage (Bandi et al., 2007). Therefore, utilization of mammography screening is an important preventive measure for detection of early tumor growth. According to the guidelines recommended by the American Cancer Society, women of all races from age 40 – 49 years are recommended to undertake mammography screening every two years, and women from age 50 years and above are recommended to undertake mammography screening annually (Bandi et al., 2007). The guidelines recommended by the USPSTF state that women of all races age 40 years

and over are recommended to undertake mammography screening, with or without clinical breast examination, every one-two years (Berg & Atkins, 2002).

A racial difference in the utilization of mammography screening is a subject of considerable debate. Although racial and ethnic differences in breast cancer mortality rates are consistently documented, reasons for the persistence of these differences are difficult to ascertain. Studies report that White women are more likely to utilize mammography screening services than other minority races, after controlling other intervening factors (Benjamins, Kirby, & Bond Huie, 2004; CDC, 1998; Husaini, Emerson, Hull, Sherkat, Levine, & Cain, 2005; Rauscher, Hawley, & Earp, 2004; Selvin & Brett, 2003; Young & Severson, 2005). Although minority women have historically undergone fewer mammography screenings than white women, several contradictory studies found small differences in mammography use between White and Nonwhite women, which are not statistically significant (Adams, Breen, & Joski, 2007; Coughlin, Uhler, Bobo, & Caplan, 2004; Dailey, Kasl, Holford, & Jones, 2007; Jones, Caplan, & Davis, 2003; O' Malley, Earp, Hawley, Schell, Mathews, & Mitchell, 2001; Qureshi, Thacker, Litaker, & Kippes, 2000; Sabatino, Coates, Ulher, Breen, Tangka, & Shaw, 2008; Wojcik, Spinks, & Stein, 2003).

The results of these studies, continuous development in technology, and improved access to screening facilities results in substantial increases in the number of women screened with mammography (Akinci & Healey, 2001). Further research is needed to elucidate the complexity of the results. Therefore, there is a need to conduct research to determine whether a significant association exists between race and utilization of mammography screening in Washington State. This study will aid policymakers to create effective strategies for addressing racial gaps, if they exist.

The age-adjusted incidence rate of breast cancer indicates that a significant number of counties have a higher age-adjusted incidence rate than the Washington State's average of 142.2 per 100,000 women (Cokkinides et al., 2008). Therefore, it is important to assess the factors associated with the utilization of mammography screening for women in Washington State. It is important to acknowledge the specific age group for the study as the incidence of breast cancer is highest among women age 40 years and older (Akinci & Healey, 2001; Colbert, Kaine, Bigby, Smith, Moore, Rafferty, et al., 2004; Coughlin, Leadbetter, Richards, & Sabatino, 2007; Coughlin, Thompson, Hall, Logan, & Uhler, 2002; Cronan, Villalta, Gottfried, Vaden, Ribas, & Conway, 2008). In the past, several studies have documented the effectiveness of mammography screening in the reduction of mortality rate of breast cancer among women aged 40 to 74 (White, Urban, & Taylor, 1993). However, limited evidence exists to suggest a mortality benefit attributable to screening older women, particularly among those over age 75 years (Akinci & Healey, 2001; Colbert et al., 2004).

Even though the mortality reduction is evident among elderly populations, 80% of the benefits (potential life expectancy benefit) are attributable to breast cancer screening before 75 years of age (Galit, Green, & Lital, 2007). A population-based survey estimated that among 3.83 million non-institutionalized women more than half of the women aged 80 years and older had mammography screening in the previous two years. However, almost 40% of women screened are unlikely to benefit from screening because of poor health status (Schonberg, McCarthy, Davis, Phillips, & Hamel, 2004). The cost-effectiveness studies on mammography screening reveal that at older ages, the life expectancy gains are small and cost-effectiveness is low than screening at younger ages (Kerlikowske, Salzmann, Phillips, Cauley, & Cummings, 1999;

Mandelblatt, Schechter, & Yabroff, 2005; Mandelblatt, Wheat, Monane, Moshief, Hullender, & Tang, 1992; Walter, Eng, & Coyinsky, 2001).

Many case studies and randomized control trials demonstrated the efficacy of mammography screening for women age of 50-74 years. However, there is lack of evidence stating the benefits of mammography screening after 74 years age (Fielder, Warwick, Brook, Gower-Thomas, Cuzick, Monypenny, et al., 2004; Moss, Summerley, Thomas, Ellman, & Chamberlain, 1992; Smith, Duffy, Gabe, Tabar, Yen, & Chen, 2004). The estimated range for the reduction in mortality for screened women in Italy and Netherlands age 40-74 years is 52 - 76 % (White et al., 1993). Factors in evaluating the benefits of screening older women are the presence of increased risk of breast cancer, probability of developing other illnesses that decrease life expectancy, and inhibiting survival benefits of early cancer detection (Galit et al., 2007).

Hypothesis

The central hypothesis is that race has a statistically significant association with utilization of mammography screening after controlling for other predisposing, need, and enabling factors among women age 40-74 years for all counties in Washington State.

The conceptual framework used for justifying the central study hypothesis and guiding the analysis is adapted from the Andersen's Behavioral Model of Health Services Utilization (Andersen, 1995; Phillips, Morrison, Andersen, & Aday, 1998).

CHAPTER TWO

THEORETICAL BASIS / LITERATURE REVIEW

The following section discusses the literature search methodology, theoretical framework, and literature review for the dependent and independent variables proposed for the study. Also, the section discusses the gaps in the literature and uniqueness of the study. A comprehensive literature review is conducted to identify relevant peer-reviewed studies that examine the predisposing, enabling, and need factors associated with the utilization of mammography screening for women of different races. 'Utilization' is defined as "ever had a mammogram in the past two years".

Literature Research Methodology

The methods used for the research of literature relevant to the topic are the Goldschmidt method (Goldschmidt, 1986) and the cross-referencing method. For the cross referencing method, one research article cited eight additional studies relevant to the topic of mammography screening utilization. PubMed and Ebscohost are the databases used to search relevant literature. The key search terms used include "breast cancer", "mammography screening", "regular", "recent", "utilization", "races", "county", "rural", and "access". The search terms are used in various combinations. The main criterion used for identifying relevant literature is the presence of statistically significant association between the key predictive factors and utilization of mammography screening for women of age 40 – 74 years of different races.

Exclusion-Inclusion Criteria

Studies are included in this review if they: (a) are published in English; (b) discuss factors associated with the utilization of mammography screening, including utilization as ever

had a screening; (c) discuss the efficacy of mammography screening for women 40–74 years old; (d) discuss the above related issue of utilization of mammography screening for different races. The time frame specified for the search is literature published from 1980 – 2009.

In 2002, USPSTF recommended that women age 40-49 years receive biannual screening mammography and women age 50 years and older receive annual screening mammography (Berg & Atkins, 2002). The USPSTF's updated recommendations for mammography screening are incompliance with the United States Department of Health and Human Services and National Cancer Institute (Berg & Atkins, 2002). The USPSTF published two earlier breast cancer recommendations in 1989 and 1996, which approved mammography screening for women over the age of 50 years (Berg & Atkins). Therefore, it is important to consider the effects of changing guidelines on the utilization of mammography screening among women of all races. The total number of citations identified are 325, out of which 87 abstracts are identified that presented information documenting components of mammography screening. The total number of relevant citations used in the review is 60 studies. The remaining 27 studies are excluded because they did not include variables specifically associated with utilization of mammography screening based on the exclusion-inclusion criteria.

Theoretical Framework

The theoretical framework used for the study is adapted from the Andersen's Behavioral Model of Health Services Utilization (Andersen, 1995, p. 6-7). Andersen's Behavioral Model for Health Services Utilization is adapted to explain the factors associated with utilization of mammography screening among women age 40–74 years (Andersen, 1995, p. 6-7; Thompson, Littles, Jacobs, & Coker, 2006)

Figure 2. **Andersen's behavioral model for health services utilization**

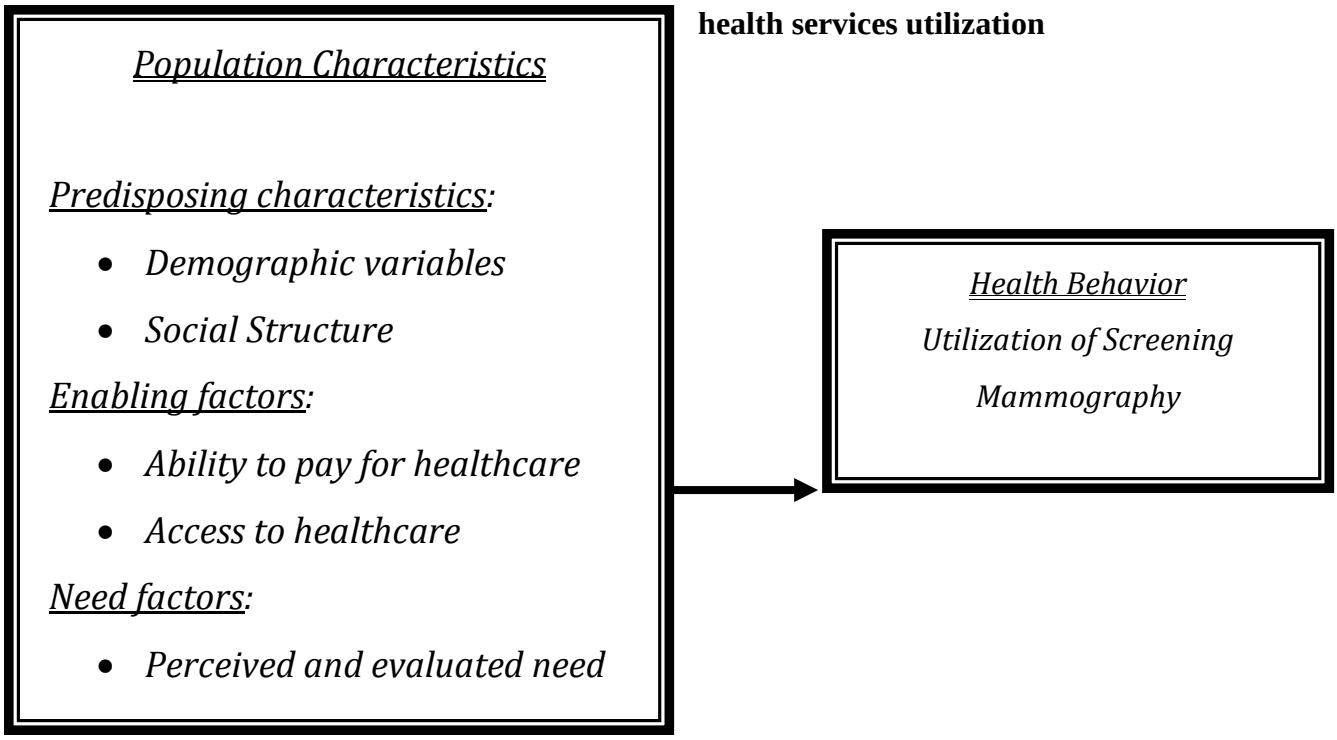


Figure 2 – "Andersen's Behavioral Model for Health Services Utilization," by Andersen, R.M. (1995). Revisiting behavioral model and access to medical care: Does it matter? ***Journal of Health and Social Behavior,*** **36, 1-10. Adapted with permission of the author.**

Andersen's Behavioral Model is the most widely used model to predict health service utilization in social healthcare research. This model is used in studies of healthcare access (Thompson, Littles, Jacobs & Coker, 2006; Lemming & Calysn, 2004), preventative screening studies (Andersen, 1995), and mammography screening studies (Akinci & Healey, 2001, Thompson et al., 2006). Mammography screening is a preventive service for breast cancer. Based on prior studies and analyses of the data available for this study the Behavioral Model of Health Services Utilization (Andersen, 1995, p. 7) is the best framework for the study. Andersen's theoretical framework demonstrates that certain predisposing, enabling, and need factors predict the use of healthcare services (Akinci & Sinay, 2003; Andersen, 1995; Coughlin et al., 2007).

The predisposing factors are individual-level factors that determine if an individual is in need of healthcare services (Akinci & Sinay, 2003; Akinci & Healey, 2001; Coughlin et al., 2007; Andersen, 1995). The enabling factors are the resource factors that either facilitate or impede the use of healthcare services (Akinci & Healey, 2001; Andersen, 1995; Coughlin et al., 2007). The need factors are perceived or evaluated factors for the actual use of healthcare services (Andersen, 1995, p. 8). A person's need factors vary depending on the healthcare service utilized. With preventive services, the need factors are based on the patient perception of an important healthcare service, which is highly dependent on the enabling factors (Andersen, 1995). The predisposing, enabling, and need factors influence potential access, while utilization and satisfaction of the health services influences realized access (Andersen, 1995). The predisposing factors that are applicable to mammography screening are demographics and social structure (Akinci & Healey, 2001; Andersen, 1995; Coughlin et al.). The enabling factors used in the study are ability to pay for health care and access to health care services (Akinci & Healey,

2001; Andersen, 1995; Coughlin et al.). The perceived and need factors used in the study are individual health status and visits for preventive services (Akinci & Healey; Andersen, 1995; Coughlin et al.).

Literature Review

It is evident from the literature that the regular utilization of mammography screening increases the probability for early detection of breast tumor (Bandi et al., 2007). It is important to determine the factors associated with utilization of mammography screening for women specified in the guidelines. In order to determine the utilization of mammography screening for detection of breast cancer, the screening behavior of "ever had a mammography screening in the past two years" is examined.

Predisposing Factors

Age. The Washington Behavioral Risk Factor Surveillance System (BRFSS) for 1998 2000, states that 82.8% (± 2.3%) of women age 40 – 49 years reported at least one mammogram at some time in their lives, 66.4% (± 2.8%) in the last two years (Washington State Cancer Registry, 2004). Among women age 50 years and older, 93.0% (± 1.1%) reported ever having had a mammogram, 77.9% (± 1.9%) in the past two years (Washington State Cancer Registry, 2004). The incidence of breast cancer increases with age for women (Colbert et al., 2004). A state-based survey (BRFSS) for year 1997, states that the median percentage of women age 50 years and older for mammography screening is higher among African-American women (76.1%) than White (73.7%) or Hispanic women (Bolen, Rhodes, Powell-Griner, Bland, Holtzman, 2000). Studies have found that women age 40-49 years are less likely than women age 50-64 years to adhere to screening recommendation (Akinci & Healey, 2001; Colbert et al., 2004;

Coughlin et al., 2007; Coughlin et al., 2002; Cronan et al., 2008; Tejeda, Thompson, Coronado, Martin, & Heagerty, 2009). However, other studies reveal that elderly women (≥ 65 years) are less likely to ever have a mammography screening than younger women, controlling for all other variables (Mandelblatt, Gold, O'Malley, Taylor, Cagney, Hopkins, & Kerner, 1999; Rawl, Champion, & Menon, 2000; Young & Severson, 2005). This suggests that as a woman gets older, her likelihood of compliance with mammography screening decreases (Young & Severson, 2005).

Race / Ethnicity. Race is an important factor associated with mammography screening. The Behavioral Risk Factor Surveillance System (BRFSS) of 1998-1999 (Coughlin et al., 2002) and a Tennessee study (Husaini et al., 2005) states that race/ethnicity along with rural residence are strongly associated with recent mammography screening. The BRFSS study shows that 63.9% White women have had a mammography screening in comparison to 60.6% African-American women (Coughlin et al., 2002). The BRFSS study in Tennessee shows that 67.2% of White women report at least one mammography in their lifetimes, compared to 59.0% of African-American women (Husaini et al., 2005). The Medical Expenditure Panel Survey (MEPS) and the Area Resource File (ARF; 1996–1998) investigation report that Hispanic women residing in counties with high percentages of African-American report higher levels of utilization of mammograms as compared to Hispanic women residing in other counties, suggesting association between county racial/ethnic composition and ethnicity (Benjamins et al., 2004). Both the National Health Interview Survey (NHIS) and the Behavioral Risk Factor Surveillance System (BRFSS) datasets show that self-reported mammography screening among Hispanics lags behind non-Hispanic women (Anderson & May, 1995; Bolen, Rhodes, Powell-Griner, Bland, & Holtzman, 2000). A study of North Carolina women 50 years and older found

that that African-American women are only half as likely as White women to have had a mammography screening in the past two years (O'Malley, Earp, & Harris, 1997). Medicare data revealed that African-American female beneficiaries age 65 years and older, especially in rural areas, are less likely than White female beneficiaries to receive mammography screening (Escarce, Epstien, Colby, & Schwartz, 1993; Trontell & Franey, 1995). Other studies revealed that African-American women are less likely than White women to utilize mammography screening, after controlling for prior mammography history (Rauscher et al., 2004; Selvin & Brett, 2003). Asian women report the lowest utilization of mammography screening among all the racial groups, while Native American population show a large increase in the mammography screening rates from the period of 1993 to 2005 (Sabatino et al., 2008; Somkin, McPhee, Nguyen, Stewart, Shema, Nguyen, & Pasick, 2004).

Contradicting reports state that after controlling for education and annual family income, the racial/ethnic differences in utilization of mammography screening are eliminated (Adams et al., 2007; Akinci & Healey, 2001; Coughlin et al., 2007; Coughlin et al., 2004; Jones et al., 2003; O' Malley et al., 2001; Qureshi et al., 2000; Wojcik et al., 2003). A study conducted in the Yakima Valley of Washington State reveals that there is no association between having had a mammogram within the previous two years with any of the predisposing and enabling factors varied by race/ethnicity (Tejeda et al., 2009). Recent studies revealed that perceived racial discrimination is not associated with non-adherence of age-specific mammography screening guidelines among African-American and White women (Dailey et al., 2007; Jones et al., 2003).

Area of residence. On average, women living in rural areas of the United States are older, more likely White, less likely single, less educated, more likely to report fair or poor general health status (as compared with good or excellent general health status), less likely to have health insurance, and more likely to have a lower household income, than women in other geographic areas of the country (Amey, Miller, & Albrecht, 1997; Husaini et al., 2005; McAlearney, Reeves, Tatum, & Paskett, 2007; Paskett, Tatum, Rushing, Michielutte, Bell, Foley, et al., 2004; Zhang, Tao, & Irwin, 2000). Rural and non-rural areas in the United States differ in health care workforce, healthcare provider supply and distance to mammography screening facilities (Amey et al., 1997; Husaini et al., 2005). After adjusting for age and year of survey, the BRFSS study for years 1998-1999 reveals 81.5% of rural women aged 40 years or older reported having had a mammography screening in comparison to 87.3% of metropolitan women (Coughlin et al., 2002). Also, distance between mammography facilities and rural residence is a significant barrier for utilization of the mammography services (Amey at al.; Guagliardo, 2004; Salsberg & Forte, 2002; Yabroff, Lawrence, King, Mangan, Washington, Yi, et al., 2005).

Studies have found that rural women have lower breast cancer screening rates than women in urban areas (Benjamins et al., 2004; Coughlin et al., 2002; Coughlin et al., 2007; Paskett et al., 2004; Zhang et al., 2000). There are no differences in recent mammogram rates as per race in counties with a lower supply of health centers or clinics (Coughlin et al., 2007). In counties with the greatest supply of health centers or clinics (i.e., 5 or more per 100,000 female populations), American Indian/ Alaska Native women are more likely than White women to have had a recent mammogram (Coughlin et al.). Women residing in non-rural areas are more likely to have significantly greater number of health services providers than rural areas (Coughlin et al.;

Zhang et al., 2000). Fischer & Wennberg (2003) found regional variation in the proportion of early stage breast cancer patients undergoing lumpectomy, stating that the availability of services varies from region to region in United States.

Marital status. Marital status is an important factor to have an association with mammography screening. Studies show that women are more likely to get a mammography screening when there is a social support system, such as marriage (Coughlin et al., 2002; Dailey et al., 2007; Jones et al., 2003; Mickey, Durski, Worden, & Danegelis, 1995; Phillips et al., 1998). The marital status of women is positively associated with utilization of mammography screening (Coughlin et al., 2007; Mickey et al., 1995; Phillips et al., 1998).

Enabling Factors

Insurance status. The ability to pay for healthcare services is associated with insurance coverage. The individual-level factors such as health insurance coverage are more influential determinants of mammography screening than measures of availability of care (Benjamins et al., 2004; Coughlin et al., 2002; Coughlin et al., 2004; Jones et al., 2003; McAlearney et al., 2007; Qureshi et al., 2000; Sabatino et al., 2008; Tejeda et al., 2009). The National Breast and Cervical Cancer Early Detection Program (NBCCEDP) for 1996-2000, states that 32% of low income women without insurance received a mammogram versus 62% of low-income women with insurance (Adams et al., 2007). Prior studies suggest that mammography screening rates vary according to type of health services delivered, for example, health maintenance organizations versus fee-for-service (Baker, Philips, Haas, Liang, & Sonneborn, 2004). The individual status of uninsured or publicly insured is a greater barrier for White women than African American and Hispanic women (Adams et al., 2007; Sabatino et al., 2008; Tejeda et al., 2009). This indicates

that African American and Hispanic women have better knowledge and support of "utilizing and accessing the safety net providers or subsidized services" when uninsured than non-Hispanic White women (Adams et al.; Sabatino et al.). The take-up rate of public insurance also increased for African Americans and Hispanic women in comparison to White women over the period of 1996-2000, narrowing the gaps in mammography screening rates (Adams et al.; Sabatino et al.).

Income and education. The ability to pay for healthcare services is associated with factors like family income, employment status, and education. After controlling for other characteristics except education and income, racial/ethnic differences in utilization of mammography screening are not eliminated (Adams et al., 2007; Coughlin et al., 2004; Coughlin et al., 2002; McAlearney et al., 2007; O'Malley et al., 2001; Sabatino et al., 2008; Somkin et al., 2004; Tejeda et al., 2009). The association between rural residence and utilization of mammography screening is not statistically significant after adjustment for education, household income, and health insurance status (Jones et al., 2003; Rosenberg, Wise, Palmer, Horton, & Adams-Campbell, 2005; Zhang et al., 2000). For all educational and socioeconomic levels, minority women are more likely than White women to have less formal education and lower incomes (Qureshi et al., 2000; Sabatino et al., 2008). Income above 200% of the federal poverty line is a strong predictor for mammography screening for minority women (Selvin & Brett, 2003). Women of all races with a bachelor's degree or higher education are twice as likely to report mammography screening as women with high school education (Coughlin et al., 2004; Cronan et al., 2008; Selvin & Brett, 2003). Sabatino et al. (2008) stated that the gap between the utilization of mammography screening among the low-income and high-income has narrowed for a period of 1993-2005. Also, minority women in a community misperceive the risks of breast cancer, therefore are less likely to have education about mammography screening (Selvin &

Brett; Young & Severson, 2005). Another study revealed that women from minority populations, residing in rural regions, and with less formal education are less likely to have had a mammography screening (Paskett et al., 2004).

Regular source of care. Residential location is associated with mammography use, which is incompliance with geographic variation in the availability and proximity of providers, clinics, and screening services. Measures of availability of healthcare services like numbers of primary care physicians, recommendations from physicians, health centers/clinics, and mammography screening centers are enabling factors (Amey et al., 1997; Coughlin et al., 2004; Guagliardo, 2004; Jones et al., 2003; Qureshi et al., 2000; Rauscher et al., 2004; Salsberg & Forte, 2002; Yabroff et al., 2005). A recent study has assessed that African-American women are more likely than White women to have had a recent mammogram in counties with a moderate supply of health clinics, while American Indian/ Alaska Native women are more likely than White women to have had a recent mammogram in counties with large supply of health clinics (Coughlin et al., 2007). Over 90% of rural counties have fewer than 300 primary care physicians per 100,000 female populations compared with less than 37% of the non-rural areas (Coughlin et al., 2007). Studies have also evaluated that women irrespective of their race, sociodemographics, and health status with a usual source of care are three times more likely to have reported a mammography screening in comparison to women without a usual source of care (Coughlin et al., 2004; Mandelblatt et al., 1999; Selvin & Brett, 2003).

Many studies suggest that women reporting a physician recommendation for having a mammography screening in the past year are significantly more likely to have had a mammogram in the past two years, after controlling for personal, health, and access characteristics (Coughlin et al., 2004; Coughlin, Breslau, Thompson, & Benard, 2005; Lerman et

al., 1990; O' Malley et al., 2001; Paskett et al., 2004; Rauscher et al., 2004; Young & Severson, 2005; Zapka, Stoddard, Maul, & Costanza, 2002; Zapka, Puleo, Vickers-Lahti, & Luckmann, 1991). Some studies found that residing in a county with a greater number of physicians is associated with increased mammography screening (Benjamins et al., 2004; Zapka et al., 2002; Zapka et al., 1991). Physician recommendations (primary care physician) are the strongest predictor of initiation and maintenance of regular mammography screening (Cronan et al., 2008; Davidson, Bastani, Nakazono, & Carreon, 2005; Rauscher et al., 2004).

Perceived and Evaluated Need Factors

Individual preventive orientation and self perceived health status have a significant impact on the screening practices among women (Young & Severson, 2005). Women who have had a clinical breast exam are more likely to have a mammography screening. Therefore, there is a strong association between the two variables (Akinci & Healey, 2001; Coughlin et al., 2007; Coughlin et al., 2002; Young & Severson, 2005). Health belief factors like fear of mastectomy or radiation, fear of cancer detection, embarrassment, and a lack of knowledge about self-breast examinations are significantly associated with low screening rates in women (Coughlin et al., 2004; Rawl et al., 2000; Somkin et al., 2004; Tejeda et al., 2009; Young & Severson).

Lower percentages of Hispanic women are able to name the mammogram or clinical breast exam as tests to find breast cancer early as compared to non-Hispanic women (Tejeda et al., 2009). Support from physicians, family, and friends are considered influential for women to utilize mammography screening services. The physician-patient relationship is a significant factor influencing women to undergo regular screening practices (O' Malley et al., 2001; Rawl et al., 2000; Taylor, Thompson, Montano, Mahloch, Johnson, & Li, 1998).

Limitations

The common limitations found in the literature include presence of errors in estimation of survival rates, self reporting by subjects, selection bias, and sample size in cohort studies (Adams et al., 2006; Akinci & Healey, 2001; Benjamins et al., 2004; Coughlin et al., 2007; Coughlin et al., 2005; Coughlin et al., 2004; Coughlin et al., 2002; Cronan et al., 2008; Dailey et al., 2007; Husaini et al., 2005; Jones et al., 2003; Mandelblatt et al., 1999; McAlearney et al., 2007; Qureshi et al., 2000; Rauscher et al., 2004; Rawl et al., 2000; Selvin & Brett, 2003; Somkin et al., 2004; Wojcik et al., 2003; Zapka et al., 1996). Most of the data collection methods are personal interviews, mail questionnaire surveys, and telephone interview surveys. Overall, these methods have a high probability of recall bias as subjects are forced to recollect medical information in the past. Some studies stated limits on the number of subjects available for follow-up (Dailey et al., 2007; Young & Severson, 2005). The most important limitation, which causes a large variation in the results, is the varying definition of recent mammography screening. The varying definitions of utilization of mammography screening directly result in different authors choosing different independent variables. Researchers define the variables capturing utilization of mammography screening depending on the regular (follow-up screening) use of mammography screening service.

With respect to other limitations of studies, the internal validity of the studies is under scrutiny because the data obtained for the analyses are based on self-reports (Adams et al., 2006; Akinci & Healey, 2001; Amey et al., 1997; Benjamins et al., 2004; Coughlin et al., 2007; Coughlin et al., 2005; Coughlin et al., 2004; Coughlin et al., 2002; Cronan et al., 2008; Dailey et al., 2007; Guagliardo, 2004; Husaini et al., 2005; Jones et al., 2003; Mandelblatt et al., 1999; McAlearney et al., 2007; O' Malley et al., 2001; Qureshi et al., 2000; Rauscher et al., 2004;

Rawl et al., 2000; Rosenberg et al., 2005; Salsberg & Forte, 2002; Selvin & Brett, 2003; Somkin et al., 2004; Wojcik et al., 2003; Zapka et al., 2002; Zapka, Bigelow, Hurley, Ford, Egelhofer, & Cloud, 1996; Zhang et al., 2000) which are not matched with medical records. Some studies stated missing data for particular variables as a limitation of the analysis (Coughlin et al., 2007; Coughlin et al., 2005; Coughlin et al., 2004). The study by Zapka et al. (1996) presents a firm report on the internal validity of self-reporting by comparing women's reports on recent mammography screening with the medical record data (Zapka et al., 1996).

The Area Resource File (ARF) data do not capture possible incongruence between county of residence and county of medical service provider or facility, because the medical service providers do not necessarily correspond to county boundaries (Goodman, Mick, Bott, Stukel, Chaing-hua, Marth, et al., 2003). The BRFSS data do not account for heterogeneity within the counties, with respect to geographic and population differences of various counties (Coughlin et al., 2007; Goodman et al., 2003).

Gaps in the Literature and Study Contribution

Washington State has the highest age-adjusted incidence of breast cancer in women in the United States. Given the high incidence rates of breast cancer it is important for researcher's to determine the factors associated with the utilization of mammography screening. The major gap found in the literature is a lack of a detailed analysis of factors associated with utilization of mammography screening for Washington State. The majority of studies suggest that, after controlling for income, education, and socioeconomic status, race is a significant predictor of utilization of mammography screening. However, contradictory studies are also documented stating that the racial gap for the utilization of mammography screening has decreased. Further research is needed to illuminate this complex relationship. Specifically, those studies that fail to show a significant association between race and utilization of mammography screening need replication so that policymakers can create effective strategies for addressing those racial gaps that do exist.

The use of state data on cancer incidence, mortality, and risk-related behaviors will help communities set priorities and guide program planning for early cancer detection. This is an important consideration for data-based intervention research for public health agencies, to assess, predict, and target preventive interventions for the specific vulnerable population groups. This comprehensive study provides appropriate information of the most significant factors associated with utilization of the mammography services. The results of this study will facilitate health education and outreach efforts to devise strategies to improve access to mammography screening services for women in Washington State.

CHAPTER THREE

METHODS / RESEARCH DESIGN

The methods section discusses the research design, data source, survey instrument, survey limitations, and statistical analysis plan of the study. The description includes the operational definitions and coding for the dependent and independent variables.

Research Design

A survey research design is used to demonstrate an association between predisposing, enabling, and need factors and utilization of mammography screening. The design is appropriate to assess the degree of co-variation among the independent variables (Hoyle, Harris, & Judd, 2002). Washington State BRFSS Women's Health survey is the secondary data source.

Data Source

Initiated in 1984, the BRFSS is a collaborative project of the Centers for Disease Control and Prevention (CDC) and U.S. states and territories. The BRFSS, administered and supported by CDC's Behavioral Surveillance Branch, is designed to obtain data on behavioral health risk factors, health status, access to health services, and socio-demographic factors (Washington State Department of Health, 2008). BRFSS is a state-based system of household telephone health survey that targets the adult population of United States. The BRFSS Women's Health survey is an optional CDC module survey (Washington State Department of Health, 2008). The module survey addresses specific women's health questions.

Sampling

In Washington State, the sampling methodology used is disproportionate stratified random sampling (DSS) (Washington State Department of Health, 2008). In DSS, a sample of telephone numbers is drawn from all possible area codes and three digit prefixes assigned to a state. Then, telephone numbers are drawn from two strata or lists that are based on the presumed density of known telephone household numbers (Washington State Department of Health, 2008). Information obtained from previous surveys is used to classify 100-number blocks of telephone numbers into strata that are either high density or medium density to yield residential telephone numbers (Washington State Department of Health, 2008).

The Washington State BRFSS interview panel uses a computer-assisted telephone interviewing (CATI) software program (Washington State Department of Health, 2008). In the CATI program, a questionnaire is displayed on a computer screen during the interview. The interviewer enters the responses directly into a computer. A CATI program offers several advantages:

1. Data entry errors are minimized since responses are directly entered into a computer as the first step (Shi, 2008, p. 198).
2. Questions not applicable to the current respondent (for example, age or sex-specific questions) are automatically skipped (Shi, 2008, p. 198).

3. Responses are immediately checked for acceptability. The responses that are found unacceptable (such as impossible body weight) are immediately brought to the interviewer's attention for correction (Shi, 2008, p. 198).

The BRFSS overall response rate is 32.89% for Washington State in 2006. The total number of survey respondents is 23,760. Of this sample, 9,335 women are eligible for mammography screening. According to the protocol for administrating the survey, an eligible household is a unit that has a separate entrance, where occupants eat separately from other persons on the property, and that is occupied by its members as their principal or secondary place of residence (Washington State Department of Health, 2008). Proxy interviews are not conducted within the BRFSS (Washington State Department of Health, 2008). An interview is considered complete if data are collected for age, race, and sex. If values on age or race are not entered, imputed values are generated and used to assign post stratification weight (Washington State Department of Health, 2008).

Weighting

Data weighting is conducted as an important statistical process that attempts to remove the biases in the sample (Washington State Department of Health, 2008). The purpose of the data weighting is to correct for differences in the probability of selection due to non-response and non-coverage and for adjusting the variables of age, race, and gender between the sample and the entire population (Shi, 2008, p. 316-317). Therefore, data weighting reduces the selection threat to internal validity of the study. It also allows the generalization of the findings to the whole population, and not just those who respond to the survey, thus increasing the external validity (Shi, 2008, p. 316-317). The protocol also enforces all the

states to ask the core component questions without modification. States can choose to add any, all, or none of the optional modules and state-added questions after the core component questionnaire. The consistency of the survey allows comparability of survey responses and reduces the instrumentation threat to internal validity for the study (Shi, 2008).

BRFSS uses a complex, multistage sample design in order to get the appropriate number of respondents from each region or province (Washington State BRFSS Women's Health Module, 2006). This study uses SUDAAN version 10.0 to correct the stratifications and clustering (Williams, 2000). The analysis uses existing data to address the research question of which independent variables have an association with utilization of screening mammography (dependent variable) in Washington State.

Survey Instrument

The survey instrument consists of three primary components, which are fixed core questions, optional modules, and state-added questions. The fixed core questionnaire consists of a set of questions that measure health status, health insurance status, demographics, and routine checkup. The optional modules consist of Women's Health module (Washington State BRFSS Women's Health Module, 2006). The module includes questions pertaining to utilization of screening mammography addressed as "have had a mammogram in the past 2 years." Telephone calls for the survey are made seven days a week during daytime and evening. The interviewers of BRFSS complete approximately 300 interviews per month in Washington State (Washington State BRFSS Women's Health Module, 2006).

The study on the reproducibility of the BRFSS Women's module, states that the survey questionnaires yield highly consistent group mean estimates of prevalence when administered repeatedly to the same individuals (Stein, Lederman, & Shea, 1996).
The differences across the administrations in mean prevalence of screening are small. The reproducibility of the question "ever had a mammogram" is near excellent ($\kappa = 0.68$, where $\kappa \geq 0.70$ excellent) (Stein et al., 1996). The individual reproducibility is excellent. However, the reproducibility declines among minority responders (Stein et al.). The reliability is high for behavioral risk factors such as individual level employment and income, demographic variables, and educational attainment because the coefficients are above 0.70 (Stein et al.). A high reliability improves the reproducibility of the survey (Stein et al.). Reliability is lower among Hispanic respondents than among White or Black respondents (Stein et al.). Although telephone interviews do not gather information about women without telephones or non-respondents, Degnan et al. (1992) reports that validated of self-reports (34%) are in close congruence with institutional records (36%) (Degan, Harris, Ranney, Quade, Earp, & Gonzalez, 1992). The women interviewees self reporting "ever had a mammogram" have a 66% accuracy with the institutional mammography records (Degnan et al., 1992).

Limitations

The BRFSS relies on information reported directly by the respondent. This self-reported data are subject to a number of sources of possible error. The manner in which the questions are worded elicits responses that result in measurement error. Similarly, the ability of individuals to accurately recall details is subject to response bias (Shi, 2008). Because the questionnaire is asked in English and Spanish in Washington State, adults who are not able to respond in English or Spanish are not included in the sample. Also,

individuals without telephones are not contacted. As a result, BRFSS findings are generalizable to English-speaking and Spanish-speaking adults living in households with telephones.

BRFSS Quality Report indicates selection bias by sex, age and race. The bias range for female population is 9.87%, which is above the standard range (3% - 9%) (Washington State BRFSS Survey Data Quality Report, 2006). The bias range for age groups 55-64 years and 65 years and older is 5.08% and 4.48% respectively, which is above the standard range (-1% - +3%) (Washington State BRFSS Data Quality Report, 2006). For White race the bias range is 5.62%, which is above the standard range (-2% - +3%) (Washington State BRFSS Data Quality Report, 2006). Large selection biases are a strong indicator of possible biases in the data. However, the selection biases do not indicate the source of the reported bias (Washington State BRFSS Data Quality Report). Some sources of non-sampling errors under the control of the data collector are not working the sample hard enough or according to BRFSS protocol, interviewer misconduct (for example, fabrication of interviews, recording one adult in a household in order to interview the person on the phone), or untrained interviewers not inducing interview respondents to complete an interview (Washington State BRFSS Data Quality Report, 2006).

Operational Definitions

The key construct of interest, utilization of screening mammography is determined by measuring "have had a mammogram in the past two years" as the dependent variable for women age 40-74 years (Coughlin et al., 2007; Coughlin et al., 2004; Coughlin et al., 2002; Washington State BRFSS Survey Module, 2006). The dependent variable is measured as "yes" and "no" for women reporting "have had a mammogram in the past two years" (Washington State BRFSS Survey Module, 2006). Three categories of potential independent variables associated with mammography utilization are identified based on the literature review and Andersen's Behavioral Model of Health Services Utilization. The independent variables are predisposing, enabling, and need factors for utilization of mammography screening. The dependent and independent variables are listed in Table 2.

Table 2. **Coding of study variables**

Variable Type	Codes
Dependent variable	
Have had a mammogram in the past two years	1 = Yes 2 = No
Independent variables	
Predisposing Factors	
Age	1 = 40-49 years 2 = 50-64 years 3 = 65-74 years
Marital Status	1 = Married 2 = Divorced or Separated / Widowed 3 = Never Married / Member of a unmarried couple
Race	1 = White 2 = Non White
Ethnicity	1 = Hispanic 2 = Non-Hispanic
Rural/ Urban County	1 = Urban 2 = Rural
Enabling Factors	
Annual Household Income	1 = < $15,000 2 = $15,000 - $49,999 3 = >= 50,000
Education	1 = < High school graduate 2 = High school graduate 3 = College graduate
Employment Status	1 = Employed 2 = Homemaker or retired 3 = Unemployed or student 4 = Unable to Work
Health Insurance	1 = Yes 2 = No
Access to Healthcare Provider	1 = Yes 2 = No
Perceived or evaluated need factors	
Health Status	1 = Excellent / Very good / Good 2 = Fair or poor
Physical Breast Exam	1 = Yes

2 = No

Statistical Analyses Plan

Frequencies and chi-square test are used to assess the differences in mammography use by predisposing factors (age, marital status, ethnicity, race, and area of residence), enabling factors (annual household income, education, employment status, health insurance, and healthcare provider), and need factors (health status and physical breast exam). Collinearity between the independent variables is assessed. None of the independent variables have a strong correlation (Correlation coefficient >= 0.8). Therefore, all the variables are included in the multivariate analysis. Bivariate frequency distribution between education and annual household income is shown in Appendix A. A high percentage (13%) of women respondents refused to provide information about their annual household income (Table 3). Women respondents who are high school graduates have the highest percentage (68%) of missing data (Appendix A).

Based on statistical significance in the bivariate analysis and/or theoretical importance, a multivariate logistic regression is conducted. SUDAAN version 10.0 is used to perform the bivariate and multivariate analyses. These analyses are done to determine which independent variables have an association with the utilization of screening mammography individually and together. Statistical significance for the multivariate analysis is affirmed as an independent variable having a p-value of less than 0.05 and the number 1 is not included in the 95 percent confidence interval (Shi, 2008).

Goodness-of-Fit

Determining overall “goodness of fit” of the entire logistic regression model is important as it aids in the comparison of competing models. This test is done to measure how well the logistic

regression model fits the available data (Hosmer & Lemeshow, 2000). The “goodness-of-fit” measure, developed by Hosmer and Lemeshow, is appropriate to measure the logistic model for dichotomous dependent variables. The Hosmer-Lemeshow goodness-of-fit statistic is calculated from the Pearson chi-square statistic of the observed and estimated expected frequencies (Hosmer & Lemeshow, 2000). Goodness of fit works by collapsing the relevant data into deciles based on the predicted probability of having the characteristic of interest, which is determined by examining the overall size of the fitted residuals (Hosmer & Lemeshow, 2000).

CHAPTER FOUR

RESULTS

This chapter discusses the results for the factors associated with the utilization of mammography screening for women age 40-74 years along with the corresponding tables. The discussion includes the results from the bivariate (chi-Square) analysis and the logistic regression.

Descriptive Analysis

A total of 9,335 women respondents are included in the analysis. All the respondents with missing data are excluded from the analysis. Table 3 summarizes the unweighted and weighted frequency and percentage distribution of women respondents for the dependent variable, predisposing factors, enabling factors, and need factors. Table 3 presents the frequency and percentage of missing data for each individual variable. For the variable “annual household income”, 13% of the data is missing (Table 3). The weighted percentage of women utilizing mammography screening services is 75.8 % as opposed to 24.2 % women not utilizing the service (Table 3).

Table 3. **Description of study variables for women age 40-74 years in Washington State**

Variables	N	N %	est. N	SE	Est. N %
Dependent Variable					
Mammography screening within the past two years					
Yes	6,970	74.7	946,365	8,920	75.8
No	2,233	23.9	302,540	7,877	24.2
Total	9,203	98.6	1,248,905	7,365	
Missing	132	1.4			
Independent Variables					
Predisposing Factors					
Age					
40 - 49 years	2,583	27.7	462,766	7,210	36.6
50 - 64 years	4,577	49	605,072	8,872	47.8
65 - 74 years	2,162	23.2	197,998	4,930	15.6
Total	9,322	99.9	1,265,837	7,210	
Missing	13	0.1			
Marital Status					
Married	5,447	58.4	861,325	10,613	68.3
Divorced or Separated /Widowed	3,080	33	296,968	5,991	23.5
Never Married/Member of an Unmarried Couple	756	8.1	102,817	4,577	8.2
Total	9,283	99.4	1,261,110	7,306	
Missing	52	0.6			
Ethnicity					
Hispanic	320	3.4	48,727	3,605	3.9
Non-Hispanic	8,980	96.2	1,214,311	7,515	96.1
Total	9,300	99.6	1,263,038	7,237	
Missing	35	0.4			
Race					
White	8,514	91.2	1,134,574	8,100	90.2
Non White	749	8	123,263	5,660	9.8
Total	9,263	99.2	1,257,837	7,292	
Missing	72	0.8			

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

Table 3. **Description of study variables for women age 40-74 years in Washington State**

(Continued)

Variables	N	N %	est. N	SE	Est. N %
Area of Residence					
Urban	5,077	54.4	899,946	7,999	71.1
Rural	4,241	45.4	366,093	5,931	28.9
Total	9,318	99.8	1,266,039	7,221	
Missing	17	0.2			
Enabling Factors					
Annual Household Income					
< $15,000	757	8.1	71,580	3,408	6.5
$15,000 - $49,999	3,932	42.1	450,656	8,016	40.8
> $50,000	3,434	36.8	581,709	9,653	52.7
Total	8,123	87	1,103,946	8,525	
Missing	1,212	13			
Education					
< High School Graduate	540	5.8	61,699	3,705	4.9
High School Graduate	5,587	59.9	716,654	9,363	56.7
College Graduate	3,184	34.1	485,933	8,567	38.4
Total	9,311	99.7	1,264,286	7,236	
Missing	24	0.3			
Employment Status					
Employed	4,752	50.9	708,456	9,685	56.1
Home Maker or Retired	3,336	35.7	401,247	7,987	31.7
Unemployed or Student	423	4.5	63,071	3,850	5
Unable to work	795	8.5	91,118	4,243	7.2
Total	9,306	99.7	1,263,891	7,242	
Missing	29	0.3			
Health Insurance					
Yes	8,529	91.4	1,161,003	7,946	91.7
No	795	8.5	105,770	4,976	8.3
Total	9,320	99.8	1,265,366	7,197	
Missing	15	0.2			

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

Table 3. **Description of study variables for women age 40-74 years in Washington State**

(Continued)

Variables	N	N %	est. N	SE	Est. N %
Healthcare Provider					
Yes	8,361	89.6	1,138,747	8,185	90.0
No	959	10.3	126,620	5,365	10.0
Total	9,320	99.8	1,265,366	7,197	
Missing	15	0.2			
Perceived or Evaluated Need Factors					
Health Status					
Excellent /Very Good / Good	7,715	82.6	1,069,847	8,733	84.6
Fair or Poor	1,598	17.1	195,340	6,155	15.4
Total	9,313	99.8	1,265,187	7,229	
Missing	22	0.2			
Physical Breast Exam					
Yes	8,915	95.5	1,211,504	7,627	96.7
No	320	3.4	40,885	3,197	3.3
Total	9,235	98.9	1,252,389	7,322	
Missing	100	1.1			

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

Bivariate Analysis

Table 4 summarizes the weighted results of factors that have a statistically significant association with the utilization of mammography screening. Findings from the bivariate analysis in Table 4 show that all the predisposing, enabling, and need factors have a statistically significant association with utilization of mammography screening within the past two years, except for race and ethnicity.

Predisposing Factors

Among the predisposing factors, age, marital status, and area of residence are statistically significant predictors of utilization of mammography screening (Table 4). Thirty three percent of women ages 40 – 49 years have not had a mammography screening within the past two years in comparison to women age 50 – 64 years (20%) and 65 – 74 years (17%). Women who are never married, or are a member of an unmarried couple, have the lowest mammography screening rate (67%). Ethnicity and race are not significant predicators of utilization of mammography screening for women. Twenty seven percent of women residing in rural areas have not utilized mammography screening within the past two years compared with urban women.

Enabling Factors

Among the enabling factors, annual household income, education, employment status, health insurance, and access to a healthcare provider are statistically significant predictors of utilization of mammography screening (Table 4). Women from lower income groups have lower mammography screening rates (< $15,000 = 64% and $15,000 - $49,999 = 71%) than women in

higher income groups. Women with less than a high school education have lower mammography screening rates (65%) than women with higher education (College graduate = 80%). Unemployed women have lower mammography screening rate (66%) than women who are home makers or retired (79%) and employed (75%). Women without insurance have a lower mammography screening rate (45%) than women with insurance (79%). Also, women without any access to a healthcare professional have a lower mammography screening rate (44%) than women with access to a healthcare professional (79%).

Perceived or Evaluated Need Factors

Among the need factors, health status and having had a physical breast exam are statistically significant predictors of utilization of mammography screening (Table 4). Women with fair or poor health status have a lower mammography screening rate (70%) than women with excellent, very good, or good health status (77%). Also, women who have not had a physical breast exam have a lower mammography screening rate (38%) than women who have had a physical breast exam (77%).

***Table 4*. Factors associated with utilization of mammography screening for women age 40-74 years in Washington State**

Variables	Mammography Screening in the past two years				X^2	P
	Yes		No			
	est. N	%	est. N	%		
Predisposing Factors						
Age						
40 - 49 years	306,072	67	150,487	33	57.1	0.000*
50 - 64 years	477,938	80	119,316	20		
65 - 74 years	162,355	83	32,737	17		
Marital Status						
Married	664,085	78	184,333	22	19.2	0.000*
Divorced or Separated / Widowed	211,151	72	82,344	28		
Never Married/Member of an Unmarried Couple	68,177	67	34,034	33		
Ethnicity						
Hispanic	34,668	74	12,483	26	0.5	0.491
Non-Hispanic	909,359	76	288,797	24		
Race						
White	853,494	76	269,023	24	0.9	0.352
Non White	87,532	74	30,869	26		
Area of Residence						
Urban	680,432	77	206,189	23	7.5	0.006*
Rural	264,555	73	96,003	27		
Enabling Factors						
Annual Household Income						
< $15,000	44,626	64	25,429	36	37.7	0.000*
$15,000 - $49,999	318,048	71	129,252	29		
> $50,000	465,342	81	112,479	19		

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

NOTE: Statistical Significance (*) is based on a p-value of < 0.05.

Table 4. Factors associated with utilization of mammography screening for women age 40-74 years in Washington State *(Continued)*

Variable Values	Mammography Screening in the past two years				X^2	P
	Yes		No			
	est. N	%	est. N	%		
Education						
< High School Graduate	38,242	65	21,028	35	16.3	0.000*
High School Graduate	523,828	74	182,198	26		
College Graduate	383,279	80	98,689	20		
Employment Status						
Employed	526,785	75	171,602	25	11.0	0.000*
Home Maker or Retired	315,506	79	81,588	21		
Unemployed or Student	41,136	66	21,244	34		
Unable to work	61,812	69	27,426	31		
Health Insurance						
Yes	899,398	79	244,505	21	127.1	0.000*
No	46,428	45	57,233	55		
Healthcare Provider						
Yes	890,270	79	231,436	21	176.1	0.000*
No	54,209	44	70,379	56		
Perceived or Evaluated Need Factors						
Health Status						
Excellent /Very Good / Good	810,813	77	244,091	23	8.2	0.000*
Fair or Poor	133,418	70	57,705	30		
Physical Breast Exam						
Yes	929,151	77	276,301	23	16.3	0.000*
No	15,573	38	25,298	62		

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

NOTE: Statistical Significance (*) is based on a p-value of < 0.05.

Logistic Regression

According to the multivariate logistic regression, the independent variables that have a statistically significant association with the lack of utilization of mammography screening are younger age, ethnicity, lower household income, not having health insurance, not having a regular healthcare provider, poor or fair health status, and not having had a physical breast exam. The independent variables marital status, race, area of residence, education, and employment status do not have a statistically significant association with utilization of mammography screening.

***Table 5*. Unadjusted and adjusted odds ratio's for not utilizing mammography screening for women age 40-74 years in Washington State**

Variables	est. N	%	Unadjusted		Adjusted		Wald-F	p-value Wald-F
			OR	95% CI	OR	95% CI		
Predisposing Factors								
Age								
40 - 49 years	150,487	33	2.4	2.0, 2.9	2.4	1.8, 3.1	34.9	0.000*
50 - 64 years	119,316	20	1.2	1.0, 1.4	1.3	1.0, 1.6		
65 - 74 years	32,737	17	Ref		Ref			
Marital Status								
Married	184,333	22	Ref		Ref		1.2	0.304
Divorced or Separated / Widowed	82,344	28	1.4	1.2, 1.6	1.0	0.9, 1.3		
Never Married/Member of an Unmarried Couple	34,034	33	1.8	1.4, 2.2	1.2	0.9, 1.5		
Ethnicity								
Hispanic	12,483	26	Ref		Ref		8.6	0.003*
Non-Hispanic	288,797	24	0.8	0.6, 1.2	2.3	1.3, 3.9		
Race								
White	269,023	24	Ref		Ref		0.05	0.816
Non White	30,869	26	1.1	0.8, 1.4	0.9	0.7, 1.3		

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

NOTE: Statistical Significance (*) is based on a p-value of < 0.05 & the number 1 not being in the C.I.

***Table 5*. Unadjusted and adjusted odds ratio's for not utilizing mammography screening for women age 40-74 years in Washington State (*Continued*)**

Variables	est. N	%	Unadjusted OR	Unadjusted 95% CI	Adjusted OR	Adjusted 95% CI	Wald-F	p-value Wald-F
Area of Residence								
Urban	206,189	23	Ref		Ref		2.3	0.123
Rural	96,003	27	1.2	1.0, 1.3	1.1	0.9, 1.3		
Enabling Factors								
Annual Household Income								
< $15,000	25,429	36	2.3	1.8, 2.9	1.5	1.1, 2.2	5.4	0.004*
$15,000 - $49,999	129,252	29	1.6	1.4, 1.9	1.3	1.1, 1.5		
> $50,000	112,479	19	Ref		Ref			
Education								
< High School Graduate	21,028	35	2.1	1.6, 2.8	1.0	0.7, 1.6	1.9	0.142
High School Graduate	182,198	26	1.3	1.1, 1.5	1.1	1.0, 1.4		
College Graduate	98,689	20	Ref		Ref			
Employment Status								
Employed	171,602	25	Ref		Ref		0.6	0.569
Home Maker or Retired	81,588	21	0.7	0.6, 0.9	0.8	0.7, 1.0		
Unemployed or Student	21,244	34	1.5	1.2, 2.0	1.0	0.7, 1.4		
Unable to work	27,426	31	1.3	1.0, 1.7	0.9	0.6, 1.3		

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

NOTE: Statistical Significance (*) is based on a p-value of < 0.05 & the number 1 not being in the C.I.

***Table 5*. Unadjusted and adjusted odds ratio's for not utilizing mammography screening for women age 40-74 years in Washington State (*Continued*)**

Variables	est. N	%	Unadjusted		Adjusted		Wald-F	p-value Wald-F
			OR	95% CI	OR	95% CI		
Health Insurance								
Yes	244,505	21	Ref		Ref		42.9	0.000*
No	57,233	55	4.5	3.6, 5.5	2.4	1.8, 3.1		
Healthcare Provider								
Yes	231,436	21	Ref		Ref		134.1	0.000*
No	70,379	56	4.9	4.1, 6.0	3.7	2.9, 4.6		
Perceived or Evaluated Need Factor								
Health Status								
Excellent/Very Good/ Good	244,091	23	Ref		Ref		4.9	0.025*
Fair or Poor	57,705	30	1.4	1.2, 1.6	1.4	1.0, 1.7		
Physical Breast Exam								
Yes	276,301	23	Ref		Ref		52.6	0.000*
No	25,298	62	5.4	3.9, 7.5	4.0	2.7, 5.9		

Cox & Snell R^2	HL Chi-Square	HL Chi-Square P-value
0.11	17.4	0.026

SOURCE: Behavioral Risk Factor Surveillance System, 2006.

NOTE: Statistical Significance (*) is based on a p-value of < 0.05 & the number 1 not being in the C.I.

Predisposing Factors

The findings for logistic regression after weighting the data show that women of age 40-49 years are two times more likely to not utilize mammography screening compared to women of age 65-74 years (adjusted OR = 2.4; 95% CI 1.8 – 3.1). Second, adjusted odds ratio for ethnicity is a significant predictor for utilization of mammography screening rather than the unadjusted odds ratio. Non-Hispanic women are two times more likely to not utilize mammography screening compared to Hispanic women (adjusted OR = 2.3; 95% CI 1.3 – 3.9). Third, race is not a significant predictor for utilization of mammography screening (adjusted OR = 0.9; 95% CI 0.7 – 1.3).

Enabling Factors

First, women with a household income of < $15,000 are one and a half times more likely to not utilize mammography screening than women with an income > $50,000 (adjusted OR = 1.5; 95% CI 1.1 – 2.2). Also, women with a household income of $15,000-$49,999 are one and a half times more likely to not utilize mammography screening services than women with an income > $50,000 (adjusted OR = 1.3; 95% CI 1.1 – 1.5). Second, women without health insurance are two times more likely to not utilize mammography screening than women with insurance (adjusted OR = 2.4; 95% CI 1.8 – 3.1). Third, women without a regular healthcare provider are four times more likely to not utilize mammography screening than women with a regular healthcare provider (adjusted OR = 3.7; 95% CI 2.9 – 4.6).

Perceived or Evaluated Need Factors

Women with a perceived poor or fair health status are one and a half times more likely to not utilize mammography screening than women with better health status (adjusted OR = 1.4; 95% CI 1.0 – 1.6). Finally, women who have not had a physical breast exam are four times more likely to not utilize mammography screening than women who have had a physical breast exam (adjusted OR = 4.0; 95% CI 2.7 – 5.9).

The goodness-of-fit statistic is 17.4, with a p-value of 0.026, which indicates that the model is not a good fit (Hosmer & Lemeshow, 2000). The Cox & Snell R^2 statistic is 0.11, which indicates that the predisposing, enabling, and need factors account for approximately 11% of the explanation for not utilizing mammography screening in Washington State.

Although the logistic model does not fit, it is important to include all the variables in the logistic model because the prior research, Andersen's behavioral model of health services utilization, and the bivariate analysis (Table 4) provide evidence that all the variables included the model are statistically significant predictors of mammography utilization (Hosmer & Lemeshow, 2000). Therefore, all the variables are included in the logistic model. Also, with the goodness-of-fit test, the grouping of the variables into smaller categories can result in a deviation from fit due to a small number of individual data points (Hosmer & Lemeshow, 2000).

CHAPTER FIVE

CONCLUSION / LIMITATIONS OF THE STUDY / RECOMMENDATIONS

The last chapter consists of the conclusions and limitations of the study, as well as the recommendations for policy and further research.

Conclusion

This study examines the role of potential predicting variables in the utilization of mammography screening in Washington State. In order to detect breast cancer in a timely manner, it is imperative for women to have access to mammography screening services (CDC, 2008). Results from the BRFSS survey indicate that racial disparities in utilization of mammography screening among women age 40 – 74 years do not exist in Washington State. After adjusting for sociodemographics, access to care, individual preventive orientation, and self perceived health status, results suggest that there is no statistically significant difference in the utilization of mammography screening services between White and non-White women in Washington State. Evidence regarding the importance of race in mammography utilization is mixed in the literature. The result of this study is contradictory to the stated hypothesis that race is a statistically significant factor associated with the utilization of mammography screening after controlling for all other factors. However, the results are consistent with the studies detailing that race is not a statistically significant predictor of utilization of mammography screening in Washington State (Adams et al., 2007; Akinci & Healey, 2001; Coughlin et al., 2007; Coughlin et al., 2004; Dailey et al., 2007; Jones et al., 2003; O' Malley et al., 2001; Qureshi et al., 2000; Tejeda et al., 2009; Wojcik et al., 2003)

Several independent variables have a statistically significant association with utilization of mammography screening for women in Washington State. Women of younger age, lower income, lack of health insurance, and lack of access to a healthcare provider are less likely to utilize mammography screening services (Adams et al., 2007; Akinic & Healey, 2001; Amey et al., 1997; Benjamins et al., 2004; Colbert et al., 2004; Coughlin et al., 2007; Coughlin et al., 2004; Coughlin et al., 2002; Cronan et al., 2008; Guagliardo, 2004; Jones et al., 2003; Lerman et al., 1990; Mandelblatt et al., 1999; McAlearney et al., 2007; O'Malley et al., 2001; Qureshi et al., 2000; Sabatino et al., 2008; Salsberg & Forte, 2002; Selvin & Brett, 2003; Tejeda et al., 2009; Yabroff et al., 2005; Zapka et al., 1991; Zapka et al., 2002).

Also, women who have not had a physical breast exam and have poor or fair perceived health status are significantly less likely to utilize mammography screening services (Coughlin et al., 2007; Coughlin et al., 2002; Rawl et al., 2000; Somkin et al., 2004; Tejeda et al., 2009; Young & Severson, 2005). Regarding ethnicity, the results are encouraging as compared to other studies. Both the NHIS and BRFSS datasets have shown that self-reported screening among Hispanics continues to lag behind non-Hispanics (Andersons & May, 1995; Bolen et al., 2000). However, the results of this study are consistent with other studies, which state that Hispanic women are significantly more likely than non-Hispanic women to utilize mammography screening services in Washington State (Jones et al., 2003).

Since 1980's, mammography use has substantially increased among minority women. National surveys including BRFSS, NHIS, Robert Wood Johnson Access to Care Survey, and Mammography Attitudes and Usage Study (MUAS) have demonstrated steady increases in utilization of mammography screening among women 40 years and older (CDC, 1998; Hayward, Shapiro, Freeman, & Corey, 1988; Heath & Fink, 1989; Smith & Haynes, 1992). The results of

this study are important because they are based on a Washington State representative population and the use of regression analysis demonstrates that race is not a statistically significant predictor of mammography utilization after controlling for other factors.

The gap between White and minority women in utilization of mammography screening services has narrowed largely due to greater emphasis on promoting and providing affordable mammography services that are easily accessible to minority subpopulations. Increasing access to screening services is the focus for federal, state, and local levels of government for the past ten years (CDC, 1998; Washington State Department of Social and Health Services, 2009). Medicare began to cover biennial mammography screening in 1991 and annual mammography screening in 1998 (McCarthy, Burns, Freund, Marwill, Shwartz, Ash, et al., 2000). Several large-scale programs were implemented, including the Breast Cancer Detection Demonstration Program, National Breast and Cervical Cancer Early Detection Program, National Mammography Campaign, and Breast and Cervical Cancer Health Program (Baker, 1982; CDC, 1998; Washington State Department of Social and Health Services, 2009).

Limitations

The first limitation of this study is that the results are based on self-reported use of mammography screening services. Self-reported information about cancer screening practices differs from information obtained from medical records of healthcare providers. Validation studies have suggested that patients tend to over-report their use of screening and under-report the time lapse since their last screening (Paskett, Tatum, Mack, Hoen, Case, & Velez, 1996; Saurez, Goldman, & Weiss, 1995; Zapka et al., 1996). The clinical verification of mammogram utilization can make the results more reliable. In United States, it is difficult to get clinical verification for each woman since there are many healthcare payer systems.

The second limitation of the study is that it does not account for any of the psychological factors that have an association with utilization of mammography screening. Women do not comply with the mammography screenings as it reminds or relates them to the risk of developing breast cancer (Hart & Bowen, 2009; Russell, Champion, & Skinner, 2006). Some of the psychological factors that are associated with non-compliance with mammography screening are perceived risk of breast cancer, fear of breast cancer, lack of trust in provider, lack of knowledge of mammography screening, and cultural beliefs (Hart & Bowen, 2009; Russell, Champion, & Skinner, 2006). Since psychological factors contribute to the reason women do not utilize mammography screening services, it is important that the reader realizes that these factors are not taken into account in this study.

Third, the goodness-of-fit value for the logistic regression model indicates a poor fit. However, it is evident from the prior research and the Andersen's Behavioral Model for Health Services utilization that the variables included in the analysis are significant predictors of mammography utilization. Finally, the total number of respondents in the BRFSS survey is sufficiently large for the purpose of statistical inference. However, analyses of subgroup data, especially within a single data year or geographic area, can lead to unreliable statistical estimates (Center of Disease Control & Prevention, 2006). Reliability of a statistical estimate depends on the actual unweighted number of respondents in a category, not on the weighted number of respondents (Center of Disease Control & Prevention, 2006).

With respect to other limitations of the study, response biases need acknowledgment because telephone surveys exclude households without telephones. During the year 2006, among the eligible households with telephones, 14.24% - 15.31% of respondents refused to participate in the interview (Washington State BRFSS Survey Data Quality Report, 2006). Also during 2006,

among the households that were selected for interviews, 35.34% - 40.40% of the respondents did not complete the interview process (Washington State BRFSS Survey Data Quality Report, 2006). According to studies, lack of telephone service is more common among households with ethnic and racial minorities, lower socio-economic status, poorer health outcomes, and fewer opportunities for access to medical care (Blumberg, Luke, & Cynamon, 2006; Frankel, Srinath, Hoaglin, Battaglia, Smith, Wright, et al., 2003). The exponential increase in cell phone utilization presents a challenge to the tradition of random digit dial (RDD) surveys of households (Kempf & Remington, 2007). Increasing use of cell phones has contributed to continuing declines in response rates and increasing costs of conducting telephone surveys (Kempf & Remington, 2007).

Policy Recommendations

Despite the limitations, this study has provided additional empirical evidence that racial gaps in mammography utilization have substantially narrowed. These results underscore the need for continued efforts to provide breast cancer screening to medically underserved populations in Washington State. Policy makers in Washington State need to recognize that annual household income, access to health insurance, and access to a healthcare provider have a statistically significant association with mammography utilization. Successful approaches to increase breast cancer screening among women include community education interventions and low cost mammography services. Various interventions designed to improve breast cancer screening are successful in reducing or eliminating cost as a barrier (Kiefe, Mckay, Halevy, & Brody, 1994; Skaer, Robinson, & Sclar, 1996; Stoner, Dowd, Carr, Maldonado, Church, & Mandel, 1998).

Also, programs designed to increase the utilization of mammography screening are substantially beneficial by educating women about the risks of breast cancer and actual cost of

mammography screening. Policy makers need to develop programs that improve access to primary care for women, regardless of health status or insurance coverage, which is a logical starting point for the development of interventions that increase use of mammography screening services and enhance early detection of breast cancer.

Research Recommendations

This study does not account for the availability of the services in terms of the number of healthcare organizations that provide mammography screening services per county. Results of a recent study show a significant interaction between individual-level race and number of health centers or clinics per 100,000 populations (Coughlin et al., 2007). In counties with 2 or more health centers or clinics per 100,000 female populations, Black women were more likely than White women to have had a recent mammogram (Coughlin et al., 2007). Further research is needed to determine the association between the availability of health centers and utilization of mammography screening, as per individual race for Washington State women. Prior research in King County of Washington State has documented racial disparities in the regular use of mammography screening (Song & Fletcher, 1998). Future research needs to determine which predisposing, enabling, and need predictors have a statistically significant association with regular/repeat use of mammography screening in Washington State. Therefore, research is needed in determining whether the increase in mammography use and a decrease in the disparity trend extend to long term rescreening. Also, the results of this study can be confirmed by conducting replication studies for Washington State.

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APPENDIX

Appendix A. **Cross tables between education and annual household income**

Education	Annual Household Income				Total
	Collected Data		Missing data		
	N	%	N	%	
< High School Graduate	442	5	98	8	540
High School Graduate	4,839	60	748	63	5,587
College Graduate	2,836	35	348	29	3,184
Total	8,117		1,194		9,311

Appendix B. **Graphical representation of the distribution between education and annual household income**