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MAMMOGRAPHY UTILIZATION IN AFRICAN AMERICAN WOMEN

A Dissertation

Submitted to the School of Nursing

Duquesne University

In partial fulfillment of the requirements for

the degree of Doctor of Philosophy

By

April D. Kidd

December 2017

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2017

MAMMOGRAPHY UTILIZATION IN AFRICAN AMERICAN WOMEN

By

April D. Kidd

Approved November 16, 2017

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ABSTRACT

MAMMOGRAPHY UTILIZATION IN AFRICAN AMERICAN WOMEN

By

April D. Kidd

December 2017

Dissertation supervised by Alison M. Colbert, PhD, PHCNS-BC

Purpose: Breast cancer presents differently among women causing breast cancer health disparities with women of color disproportionally shouldering later-stage screening, incidence, and treatment, and greater mortality. This study assessed 10 predictors and rates of recent and long-term mammography utilization for women 43-79 years of age to better understand differences among age strata and races. This was the first study to use both the calculated Gail Risk scores (calculates absolute breast cancer risk over time intervals) from the 2010 National Health Interview Survey (NHIS) and a temporary homelessness variable in predicting mammography utilization using national-level data.

Theoretical Framework: A modified Behavioral Model for Vulnerable Populations guided this study and provided a unique and well-established framework in evaluating vulnerable population domains and ethnicities.

Methods: Secondary data analysis of 2010 NHIS data was completed, that included a Cancer Control Module (cancer control questions), which is incorporated into the NHIS every five years. Using logistic regression, N= 6,334; n=1,141 for African American (AA) was used to examine mammography utilization differences between and among age strata and races (AA, Non-Hispanic White, and Hispanic), with focus on younger AA women in their 40s. Wald F test statistics with two-sided p-values <.05 and odds and adjusted ratios were used to determine statistical significance.

Results: AA had the highest (79.3%) of lowest risk Gail Risk scores, while Whites had the highest (30.7%) of highest risk Gail Risk scores. There was no statistically significant difference in Gail Risk scores by race on recent, Wald F(2, 299)=1.76, p=0.18, and long-term Wald F(2, 299)-0.58, p=0.56. Women in the 50-64 age strata had greater odds of both recent, Wald F(2, 299)=7.52, p<0.01 and long-term,Wald F(2, 299)=38.04, p<0.01. Whites had 0.62 adjusted odds ratio (AOR) (95% CI, 0.46-0.83) to have recent, and 0.76 AOR (95% CI, 0.59-0.99) to have long-term. Homelessness and transportation delays were not predictors in the adjusted recent model, while only transportation delay was not a predictor for long-term. AA long-term mammography utilization were consistent with long-term mammography utilization for all three races together with the older two age strata with higher odds (50-64 strata: 1.80 odds ratio (OR) (95% CI, 1.24-2.62) and 65-79 strata: 1.75 OR (95% CI, 1.18-2.59)).

Significance to Nursing: Risk assessment and mammography are vital prevention modalities in mitigating breast cancer health disparities. It is important for women to know their risk and for continued testing of predictor interactions to improve mammography knowledge and practice.

DEDICATION

This study is dedicated to the loving memory and inspiration of my mother, Addie M. Lewis, who at age 37, lost her unyielding battle with breast cancer when I was three. It is through and for her, that I developed the desire of adding knowledge to the state of the science in breast cancer research, specifically in younger African American women.

I would also like to dedicate this study to my immediate family and close-knit friends. Thank you to my two amazing children, daughter Ashia Kidd, and son, Zion Kidd, for their sacrifice and altruistic understanding of lost family time. Thank you to my cousins/ sisters, Anita Jackson-Smith and Laurice White, and close friends, Yolanda Wilson and Patricia McKinney, for always encouraging me to remain committed to this arduous journey, despite continuous set-backs, and my thoughts of forgoing completion. Thank you for the listening ear, and words, thoughts, and prayers of enlightenment, enliftment and encouragement.

Lastly, this study is dedicated to women for whom this study will impact or change their breast cancer screening prevention practice.

ACKNOWLEDGEMENT

I would like to first acknowledge my dissertation chair, Dr. Alison Colbert. Thank you for your patience. I could not have been successful at any pivotal juncture on this PhD journey without her continuous scholarly guidance and support. Dr. Colbert's expediency of reply, constant encouragement, and prolific feedback were intrical in my progression and success. I would like to acknowledge both Dr. Colbert and Dr. Ismail Jatoi for offering their scholarly expertise on the literature review manuscript that is part of this dissertation. Thank you to committee members, Dr. Jatoi for guiding me out of my comfort zone to explore and understand key aspects of mammography, and Dr. Joan Lockhart for providing her intellectual and editorial expertise on my dissertation. I acknowledge the amazing scholarly feedback and adeptness of committee member, Dr. Nancy Breen, and committee statistical consultant, Dr. Barry Graubard. Their expertise in the fields of health services research and population health is unparalleled. Thank you to my committee for collectively cultivating my thinking and writing abilities. Thank you to the many Duquesne University faculty, staff, fellow PhD Cohort members, U.S. Public Health Service mentors and friends, and researchers from all walks of life who have poured into me, believed in me, and offered their encouraging support. Thank you for pushing me to the next level.

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CHAPTER 1

INTRODUCTION

1.1 Background

Breast cancer is second only to lung and bronchus cancer as the leading cause of cancer death among women in the United States (American Cancer Society, 2017; Oeffinger et al., 2015). Mammography is one facet of secondary cancer prevention that, if routinely utilized, may decrease breast cancer mortality in some women (American Cancer Society, 2016, 2017; Andersson & Janzon, 1997; Duffy et al., 2010; Mahon, 2007; Tabar et al., 1995). Understanding mammography behaviors in those for whom it is clinically, theoretically, and/or practically appropriate can provide an opportunity for improving breast health, as well as potentially mitigating breast cancer health disparity that plague women of color.

Although there has been more research over the last several years surrounding factors associated with breast health practices in older women, little is known about the mammography behaviors of African American women, and far less is known about mammography behaviors of younger African American women in their 40s and their associated individual breast cancer risk (Conway-Phillips & Millon-Underwood, 2009; Kidd, Colbert, & Jatoi, 2015). This scarcity of information specifically for younger women is due in part to the controversy surrounding mammography's questionable benefit in this population (Buist, Porter, Lehman, Taplin, & White, 2004; Jatoi & Baum, 1993; Tabar et al., 2011). Regardless of the debate surrounding its utilization and benefit in this younger population, mammography is used and has benefit to some (Ooi,

Martinez, & Li, 2011; Siu, Bibbins-Domingo, Grossman, LeFevre, & Force, 2016; van Ravesteyn et al., 2012). Therefore, it is important to understand these behaviors that may promote better breast health in this younger African American population.

Screening mammography has been used in the United States as a mass population screening intervention since the 1960s to detect the presence of breast cancer, facilitating early treatment and cure (Shapiro, 1977, 1997; Shapiro, Strax, & Venet, 1966). The controversy surrounding mammography has centered on its benefit versus harm, particularly in women in their 40s (Kerlikowske, 2012; Passmore, Williams-Parry, Casper, & Thomas, 2017; van Ravesteyn et al., 2012). Other issues surrounding mammography include concerns due to false positives, unnecessary testing and biopsies, low-dose radiation exposure, over diagnosis, and increased lead time (Beemsterboer, Warmerdam, Boer, & de Koning, 1998; Bleyer & Welch, 2012; Jatoi & Anderson, 2010a; Loberg, Lousdal, Bretthauer, & Kalager, 2015).

1.1.1 Breast Cancer Health Disparity

Despite advances in care and treatment, health disparities persist in breast cancer, most notably in relation to race (Desantis, Ma, Bryan, & Jemal, 2013; DeSantis, Naishadham, & Jemal, 2013). Women of color, and specifically African American women, disproportionately shoulder later-stage diagnosis and breast cancer mortality (American Cancer Society, 2016; Amirikia, Mills, Bush, & Newman, 2011; Sassi, Luft, & Guadagnoli, 2006; Vona-Davis & Rose, 2009). Research suggests that this health disparity can be attributed to multiple causes, to include socioeconomic (Rahman, Dignan, & Shelton, 2003; Vona-Davis & Rose, 2009), structural, cultural, biological (Jerome-D'Emilia & Suplee, 2015; Sturtz, Melley, Mamula, Shriver, & Ellsworth, 2014),

intrapersonal, and interpersonal factors (American Cancer Society, 2016; Mishra, DeForge, Barnet, Ntiri, & Grant, 2012; Watson-Johnson et al., 2011). Screening mammography is an important intervention in mitigating this breast cancer health inequity (Conway-Phillips & Millon-Underwood, 2009; Freedman, Petitti, & Robins, 2004; Oeffinger et al., 2015; Siu et al., 2016; Smith, 2014) .

Breast cancer is the leading site of new cancer cases and the second leading cause of cancer death for African American women (American Cancer Society, 2016, 2017; Oeffinger et al., 2015; Smith, Brooks, Cokkinides, Saslow, & Brawley, 2013). Although White women generally have a higher incidence of breast cancer, African American and other women of color shoulder a disproportionate disease burden, with higher mortality from the disease (American Cancer Society, 2015; Amirikia et al., 2011; Surveillance, 2017). An aggressive form of breast cancer (referred to as triple-negative), has poorer prognosis, and is almost twice as common in African Americans than in other races (American Cancer Society, 2015; Amirikia et al., 2011; Carey et al., 2006).
The higher breast cancer mortality seen in younger African American women (in their 40s and younger) is due in large part to this aggressive tumor morphology and higher rates of interval cancers (Buist et al., 2004; Carey et al., 2006; Ooi et al., 2011), while other causes of higher cancer mortality in racial and ethnic women of color can be attributed to obstacles in cancer prevention and detection (American Cancer Society, 2016; Bjurstam et al., 2003; Conway-Phillips & Millon-Underwood, 2009; Smith et al., 2013).

1.2 Purpose of the Study

The purpose of this study is to explore associations and predictors of mammography utilization for women 43-79 years of age to better understand differences among and between the age groups and races (African American, Non-Hispanic White, and Hispanic) that may contribute to the breast cancer health disparity, using variables borne from the literature and identified in a modified Behavioral Model for Vulnerable Populations. The Behavioral Model for Vulnerable Populations provided an explorative perspective unique within vulnerable populations that explained the many factors impacting health behaviors and outcomes (Aday & Andersen, 1974; Andersen, 1995; Gelberg, Andersen, & Leake, 2000). Special attention and focus in the study was on the in younger African American women and women in their 40s.

This study also compared the relative impact of a woman's individual breast cancer risk, the Gail risk score, on mammography utilization. This study evaluated recent mammography utilization (having had a mammogram in the past 1-2 years) (Clark, Rakowski, & Bonacore, 2003), and long-term mammography utilization (having an on-schedule mammography over a prolonged period of time) (Rakowski et al., 2006; Vernon et al., 2008). Assessing recent mammography utilization, though important, evaluating mammography over extended periods of time provides a considerable enhanced gauge in measuring health improvement (Breen & Meissner, 2005a; Clark et al., 2003; Kindig & Stoddart, 2003; Kindig, 2007; O'Neill et al., 2008).

1.3 Study Data: The National Health Interview Survey

Secondary data analysis of 2010 National Health Interview Survey (NHIS) data was used for this study. The NHIS allowed cross-sectional analysis of the data and

generalizability. The NHIS is a nationwide multi-purpose health survey of civilian non-institutionalized households of the United States, conducted by the US Census Bureau (Ackermann & Cheal, 1994; Center for Disease Control and, 2011b, 2011c, 2012). The 2010 NHIS included a Cancer Control Supplement, which asked questions on cancer control, and is administered every five years (Center for Disease Control and, 2011b). The 2010 NHIS data was used because, at the time of the study, 2015 NHIS data had not been released and Gail risk were not calculated for the 2015 data.

1.4 Research Questions

Question 1. Are there differences in recent and long-term mammography utilization for African American women by age strata: 43-49, 50-64, and 65-79?

Question 2. Are the predisposing (age, race, marital status, Gail risk score, and homelessness), enabling (regular source of care, income, transportation, and health insurance) and need (perceived health status) variables associated with recent and long-term mammography utilization?

Question 3. Do the model variables associated with recent and long-term mammography utilization differ by race for women in the same age strata?

Question 4. Does Gail risk score on recent and long-term mammography utilization differ by race?

1.5 Dissertation Organization and Progression

The researcher completed the manuscript dissertation option, wherein each chapter is its own stand-alone document. The chapters delineate the progressive growth, development, and evolution of the study. From the initial approved study proposal, to the

results manuscript, changes were made that refined study analysis using the complex data of the NHIS.

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CHAPTER 2

REVIEW OF THE LITERATURE

Chapter 2 content has been published in a peer-reviewed journal. The journal has granted permission for the researcher to include the accepted peer-reviewed, pre-final layout and pre-final copy-edited version of the manuscript in this Chapter 2. Readers can access the final layout and final copy-edited version of the manuscript at:

Kidd, A. D., Colbert, A.M., & Jatoi, I. (2015). Mammography: Review of the controversy, health disparities, and impact on young African American women. *Clinical Journal of Oncology Nursing*, 19(3), E52-58. Doi: 10.1188/15.CJON.E52-E58

2.1 Abstract

The mammography controversy has presented both opportunities and challenges for achieving optimal breast health in younger African American women, and in battling health inequities that place them at greater risk of mortality. In spite of the controversy, there remains a need to understand the complex issues related to mammography knowledge, attitudes and behaviors of young minority women, while empowering them to take an active role in their breast healthcare. The purpose of this article is to describe the complicated issues related to screening in younger African American women (in their 40s), within the context of the uncertainty about the evidence surrounding screening practices. Literature was reviewed to garner a comprehensive update of the mammography controversy, and its impact on mammography practices. **Implication for Practice:** Nurses should be aware of the mammography controversy and breast cancer risk assessment and how they affect younger women's participation in mammography screening. Mammography screening should be shared decision making between patient and health provider. Better understanding of breast health and its effect and impact on younger minority women is needed. Nurses have a prominent role to advocate for, empower, and educate patients as they face the task of deciding whether to begin and/or continue mammography in their 40s.

2.2 Introduction

Mammography screening for women in their forties has been contentious since its early beginnings (Christie, 1977; Hale & deValpine, 2014; Shapiro, Venet, Strax, Venet, & Roeser, 1985). Recommendations are vehemently debated, and consensus has not been reached about best practice guidelines for women, most notably the optimal age to initiate, optimal interval (annually versus biennially), and the age screening should stop (Jatoi & Baum, 1993; Quanstrum & Hayward, 2010). There is also theoretical concern that low dose radiation from screening mammography may potentially induce breast cancers in women who harbor mutations in the BRCA 1 or BRCA 2 genes (these genes are responsible for DNA repair, and mutations in these genes may reduce the ability to repair damage from low-dose radiation)(Foulkes, 2008; Frankenberg-Schwager & Gregus, 2012; Swift, Morrell, Massey, & Chase, 1991; Taylor, 1992). Moreover, mammography screening is associated with false-positives, which may result in unnecessary biopsies and anxiety, has been associated with a significant rate of breast cancer overdiagnosis (finding lesions that would never progress and are not life threatening), and lead time (the time mammography detected cancers remain in the preclinical phase) (Bleyer & Welch, 2012; Bleyer & Welch, 2012; Christie, 1977; Hale & deValpine, 2014; Jatoi & Baum, 1993). Although opinions are polarized, there is agreement that women should be encouraged to participate fully in the discussions surrounding their breast health and the ultimate decision making. Therefore, cogent guidance is needed to enable women--along with their health provider-- to make the best breast health decision.

In addition to the controversy, a very real disparity in breast cancer outcomes exists, steeped in differences surrounding early detection and treatment. There is a distinct and resolute need to provide good quality health care to all populations, but often, younger African American women's breast health has been overlooked, leading to a breast cancer health disparity, due in part to them shouldering the burden of breast cancer mortality (Conway-Phillips & Millon-Underwood, 2009). This crisis of inequity demands better understanding and solutions that take into consideration the unique needs of younger minority women. While there are many factors that contribute to this disparity, it is essential that the mammography controversy does not overshadow the real need for quality, individualized breast care, which includes a thorough understanding of screening risks, benefits and options. There must be a degree of consensus reached concerning the optimal level of breast health education and screening required for the unique needs of this population. In addition to the demand for high-quality care, this new landscape of seemingly constant changes and modifications to recommendations based on the evolving evidence, also challenges health care providers to ensure that women are provided the necessary information to make informed choices about their own care.

Nurses need to be aware of the existing health care disparity and the continuously evolving debate in mammography screening in order to provide comprehensive care to the patients. The purpose of this article is to describe the complicated issues related to mammography screening in younger African American women, within the context of the uncertainty about the evidence surrounding screening practices.

2.3 Breast Cancer Health Disparity

Health disparities arise from many factors, including unequal socioeconomic factors, culture differences, discrimination, and health system barriers that influence access to cancer prevention and treatment services (American Cancer Society, 2013a; American Cancer Society, 2013b; American Cancer Society, 2014; Calvocoressi et al., 2004; Finney, Tumiel-Berhalter, Fox, & Jaen, 2006). Mitigating health disparities is a major concern as evidenced by its inclusion in national health benchmarks within Healthy People 2020 and the National Prevention Strategy, which identify ideal population health improvement targets (U.S. Department of Health and Human Services, 2011a; U.S. Department of Health and Human Services, 2011b).

Breast cancer, a leading example of US health disparity, accounts for an estimated 15% of US cancer deaths and is the leading site of new cancer cases in women and the second leading cause of cancer death for African American women (American Cancer Society, 2011; American Cancer Society, 2013a; American Cancer Society, 2013b; American Cancer Society, 2014). A percentage of the higher breast cancer mortality seen in younger African American women is due to aggressive tumor morphology, while other gaps in cancer mortality for racial and ethnic minorities can be attributed to obstacles in cancer prevention and detection (American Cancer Society, 2011; American Cancer Society, 2013a; Andersson & Janzon, 1997; Bjurstam, Bjorneld, Duffy, Smith, Cahlin, Erikson et al., 1997; Conway-Phillips & Millon-Underwood, 2009). Although African American women have a lower incidence of breast cancer than White women overall, among women under 45 years of age, African American women have a higher incidence

of breast cancer than Whites (American Cancer Society, 2013b; American Cancer Society, 2013b).

The reasons for this disparity are not fully understood, but may partly be attributed to differences in knowledge, attitudes, and behavior around breast health in young African American women. Mammography is often recommended for women considered average risk beginning at age 40 or 50, but many African American women lack knowledge about their own risk, and consequently present in later stages of cancer development (Byrne, Glasgow, & DeShields, 2011; Conway-Phillips & Millon-Underwood, 2009; Dailey, Kasl, Holford, & Jones, 2007; Feldstein et al., 2011). This lack of information about screening options and less breast cancer awareness, or acknowledgment of risk, may, in many instances, serve as a catalyst for increased breast cancer mortality. In order to effectively address the reality of these health disparities, it's important to understand the controversy around screening, and how the current climate can allow for healthy debate, without jeopardizing advancements in health equity.

2.4 The Case for Mammography

The main issue that has fueled the controversy is the lack of randomized clinical trial (RCT) evidence supporting mammography's benefit or lives saved if used by women in their forties. Of the nine mammography RCTs conducted globally to evaluate the efficacy of screening, only one has been conducted in the United States, the 1960s Breast Cancer Screening Project of the Health Insurance Plan (HIP) of New York, and few, if any, included minority populations such as African American women. Only two trials (the Canadian National Breast Cancer Screening Study, and the UK Age Trial) have been conducted to specifically address mammography efficacy for women in their forties, both

indicating that if women begin screening in their 40s, benefit would not be seen until 12-14 years, at which time, they would already be in their 50s, presumably with less screening benefit for the younger age group (Bjurstam, Bjorneld, Duffy, Smith, Cahlin, Eriksson et al., 1997; Bjurstam et al., 2003; Elwood, Cox, & Richardson, 1993; Hendrick, Smith, & Rutledge, 1997; Miller, To, Baines, & Wall, 2002; Nystrom & Larsson, 1993; Nystrom et al., 1993; Tabar et al., 1995; Tabar et al., 1996). The HIP trial results were the impetus for the initiation of mass mammography screening in the U.S., because this trial demonstrated a reduction in breast cancer mortality for women who were screened, versus those who were not (Shapiro et al., 1985; Shapiro, 1997). The HIP trial was initiated in 1963, and there have now been questions surrounding its methodology, power, and screening technologies, when comparing it to newer trials. For younger women specifically, mammography clinical trials have shown far less of a benefit for women in their 40s than in their 50s. This lesser perceived benefit (lives saved), coupled with the theoretical risk of inducing breast cancer in younger women who already have a hereditary predisposition for breast cancer, cause significant concern for mass screening, as it may often be used without scrutiny of these individualized risks (Clark, 2004; Foulkes, 2008; Taylor, 1992).

Despite this, many organizations, researchers and clinicians maintain that screening mammography may have benefit in the broad context of detecting breast cancer in its precocious stage of development in some women, allowing early cancer treatment and cure than would otherwise be accomplished if cancer was detected later (Hale & deValpine, 2014; Tabar et al., 2011; US Preventive Services Task Force, 2009). The two sides of this issue are complex, but recent advances in what is known about breast cancer

itself, as well as where it may have most benefit, could bring some consensus about mammography use.

Breast cancer is not a homogenous disease, but a heterogeneous disease consisting of many facets, with differences based on the type of cells, location of the cancer, and invasiveness of the disease (Habel & Stanford, 1993; Stanford & Greenberg, 1989). Because of this, there is not a single screening modality that detects all types of breast cancers at equal levels of specificity and sensitivity (Kolb, Lichy, & Newhouse, 2002; Tilanus-Linthorst et al., 2002). Breast cancer morphology is also complex, with different presentation and characteristics among women. Tumors are typically described by their level of expressed estrogen. High- grade estrogen negative (ER-) cancers do not express estrogen (also referred to as triple receptor- negative when additionally negative for progesterone receptor and human epidermal growth factor receptor), and women with this type have a poorer prognosis (Habel & Stanford, 1993; Krizmanich-Conniff et al., 2012; Stanford & Greenberg, 1989). Alternatively, low-grade estrogen positive (ER+) cancers express estrogen, and women with this type have a better prognosis (Habel & Stanford, 1993; Stanford & Greenberg, 1989). White women have a higher incidence of ER+ breast cancers, which are slow growing, lending itself to better mammography detection (Howlader et al., 2013; Stanford & Greenberg, 1989). Conversely, ER- cancers are fast-growing, and are most prevalent in younger African American women (< 50 years of age) (Gapstur, Dupuis, Gann, Collila, & Winchester, 1996; Ooi, Martinez, & Li, 2011; Stanford & Greenberg, 1989). Because of ER- tumor histological make up, and its aggressive growing nature, mammography does not detect ER- tumors as readily as ER+ tumors (Foulkes, 2008; Tilanus-Linthorst et al., 2002).

This is further complicated by the "collateral effects" of mammography screening that don't address its effectiveness in detection, but rather harm caused by the test itself. Although mammography has been shown to detect cancer early and save the lives of some women who use it, it has also caused undue harm to many women due to false positives, over-diagnosis, lead-time, and low-dose radiation exposure, causing unnecessary further testing and biopsies, and the needless exposure to radiation (Beemsterboer, Warmerdam, Boer, & de Koning, 1998; Bleyer & Welch, 2012; Jatoi & Anderson, 2010). Clearly, it may not be most beneficial for younger minority women, due to elevated associated risks (Bjurstam et al., 2003; Shapiro, 1977; Shapiro, 1997). However, clinicians cannot afford to dismiss mammography in it's entirely for this population. Again, if it's going to be used, researchers and health care providers must figure out ways to address the shortcomings of mammography, while also mitigating the risks surrounding its utilization in the younger at risk population.

Recently, a risked–based or risk stratification approach to mammography utilization has been advocated, which would help women ascertain their individual breast cancer risk using prediction models by including various factors such as breast density, menopause status, and age (Bertrand et al., 2013; Kerlikowske et al., 2013). There are easily available risk-based online tools to support and provide women guidance on if and when they should engage in mammography, and the most appropriate interval based on their risk of developing cancer (Centre for Cancer Prevention, 2014; Fletcher, 2011; Kerlikowske et al., 2013; National Institutes of Health, 2011). Individual risk factors should play a potent role in guiding screening practices (Schrager & Marko, 2013). In a recent comparative modeling study (median of 10,610 (N) in four models) to determine

the threshold relative risk for the harm-benefit ratio of screening between women in their 40s to those 50-74 years of age, for those with a 2-fold elevated risk of breast cancer, their risk of starting biennial screening at 40 was comparable to average risk women beginning biennial screening at 50 (van Ravesteyn et al., 2012). Mammography is promoted as an intervention, if practiced early and routinely within the context of individualized assessment, could help equalize breast cancer health disparity and decrease breast cancer mortality.

It is understood mammography is one tool, often accompanied by other detection modalities (i.e. ultrasound, magnetic resonance imaging, clinical breast exam, etc.), that may be used in detecting breast cancer early (Fletcher, 2011; Kolb et al., 2002; Patterson & Noroozian, 2012; Taylor, 1992; Tilanus-Linthorst et al., 2002). Developments in knowledge about the disease suggest that mammography may be more ideal as an individualized tool than as a mass screening tool. Despite this, mammography may still have a place in the spectrum of breast cancer early detection in younger and older women. The challenge is ascertaining through further research, its most appropriate place.

Digital breast tomosynthesis (DBT), a fairly new technology, is providing even greater detection clarity of non-calcified masses by providing a 3-dimensional view of images, and reducing tissue superimposition (Houssami & Skaane, 2013; Houssami & Zackrisson, 2013; Patterson & Noroozian, 2012; Rafferty, Park, Philpotts, Poplack, Sumkin, Halpern, & Niklason, 2013b; Skaane et al., 2013). In clinical trials, DBT has shown increased detection rates of 30%, fewer recalls, and fewer false-positives when combined with 2-dimensional digital mammography (Rafferty, Park, Philpotts, Poplack,

Sumkin, Halpern, & Niklason, 2013b; Skaane et al., 2013; Tingberg et al., 2011). DBT is continuing in clinical trial testing, and thus far does not provide promise in reducing interval breast cancers in high risk women. Magnetic Resonance Imaging (MRI) is used as adjunct in high risk women, and specifically women with BRCA gene mutation, offering significant detection benefit without using ionizing radiation, and is more sensitive than mammography (Bosse et al., 2013; Kuhl et al., 2005). Cost limits the use of MRI in at risk populations, further expanding the cancer disparity (Mahon, 2007; Patterson & Noroozian, 2012). Additionally, MRI has not been widely implemented due to associated higher false-positive rates (Bosse et al., 2013; Patterson & Noroozian, 2012). Despite these detection advances, continued improvements are needed for high risk women, and until such time, mammography will continue to have a place in the early detection portfolio.

2.5 Screening Guidelines

When screening is utilized, it should be conducted systematically and following the best practice guidelines for frequency and timing (American Cancer Society, 2011; American Cancer Society, 2013a; Christie, 1977; Institute of Medicine, 2003; Malmgren, Parikh, Atwood, & Kaplan, 2012; Quanstrum & Hayward, 2010). Breast cancer screening guidelines differ based on the screening commencement age and screening interval, using research results favored by the guideline sponsoring organization (i.e. American Cancer Society, U.S. Preventive Services Task Force, Center for Disease Control and Prevention, American College of Radiology, etc.) (American Cancer Society, 2011; American Cancer Society, 2013a; American Cancer Society, 2014; Mahon, 2007; US Preventive Services Task Force, 2009). Unfortunately, the widely accepted practice of mass screening has led

to a blanket passage for women to participate in screening without adequately provided individualized understanding and informed consent.

There have been significant changes recently to mammography screening guidelines, which has caused women to have many different screening routines (Calvocoressi, Sun, Kasl, Claus, & Jones, 2008; Squiers et al., 2011). All of the guidelines are ostensibly based on the same body of evidence, but there is still discrepancy. There is RCT evidence to support recommended mammography commencement at age 50, while an abundance of epidemiological and observational studies do lend credence to screening by younger women in their 40s (American Cancer Society, 2011; American Cancer Society, 2013a; Christie, 1977; Hendrick et al., 1997; Kerlikowske et al., 2013; Shapiro, 1977; Shapiro, 1997). In 2009, The US Preventive Services Task Force (USPSTF) changed their recommended age from 40 to 50 (US Preventive Services Task Force, 2009). The discussion and rationale surrounding this change has stemmed debate, as well as sparked screening behavior change in this younger population (Kremer et al., 2012). In the absence of health provider guidance and informed consent, this behavior change that now recommends women in their 40s delay screening may place high risk African American women at even greater risk of developing later stage breast cancer (Calvocoressi et al., 2008). Table 1 provides an overview of selected organizational mammography screening recommendations, which show the varied differences and similarities advocated among organizations.

Table 2.1 Overview of Selected Agency Mammography Screening Guidelines for Asymptomatic Women		
AGENCY	**INTENDED USER**	**MAMMOGRAPHY RECOMMENDATION**
American Cancer Society (ACS)	Patients and Physicians	Annually beginning at age 40
U.S. Preventive Services Task Force (USPSTF)	Physicians, Nurses, and Allied Healthcare Professionals	Biennial beginning at age 50 until age 74
American College of Radiology (ACR)	Physicians	Annually beginning at age 40
National Comprehensive Cancer Network (NCCN)	Physicians	Annually beginning at age 40

(American Cancer Society, 2013a; American Cancer Society, 2014; Mahon, 2007; Mainiero et al., 2012; National Comprehensive Cancer Network, 2013; US Preventive Services Task Force, 2009)

2.6 Informed Consent

Practice guidelines dictate that prior to the administration of a medical procedure, patients are provided informed consent. This involves providing specific details to patients on the purpose, benefits, risk of a medical procedure, and alternatives, and without it, care is considered malpractice or neglect (Jatoi & Baum, 1993; Osman, 2001; Ward, 1999). Nurses have been and continue as an integral entity of the multidisciplinary healthcare team, involved in protecting patient rights, and ensuring they understand medical procedures and interventions (Judkins-Cohn, Kielwasser-Withrow, Owen, & Ward, 2014; Sims, 2008a; Sims, 2008b). Therefore, in providing consent to patients, nurses must not only have the communication skills to function in this role, but also the clinical, legal and ethical knowledge to serve in a number of roles: manager (ensuring adequate process); witness (record patient's understanding); patient advocate (ensure patient's understanding); and information giver (recapitulate information in lay terms) (Judkins-Cohn et al., 2014; Susilo et al., 2013).

Informed consent has been an important facet of the mammography controversy. Mass population screening practices are not ideal for women in their 40s in the absence of informed consent due to potential risk that could cause breast cancer or other unnecessary harm. Informed consent is not generally practiced in mammography screening; more of a simple consent is routinely used. A cornerstone of health empowerment and education is a social justice approach to health knowledge, risks, and benefits related to screening mammography. Although women may be at risk of early breast cancer morbidity and mortality with delayed screening, the larger risk is conducting an unnecessary intervention without informed consent. Younger women have dual challenges of knowing and understanding both their breast cancer and screening risks (Jatoi & Baum, 1993; Tabar et al., 2011).

There is a clear social justice need to have equal informed consent for women undergoing screening mammography, without which is both assault on patient rights, and medical malpractice (Jatoi & Baum, 1993; Osman, 2001; Tabar et al., 2011; Ward, 1999). Informed consent is not a standard of care practiced across the U.S. with mass, mobile, and some primary care prescribed mammography screenings (American Cancer Society, 2011; American Cancer Society, 2014; Jatoi & Baum, 1993; Marshall, 2005). Typically with mass and mobile screenings, health providers are not present at the point of care with patients, as mammography technicians provide the onsite screening services. Assuring mammography screening informed consent might be a challenge, as the current health infrastructure does not readily avail itself to this seldom practiced standard. Therefore, health service infrastructures that provide mammography screening services

should be retooled to accommodate the availability of informed consent prior to screening accessibility.

An understanding by patients of the risks and benefits of a medical intervention or procedure is the foundation of patient autonomy, and serves as the standard of decision making in healthcare. Patient autonomy is synonymous with liberty, privacy, and individual choice, forming the doctrine of informed consent (Jatoi & Baum, 1993; Osman, 2001). Informed consent allows patients to accept or decline participation in a medical procedure (American Cancer Society, 2012). Simple consent is not appropriate for a medical intervention or procedure (American Cancer Society, 2012; Osman, 2001; Ward, 1999). Informed consent should serve as the standard of care for all medical procedures, to include screening mammography (Jatoi & Baum, 1993; Osman, 2001).

Women must be informed about the potential harmful effects of mammography (Beemsterboer et al., 1998; Jatoi & Baum, 1993; Tabar et al., 2011; Ward, 1999). Overdiagnosis produces anxiety in women surrounding some preclinical cancers such as ductal carcinoma in situ (DCIS) that can realistically be present for years without progressing to invasive cancer. And since there is no consensus that DCIS leads to clinical cancer, overdiagnosis of DCIS can also lead to unnecessary anxiety and stress in patients. False positive results can also cause anxiety and stress, by leading to unnecessary additional tests and procedures for women who believe they have breast cancer when they do not (American Cancer Society, 2014; Feig, 2006; Smith, Cokkinides, & Eyre, 2007). Although costs should also be considered, costs may be less of a problem due to the availability of mammography coverage by the vast array of

insurance providers, and due to the availability of free or reduced cost mammography (Eddy, Hasselblad, McGivney, & Hendee, 1988).

African American women must also be informed about the preponderance of the evidence showing differences in cancer characteristics including its aggressiveness. Information should also be shared on the breast cancer disparity and potential causes, leading to increased mortality in this population. Shared knowledge surrounding prominent aspects that have led to this cancer disparity provide avenues for changing and improving the breast cancer landscape. Screening informed consent, specifically for African American women, should encompass the very real aspects of the problem, risk, and alternatives.

2.7 Conclusion

The mammography controversy highlights the very real concerns surrounding screening for women in their forties. Issues raised present both opportunities and challenges for achieving optimal breast health in younger high risk women, and in battling the pervasive health inequities that put younger African American women at greater risk of mortality. Additionally, there remains a critical need to understand the complex issues related to the mammography knowledge, attitudes and behaviors of minority women, especially as we move away from population-based recommendations to more personalized healthcare decision making. Paramount to this, is the real-world perspective of the unique mammography needs and challenges of African American women. Nurses are in a unique position to educate patients and provide the necessary support—however, they must be adequately prepared to discuss risks and benefits that are constantly changing. They must also be well-versed in the implications of

recommended guidelines, and the disparate way those recommendations can impact different populations. This poses a significant challenge for nurses, and requires that they keep up to date on research, expert guidelines, and interpretations that evidence for patient care. They must also be acutely aware of existing disparity, and how advances in personalized healthcare can contribute to patient care and treatment plans that are tailored to meet the unique needs of their patients as individuals.

There is no longer a simple diagnosis of "breast cancer." Scientific advances have provided the knowledge needed to differentiate different kinds of cancer, and with that, different modes of detection and treatment, yet more remains to be done. One size does not fit all, and that means that healthcare providers must view screening guidelines through the lens of personalized healthcare. Women must weigh their own individual health risks, along with consultation with their health provider, in deciding their breast health regimes (American Cancer Society, 2012; Jatoi & Baum, 1993; Osman, 2001). Empowering younger women to take an active and informed role in their health care improves health behaviors systemically. The decision to proceed with mammography screening is an individual one that should be entered into with care, knowledge, understanding, and a deliberate effort to adhere to screening guidelines if the benefits outweigh the risk. Due to the cancer disparity facing young African American women, it is paramount that they receive education and guidance on their cancer risk (socioeconomic factors that influence access to health services, and knowledge on tumor morphology and overall breast health), as well as their optimal screening choices. While there may never be a definitive consensus on screening practices, close attention to the highest quality research, combined with an equal amount of attention on the preferences

and experiences of young African American women, has the potential to improve advances in the country's breast cancer detection and treatment rates, and addressing the existing grave racial breast cancer health disparity that exits.

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CHAPTER 3

PROPOSAL

3.1 Specific Aims

Specific Aim 1. To describe the mammography adherence rates of African American women 43-79 years of age. Are there differences in mammography adherence rates (short-term and long-term) for African American women by age strata 43-49, 50-64, and 65-79 years of age? Mammography adherence rates between age strata will be compared to determine if there are significant differences. Mammography adherence will be operationalized using the number of on-schedule mammograms over a total six year period; at least two for short-term, and three or more for long-term adherence.

Specific Aim 2. To identify relationships between and among Behavioral Model population variables (predisposing, enabling, and need variables) on the mammography adherence health behavior variable. What are the relationships between and among *predisposing* – age, race, marital status, Gail risk score, and homelessness; *enabling* – regular source of care, income, transportation, and insurance; *need* – perceived health condition; and *health behavior* – mammography adherence. This aim will identify relationships of selected population variables on mammography adherence, and well as determine which variables may predict adherence. Predisposing variables are social-demographic, genetic, and cultural and community status variables, which may describe one's propensity to participate in health services (Aday & Andersen, 1974; Andersen, 1995; Gelberg et al., 2000). The predisposing variables age, race, marital status, homelessness, and Gail risk score will be used. Enabling variables outline the individual and community means and resources that may facilitate accessing health services (Aday

& Andersen, 1974; Andersen, 1995; Gelberg et al., 2000). The enabling variables regular source of care, income, transportation, and insurance will be used. Need variables describe knowledge, values, and needs about an individual's perceived or evaluated health (Aday & Andersen, 1974; Andersen, 1995; Gelberg et al., 2000). Perceived health will be evaluated in this study. Mammography adherence will be operationalized using the number of on-schedule mammograms over a total six year period; at least two for short-term, and three or more for long-term adherence.

Specific Aim 3. To compare long-term mammography adherence rates and the Behavioral Model variables that differ between and among ethnicities for women in the same age strata. Do long-term mammography adherence rates and the model variables differ between and among ethnicities for women in the same age strata - 43-49, 50-64, and 65-79 years of age? This aim will provide information to better describe and compare both statistically significant model variable differences between and among women 43-79 years of age (by age strata) of different ethnicities and their long-term mammography adherence rates. For this study, ethnicity will be used to denote race (non-Hispanic White, non-Hispanic African American, and Hispanic) and/ or the terms may be used interchangeably.

Specific Aim 4. To identify and describe the relationship of individual breast cancer risk on mammography adherence. What is the relationship of Gail risk scores on mammography adherence? The Gail risk score provides awareness into a woman's five-year and lifetime risk of developing breast cancer (National Institute of Health, 2011). This aim will provide insight into the applicability and consideration of an individual's breast cancer risk on mammography adherence practices. As the individual need for

mammography continually becomes a formidable determinant of mammography practices, this aim, provides information retrospectively on the relationship between risk and adherence.

3.2. Background and Significance

Scientific evidence posits that cancer is caused by both external factors (mutable) and internal factors (immutable) (American Cancer, 2013a, 2014). Although little can be done to eradicate immutable factors, there are ways to mitigate mutable cancer factors through awareness, knowledge, and behavior change. Some cancers can be prevented and/or detected early through health promoting behavior, resulting in early removal of precancerous growth. The five-year survival rate for all cancers improved from 50% in the mid to late 1970s, to 68% in the early 2000s, due in part to early detection (Mahon, 2007; Services, 2000; Smith et al., 2003; Tabar, Duffy, Vitak, Chen, & Prevost, 1999; Tabar et al., 2011). Breast cancer affects women in significant numbers all across the world, accounting for just over one million cases; second only to lung cancer (American Cancer, 2013a; World Health, 2009). Breast cancer is the most common cancer globally among women, and often the most likely cause of cancer death (American Cancer, 2013a, 2013b).

Research has shown that early detection of breast cancer – breast self-exam (BSE)/ breast self-awareness, clinical breast exam (CBE), magnetic resonance imaging (MRI), and mammography- provide the greatest prospect for optimal treatment (American Cancer, 2013a, 2013b; Duffy et al., 2010; Smith et al., 2013; U. S. Preventive Services Task Force, 2009; World Health, 2009). While each detection modality may have a place in the broad spectrum of early cancer detection, mammography (along with

MRI for high risk women) has the highest levels of specificity and sensitivity in detecting cancers early. Although some have questioned mammography's reliability and efficaciousness versus benefits and risks in women <50 years of age, screening mammography remains the cornerstone of improved breast cancer control – the gold standard screening modality (American Cancer, 2013a; Kearney & Murray, 2009; Tabar et al., 2011; World Health, 2009). Continued updates to the mammography screening guidelines, although beneficial, have led to some ambiguity for patients, particularly in women 40-49 years of age (American Cancer, 2013a; Conway-Phillips & Millon-Underwood, 2009; U. S. Preventive Services Task Force, 2009). This ambiguity surrounding the mammography guidelines, along with lagging social capital cohesiveness about breast health, has caused some women to question mammography's benefit, delay screening until their 50s or later, and question whether they should participate in mammography (Conway-Phillips & Millon-Underwood, 2009; Dean et al., 2014; Hale & deValpine, 2014).

Health disparity among different populations is a growing concern in the United States (US), placing some communities at a disadvantage in shouldering disease burden (Byrne, Glasgow, & DeShields, 2011; Conway-Phillips & Millon-Underwood, 2009; Feldstein et al., 2011). Despite improvements seen by lowered cancer mortality nationally, continued gaps exist between segments of the population, with the majority of cancer burden among racial and ethnic minorities. For example, African American women cancer mortality rates have declined more slowly in comparison to white women (American Cancer, 2013b, 2014). Gaps in cancer mortality for racial and ethnic minorities are due primarily to obstacles in cancer prevention and detection (American

Cancer, 2013a, 2014; O'Malley, Sheppard, Schwartz, & Mandelblatt, 2004; Rawl, Champion, Menon, & Foster, 2000).

A major goal of population health is improving the overall health of a population, which is accomplished by assessing health behaviors over longer periods of time; what is considered over the life course (Kindig & Stoddart, 2003; Kindig, 2007). Population health is the study of health determinants or variables that impact individuals of a group and the distribution of health outcomes within the population. Therefore, assessing health behavior adherence long term provides a more tangible evaluation of overall population health, than health behavior evaluation of a single point in time (Andersen, 1995; Kindig & Stoddart, 2003; Kindig, 2007). Identification, evaluation, and analysis of the determinants of health and their impact are a vital trajectory towards optimal health outcomes (Andersen, 1995; Evans & Stoddart, 1990; Services, 2000, 2011a). The multiple determinants of health are: social environment, biology, behaviors, physical environment, and access to health services (Evans & Stoddart, 1990; Services, 2011a). Conceptualization of multiple variables that may impact or predict screening mammography adherence is paramount to greater mammography understanding, as well as health improvement (Andersen, 1995; Evans & Stoddart, 1990; Kindig & Stoddart, 2003).

3.2.1 Mammography Adherence

Adherence to screening guidelines often refers to consistently following a guideline supported by a specific health organization. Mammography adherence has also been used to describe having had a recent mammogram within the past two years, as well as having an initial mammogram (Clark et al., 2003; Gierisch, Reiter, Rimer, & Brewer,

2010; O'Neill et al., 2008). As an example, if a woman received her first mammogram at 40, and she continued to receive them annually, she would be considered adherent to the American Cancer Society (ACS) mammography guidelines; she would not be considered adherent to the ACS guidelines if she did continue following the annual guidance in subsequent years (American Cancer, 2013a; Smith et al., 2013).

Significant research concerning mammography utilization has addressed the existence of an initial mammogram – whether or not a women has ever had a mammogram, as well as recent mammogram (Clark et al., 2003; Mack, Pavao, Tabnak, Knutson, & Kimerling, 2009; Steele-Moses et al., 2009). Both initial and recent mammography, although important, provide limited information on health behaviors over time, as they only provide the existence of a single health behavior activity (Kindig & Stoddart, 2003; Kindig, 2007). It is vitally important to assess mammography adherence over a longer period of time aside from merely the first (initial) and second utilization, to better understand individual and population health patterns and trends (Breen & Meissner, 2005a; Gierisch, Reiter, et al., 2010).

Much of the literature before 2000 used the term ‘adherence’ to describe a woman’s compliance with screening mammography recommendations as defined by having an initial mammogram at the recommended age. The health literature after 2000 has used several terms to describe ‘adherence,’ many with slightly different meanings: mammography maintenance, sustained mammography, mammography utilization, regular mammogram, interval and repeat mammogram, and screening compliance (Marchi & Gurgel, 2010; O'Malley, Forrest, & Mandelblatt, 2002; O'Neill et al., 2008; Purc-Stephenson & Gorey, 2008; Rakowski et al., 2006; Smith-Bindman et al., 2006).

Until recently, little research has addressed mammography adherence, or what could be considered as successive on-schedule mammography screening over time (two years and greater). Consequently, without standard terminology to describe successive on-schedule mammography screening over time, ambiguity and varying definitions permeate, to include difficulty in comparing research study methodologies and results (Clark et al., 2003; O'Neill et al., 2008; Phillips & Wilbur, 1995; Phillips, Kerlikowske, Baker, Chang, & Brown, 1998). Therefore, a standard way to label, measure, and describe consistent adherence to recommended breast cancer screening recommendations should exist (Breen & Meissner, 2005a; Clark et al., 2003; Gierisch, Earp, Brewer, & Rimer, 2010; Gierisch, Reiter, et al., 2010; Kearney & Murray, 2009; Phillips, Morrison, Andersen, & Aday, 1998).

It is proposed that mammography adherence be thought of as short-term or long-term adherence to recommended screening guidelines. Short-term adherence is proposed as screening of at least twice consecutively on a routine schedule. Long-term adherence is proposed as "sticking to" screening guidelines of three or more consecutive occasions. For the purpose of this study, both annual and biennial screening guidelines will be used, gaining a better understanding of adherence regardless of the recommended guideline followed. The term long-term adherence provides both an operational and conceptual idiom that allows evaluation and analysis of health success (Kindig & Stoddart, 2003; Kindig, 2007; O'Neill et al., 2008).

Past research has provided insight as well as contradictions into generalized predictors and barriers to mammography screening in women 50 years of age and older, to include: age, race, marital status, income, level of education, health care access and

insurance, prior breast problems, and participation in other healthcare preventive services (O'Neill et al., 2008; Phillips, Kerlikowske, et al., 1998; Rakowski et al., 2006; Stoddard et al., 1998). Although helpful, there is a more recent need to further address and analyze mammography behaviors by race, age, and, individualized medical requisite (Conway-Phillips & Millon-Underwood, 2009; Jatoi & Anderson, 2010b; Shippee et al., 2012). The need to analyze predictors and barriers to mammography adherence by African American women have been associated with many factors – cultural attitudes, health care access, socioeconomic status, cost, failure of health provider to recommend mammography, lack of insurance, cancer fear, mammography misconception, and health provider trust (Champion et al., 2004; Champion et al., 2008; Conway-Phillips & Millon-Underwood, 2009; O'Malley et al., 2004; Schueler, Chu, & Smith-Bindman, 2008). Yet, there is still a greater need to further explore and verify predictors in younger women in their 40s, particularly in African American women in efforts to help mitigate breast cancer disparity and improve overall breast health. Although mammography utilization has remained high since 2005, the lowest utilization numbers are for women 40-49 years of age at 62.3%, which causes some concern and heightened need for further evaluation (American Cancer, 2013a; Conway-Phillips & Millon-Underwood, 2009; Duffy et al., 2010; Gierisch et al., 2009).

3.2.2 Breast Cancer Health Disparity

Breast cancer, accounts for 15% of all US cancer deaths, and is the leading site of new cancer cases and the second leading cause of cancer death for African American women (American Cancer, 2013a, 2013b; Smith et al., 2013). A percentage of the higher breast cancer mortality seen in younger African American women is due to aggressive

tumor morphology, while other gaps in cancer mortality for racial and ethnic minorities can be attributed to obstacles in cancer prevention and detection (American Cancer, 2013a; Andersson & Janzon, 1997; Bjurstam et al., 1997; Conway-Phillips & Millon-Underwood, 2009). Although African American women have a lower incidence of breast cancer than White women overall, among younger women under 45 years of age, African American women have a higher incidence of breast cancer than Whites (American Cancer, 2013a). Therefore, greater depth of understanding is needed into mammography behaviors of younger high risk African American women.

Health disparities arise from many factors, including unequal socioeconomic factors, culture differences, discrimination, and health system barriers that influence access to cancer prevention and treatment services (American Cancer, 2014; Calvocoressi et al., 2004; Finney, Tumiel-Berhalter, Fox, & Jaen, 2006). Mitigating health disparities is a major concern as evidenced by its inclusion in national health benchmarks within Healthy People 2020 and the National Prevention Strategy, which identify ideal population health improvement targets (Services, 2011a, 2011b). Healthy People is a series of various 10-year health objectives used to monitor the health progress of the United States (US). The latest initiative, Healthy People 2020, has a goal of decreasing health disparity and promoting health equity among all ages (Services, 2011a). One way of ascertaining the status of health disparity and health equity, as well as goal progression, is by evaluating health behaviors over an extended period of time (Kindig & Stoddart, 2003).

The reasons for breast cancer health disparity are not fully understood, but may partly be attributed to differences in knowledge, attitudes, and behavior around breast

health in young African American women. Mammography is often recommended for women considered average risk beginning at age 40 or 50, but many African American women lack knowledge about their own risk, and consequently present in later stages of cancer development (Byrne et al., 2011; Conway-Phillips & Millon-Underwood, 2009; Dailey, Kasl, Holford, & Jones, 2007; Feldstein et al., 2011). This lack of information about screening options and less breast cancer awareness, or acknowledgment of risk, may, in many instances, serve as a catalyst for increased breast cancer mortality. In order to effectively address the reality of these health disparities, it's important to understand the controversy around screening, the impact of individual cancer risks, and how the current climate can allow for healthy debate, without jeopardizing advancements in health equity.

3.2.3 Mammography Controversy

The main issue that has fueled the controversy is the lack of agreed upon evidence surrounding randomized clinical trial (RCT) evidence supporting mammography in women in their 40s. Of the nine RCTs addressing mammography efficacy, only the 1960 Breast Cancer Screening Project of the Health Insurance Plan (HIP) of New York was completed in the US, and of the 31,000 participants in the study group, approximately 20% were African American (it is not clear how many African American women were also in the control group of 31,000) (Fink, Shapiro, & Roester, 1972; Shapiro, Strax, & Venet, 1971). The two trials (the Canadian National Breast Cancer Screening Study, and the UK Age Trial) that have been conducted to address mammography efficacy for women in their forties, have indicated that should women begin screening in their 40s, benefit may not be seen until 12-14 years. Consequently, the Canadian and UK RCTs

indicate that women who begin screening in their 40s would already be in their 50s before any benefit may be seen (Bjurstam et al., 1997; Bjurstam et al., 2003; Elwood, Cox, & Richardson, 1993; Hendrick, Smith, & Rutledge, 1997; Miller, To, Baines, & Wall, 2002; Nystrom & Larsson, 1993; Tabar, Duffy, & Chen, 1996; Tabar et al., 1995). The HIP trial results were the forbearer for the initiation of mass screening in the U.S., because this trial demonstrated a reduction in breast cancer mortality for women screened, versus those who did not screen (Shapiro, 1997; Shapiro, Venet, Strax, Venet, & Roeser, 1985). The datedness of the HIP trial has raised questions concerning its methodology, power, and screening technologies, when comparing it to more recent trials. For younger women specifically, mammography clinical trials have shown far less of a benefit for women in their 40s than in their 50s. Nevertheless, many organizations, researchers, and clinicians maintain that screening mammography may have benefit in the broad context of detecting breast cancer in its precocious stage of development in some women, allowing early cancer treatment and cure than would otherwise be accomplished if cancer was detected later (Duffy et al., 2010; Hale & deValpine, 2014; Humphrey, Helfand, Chan, & Woolf, 2002; Tabar et al., 2011; U.S. Preventive Services Task Force, 2016).

Breast cancer is not a homogenous disease, but a heterogeneous disease consisting of many facets, with differences based on the type of cells, location of the cancer, and invasiveness of the disease (Habel & Stanford, 1993; Stanford & Greenberg, 1989). Because of this, there is not a single screening modality that detects all types of breast cancers at equal levels of specificity and sensitivity (Kolb, Lichy, & Newhouse, 2002; Tilanus-Linthorst et al., 2002). Breast cancer morphology is also complex, with different

presentation and characteristics among women. Tumors are typically described by their level of expressed estrogen. High- grade estrogen negative (ER-) cancers do not express estrogen, and alternatively, low-grade estrogen positive (ER+) cancers do express estrogen (Habel & Stanford, 1993; Stanford & Greenberg, 1989). White women have a higher incidence of ER+ breast cancers, which are slow growing, lending itself to better mammography detection (Howlader et al., 2013; Stanford & Greenberg, 1989). Conversely, ER- cancers are fast-growing, and are most prevalent in younger African American women (< 50 years of age) (Gapstur, Dupuis, Gann, Collila, & Winchester, 1996; Ooi et al., 2011; Stanford & Greenberg, 1989). Therefore, because of ER- tumor histological make-up, and its aggressive growing nature, mammography does not detect ER- tumors as readily as ER+ tumors, which does create detection challenges (Foulkes, 2008; Tilanus-Linthorst et al., 2002).

The controversy is further complicated by the "collateral effects" of mammography screening that don't address its effectiveness in detection, but rather harm caused by the test itself. Although mammography has been shown to detect cancer early and save the lives of some women who use it, it has also caused undue harm to many women due to false positives, over-diagnosis, lead-time, and low-dose radiation exposure, causing unnecessary further testing and biopsies, and the needless exposure to radiation (Beemsterboer et al., 1998; Bleyer & Welch, 2012; Jatoi & Anderson, 2010b). These lesser perceived benefits, coupled with the theoretical risk of inducing breast cancer in younger women who already have a hereditary predisposition for breast cancer, cause significant concern, as it may be used without assessing individualized risk (Clark, 2004; Foulkes, 2008; U.S. Preventive Services Task Force, 2016). Mammography may

not be most beneficial for younger minority women, due to elevated associated risks, but, clinicians cannot afford to dismiss mammography in it's entirely for this population, but figure out ways to address its shortcomings, while also mitigating the risks in the younger at-risk population (Bjurstam et al., 2003; Shapiro, 1977, 1997).

3.2.4 Individual Cancer Risk

Recently, a risked –based or risk stratification approach to mammography utilization has been advocated, which would help women ascertain their individual breast cancer risk using prediction models by including various factors such as breast density, menopause status, and age (Bertrand et al., 2013; Kerlikowske et al., 2013). The Gail risk score is one such risk-based tool that can be used to determine a woman's 5-year and lifetime individual risk of developing breast cancer (National Institute of Health, 2011). Although not routinely utilized along with mammography guidance, a risk-based approach to screening would provide women guidance on if and when they should engage in mammography, and the most appropriate interval (Fletcher, 2011; Kerlikowske et al., 2013). Mammography is promoted as an intervention, if practiced early and routinely within the context of individualized assessment, could help equalize breast cancer health disparity and decrease breast cancer mortality (Pace & Keating, 2014).

It is understood mammography is one tool, often accompanied by other detection modalities (i.e. ultrasound, magnetic resonance imaging, clinical breast exam, etc.), that may be used in detecting breast cancer early (Fletcher, 2011; Kolb et al., 2002; Patterson & Noroozian, 2012; Taylor, 1992; Tilanus-Linthorst et al., 2002). Developments in knowledge about the disease suggest that mammography, along with individualized risked-based approach, may be more ideal as an individualized tool than as a mass

screening tool (Fletcher, 2011; Kerlikowske et al., 2013; Pace & Keating, 2014). Utilizing the knowledge gained through decades of mammography utilization, along with the newer knowledge on risk-based modeling, and the consideration of newer screening adjunct modalities, solidifies the premise that mammography may still have a place in the spectrum of breast cancer early detection in younger and older women. The challenge is ascertaining through further research, its most appropriate place in the spectrum of both mass and individualized decisions.

3.3 The Behavioral Model for Vulnerable Populations

The Behavioral Model for Vulnerable Populations is derived from Andersen's original Behavioral Model developed in the 1960s to study access to medical care. The model was later expanded by Andersen and Aday in 1974 to include an elaboration of health service measures, which also identified four specific characteristics that are derived from health policy: health delivery systems, the population at risk, consumer satisfaction, and utilization of health services (Aday & Andersen, 1974). The original model has gone through many revisions since its development to more adequately reflect advances in the science, and to incorporate a portrayal of multiple influences that may impact health status (Andersen, 1995). The original and updated Behavioral models identify population characteristics variables (predisposing, enabling, and need factors) as predictors of personal health behavior (Aday & Andersen, 1974; Andersen, 1995; Gelberg et al., 2000).

Within the Behavioral Model, health behaviors are impacted by population characteristics- predisposing, enabling, and need variables. Predisposing variables are social-demographic, genetic, and cultural and community status variables, which may

describe one's propensity to participate in health services (Aday & Andersen, 1974; Andersen & Urban, 1998). Enabling variables are an individual or population's own personal resources, and directly impacts their ability to access and use health services (Aday & Andersen, 1974; Andersen, 1995). Need variables are an individual or population's self-rated and evaluated view of their health conditions (Aday & Andersen, 1974; Andersen & Urban, 1998; Gelberg et al., 2000). Participation in personal health practices, such as adherence to self-care or safe or unsafe behaviors is influenced by population characteristics. The model conceptualizes the complex interactions and importance of a population's predisposing, enabling, and need characteristics on their health behavior practices.

The Behavioral Model for Vulnerable Populations provides an explorative perspective that encapsulate domains, although not exclusive, are unique within vulnerable populations, which are not oftentimes considered within the context of the original and subsequent Behavioral Model updates. Therefore its utilization provides an optimal avenue in guiding this study on mammography adherence in African American women. The Behavioral Model for Vulnerable Populations depicts that population characteristics predict another in a linear fashion (predisposing predicts enabling, and enabling predicts need), and together collectively, explain health behaviors and outcomes (Gelberg et al., 2000). For this study, the model was modified to conceptualize both the impact that population characteristics have in a linear fashion (predisposing on enabling; and predisposing and enabling on need), as well as their impact individually on mammography adherence. In addition, the model was also modified to conceptualize the

collective impact Gail risk scores have as part of the collective predisposing variable, as well as their impact individually on mammography adherence.

Gelberg et al. (2000) originally tested the Behavioral Model for Vulnerable Populations in a prospective study (N=363) who were homeless, to identify predictors of health service utilization and physical health outcomes. Physical health outcomes included conditions of immediate impact (leg/skin/foot problems and vision impairment), as well as more serious long-term consequence problems (tuberculosis exposure and high blood pressure) (Gelberg et al., 2000). Study participants were followed longitudinally for up to eight months if they met one of the study conditions. Results indicated the health status for the four physical health outcomes improved over time, and were predicted by a number of variables, and most prominently, having access to care. In this homeless population, mental health, residential history, substance abuse, victimization history, and competing needs affected the use of health services and health outcomes. Notably, the homeless adults were willing to use health services if they believed it was important (Gelberg et al., 2000). Additional testing of the model was recommended with other vulnerable populations.

The Behavioral Model for Vulnerable Populations has been used in various studies to predict health behaviors among different vulnerable populations. Bazargan, Farooq, and Baker (2004) used the model to examine correlates of adherence to cervical cancer screening among publicly housed Hispanic and African American women. They identified continuity of care, affordability, and recommendation from a health care provider as significant predictors to having an up-to-date cervical cancer screen (Bazargan, Bazargan, Farooq, & Baker, 2004). Austin, Andersen, and Gelberg (2008)

used the model to describe ethnic differences in the correlates of mental distress between population characteristic (predisposing and enabling) variables among African American, Hispanic, and White homeless women. The model's utilization in vulnerable populations involving various ethnic groups, including African American women, has identified contributing factors to a health behavior or outcome, that differ among ethnic groups, which signify the importance of cultural competence and assessing outcomes of interest separately for each ethnic group (Austin et al., 2008; Bazargan et al., 2004; Fernandez & Morales, 2007; Gonzalez et al., 2012; Harcourt et al., 2013; Owusu et al., 2005).

Race and ethnicity were further explored using the model to examine cervical cancer screening among minority women (Hispanic American, Hispanic immigrant, and African American). Non-Hispanic Whites were screened more often than minority women. African American women were less likely to have cervical cancer screening than Non-Hispanic White women, but more likely to have screening than the Hispanic groups (Owusu et al., 2005). In a study by Gonzalez, Castaneda, Mills, Talavera, Elder, and Gallo (2012), the model was used in a self-reported cancer screening study (breast, cervical, and colorectal) in Mexican-American women, which showed that having a regular source of care was a significant predictor to screening adherence. Additionally, the study showed that principle correlates for cancer screening adherence was sticking to other preventive services.

Fernandez and Morales (2007) identified in their study of cervical and breast cancer screening utilization in Texas Mexican American women, that most differences in screening were due largely to socioeconomic characteristics and access barriers. Harcourt et al. (2013), used the model to evaluate breast and cervical cancer screening by

African Immigrant women living in Minnesota, which showed screening barriers to include duration of residence in US and ethnicity. Utilization of the Behavioral Model for Vulnerable Populations has shown sound applicability for utilization across ethnicities, as well as in evaluating correlates and predictors of cancer screening in women (Fernandez & Morales, 2007; Gonzalez et al., 2012; Harcourt et al., 2013; Owusu et al., 2005). However, the model has not been used extensively to evaluate breast cancer screening in African American women, which creates an opportunity for further exploration.

Research using the model in other vulnerable populations has demonstrated a critical need for assessing outcomes of interest separately among ethnic groups, helping to inform needed culturally, competent, and appropriate care. The model provides further insight into characteristics that may predict or serve as barriers to sustained mammography adherence in African American women in their 40s. For the proposed study, a modified Behavioral Model with variables from the Behavioral Model for Vulnerable Populations that are reflective of a vulnerable population will be utilized. The following selected variables will be used: predisposing (age, race, marital status, Gail risk score, and homelessness variables); enabling (regular source of care, income, transportation, and insurance variables); and need (perceived health status variable). These selected variables will be tested to determine their relationship on mammography adherence health behavior. The model used to guide this study is depicted in

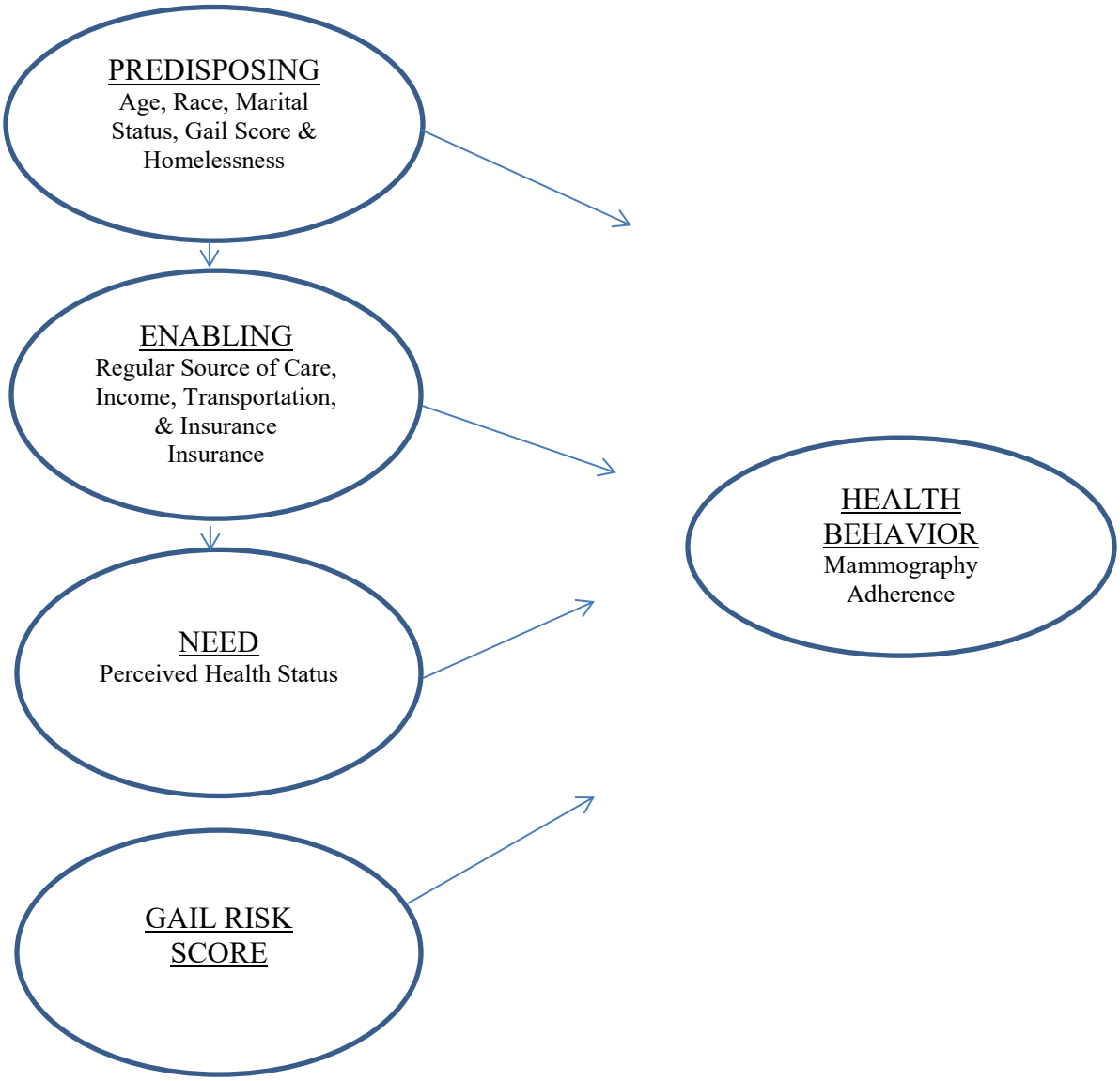


Figure 3.1 Modified Behavioral Model depicted with proposed study variables.

3.4 Identification of Study Variables

Figure 3.1 identifies the variables that will be used in the proposed study, as guided by a Modified Behavioral Model of Vulnerable Populations. The selected predisposing variables are age, race, marital status, and homelessness. Enabling variables are regular source of care, income, transportation, and insurance. The selected need

variable is perceived health status, and mammography adherence is the selected health behavior. Each of the variables and their relationships to one another as postulated in the model, are described below.

3.4.1 Mammography Adherence

The Healthy People initiative has provided a health odometer for the U.S. for the past 30 years, with the goal of improving overall health and wellness. However, the mammography screening objective only evaluates recent mammography – a singular episode in time (Department of Health and Human Services, 2012). This singular health behavior does little to evaluate health behaviors over time, which is important to ascertaining population health improvement. In understanding the mammography screening decisions of women, adherence should not be evaluated as a singular dichotomous episode in isolation. Instead, assessing health behaviors over an extended period of time provides a much better gauge to evaluate health improvements (Kindig & Stoddart, 2003; Kindig, 2007; O'Neill et al., 2008).

Adherence to screening guidelines often refers to consistently following the guideline supported by a specific health organization. There is no clear and agreed upon way to define and conceptualize adherence to screening guidelines. A standard way to label, measure, and describe consistent adherence to the recommended breast cancer screening recommendations is necessary to create a solid foundation for both research and practice (Breen & Meissner, 2005a; Clark et al., 2003; Gierisch, DeFrank, et al., 2010; Gierisch, Earp, et al., 2010; Gierisch, Reiter, et al., 2010; Phillips, Morrison, et al., 1998). Since the measurement of mammography adherence can vary, depending on how it is operationalized, it is beneficial to look at two different elements of mammography

adherence – short-term and long-term. It is proposed that short-term mammography adherence refer to at least two episodes of consecutively sticking to a recommended screening guideline (Blackman, Bennet, & Miller, 1999; Rakowski et al., 2004; Rakowski et al., 2006). It is also proposed that long-term mammography adherence refer to three or more episodes of consecutively sticking to a recommended screening guideline. In a study by Russell, Champion, and Skinner (2006), evaluating psychosocial factors related to repeat mammography, in one of the first times the term long-term screening was utilized, the term reflected mammography utilization over a 5-year period (Russell, Champion, & Skinner). In their study, women's participation in long-term screening was associated with greater knowledge about screening and fewer screening barriers (Russell, Champion, et al., 2006). For this study, short-term adherence is proposed as screening of at least twice consecutively on a routine schedule. Long-term adherence is proposed as "sticking to" screening guidelines of three or more consecutive occasions. Both annual and biennial screening guidelines will be used in this study, gaining a better understanding of adherence regardless of the recommended guideline followed.

3.4.2 Age

Breast cancer is the most common cancer among women, and often the most likely cause of cancer death (American Cancer, 2013a; Smith, Cokkinides, & Eyre, 2007). As women age, her lifetime probability of getting breast cancer increases, therefore, age, an immutable factor, was selected as a key population characteristic to stratify the study population, with primary focus on women in their forties (American Cancer, 2013a). The odds of breast cancer increases with age, particularly over the age

of 50, yet women younger than age 50 do get breast cancer in alarming numbers (American Cancer, 2013a, 2014). According to the American Cancer Society (2014), of the 288,130 cases of breast cancer for all aged women, 64,670 are in women under 50 years of age (American Cancer, 2013a, 2014; Smith et al., 2007). For younger African American women who present with breast cancer in their 40s or younger, it is often an aggressive form (American Cancer, 2013b; Conway-Phillips & Millon-Underwood, 2009).

There are conflicting reports surrounding whether or not age is a predictor of mammography utilization (Augustson, Vadaparampil, Paltoo, Kidd, & O'Malley, 2003; Nash, Chan, Horowitz, & Vlahov, 2007; Phillips, Kerlikowske, et al., 1998; Russell, Champion, et al., 2006). In a study by Russell and colleagues (2006) evaluating psychosocial factors related to repeat mammography specifically in African American women >= 50 years of age, there were no significant differences noted by age (Russell, Champion, et al.). A number of studies have indicated that women 50-74 years of age are more adherent to mammography screening in comparison to women in their 40s (Calvocoressi et al., 2004; Nash et al., 2007; Rakowski et al., 2006). On the other hand, other studies indicate that women in their 40s adhere to screening more often than women 50 years of age and older (Calvocoressi et al., 2004; Calvocoressi, Sun, Kasl, Claus, & Jones, 2008; Rawl et al., 2000). Despite conflicting study results, age is shown to be a predictor of mammography utilization (Hiatt, Klabunde, Breen, Swan, & Ballard-Barbash, 2002; Hiatt et al., 2001; Hiatt et al., 2008; Mandelblatt et al., 1999; Nash et al., 2007; Phillips, Kerlikowske, et al., 1998).

Age has also been noted as a predictor of other cancer screenings such as cervical cancer, while participating in other prevention screening services (Jennings-Dozier & Lawrence, 2000; O'Malley et al., 2002; O'Malley, Mandelblatt, Gold, Cagney, & Kerner, 1997; Rawl et al., 2000). Of the socio-demographic variables, age has routinely correlated most strongly with cancer screening and adherence, as well as serving as a significant predictor for mammography utilization (Evans et al., 1998; Finney et al., 2006; Hiatt et al., 2002; Nash et al., 2007; Phillips, Kerlikowske, et al., 1998; Welch, Miller, & James, 2008). Additionally, mammography has been found to have significant utilization or adherence differences between age groups, with lower utilization in older women as compared to younger women, with age and race having a significant interaction (Finney et al., 2006; Hiatt et al., 2002; Rawl et al., 2000).

There is a dearth of knowledge surrounding mammography adherence behaviors of African American women in their forties, which demands further exploration. Mammography ambiguity exists by younger women due in part to the mammography controversy, which is centered upon mammography's benefit and efficaciousness versus risk, coupled with the changing and varied recommended screening guidelines that either recommends screening for average risk women beginning at 40 or 50 years of age. A guideline change by the U.S. Preventive Services Task Force (USPSTF) in 2009 recommended that average risk women begin screening at 50 versus 40 years of age, has been prompted by conflicting bodies of evidence surrounding the benefits of screening, and questionable lives saved and decreases in mortality (Nystrom & Larsson, 1993; Tabar et al., 1995; Tabar et al., 2011; U. S. Preventive Services Task Force, 2009). Although screening this younger population has shown benefit in smaller studies, there

has been lack of statistically significant benefit in the eight RCTs, showing no benefit until 12-14 years after initiating screening (Andersson & Janzon, 1997; Elwood et al., 1993; Nystrom et al., 1993; Tabar et al., 2011). Consequently, with the numerous conflicting results as to whether or not age is a significant predictor for mammography adherence, there is credence for including age as a variable needing further research.

3.4.3 Race

Breast cancer is not a homogeneous disease, and therefore may present differently in women of different ethnicities (Habel & Stanford, 1993; Stanford & Greenberg, 1989). Because of this, breast cancer clinical presentation, psychosocial and behavioral practices (screening) differences must be further explored so that clinical and public health strategies can ensure optimal breast health among ethnicities (Andaya et al., 2012; Gelberg et al., 2000; Jatoi & Baum, 1993). In a meta-analysis by Purc-Stephenson and Gorey (2008) of mammography adherence articles from 1990-2006, they found evidence suggesting that screening differences persist among ethnic minority women (Purc-Stephenson & Gorey). As a consequence, there are significant breast cancer health disparities by race in the United States (American Cancer, 2013a, 2014). White women have the greatest breast cancer incidence, yet African American women have higher mortality from the disease, which warrants further exploration (American Cancer, 2013a, 2014; Conway-Phillips & Millon-Underwood, 2009).

Breast cancer incidence for other minority races (American Indian, Asian American/ Pacific Islander, and Hispanic/Latina) has remained lower than that of both Whites and African American over the past 15 years (American Cancer, 2013a). Overall, minority women shoulder a disproportionate disease burden – higher rates of breast

cancer, disease mortality, and obstacles to prevention and detection (American Cancer Society, 2013a). For women in their 40s, African American women disproportionately shoulder the disease burden, due in part to the aggressive nature of the breast cancer as well as obstacles in cancer prevention and detection (American Cancer, 2013a, 2013b; Andersson & Janzon, 1997; Bjurstam et al., 1997; Conway-Phillips & Millon-Underwood, 2009; Rawl et al., 2000).

In Breen and Kessler's study comparing multi-year (1987 and 1990) National Health Interview Survey results, mammography screening rates differed by race, with African Americans participating in more mammography (1994). Race has been a prominent mammography screening predictor variable in several studies, although this result conflicts with other studies where race was not a good predictor of mammography screening (Breen & Kessler, 1994; Breen & Meissner, 2005a; Breen, Rao, & Meissner, 2010; Calvocoressi et al., 2004; Hiatt et al., 2002; Owusu et al., 2005; Phillips, Kerlikowske, et al., 1998). In Rawkowski and colleague's (2006) study of correlates of repeat mammography in women 45-75 years of age using 2003 Health Information National Trends Survey (HINTS) data, surprisingly, race was not statistically significantly associated with repeat mammography (Rakowski et al.). Nevertheless, studies do agree that cancer screening behaviors differ by race (Dailey, Kasl, Holford, Calvocoressi, & Jones, 2007; Evans et al., 1998; Foulkes, 2008; Gapstur et al., 1996; Howlader et al., 2013).

Mammography is often associated with anxiety, pain, and fatalism, which are mammography barriers in African American women (Champion & Springston, 1999; Halbert et al., 2006; Hiatt et al., 2002; Rimer et al., 1996; Watson-Johnson et al., 2011;

Wilson et al., 2009). African Americans oftentimes have this fatalistic approach to screening, believing that if cancer is found, death is imminent (Champion & Springston, 1999; Rimer et al., 1996; Russell, Champion, et al., 2006). Younger African American women, who present with breast cancer, may have an aggressive form of cancer, which may avert mammography detection due to its fast growth between screening schedules (Stanford & Greenberg, 1989). Therefore, in addition to mammography screening, education on individual cancer risk is needed, particularly for younger women, that could provide them tailored guidance on when to start screening as well as suggested interval between screenings (Bertrand et al., 2013; Bleyer & Welch, 2013; Kerlikowske, 2012; Kerlikowske et al., 2013).

Mammography does still have a role in early screening in younger African American women as well as in other minority women. Although race has been shown is several studies not to be a statistically significant predictor of mammography utilization, there are differences in utilization by race due in part to a variety of factors such as cultural beliefs and religion (Chagpar, Polk, & McMasters, 2008; Champion et al., 2008; Champion & Springston, 1999; Fox et al., 2004; Gierisch et al., 2009; Meissner, Breen, Taubman, Vernon, & Graubard, 2007; O'Malley et al., 2002). For this study, ethnicity will be used to denote race (non-Hispanic White, non-Hispanic African American, and Hispanic) and/ or the terms may be used interchangeable. Further exploration into mammography screening behaviors by ethnicities is needed to mitigate breast cancer health disparities and develop strategies to improve overall breast health long-term.

3.4.4 Living Conditions

Barriers to mammography adherence by African American women have been associated with many factors to include: cultural attitudes, healthcare access, socioeconomic status, cost, failure of health provider to recommend mammography, lack of insurance, cancer fear, mammography misconception, and health provider trust (Conway-Phillips & Millon-Underwood, 2009; Hiatt et al., 2001; O'Malley et al., 2002; O'Malley et al., 2004; Ooi et al., 2011; Purc-Stephenson & Gorey, 2008; Schueler, Chu, & Smith-Bindman, 2008). Living conditions are a component of the overall socioeconomic status variables, which provides insight into an individual's social/family status and financial resources (Kindig & Stoddart, 2003; Kindig, 2007). For this study, living conditions are operationalized using marital status and homelessness. Since the selected variables of marital status and homelessness, are closely related socioeconomic conditions, they are discussed together.

Living conditions and homelessness are variables that denote vulnerability (Gelberg et al., 2000). However, Gelberg, Andersen, and Leake (2000) tested the utilization of the Behavioral Model for Vulnerable Populations in a homeless population, and found that one's homeless status did not deter them from obtaining healthcare (Gelberg et al.). Availability of a support system, such as spouse, or extended family in the home are associated with having greater health utilization of mammography (Calle, Flanders, Thun, & Martin, 1993; Dean et al., 2014; Katz et al., 2009; Russell, Champion, et al., 2006). Lack of spouse in the home and homelessness have been shown to affect mammography utilization, by offering competing demands on time, resources, and finances (Conway-Phillips & Millon-Underwood, 2009; Phillips & Wilbur, 1995;

Russell, Perkins, Zollinger, & Champion, 2006; Steele-Moses et al., 2009; Strzelczyk & Dignan, 2002; Welch et al., 2008).

Familiar companionship, such as that exhibited by the presence of a spouse, provides reciprocal concern and caring that oftentimes leads to women being reminded to conduct their preventive screenings. Forgetting to make an appointment is an identified barrier to screening, as well as simply being too busy(Gierisch et al., 2009). A spouse and/or close-knit family provides the fundamental upstream of the social determinant; the building blocks of human activity(Hiatt & Breen, 2008). Therefore, women who are unmarried or those with a lack of social support are less likely to undergo screening (Dean et al., 2014; Keating, Landrum, Guadagnoli, Winer, & Ayanian, 2006; Lopez, Khoury, Dailey, Hall, & Chisholm, 2009).

Homelessness will be assessed to determine if this status over the past year has had an effect on mammography adherence. Homelessness is a vulnerable population variable that provides insight into women's past or current living conditions. According to Barry and Breen, economically troubled or medically underserved communities increase the likelihood of late-stage cancer diagnosis (2005). Because of the distressed nature of both the community and individual resources, women may delay screening or do not participate at all.

Marital status and homelessness provide valid windows into the challenges and opportunities facing African American women, as they are also a vulnerable population. A clearer understanding of the roles that marital status and homelessness play in mammography adherence of minority women, and specifically younger African American women is needed to determine their individual and synergistic effect.

3.4.5 Economic Resources

The economic resource variables that will be evaluated in this study are income and insurance. Both variables have been shown in numerous studies to impact mammography utilization (Hiatt et al., 2001; O'Malley et al., 2002; Schueler et al., 2008). Financial barriers can be protuberant, causing healthcare to become secondary to ensuring basic needs are met. Adams, Becker, and Colbert (2001) found that cost was one of the most important reasons African American women did not have mammograms. As an available resource, health insurance aids in mitigating the cost barrier, in an attempt at making mammography affordable, as is seen with mammography vans and other affordability program (Adams et al., 2001; Sung, Alema-Mensah, & Blumenthal, 2002). Having insurance was the strongest predictor of low mammography use in a study evaluating cancer screening in California underserved women (Hiatt et al., 2001). Although the Affordable Care Act should help mitigate many health insurance barriers, it does not provide universal health care coverage to all in the US, and therefore some may still be affected by inadequate or no health coverage for mammography.

Having insurance is a key factor that directly impacts one's ability to pay for and access medical services, as well as follow up interventions, and has been significantly related to utilization of medical services (Mandelblatt et al., 1999; Sung et al., 2002). Leong-Wu and Fernandez (2006) looked at correlates of mammography in low-income Asian American women, and determined that health insurance was positively associated with adherence. Sung, Alema-Mensah, and Blumenthal (2002) looked specifically at inner-city African American women to determine associated factors for their failure to follow through with mammography after an education intervention, and lack of adequate

insurance was the associated barrier. In a study by Rakowski, Meissner, Vernon, Breen, Rimer, and Clark (2006) in identifying correlates of repeat mammography using 2003 HINTS data, having insurance was one of the strongest socio-demographic associations. Earlier using the 2000 National Health Interview Survey (NHIS) data, Rakowski and colleagues (2004) also identified not having insurance as a correlate for lowered mammography adherence in women 55-79 years of age.

Having an income equal to or greater than $35,000 is a significant predictor of annual breast screening (Dailey, Kasl, Holford, Calvocoressi, et al., 2007; Nash et al., 2007; Welch et al., 2008). Higher income associates very closely with the ability to afford health insurance, thereby mitigating the cost barrier. In a study to evaluate factors that affect adherence to screening in Latino women, lack of affordability was one of the most cited barriers (Mack et al., 2009). In a study to evaluate socio-ecological variables that impact screening, women living in areas with a higher percentage of poverty, were less likely to use mammography (Mobley, Kuo, Clayton, & Evans, 2009). Socioeconomic status along with age, are the socio-demographic variables that correlate most strongly with screening utilization (Hiatt et al., 2002; Welch et al., 2008). Therefore, income and whether a woman has health insurance to cover preventive health care are significant variables to consider.

In a study by Phillips and colleagues (1998), examining 1992 NHIS data for factors associated with women's adherence to mammography, they found that higher income, having fewer than three household members, participation in the decision to screen, and living in an area with no shortage of primary care providers were significant adherent factors. Additionally, in a study by Nash and colleagues (2007) that looked at

barriers to both cervical and breast cancer screening in New York City women 50 years of age and older, income, and employment status were statistically significantly associated with a likelihood of screening. In a study that evaluated factors associated with repeat screening, working for pay was significantly associated with repeat screening (Halabi et al., 2000). As income is a direct correlation to one's socioeconomic status, lower socioeconomic status is associated with delayed or absent utilization of primary or preventive healthcare overall, and is more pronounced in the African American community (Champion & Springston, 1999; Conway-Phillips & Millon-Underwood, 2009; Dailey, Kasl, Holford, Calvocoressi, et al., 2007; Greene, Torio, & Klassen, 2005). Despite the strong correlation of higher income to mammography utilization and adherence, Fox and colleagues (2004) in their study of mammography adherence predictors, income was not a statistically significant predictor. In their study, they surveyed multiethnic low income women 50 years of age and older to evaluate their screening experiences. Because of conflicting study results, as well as the need to learn more about the breast health behaviors of minority women, more research is needed in this area.

3.4.6 Regular Source of Care and Transportation

Access to healthcare services has been studied extensively over the past 50 years. Andersen and Aday's earlier Behavioral Model and the many studies that have tested the model, point to the fundamental need for access to healthcare to increase health utilization (Aday & Andersen, 1974; Andersen, 1995; Breen & Meissner, 2005b; Gelberg et al., 2000). Access to healthcare, as represented by the extensive research work of Andersen and Aday, point to the physical access of transportation that provides

fundamental entry to available healthcare services (Aday & Andersen, 1974; Andersen & Urban, 1998; Andersen, 1995).

In Russell, Champion, and Skinner's (2006) study of African American women to investigate their health beliefs associated with repeat mammography, as with other studies, having prior mammography, access to healthcare (a source of care and transportation), and greater knowledge of mammography, were associated with fewer perceived barriers to screening (Calvocoressi et al., 2004; Calvocoressi, Stolar, Kasl, Claus, & Jones, 2005; Halabi et al., 2000; Russell, Champion, et al.). A regular source of care and having a provider recommendation are primary predictors of mammography utilization (Adams et al., 2001; Breen & Kessler, 1994; Breen & Meissner, 2005b; Hiatt et al., 2002). Consensus in previous studies is that a regular source of care is a statistically significant predictor of mammography adherence (Gierisch et al., 2009; Rahman et al., 2003; Rakowski et al., 2004; Rakowski et al., 2006). Mandelblatt and colleagues (1999) evaluated breast and cervical cancer screening in multiethnic women ages 18-74, and determined that having a regular source of care significantly predicted screening utilization or recent mammography. A regular source of care provides entry into the healthcare system that allows ready monitoring of health care needs through continuity of care by a usual provider or provider group. A regular source of care is a significant predictor that increases utilization of cancer screening (Breen & Kessler, 1994; May, Kiefe, Funkhouser, & Fouad, 1999; Nash et al., 2007; O'Malley et al., 1997; Phillips, Kerlikowske, et al., 1998; Rakowski et al., 2004; Rakowski et al., 2006; Smith-Bindman et al., 2006).

Women need and require the dialogue with their health care provider to aid in their decision to commence and continue with screening (American Cancer, 2013a, 2014; Jatoi & Anderson, 2010b; Jatoi & Baum, 1993; Marshall, 2005). Conversely, with the changing screening recommendation and no consensus as to the need for women in their 40s to screen, women require the guidance and informed decision-making assistance from their health provider to better determine their level of risk, benefit, and need for mammography (Jatoi & Anderson, 2010a; Jatoi & Baum, 1993). Transportation is an important qualifier in mitigating access barriers. If women have transportation to healthcare services along with a regular source of health care, and insurance, they are more likely to follow through with obtaining mammography services.

3.4.7 Perceived Health Status

It is important to evaluate perceived health status, as it has a direct bearing on one's intention and eventual actualization of a health behavior. Several studies indicate that younger women often do not present for health services if they are healthy, but will show up if they perceive an ailment (Halabi et al., 2000; Hiatt et al., 2001; Mandelblatt et al., 1999; Mandelblatt & Yabroff, 2000). Conversely, other studies indicate that fear of finding breast cancer has deterred African American women from engaging in mammography (Champion & Springston, 1999; Russell, Champion, et al., 2006; Russell, Perkins, et al., 2006). Those engaging in preventive or health promotion screenings, or those who have a good perception of their health, are more likely to engage and continue with preventive screenings (Evans et al., 1998; Fox et al., 2004; Gierisch, Earp, et al., 2010; Gierisch et al., 2009). Alternatively, other studies have shown that women with a

high cancer risk also have a higher screening adherence (Gierisch et al., 2009; Halabi et al., 2000; Zapka, Stoddard, Maul, & Costanza, 1991).

Perceived health status also provides information on a population's vulnerability status (Gelberg et al., 2000). African American women may have cancer fatalism (the belief that once cancer is detected and diagnosed, death is inevitable), which may give them a false sense of having a better perceived health than their actual health status (Breen & Meissner, 2005a; Champion et al., 2006; Fair, Monahan, Russell, Zhao, & Champion, 2012). In a study by Fair and colleagues (2012), they tested the interaction of African American women's perceived risk of breast cancer and perceived benefits of mammography (Fair et al.). Those who had a high perceived risk and low perceived mammography benefit were reluctant to engage in mammography utilization and adherence (Fair et al., 2012). Additionally, studies that have evaluated other ethnicities, also point out that women who perceive their cancer risk as high, oftentimes do not adhere to mammography, due to fear of the results (Champion et al., 2008; Champion & Springston, 1999; Davis, Stewart, & Bloom, 2004). Therefore, it is paramount to determine the impact of perceived health status on mammography adherence.

The literature has provided both conflicting and agreeable support of variables that correlate, predict, and/or impact mammography screening. Select variables identified in the literature that will be tested in this study are: age, race, marital status, regular source of care, income, transportation, insurance, and perceived health status. The preponderance of this support in the literature is for women 50 years of age and older with a dearth of research on younger women in their 40s, and even less on younger minority women. The Behavioral Model has provided a broad and well utilized model for

testing healthcare access and health behavior utilization, including mammography adherence. The Behavioral Model for Vulnerable Populations has been used in exploring mammography, albeit less, it allows the inclusion of newer variables that are germane to vulnerable populations, allowing the model's expansion and exploration into challenges faced by vulnerable populations, like minorities. For this study, a modified Behavioral Model will be used, with the inclusion of a vulnerable specific variable, homelessness, from the Behavioral Model of Vulnerable Populations. As the path is laid for greater individualized healthcare screenings, of paramount exploration, is determining if a women's Gail risk score, might also impact mammography. Variables will be tested to determine their impact on mammography adherence in African American women in their 40s compared to women of other ethnicities and ages.

3.4.8 Gail Risk Score

The Gail risk score is an individualized breast cancer risk assessment tool that uses a women's personal and family medical and reproductive history to provide a 5-year and lifetime risk of developing breast cancer (Gail et al., 1989; Millstine, David, & Pruthi, 2014; National Institutes of Health, 2011). When used along with the advice of their healthcare provider, this tool can provide women insight as to when, how often, and if they should begin breast cancer screening. It is a free online tool that is readily available anytime. The tool assess the following areas: 1) medical history of breast cancer; 2) known breast cancer gene (BRCA1 or BRCA2); 3) age; 4) age at first menstrual cycle; 5) age of first live birth; 6) first-degree relatives who have or had breast cancer; 7) having had a breast biopsy; and 8) race (National Institutes of Health, 2011). Utilizing the Gail risk score in this study will provide valuable information as to its

impact on mammography adherence. The tool has been tested in large populations of both White and African American women, although further testing is needed to validate its findings in Hispanic women (National Institutes of Health, 2011). Knowledge gained through use of the Gail risk score may provide additional insight on whether risk tools such as the Gail risk score, should be promoted to better inform women of their breast cancer risk, and improve overall breast health. For this study, pre-calculated 2010 NHIS Gail risk scores will be used, with a target increased cancer risk of >=20% lifetime risk. The 20% risk was selected, as women with a >=20% elevated lifetime risk are considered high risk and advised to have both mammography and MRI screening modalities (Bosse et al., 2013; Kuhl et al., 2005; Patterson & Noroozian, 2012).

3.5 Research Design and Methods of Parent Data

3.5.1 The National Health Interview Survey

The NHIS is a continuous, multi-purpose nationwide survey of civilian non-institutionalized households of the United States (US) (Center for Disease & Prevention, 2011, 2012). The survey is conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), and population interviews are administered by the US Census Bureau. The survey was developed after the National Health Survey Act of 1956 provided for ongoing surveys and studies to obtain current statistical data on the health, illness, and health access status of the US population (Center for Disease & Prevention, 2010, 2011; Center for Disease Control and, 2012). The NHIS has been conducted since 1957, with approximately 35,000 – 40,000 households (75,000 – 100,000 individuals) annually (Botman, Moore, Moriarity, & Parsons, 2000; Center for Disease & Prevention, 2012). The size of the dataset helps to ensure optimal power. Data

from the NHIS has been a major source of data used to track national health objectives related to health status, health care access, and health disparities (Services, 2000, 2011a).

The NHIS permits the sampling of households and non-institutional quarters for the four main geographic regions as well as certain metropolitan and nonmetropolitan locations in all 50 states and the District of Columbia. Designed to generate a representative household sample, the NHIS is a stratified multistage area probability sample with the initial stage being the selection of 428 primary sampling units (PSUs) from the almost 1,900 geographically designed PSU in the US. The sample of PSUs is segregated into four panels so geographic regions can be compared. A PSU is a county, group of neighboring counties, or metropolitan statistical area. The second stage involves the selection of area segments, geographically defined with at least eight addresses, and permit area segments, which are made up of about four post-1990 addresses.

Since 1987, the NHIS has required that African American and Hispanic populations be oversampled in order to better estimate health, disease, and disability (Center for Disease & Prevention, 2012). The Asian population is now also oversampled (Center for Disease & Prevention, 2012). Each person in the sampled population has a selection probability greater than zero, and their weights are later adjusted based on age, sex, race/ ethnicity totals from the Census. All sampled addresses within the chosen segment are selected to be interviewed and all those aged 17 and over in the household, who are at home at the time, are asked to respond for themselves and/or any children or absent adults. A subsample of adults is selected to answer additional items on Sample Adult questionnaire. Information is gathered on socio- demographics, general health, mobility, and function, health behaviors, health insurance, and health care utilization.

Participants provide informed consent to participate in the survey. Participant rights are protected throughout the survey, as non-identified data is used.

NHIS data is released annually as public use data files, and is used by policymakers, academia, researchers, and the general public (Center for Disease Control and Prevention, 2011a). Additional restricted data files not released via public use files (i.e. finer geographic details, etc.), may be obtained through proposal submittal to the NCHS Research Data Center (RDCs) (Center for Disease Control and Prevention, 2011c). The RDC's goal is to protect the confidentiality of study subjects, while discriminately providing sensitive data to researchers specific to their research questions posed. The NHIS data represents a statistically representative sample of the US population, which has allowed greater generalization of research study results that use its data (Center for Disease Control and Prevention, 2010; Centers for Disease Control and Prevention (CDC), 2012). The survey consists of a core set of questions that remain routinely unchanged each year, although periodic review and revisions do occur. The core questions are comprised of basic health and demographic items (Botman et al., 2000; Center for Disease Control and Prevention, 2011d). In addition, various supplemental questions are added from year to year, ascertaining current specialized health data on a variety of health topics – cancer screening, tobacco usage, diet and nutrition, food security, fitness center use, etc. (Center for Disease Control and Prevention, 2011d; Centers for Disease Control and Prevention (CDC), 2012; National Institute of Health, 2011).

NHIS 2010 year survey data will be used for this study. Questions from the following NHIS survey sections will be used: a) Household – to assess race; b) Family

File – to assess health insurance status, marital status, income, perceived health status; c) Sample Adult– to assess gender, age, regular source of care, and homelessness, transportation, and cancer status; and d) Cancer Control Supplement – to assess mammography behavior. The literature has guided this author's proposed questions selected from the NHIS. The 2010 year survey data incorporated the Cancer Control Supplement (CCS) into its survey questions, which provides a mechanism to assess mammography adherence over time (Services, 2000; Wilson, 2007). The CCS was first fielded in the NHIS in 1987, 1990, and 1992 (Swan, Breen, Coates, Rimer, & Lee, 2003; Wilson, 2007). Since 2000, the CCS is administered with the NHIS every five years, with the latest administered in the NHIS 2010 year survey (Center for Disease Control and, 2011c). The CCS is designed to monitor trends and patterns of cancer behaviors and cancer screening. The CCS is randomly administered to selected adults 18 years of age and older, while mammography questions are administered to women 30 years of age and older (Center for Disease Control and, 2011c).

3.5.2 Survey Design & Sample

NHIS sampling and interviewing are uninterrupted throughout each year, following a multistage area probability design that permits representative sampling of households. The sampling plan used for the 2010 data was introduced in 2006, and is redesigned every 10 years. The 2010 sampling plan consists of 428 primary sampling units (PSU's) drawn from 1,900 geographically defined PSU's that cover the 50 States and the District of Columbia. A PSU may consist of a county, adjoining counties, or a metropolitan statistical area (Center for Disease Control and Prevention, 2011d). For the PSU, there are two types of second-stage units used - area and permit segments.

Geographically defined area segments contain addresses, while permit segments cover housing units built after the 2000 census.

Oversampling of Blacks, Hispanics, and Asians was done. Although samples are taken from each state and the District of Columbia, the NHIS sample is too small to provide State level data with acceptable precision. The total NHIS sample is divided into four separate panels, so that each panel is a representative sample of the population, lending itself to greater sample size flexibility (Center for Disease & Prevention, 2011). The sample of the 2010 sample selected for interview is a representative sample of the directed population (Center for Disease & Prevention, 2011; Center for Disease Control and, 2012). For the 2010 survey, there were 34,329 households interviewed (89,976 persons in 35,177 families), and the annual response rate was 90% (Center for Disease Control and, 2011c).

3.5.3 Data Collection

The NHIS is an annual cross-sectional survey conducted using computer-assisted personal interview by rigorously trained interviewers from the US Census Bureau. The NHIS is principally charged with recording, examining and analyzing a large portion of the spectrum of the population's health. The core questions are comprised of basic health and demographic items. In addition, various supplemental questions are added from year to year, ascertaining current specialized health data on a variety of health topics – such as cancer screening, tobacco use, etc. The 2010 year survey data incorporated the Cancer Control Supplement (CCS) into its survey questions, which provided a mechanism to assess mammography adherence over time. The CCS is administered with the NHIS every five years, with the latest administration in the 2010 NHIS (Center for Disease &

Prevention, 2012; Center for Disease Control and, 2011c, 2012). The CCS is randomly administered to selected adults 18 years of age and older, while mammography questions are administered to women 30 years of age and older. For items that contain the same questions from year to year, multi-year data can be pooled to increase the sample size if needed. The large sample size of the NHIS, lends itself well to analysis used in studies with many predictor variables. Participation in the survey is voluntary, and confidentiality of participants is maintained. For each family sampled, one adult and one sample child were randomly selected and information collected on each. The survey consists of a core set of questions that remain routinely unchanged each year, although periodic review and revisions do occur (Center for Disease & Prevention, 2011).

3.6 Research Design and Methods

3.6.1 Innovation

The proposed study will explore relationships between and among multiple variables in determining which variable(s) predict mammography adherence in younger African American women in their 40s as compared to women of other ethnicities and ages. The mammography behaviors of women in their 40s are often overshadowed by the controversy surrounding the risks versus benefits of its utilization in this population. The dilemma encircling the mammography controversy has too often taken center stage, blinding an equally paramount need of studying breast health behaviors. Using a modified Behavioral Model, this study will test the applicability of the Behavioral Model of Vulnerable Populations variable– homelessness – on mammography adherence, while also further exploring the impact of Gail risk scores on screening. Utilization of the Gail risk score retrospectively in this study offers a unique perspective in determining the

impact of individual cancer risk on mammography adherence. In an effort to standardize mammography adherence lexicon, conceptual terminology is proposed – short-term and long-term mammography adherence. This research will provide needed insight into the breast health behaviors of this oftentimes disparate population as compared to other ethnicities and age strata, determining predictors of mammography adherence. Using secondary data analysis of existing national level data could provide a statistically significant model of mammography adherence. Results of this study will validate adherence results, provide guidance to increasing mammography adherence, and mitigating breast cancer health disparity, and promote women's breast health promotion and disease prevention in younger African American women.

3.6.2 Approach

The researcher will complete a retrospective correlational secondary analysis study of 2010 NHIS data. Women 43-79 years of age will be included in this study. Women 40-42 years of age will not be included in the study, as non-adherence data may confound or skew results using either annual or biennial guidelines. For women in the 40-42 age range, it is more likely that recent mammography data would be available as opposed to mammography adherence data, due to the shortened timeframe. As an example, a 40 year old may not have initiated mammography as of yet, and a 42 year old may have only had one mammogram on a biennial schedule.

The NHIS is a continuous, multi-purpose nationwide survey of civilian non-institutionalized households of the US (Center for Disease & Prevention, 2011; Center for Disease Control and, 2011a, 2012). The sample is a public use dataset that is publicly available. The large sample size of the data lends itself well to having an ample sample

size that will ensure a high power. Descriptive statistics and logistic regression will be used to analyze the data.

The purpose of this study is to explore associations and predictors of mammography adherence in younger African American women in their 40s as compared to older women and ethnicities using a modified Behavioral Model. Variables of the model will be tested for their relatedness to the dependent variable, mammography adherence. Mammography adherence rates will also be compared among races.

3.6.3 Data Collection

After IRB approval, the data will be accessed from the public domain site and saved on a designated and secure MacBook designated only for this research. All data will be saved in the public domain location as de-personalized data. The research MacBook will be password protected to protect the integrity of the research data. The Center for Disease Control and Prevention's Research Data Center will be contacted for any additional data needed that is not available on the public domain site.

3.6.4 Research Questions

The following four research questions will guide this study:

1. Are there differences in adherence rates (short-term and long-term) for African American women by age strata 43-49, 50-64, and 65-79?

H_o: There is no difference in adherence rates (short-term and long-term) for African American women by age strata.

2. What are the relationships between and among *predisposing* - age, race, marital status, Gail risk score, and homelessness; *enabling* - regular source of care, income,

transportation, and insurance; and *need* – perceived health status variables on mammography adherence health behavior?

H_o: There are no statistically significant relationships between and among identified predisposing, enabling, and need variables on mammography adherence.

3. Do long-term mammography adherence rates and the model variables differ between and among ethnicities for women in the same age strata?

H_o: Long-term mammography adherence rates and model variables do not differ between and among ethnicities for women in the same age strata.

4. What is the relationship of Gail risk scores on mammography adherence?

H_o: There is no relationship between Gail risk scores and mammography adherence.

3.6.5 Sample

The 2010 NHIS is large with 89,976 persons (women, men, and children) included in the data set. Therefore, from this sample, women meeting the inclusion criteria will be included as part of the study sample. Study inclusion criteria are: African American, White, and Hispanic women 43-79 years of age. The sample will consist of women who have used both the 12 month (annual) interval, as well as those who have used the 24 month (biennial) interval. Women with a present or past history of breast cancer will be excluded from the sample.

3.6.6 Variables

Answers to select survey questions will be analyzed that address each study variable. The literature was used to guide question selection. The predisposing, enabling, and need variables are the independent variables in the study. The dependent variable is

mammography adherence. Missing data and responses of 'don't know' and 'refused to answer the question' will be excluded from data analysis, except in the case of income, where imputed income files will be used. Table 1.0 outlines the variable, questions, and coding that will be used during analysis. The 2014 American Cancer Society mammography guideline will be used to guide annual screening. The 2009 U.S. Preventive Services Taskforce mammography guideline will be used to guide biennial screening. Utilizing a 12- and 24- month screening algorithm developed by Rakowski and colleagues, mammography questions identifying mammogram month and year, as well as the time period since last mammogram, will inform the interval schedule used for women in the study (Rakowski et al., 2004). The location of care will be used as a descriptive statistic and comparison variable.

Table 3.1 **VARIABLE TABLE – 2010 NHIS**

DESCRIPTIVE VARIABLE NAME	**VARIABLE QUESTION/DEFINITION**	**LEVEL OF MEASUREMENT & DATASET VARIABLE NAME**	**CODING/ RECODING**
Gender	Question: Are you Male or Female? Provides information on adult respondent gender. 1=male, 2=female	Dichotomous (SEX)	Only Use #2 as inclusion criteria
Race	Question: What race or races do you consider yourself to be? Respondents are asked about their race and can choose one or more out of the 16 race choices. 1=White, 2=Black/African American, 3=Indian (American), 4=Alaska Native, 5=Native Hawaiian, 6=Guamanian, 7=Samoan, 8=Other Pacific Islander, 9=Asian Indian, 10=Chinese, 11=Filipino, 12=Japanese, 13=Korean, 14=Vietnamese, 15=Other Asian, 16=Some other race.	Nominal (RACE)	Include those who select 1 & 2; Exclude 3-16

DESCRIPTIVE VARIABLE NAME	VARIABLE QUESTION/DEFINITION	LEVEL OF MEASUREMENT & DATASET VARIABLE NAME	CODING/ RECODING
Race	Question: Do you consider yourself Hispanic / Latino? 1=Yes, 2=No	Dichotomous (NATOR)	Include 1 only as inclusion criteria
Race	Question: Which one of these groups would you say best represents your race. Respondents are asked this question if they selected more than one race for variable RACE. 1 =White, 2 =Black/African American, 3 =Indian (American), 4 =Alaska Native, 5= Native Hawaiian, 6= Guamanian, 7 =Samoan, 8= Other Pacific Islander, 9= Asian Indian,10 =Chinese, 11= Filipino, 12= Japanese, 13 =Korean, 14 =Vietnamese,15 =Other Asian,16= Other Race	Nominal (MLTRAC)	Include those who select 1 & 2; Exclude 3-16
Age	Question: What is your age?/How old are you? Provides an age for the adult respondent	Ratio (AGEDOB_1)	Recode to nominal level; group ages 43-49 =#1; 50-64 =#2; 65-79 = #3.
Marital Status	Are you now married, widowed, divorced, separated, never married, or living with a partner? 1. Married; 2. Widowed; 3. Divorced; 4. Separated; 5. Never Married 6. Living with partner; 7. Refused; 9 Don't know	Nominal (MARITAL)	Married = 1 & 6; Not married = 2,3,4,5
Income	**Use calculated Poverty Index Ratio** (Income and family size) Compared against the 2009 Poverty Threshold.	Ratio (RAT_CAT3)	
Income	Use imputed income data	Ratio (FIN250)	
Need - Perceived Health	Would you say [fill: your/ALIAS's] health in general is excellent, very good, good, fair, or poor? 1 Excellent; 2 Very good; 3 Good; 4 Fair; 5 Poor; 7 Refused; 9 Don't know	Ordinal (PHSTAT)	Recode to nominal; 1,2,3 = Excellent/Good; 4&5 = Fair/Poor

DESCRIPTIVE VARIABLE NAME	VARIABLE QUESTION/DEFINITION	LEVEL OF MEASUREMENT & DATASET VARIABLE NAME	CODING/ RECODING
GAIL risk score	Calculated score from various NHIS questions.	Ratio (Calculated Value from outside source)	Five year and/or Lifetime breast cancer risk >= 20%
Regular Source of Care	Is there a place that you usually go to when you are sick or need advice about your health? 1=Yes, 2=There is NO place, 3=There is More Than One place.	Nominal (AUSUALPL)	Recode to dichotomous; 1 & 3= Yes; 2= NO
Location of Care	What kind of place is it - a clinic, doctor's office, emergency room, or some other place? What kind of place do you go to most often 1=Clinic or health center, 2=Doctor's Office or HMO, 3=Hospital emergency room, 4=Hospital outpatient department, 5=Some other place, 6=Doesn't go to one place most often	Nominal (APLKIND)	Interested in #3 as potential comparison
Homelessness	Question: Have you ever spent more than 24 hours living on the streets, in a shelter, or in a jail or prison? 1= Yes, 2= No.	Dichotomous (HOMELESS)	1=Yes
Transportation	Question: There are many reasons people delay getting medical care. Have you delayed getting care for any of the following reasons in the PAST 12 MONTHS? You didn't have transportation. 1=Yes, 2= No.	Dichotomous (AHCDLY_5)	1 = Yes
Insurance	Question: (Include health insurance obtained through employment or purchased directly as well as government programs like Medicare and Medicaid that provide Medical care or help pay medical bills.) Are you/ Is anyone in the family covered by any kind of health insurance or some other kind of health care plan? 1=Yes, 2=No	Dichotomous (FHICOV)	1 = Yes
Initial Mammogram	Question: Have you EVER HAD a mammogram? 1-Yes, 2=No.	Dichotomous (MAMHAD)	1=Yes; 2= No

DESCRIPTIVE VARIABLE NAME	VARIABLE QUESTION/DEFINITION	LEVEL OF MEASUREMENT & DATASET VARIABLE NAME	CODING/ RECODING
Recent Mammogram Schedule	Question: Was (your last mammogram): 1 =A year ago or less, 2=More than 1 year but not more than 2 years,3= More than 2 years but not more than 3 years, 4= More than 3 years but not more than 5 years, 5= Over 5 years ago.	Nominal (RMAM2)	Variable used to help determine which mammography schedule used and existence of recent mammogram: 1 & 2 = annual; 3=biennial; 4 & 5 = Not on schedule
Short and Long- Term Mammography Adherence	Question: How many mammograms have you had in the LAST 6 YEARS? This question asked of women who have ever had a mammogram.	Ratio (MAM6YR)	Recode into dichotomous variables (Adherent = Yes/No). Short-term = at least two on annual or biennial schedule; Long-term = three or more on annual or biennial schedule
12- or 24- month Mammogram Interval Algorithm	*Most recent mammogram month and year: When did you have your most recent mammogram (mth); Enter year of last mammogram	Nominal (RMAM1_MT) (RMAM1_YR)	Variables used to calculate most recent mammogram and screening schedule.
Cancer	Have you ever been told by a doctor or other health professional that you had cancer or a malignancy or any kind? 1=Yes; 2=No	Dichotomous (CANEV)	1 = Yes. Used as exclusion criteria
Breast Cancer	If they have had cancer. What kind of cancer was it? 05=Breast	CANKIND_1; CANKIND_2; CANKIND_3; CANKIND_4	Only include 05 - Breast Cancer type; used as exclusion criteria

Note. Proposed study variables.

Data will be analyzed for both short and long-term mammography adherence. Independent variables will consist of the following: age, race, marital status, income, poverty index ratio, income, perceived health status, Gail risk score, regular source of care, homelessness, transportation, and insurance. The gender variable will be used to exclude male participants from the sample. Ethnicity will be used to denote race (non-Hispanic White, non-Hispanic African American, and Hispanic) and/ or the terms may be used interchangeably.

A copulation of 2-3 questions will be used to determine mammography adherence – how many mammograms a woman has had over a six year period, along with questions to help determine the interval of their most recent mammogram. Women who have ever had a mammogram will be included in the study sample. The study sample will only include NHIS participants who meet the inclusion criteria. Adherence will be defined as a number, then later recoded to a categorical variable to reflect adherence as 'yes' or 'no.' The adherence variable will be calculated using the following formulas:

a) Short-term: At least two consecutive mammograms on an annual or biennial mammography guideline schedule.

b) Long-term: At least three or more consecutive mammograms on an annual or biennial mammography guideline schedule.

The continuous mammography adherence variable will be recoded as a dichotomous variable. Both the 12- and 24-month timeframes will be used to determine significant differences. The interval algorithm established by Rakowski and colleagues (2004) will be used to determine if participants used a 12 or 24 month interval. The following

questions will be used to help determine the mammography schedule practiced by participants:

a) Recent mammogram schedule. If they had their last mammogram one year ago or less, or more than one year, but not more than two years, they will be coded as using the annual mammography schedule. If their last mammogram was more than two years ago, but less than three years, they will be coded as using biennial mammography schedule. The most recent mammogram month and year data, will be used to further delineate participant's mammography interval schedule practiced (most recent one), along with the recent mammogram schedule.

b) Formula: (recent mammography) 1 year ago or less or >1 year but < 2 years = Annual (adherent – Yes); (recent mammography) > 2 years, but < 3 years = Biennial (adherent – Yes). Women who obtained a mammogram > 3 years, but < 5 years and > 5 years are not adherent to mammography screening guidelines (adherent – No). The month and year of their last mammography will provide greater depth and verification of their most recent mammogram, if provided.

The pre-calculated Gail risk scores were computed from risk factor questions within the 2010 NHIS on age, age of first live birth, age at menarche, number of first-degree relatives with breast cancer, and the number of breast biopsies. The calculations were made using the National Cancer Institute's Breast Cancer Risk Assessment Tool, which was specifically modified to produce risk estimates for non-Hispanic African American (National Institute of Health, 2011).

3.6.7 Data Analysis Plan

The data will be cleaned and recoded to ensure that data is coded properly and that no missing data is used. The data will be analyzed using the latest version of SPSS or SAS. Although a priori sample size determination will be conducted, threats to power and effect size will be avoided due in part to the large sample size. Variable data will be recoded as needed to support appropriate level of measurement for the statistical tests used, as outlined in Table 1.0. The following analysis will be conducted for each specific aim after ensuring the sample is normally distributed:

Specific aim 1. To describe the mammography adherence rates of African American women 43-79 years of age. A three-group independent-samples chi-square (x^2) test will be used to test group differences in proportions. Both the dependent variable (mammography adherence) and the independent variable (age) are nominal variables, and meet the level of measurement for this test. Short and long-term mammography adherence will be evaluated for African American women in each age strata. Phi coefficient will be used to provide information on the magnitude of any significant differences as well as the effect size. An alpha of 0.05 will be used to define the significance.

Specific aim 2. To identify relationships between and among Behavioral Model population variables (predisposing, enabling, and need variables) on the mammography adherence health behavior variable. Logistic regression will be used to analyze the relationship between and among the Behavioral Model variables (independent variables) on mammography adherence (dependent variable). Logistic regression will also determine which variables may predict adherence. Four separate

models will be created and tested: 1) short-term/ biennial; 2) short-term/annual; 3) long-term/biennial; and 4) long-term/annual. Adherence will be recoded as yes/no. Logistic regression will allow modeling the probability of each of the variables on mammography adherence. Variables included in the logistic regression test will be verified, ensuring that they meet the level of measurement assumptions for logistic regression: the dependent variable is dichotomous, and the independent variables are nominal or ratio. Assumptions of the test will be verified to ensure that they are met: normal distribution validated, sample independently measured. Using bivariate correlation analysis, the multicollinearity assumption will be checked among the independent predictor variables to ensure they are not too closely correlated. The tolerance threshold will be >.85. Standard residuals will be checked for outliers. An evaluation of outliers will be conducted by examining standardized residuals for each case. Any outliers with a standardized residual threshold cutoff of >=3.0 will be removed from the analysis. The data will be checked to ensure that a linear relationship exists between independent variables and the log odds of the dependent variable. An alpha of 0.05 will be used to define the significance. Variables will be entered into the logistics regression model simultaneously, to achieve a parsimonious model with strong predictive power. The Wald statistic will be used to evaluate the significance of individual predictors at alpha of .05. The odds ratio (Exp(B) will be reported for each predictor. The Chi-square goodness of fit will be used to test the overall model. Nagelkerle R2 will be used to estimate the effect size. The Wald statistic or other statistic will be used to evaluate the significance of individual predictors. The odds ratio, standard error, and beta weights will be reported

for each predictor. The classification table results will be used to determine the success of the overall model, compared to the model with no predictors.

Specific aim 3. To compare long-term mammography adherence rates and the Behavioral Model variables that differ between and among ethnicities for women in the same age strata. Logistic regression will be used to compare long-term mammography adherence rates and the relationship with Behavioral Model variables (independent variables) on mammography adherence (dependent variable). Two separate models will be created and tested: 1) long-term/biennial; and 2) long-term/annual. Long-term adherence will be recoded as adherent (yes or no). Logistic regression will allow modeling the probability of each of the Behavioral Model variables on long-term mammography adherence by ethnicity (African American, White, and Hispanic). Logistic regression statistical technique as described with Specific Aim 2 will be followed. The coefficient for the variable would indicate an up or down likelihood of long term adherence within the strata ethnicity.

Specific aim 4. To identify and describe the relationship of individual breast cancer risk on mammography adherence. Independent group t-tests will be used to analyze the relationship between Gail risk score and mammography adherence; determine if the Gail risk scores are significantly related to mammography adherence. Independent group t-tests will be used to calculate the mean Gail risk score for each of the four groups: 1) short-term/ biennial; 2) short-term/annual; 3) long-term/biennial; and 4) long-term/annual. Adherence will be recoded as yes/no. A *t* statistic, degrees of freedom, and confidence intervals will be calculated. Assumptions of the test will be verified to ensure that they are met: normal distribution validated, sample independently measured, and

homoscedasticity. Levene's test for equality of variances will be conducted to generate the *F* statistic to determine if sample variances are equal. An alpha of 0.05 will be used to define the significance.

Descriptive statistics will be used to describe the sample distribution (i.e. sample size, central tendencies, and mean), compare, and characterize the sample. The mean and range will be used to describe the ratio variables. Tables will include all variables with a description of the sample. Although the large size of the sample will help minimize a Type II error and adequately enhance the study's power, an online power calculator will be used to calculate the study's power. The effect size will also be calculated using Cohen's guidelines for a moderate effect.

3.6.8 Study Limitations

The large sample size of the data does provide some advantage to the study. Despite this, the study does have potential limitations. The retrospective secondary data design of the study, and the self-reporting of the data in the parent study, all present study limitations. Self-reporting relies on the study participant's recall of events, medical tests, etc., which present recall and accuracy challenges. Despite this, the validity of self-reporting is continuously noted as an effective and efficient method to obtain reliable information (Caplan, Mandelson, Anderson, & Health Maintenance, 2003; Caplan, McQueen, et al., 2003; Cronin et al., 2009). Results of a study by Caplan and colleagues to validate women's self-report of cancer screening using a national survey tool, was highly sensitive for assessing adequate rates (Caplan, McQueen, et al., 2003). In that study, they compared Behavioral Risk Factor Surveillance System (BRFSS) self-report responses and medical record information, which agreed 95% of the time. In another

study by Caplan, Mandelson, and Anderson (2003), self-report rates exceeded medical record verification rates, which also indicated that self-report could also overestimate mammography utilization within a certain time frame. Other limitations may be identified during actual analysis of the data.

Use of the Gail risk score present study limitations surrounding its validity and accuracy in other ethnicities aside from White, Asian, and Pacific Islander women. Although the tool has been tested and performs well in African American women, it may underestimate their risk if they have had previous biopsies (Gail et al., 2007; National Institute of Health, 2011). Since the model has not been validated for Hispanic women and other ethnicities, it does not provide a good estimate of breast cancer risk in these populations, which could impact current study results (National Institute of Health, 2011). The tool is also not the most appropriate to use for women who have breast cancer-producing mutations or hereditary conditions that increase a woman's risk for breast cancer, as it can underestimate their risk (Euhus, Leitch, Huth, & Peters, 2002; National Institute of Health, 2011). The Gail risk score also present challenges of adequate genetic risk estimation, as it does not consider family history of ovarian cancer, second-degree relatives affected by cancer, nor paternal family history of cancer (American Cancer, 2013a; Gail et al., 1989; Millstine et al., 2014; National Institute of Health, 2011).

3.7 Human Protections and Planned Actions

This secondary data analysis study is exempt from full review by the Institutional Review Board. After going to the IRB, and the proposal is defended in Mar 2015, the following actions are planned:

- Access public-use data and clean and recode the data set;
- Program and Run the analysis using a statistical software package;
- Analyze the data and synthesize the findings; and
- Write up the study findings and results manuscript.

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CHAPTER 4

RESULTS MANUSCRIPT

4.1 Introduction to Manuscript

This chapter is presented as a results manuscript that will eventually be submitted for publication. The abstract has been formatted for journal submission. The remainder of this chapter has not been formatted for journal submission; therefore, it is longer than what would be provided for publication.

4.2 Abstract

Introduction: This study assessed predictors and rates of recent and long-term mammography utilization for women 43-79 years of age to better understand differences among age strata and races. This was the first study to use Gail Risk scores from the 2010 National Health Interview Survey (NHIS) and the homelessness variable in predicting mammography using national-level data.

Methods: A cross-sectional analysis of NHIS data. Using logistic regression, N= 6,334 was used to examine mammography differences (African American (AA), Non-Hispanic White, and Hispanic), with focus on younger AA. Wald F test statistics with two-sided p-values <.05 and odds and adjusted ratios used.

Results: AA had highest (79.3%) of lowest risk Gail Risk scores, while Whites had highest (30.7%) of highest risk Gail Risk scores. Women in the 50-64 strata had greater odds of both recent, Wald $F(2, 299)=7.52$, $p<0.01$ and long-term,Wald $F(2, 299)=38.04$, $p<0.01$. Whites had 0.62 adjusted odds ratio (AOR) (95% CI, 0.46-0.83) for recent, and 0.76 AOR (95% CI, 0.59-0.99) for long-term. Homelessness and transportation were not predictors for adjusted recent model, while only transportation was not a predictor for long-term. AA long-term utilization were consistent with long-term utilization for all three races together with older two age strata with higher odds (50-64 strata: 1.80 odds ratio (OR) (95% CI, 1.24-2.62) and 65-79 strata: 1.75 OR (95% CI, 1.18-2.59)).

Conclusion: Risk assessment and mammography are vital prevention modalities. It is important for women to know their risk and for continued evaluation of predictor interactions to improve mammography knowledge and practice.

4.3 Introduction

Despite advances in care and treatment, health disparities persist in breast cancer, most notably in relation to race (Desantis, Ma, Bryan, & Jemal, 2013; DeSantis, Naishadham, & Jemal, 2013). Women of color, and specifically African American women, disproportionately shoulder later-stage diagnosis and breast cancer mortality (American Cancer Society, 2016b; Amirikia, Mills, Bush, & Newman, 2011; Sassi, Luft, & Guadagnoli, 2006; Vona-Davis & Rose, 2009). Research suggests that this health disparity can be attributed to multiple causes, to include socioeconomic, structural, cultural, biological, intrapersonal, and interpersonal factors (American Cancer Society, 2016b; Jerome-D'Emilia, 2015; Mishra, DeForge, Barnet, Ntiri, & Grant, 2012; Sturtz, Melley, Mamula, Shriver, & Ellsworth, 2014; Vona-Davis & Rose, 2009; Watson-Johnson et al., 2011). Screening mammography, although controversial, is an important intervention in mitigating this breast cancer health inequity (Conway-Phillips & Millon-Underwood, 2009; D. A. Freedman, Petitti, & Robins, 2004; Oeffinger et al., 2015; Siu, Bibbins-Domingo, Grossman, LeFevre, & Force, 2016; Smith, 2014) .

Overall, breast cancer remains the second leading cause of cancer death among women in the United States (American Cancer Society, 2015, 2016a, 2017). Mammography is one facet of secondary cancer prevention that if routinely utilized, may decrease breast cancer mortality in some women (American Cancer Society, 2015; D. A. Freedman et al., 2004; Hale & deValpine, 2014; Oeffinger et al., 2015; U.S. Preventive Services Task Force, 2016). Mammography screening for women in their 40s has undergone extensive scrutiny lately, as to its effectiveness and commencement age; recent consensus from the American Cancer Society (ACS) and the U.S. Preventive Services Task Force (USPSTF) is to begin screening for women in their 40s should be

based on their individual risk factors (Ford et al., 2015; Hellquist et al., 2011; Siu et al., 2016; U.S. Preventive Services Task Force, 2016). These differences in mammography screening guidelines have caused ambiguity for women in their 40s (Calvocoressi, Sun, Kasl, Claus, & Jones, 2008; Gierisch et al., 2009; Passmore, Williams-Parry, Casper, & Thomas, 2017). Irrespective of the guideline followed, there is clear evidence mammography remains a vital component of early breast cancer detection (Coldman et al., 2014; Duffy et al., 2010; Ford et al., 2015; Shapiro, 1977; Smith, 2014; Weedon-Fekjaer, Romundstad, & Vatten, 2014).

Although women 50 and older have a higher probability of getting the disease (Bjurstam et al., 2003; Moss et al., 2006; Siu et al., 2016), women in their 40s get breast cancer in alarming numbers (23% diagnosed), and an estimated 13% die from the cancer (American Cancer Society, 2015; Bjurstam et al., 2003; Moss et al., 2006; Ooi, Martinez, & Li, 2011; Siu et al., 2016; van Ravesteyn et al., 2012). African American women in their 40s in particular, shoulder a significant burden of the disease mortality (4% of African American vs. 2% for Non-Hispanic White women), and it is acknowledged that more research is needed that will allow greater understanding of breast cancer disparities and mammography practices (American Cancer Society, 2015; Carey et al., 2006; Foulkes, 2008; Jatoi & Anderson, 2010b; Pal et al., 2015; Rawl, Champion, Menon, & Foster, 2000; Surveillance, 2017). Specifically, research in understanding mammography utilization decisions, behaviors, and key predictors in women in their 40s, with special attention to women of color , is essential to advancing breast health (Breen & Meissner, 2005; Kidd, Colbert, & Jatoi, 2015; Kindig & Stoddart, 2003; Ray, Joe, Freimanis, Sickles, & Hendrick, 2017). The purpose of this study was to examine recent and long-

term mammography utilization in women 43-79 years of age, guided by a unique model using vulnerable population domains, with specific emphasis on African American women in their 40s using nationally representative 2010 National Health Interview Survey (NHIS) data.

4.4 Background

Breast cancer is the leading site of new cancer cases and the second leading cause of cancer death for African American women (American Cancer Society, 2016b, 2017; Oeffinger et al., 2015; Smith, Brooks, Cokkinides, Saslow, & Brawley, 2013). Although White women generally have a higher incidence of breast cancer, African American and other women of color shoulder a disproportionate disease burden, with higher mortality from the disease (American Cancer Society, 2015; Amirikia et al., 2011; Surveillance, 2017). Of the four main molecular subtypes of breast cancer, 12% are referred to as triple-negative (ER-, PR-, and HER2-), an aggressive form of cancer with poorer prognosis, which is almost twice as common in African Americans than in other races (American Cancer Society, 2015; Amirikia et al., 2011; Carey et al., 2006). Carey et al. (2006) in their analysis of the Carolina Breast Cancer Study found that these basal-like cancers were more prevalent among premenopausal African American women (39%), compared to postmenopausal African American women (14%) and non-African American women (16%). Higher breast cancer mortality seen in younger African American women (in their 40s and younger) is due in large part to aggressive tumor morphology, while other causes for higher cancer mortality in racial and ethnic women of color can be attributed to obstacles in cancer prevention and detection (American Cancer

Society, 2016b; Bjurstam et al., 2003; Carey et al., 2006; Conway-Phillips & Millon-Underwood, 2009; Smith et al., 2013).

Screening mammography has been used in the United States as a mass population screening intervention since the 1960s to detect the presence of breast cancer, facilitating early treatment and cure (Shapiro, 1977, 1997; Shapiro, Strax, & Venet, 1966). The controversy surrounding mammography has centered on its benefit versus harm, particularly in women in their 40s (Kerlikowske, 2012; Passmore et al., 2017; van Ravesteyn et al., 2012). The preponderance of randomized clinical trial evidence purports that women who might begin screening in their 40s would not see benefit until 12-14 years later (Bjurstam et al., 1997; Elwood, Cox, & Richardson, 1993; Miller, To, Baines, & Wall, 2002; Nystrom et al., 1993; Tabar et al., 1995; Tabar et al., 1996). Other issues surrounding mammography include concerns due to false positives, unnecessary testing and biopsies, low-dose radiation exposure, over diagnosis, and increased lead time (Beemsterboer, Warmerdam, Boer, & de Koning, 1998; Bleyer & Welch, 2012; Jatoi & Anderson, 2010a; Loberg, Lousdal, Bretthauer, & Kalager, 2015).

Breast cancer is a heterogeneous disease with a complex morphology, and does present different among women causing breast cancer disparities due to screening, incidence, mortality, and treatment (American Cancer Society, 2015; Carey et al., 2006; Jatoi & Anderson, 2010b; Kidd et al., 2015; Rao, Breen, & Graubard, 2016; White et al., 2017). Reasons for this breast cancer disparity are not fully identified, but research suggests it may partly be attributed to modifiable risk factors—differences in breast cancer knowledge about risk, attitudes, and mammography behavior (Champion et al.,

2004; Conway-Phillips & Millon-Underwood, 2009; Samson, Porter, Hurley, Adams, & Eberth, 2016; Schueler, Chu, & Smith-Bindman, 2008; Watson-Johnson et al., 2011).

Current guidelines suggest different mammography commencement ages and intervals (e.g. ACS, USPSTF), with constant re-evaluation surrounding its net benefit versus harms for women 40-49 years of age (Ray et al., 2017; Siu et al., 2016; Siu & Force, 2016; Smith et al., 2013). Updated screening guidelines now advocate women understanding their individual breast cancer risk, informing screening commencement and continued adherence (Siu et al., 2016; U.S. Preventive Services Task Force, 2016; van Ravesteyn et al., 2012; Wu, Grabaud, & Gail, 2012).

4.4.1 Mammography Utilization

Recent mammography utilization refers to having had a mammogram in the past 1-2 years (Clark, Rakowski, & Bonacore, 2003). Once women begin screening, and have a recent screening mammogram, they have greater odds of continuing with screening (Breen & Meissner, 2005; Gonzalez et al., 2012). Long-term mammography utilization has oftentimes been described as continuing with on-schedule screening past the first screening (Clark et al., 2003; Gierisch et al., 2010; Greene, Torio, & Klassen, 2005; Rakowski et al., 2006; Vernon et al., 2008). Although assessing recent mammography is important, assessing mammography over extended periods of time provides a much better gauge to evaluate health improvement (Breen & Meissner, 2005; Clark et al., 2003; Kindig & Stoddart, 2003; Kindig, 2007; O'Neill et al., 2008).

4.4.2 Key Mammography Utilization Predictors and Barriers

Research has identified certain variables as important mammography predictors (factors that favorably influence an action occurring) and/or barriers (factors that

favorably inhibit an action occurring). Despite repeated testing of many variables, there are conflicting results surrounding their statistical significance and association to mammography. Even with the conflicting study findings, there are several key variables that have been identified as fundamental to monitoring disparities in cancer burden and screening differences—age (Duffy et al., 2010; Feldstein et al., 2011), race (American Cancer Society, 2016b; Amirikia et al., 2011; Smith et al., 2013; Wilson et al., 2009), socioeconomic status (i.e. income, health insurance, education, living conditions), and access to care (American Cancer Society, 2016b; Buki, Jamison, Anderson, & Cuadra, 2007; Feldstein et al., 2011; Watson-Johnson et al., 2011; Young, Schwartz, & Booza, 2011). Barriers to mammography utilization and adherence in African American women include: cultural attitudes (Conway-Phillips & Millon-Underwood, 2009; Watson-Johnson et al., 2011), healthcare access (O'Malley, Forrest, & Mandelblatt, 2002; Schueler et al., 2008) , socioeconomic status (Hiatt & Breen, 2008; Purc-Stephenson & Gorey, 2008; Welch, Miller, & James, 2008), cost , failure of health provider to recommend mammography, lack of insurance (Gierisch et al., 2009; Schueler et al., 2008), cancer fear (Young et al., 2011), mammography misconception, and health provider trust (Conway-Phillips & Millon-Underwood, 2009; Hiatt et al., 2001; O'Malley et al., 2002; O'Malley, Sheppard, Schwartz, & Mandelblatt, 2004; Ooi et al., 2011).

4.4.2.1 Age

There are conflicting reports on whether or not age is a predictor of mammography utilization (Augustson, Vadaparampil, Paltoo, Kidd, & O'Malley, 2003; Nash, Chan, Horowitz, & Vlahov, 2007; Phillips, Kerlikowske, Baker, Chang, & Brown, 1998; Russell, Champion, & Skinner, 2006). A number of studies found that women 50-

74 years of age are more adherent to mammography screening in comparison to women in their 40s (Calvocoressi et al., 2004; Nash et al., 2007; Rakowski et al., 2006). Other studies have indicated that women in their 40s adhere to screening more often than women 50 years of age and older (Calvocoressi et al., 2004; Calvocoressi et al., 2008; Finney, Tumiel-Berhalter, Fox, & Jaen, 2006; Hiatt, Klabunde, Breen, Swan, & Ballard-Barbash, 2002; Rawl et al., 2000). As mammography behaviors differ among diverse-age women, it is important to continuously explore age as a predictor in mammography utilization.

4.4.2.2 Race/ Ethnicity

Race/ethnicity has been examined extensively in past studies as a predictor variable (Breen et al., 2011; Calle, Flanders, Thun, & Martin, 1993; Carey et al., 2006; Chagpar, Polk, & McMasters, 2008; Gierisch et al., 2009; Jepson et al., 2000), with conflicting reports. In a meta-analysis by Purc-Stephenson and Gorey of mammography adherence articles from 1990-2006, the authors found evidence suggesting that screening differences persist among ethnic women of color—African American and Hispanics were screened less than Whites (African American: OR.87, 95% CI 0.75; Hispanic: OR0.65, 95% CI 0.50, 0.85) (2008). However, when controlling for socioeconomic status, ethnic differences were no longer significant. Similarly in other studies, mammography did not differ by race (Calvocoressi et al., 2008; Gierisch et al., 2009).

In Rakowski and colleague's study of correlates of repeat mammography in women 45-75 years of age using 2003 Health Information National Trends Survey data, race was not statistically significantly associated with repeat mammography (Rakowski et al., 2006). Conversely, Lopez, Khoury, Dailey, Hall, and Chisholm found in their study

of characteristics of current, overdue, and never screeners in the south that race was a statistically significant mammography barrier for African Americans (2009). In studying the impact of age and race on mammography practices, Rawl, Champion, and Menon, did find significant interaction between age and race (2000), as did Wu, Hsieh, and West in their study Among Asian-American women (2008). Since breast cancer may present differently in women of different ethnicities, it is paramount to explore mammography behavioral practice differences by race within the evolving structure of expanded interactions and technologies (Gelberg, Andersen, & Leake, 2000; Jatoi & Anderson, 2010b; Phillips et al., 1998; Rawl et al., 2000).

4.4.2.3 Breast Cancer Risk Assessment

Recent mammography screening guideline changes by both the ACS and the USPSTF in 2015 promote the need for women to individually assess their breast cancer risk (Anderson, 2010; Oeffinger et al., 2015; Siu et al., 2016). This approach better informs women and their health providers of the optimal screening commencement age and interval (Maas et al., 2016). Although risked-based assessments are not widely used as of yet, in a study by Schapira et al. assessing practice-based systems to support breast and cervical cancer screening, 60.5% of providers routinely assessed breast cancer risk; yet only 21% used a breast cancer risk calculator (2016). Several risk calculators are available online, such as the Breast Cancer Risk Assessment Tool/ Gail model or the Tyrer-Cuzick (IBIS) model (Amir et al., 2003; Amir, Freedman, Seruga, & Evans, 2010; Gail et al., 1989; Graubard, Freedman, & Gail, 2010).

The Gail model calculates a woman's Gail risk score—her absolute risk of breast cancer over successive intervals of time, and is based on various factors including current

age, race, age at first live birth, age at menarche, family history of breast cancer, genetic predisposition for breast cancer, and number of breast biopsies (Banegas, Leng, Graubard, & Morales, 2013; Euhus, Leitch, Huth, & Peters, 2002; Gail et al., 1989; Gail et al., 2007). Women who know they have an elevated risk of breast cancer are more adherent to mammography (Anderson, 2010; Hiatt et al., 2002; Jepson et al., 2000; Rakowski et al., 2004). Women with an elevated Gail risk score are potentially eligible for chemoprevention to lower their risk (Freedman et al., 2003). Gail risk scores use a functional combination of risk factor variables to obtain a meaningful probability summary of individual absolute risks that a woman may get breast cancer over a set period of time (5 yr, 10 yr, 20 yr, or a lifetime) (Banegas et al., 2013; Freedman et al., 2003; Gail et al., 1989; Gail et al., 2007; Maas et al., 2016; National Institute of Health, 2011).

4.4.2.4 Homelessness

Those faced with homelessness have significant barriers to preventive services while also having increased prevalence of most cancer risk factors, which leads to lower cancer screening rates (Chau et al., 2002; Heyding, Cheung, Mocarski, Moineddin, & Hwang, 2005). Homelessness can lead to less concern about preventive services and greatest concern on basic necessity challenges (e.g. food, shelter) (Austin, Andersen, & Gelberg, 2008; Gelberg et al., 2000; Moxley & Washington, 2016; Ritchey, La Gory, Fitzpatrick, & Mullis, 1990).

4.4.2.5 Income

There is some evidence of a relationship between high poverty and aggressive tumors, particularly in younger African American women (Andaya et al., 2012; Bao, Fox,

& Escarce, 2007; Chagpar et al., 2008). Access to health care resources and greater utilization of those resources have been directly correlated to higher income (Adams et al., 2009; Anderson & Jakesz, 2008; Bao et al., 2007; Choi, 2011).

4.4.3 Theoretical Model

The Behavioral Model for Vulnerable Populations (BMVP) guided this study. The BMVP is an adaptation of the original Behavioral Model of Health Services Use (BM), designed to describe how families and individuals use health services (Aday & Andersen, 1974; Andersen, 1995; Evans & Stoddart, 1990). The BMVP was adapted from the BM to uniquely include and garner a better understanding of vulnerable population domains. The BMVP, though conspicuously different than the BM, contains three main elements: population characteristics, health behaviors, and health outcomes (Gelberg et al., 2000). Gelberg et al. (2000) originally tested the BMVP in a prospective study with people who were homeless, identifying predictors of health service utilization and physical health outcomes. According to Gelberg et al., results of this vulnerable population study indicated the health status for the four health outcomes improved over time, and were predicted by a number of variables, most prominently having access to care. Gelberg et al. noted the major differences between the BM and the BMVP are the addition of vulnerable population domains (i.e., homelessness, criminal behavior, transportation, vulnerable population health conditions, etc.), and ability to consider the impact of utilization on health status outcomes.

Population characteristics are individual determinants that predict personal health practices, and are divided into predisposing, enabling, and need factors (Andersen, 1995; Gelberg et al., 2000). Predisposing factors describe how individuals use services and

include demographic factors (i.e. age, gender, and marital status, etc.), health beliefs, and social structure (i.e. living conditions, race, social networks, homelessness, etc.) (Gelberg et al., 2000). Enabling factors impede or facilitate one's ability to use health services, and include one's personal and family resources (i.e. regular source of care, insurance, income, transportation, social support, etc.) (Gelberg et al., 2000). Need factors include an individual's self-perception and objective evaluation of their health, as well as a vulnerable population's health condition (Gelberg et al., 2000). According to Gelberg et al., health behavior variables include one's personal health practices.

The BMVP has guided studies examining correlates and predictors of adherence to cervical and breast cancer screening in women of color, to include African American women (Bazargan, Bazargan, Farooq, & Baker, 2004; Gonzalez et al., 2012; Owusu et al., 2005). Additionally, the BMVP has guided studies exploring racial differences in vulnerable populations, identifying contributing factors to health behaviors (Austin et al., 2008; Bazargan et al., 2004; Gelberg et al., 2000; Harcourt et al., 2013). Using the BMVP, having a regular source of care, affordability, sticking to other preventive services, and race were shown to be principle correlates and/or predictors in cervical and breast cancer screening adherence (Bazargan et al., 2004; Gelberg et al., 2000; Gonzalez et al., 2012; Harcourt et al., 2013; Owusu et al., 2005). Using the model, socioeconomic characteristics, access barriers, and women of color have also shown to be barriers to cervical and breast cancer screenings (Fernandez & Morales, 2007; Owusu et al., 2005).

Although great strides have been made using the BMVP, research results suggests that comprehensive identification of factors is needed to better understand the complex role of race in health utilization and cancer screening (Austin et al., 2008; Bradley et al.,

2002; Breen & Meissner, 2005; Harcourt et al., 2013; Owusu et al., 2005). Due to the model's sound applicability for utilization across ethnicities in vulnerable populations, and in evaluating predictors of cancer screening in women, it had reliable utilization in evaluating the relationships between the study variables. A modified BMVP was used to guide this study (Figure 4.1). The modified BMVP emphasizes vulnerable population domains, with collective predictive effects of predisposing, enabling, and need factors on mammography utilization.

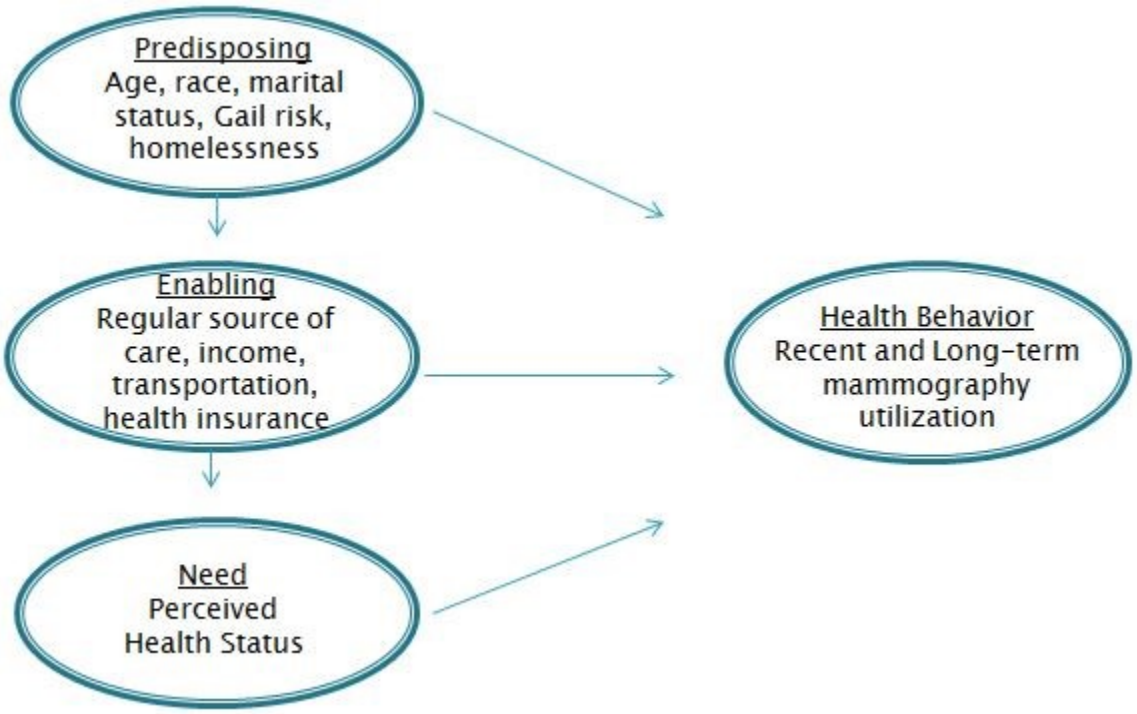


Figure 4.1. Behavioral Model for Vulnerable Populations with study variables, from "The Behavioral Model for Vulnerable Populations: Application to Medical Care Use and Outcomes for Homeless People," by L. Gelberg, R. Andersen, and B. Leake, 2000, Journal of Health Services Research, 34:6, p. 1278.

4.5 Research Design and Methods

The purpose of this study was to examine recent and long-term mammography utilization predictors for women 43-79 years of age to better understand differences

among and between age groups and races that may contribute to the breast cancer health disparity. Four research questions were examined: (1) Are there differences in recent and long-term mammography utilization for African American women by age strata: 43-49, 50-64, and 65-79? (2) Are the predisposing (age, race, marital status, Gail risk score, and homelessness), enabling (regular source of care, income, transportation, and health insurance) and need (perceived health status) variables associated with recent and long-term mammography utilization? (3) Do the model variables associated with recent and long-term mammography utilization differ by race for women in the same age strata? and (4) Does Gail risk score on recent and long-term mammography utilization differ by race?

This is the first study to test the 2010 NHIS Gail risk score, and homelessness in predicting mammography utilization using national-level data. Because this study specifically focuses on younger women aged 43-49 and African American women, African American women and women 43-49 years of age were used as reference groups for most of the analysis. Because this study used secondary analysis of existing de-identified public use data, the study was deemed exempt from human protections review.

This is a hypothesis-driven cross sectional analysis of the 2010 NHIS data. The NHIS is a nationwide multi-purpose health survey of civilian non-institutionalized households of the United States, conducted by the US Census Bureau (Ackermann & Cheal, 1994; Center for Disease Control and, 2011a, 2011b, 2012). The 2010 NHIS included a Cancer Control Supplement, which asks questions on cancer control, and is administered every five years (Center for Disease Control and, 2011a). The 2010 NHIS

data was used because, at the time of the study, 2015 NHIS data had not been released and Gail risk were not calculated for the 2015 data.

The 2010 NHIS oversampled both African Americans and Hispanics to better estimate health and disease in this population (Center for Disease Control and, 2011b). Information was gathered on socio-demographics, general health, mobility and function, health behaviors, health insurance, and health care utilization (2011b; Parsons et al., 2014). Participants provided informed consent to participate in the survey. The NHIS data represents a statistically representative sample of the US population, which allows greater generalization of research study results (Centers for Disease Control and, 2012; Hiatt et al., 2002). For the 2010 NHIS, there were 34,329 households interviewed (89,976 persons in 35,177 families), with an annual response rate of 90% (Center for Disease Control and, 2011a, 2011b). The initial population of N=27,157 was used, as questions selected for this study were only asked of sample adults using Person-Level and Family-Level data.

All men and women who had reported a history of cancer were excluded from the NHIS adult population for the study sample. Figure 4.2 illustrates the sample selection steps. Women who refused to answer, who did not know if they ever had a mammogram, when their most recent mammogram occurred, or the number of mammograms they had in the past six years were excluded from the final sample. The final analytic sample consisted of N=6,334, which only included women ages 43-79, who were non-Hispanic African American, Non-Hispanic White, and Hispanic, with no history of breast cancer. Sample race/ ethnicity groups limited to the three included groups, due to the Office of Management and Budget requirements on race classifications and because the sample

size of the other minority groups was not homogenous; they included an extremely small proportion of the total U.S. population. Of this final sample, 1,141 were Non-Hispanic African American women, referred to as African American women throughout the study.

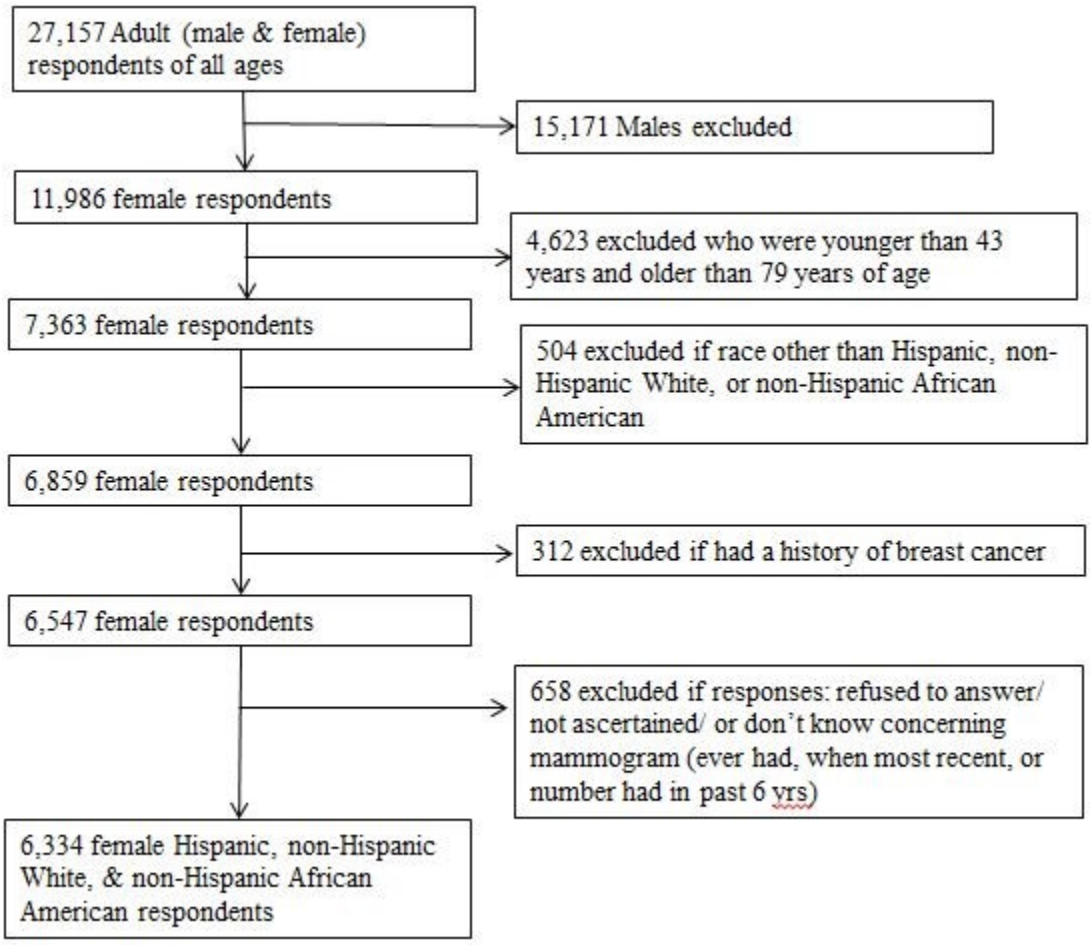


Figure 4.2. Derivation of Analytic Sample.

4.5.1 Variables

Table 4.1 shows the 10 independent study variables (predisposing, enabling and need), the two dependent variables, and the NHIS question(s) used to conceptualize and operationalize each variable.

Table 4.1 Source and Definition of Independent and Dependent Variables

Variable	NHIS Question	Study Operational Definition
Predisposing		
Age	What is your age/ how old are you? RECODE into: Under 1 yr; 1 - 84 yrs; 85+ yrs	Groups: 43 - 49 yrs; 50 - 64 yrs; 65 - 79 yrs
Race*	Do you consider your self Hispanic? What race or races do you consider yourself to be? (chose one or more out of 16 choices). RECODE into: Hispanic; non-Hispanic White; non-Hispanic Black; non-Hispanic Asian; non-Hispanic All other races	Hispanic Non-Hispanic White Non-Hispanic Black/ African American *Race and Ethniticity used interchangably
Marital Status	Are you married, widowed, divorced, separated, never married, or living with a partner?	Married: Living with a spouse or partner in household Not-Married: all other
Gail Risk Score	Calculated using answers to various questions: age; age when first child was born; total number of live births, ever had breast cancer, mother ever had breast cancer, number of sisters diagnosed with breast cancer; number of lumpectomies; age at first menarche; numer of first degree female relatives known to have breast cancer; ever had a hysterectomy; had non-cancerous breast lump removed; total number of biopsies; weight/ body mass index; and sociodemographic factors	A 5-year Gail risk score of equal to or greater than 1.67% was targeted, as women with this score are considered high-risk and eligible for chemoprevention to lower their risk. Women with a score less than 1.67% are not considered to have an elevated 5-year risk.
Homelessness	Have you ever spent more than 24 hours living on the streets, in a shelter, or in jail or prision?	Spent > 24 hours living on streets, in shelter, or in jail or prison: Yes/No
Enabling		
Regular Source of Care	Is there a place that you usually go to when you are sick or need advice about your health?	Regular source of care: Yes/No
Income	What is family income, family size, number of kids in household under 18 yrs? Ratio of family income to poverty threshold calculated using calendar year 2009 weighted federal poverty threshold. Five categories established.	Ratio of family income to poverty threshold (PT). Poverty threshold set annual expenditure amount below which a family is considered poor. Categories indicate income/ resources are a numerical value times (below or above) the poverty threshold. $13,000 used for PT for family of two. < 1 - below poverty threshold 1 - < 2 - between 1 & 1.99 times PT (poor) 2 - < 3 - between 2 & 2.99 times PT 3 - < 4 - between 3 & 3.99 times PT 4 or more - 4 or more times PT (highest)
Transportation	Have you delayed getting health care in the past 12 mths because you did not have transportation?	Transporation delays: Yes/No
Health Insurance	Are you covered by any kind of health insureance or some kind of health plan? RECODE: Covered or Not Covered	Had insurance: Covered Did not have insurance: Not-Covered

Variable	NHIS Question	Study Operational Definition
Need		
Perceived Health Status	Would you say your health in general is excellent, very good, good, fair, or poor?	Excellent/very good/good OR Fair/poor
Dependent Variables		
Recent Mammography	Have you ever had a mammogram? If so, when was your most recent mammogram?	RECENT: Had a mammogram 2yrs ago or less. NOT RECENT: Had a mammogram more than 2 yrs ago.
Long-Term Mammography	Have you ever had a mammogram? If so, how many mammograms have you had in the last 6 years?	Adherent to long-term mammography if had 3 or more mammograms in the past 6yrs.

Note. Study variables identified using a modified Behavioral Model for Vulnerable Populations by L. Gelberg, R.M. Andersen, and B.D. Leake, 2000, *Health Services Research Journal*, 34:6, p. 1280.

4.5.1.1 Predisposing Variables

Women 43-79 years of age were included. The younger 40-42 year old women would not have had an opportunity to have more than one mammography, and therefore would not have met the long-term mammography utilization criteria. The 79 age limit was chosen to reflect the older age throughout the time women might continue mammography, as mammography declines are seen after age 74 (Breen, Feuer, Depuy, & Zapka, 1997; Buchbinder et al., 2016; Oeffinger et al., 2015; Rakowski et al., 2004; Siu et al., 2016). For purposes of this study, race and ethnicity are used interchangeably. Following the Office of Management and Budget classification of federal data on race and ethnicity, and ensuring that the three ethnicities of were included, the study only included Non-Hispanic African American, Non-Hispanic White, and Hispanic (Register, 1997; Williams & Jackson, 2000).

The 5-year Gail risk scores for the 2010 data were calculated separately from information women provided to interviewers. Participants were not informed of their Gail

risk score when responding to the survey questions (Banegas et al., 2013; Graubard et al., 2010). A 5-year Gail risk score >= 1.67% was high risk, indicating a woman had an absolute risk of 1.67% or greater for having breast cancer in 5 years (Banegas et al., 2013; Rakowski et al., 2004). Even though age and race are used with other risk factors in computing the Gail risk score, simultaneously including these variables with the Gail risk in the analyses in this study as separate independent variables is not problematic because it will provide further adjustment for these variables. Temporary homelessness was evaluated by assessing whether respondents had ever lived more than 24 hours in jail, prison, shelter, or in streets.

4.5.1.2 Enabling and Need Variables

The existence of a regular source of care was assessed by inquiring if women usually went to a certain place for healthcare when they were sick. To measure income, the federal poverty threshold was used (Center for Disease Control and, 2011b; Department of Health and Human, 2017). Because of the historically high nonresponse rate for income (only 15-20% providing response), NHIS created five sets of imputed values for income using the multiple imputation method, which allows for the assessment of both variability of the imputation process along with the variability of the estimation in the standard errors and inferences. For the 2010 data, $13,000 was used as the NHIS poverty threshold for a family of two (a least one member >= 65 years of age) (Center for Disease & Prevention, 2011).

4.5.1.3 Dependent Variables/ Health Behavior

Recent and long-term mammography utilization were evaluated based on the need to evaluate mammography trends and measure improvements as both a one-time behavior

and over time (Breen & Meissner, 2005; Hiatt et al., 2002; Rakowski et al., 2006; Russell et al., 2006). Operationalized definitions for the dependent variables reflected women as 'on schedule' irrespective of their screening interval schedule used (annual or biennial).

4.6 Analysis

To avoid biased point estimates and standard errors due to the complex NHIS sample design, analysis was completed using SAS version 9.4, and SUDAAN version 11.0.1. The study sample included 10 independent variables and two dependent variables (recent and long-term mammography utilization) shown in Table 1. The 5-year Gail risk scores were previously calculated using questions from the 2010 NHIS data (Banegas et al., 2013).

Questions were used from the 2010 NHIS Person-Level and Family-Level data. Although the analytic sample size was 6,334, some participants were excluded from analysis if they had a missing value for any of the variables used in the statistical analysis modeling (except for income that is multiply imputed). Therefore, the sample size varied between 6,321 and 6,334, as outlined in Table 2.

Frequency distributions were conducted on each variable to check for accuracy, missing data, and data consistency. The Taylor Linearization Method was used to compute standard errors that accounts for the complex survey design of the NHIS. Logistic regression was used to test for group differences (e.g., race/ethnicity) for specific outcome variables (e.g., recent mammography utilization) and to test for interactions between key independent variables and variables indicating group membership. Wald F test statistics that account for the NHIS sample weights and utilize the Taylor Linearization variance estimates were used for obtaining p-values of tests of hypotheses

for odds ratios (OR) and adjusted odds ratios (AOR) obtained from the logistic regressions. Two-sided p-values <0.05 that were not adjusted for multiple comparisons were used to determine statistical significance.

For the income variable used in the analysis, all five sets of the imputed data for the income to poverty threshold were used. To quantify income variable results, multiples of the 2009 poverty threshold ($13,000 for a family of two) was used regardless of the woman's family size (e.g. an income of 2 - <3 was 2.99 x $13,000). Unadjusted independent variables were evaluated using logistic regression. The resulting AORs for main effects are interpreted as the odds ratio holding all other independent variables constant. A comparison between the two models (unadjusted and adjusted) was done, assessing each variable's impact on the dependent variables.

4.7 Results

Table 4.2 shows weighted percentages of the sample characteristics for the 10 independent variables. Ninety-five percent of Hispanics reported a 5-year Gail risk < 1.67%, as compared to 69% of Whites and 79% of African Americans. Sixteen percent of Hispanics reported no usual source of care, as compared to 7% of Whites and 8% of African Americans. Twenty-six percent of Hispanics reported no health insurance, as compared to 9% of Whites and 15% of African American. Thirty-nine percent of African Americans reported being married, compared to 67% of Whites and 61% of Hispanics. Forty-seven percent of Whites reported incomes of $51,870 or greater, as compared to 23.1% of African American and 21% of Hispanics. Seventy-three percent of women in the sample did not have an elevated 5-yr Gail risk score.

Table 4.2

Sample Characteristics

	(n = 6,334) No. (%)	AA[a] (n = 1,141) No. (%)	White (n = 4,156) No. (%)	Hispanic (n = 1,037) No. (%)
Age Strata				
43-49 yr	1,523 (25.9)	299 (28.7)	885 (23.9)	339 (36.1)
50-64 yr	3,019 (49.3)	551 (50.5)	2,011 (49.8)	457 (44.3)
65-79 yr	1,792 (24.9)	291 (20.7)	1,260 (26.3)	241 (19.6)
Marital Status				
Married	2,985 (63.2)	300 (38.9)	2,190 (67.3)	495 (60.7)
Not Married	3,339 (36.8)	838 (61.1)	1,960 (32.7)	541 (39.3)
5-y Gail risk				
>=1.67%	1,668 (26.7)	257 (20.7)	1,352 (30.7)	59 (5.0)
<1.67%	4,662 (73.3)	883 (79.3)	2,801 (69.3)	978 (95.0)
Homelessness				
Yes	213 (3.0)	58 (4.2)	137 (3.0)	18 (2.0)
No	6,119 (97.0)	1,083 (95.8)	4,018 (97.0)	1,018 (98.0)
Regular Source of Care				
Yes	5,787 (92.2)	1,051 (92.3)	3,863 (93.5)	873 (83.6)
No	547 (7.8)	90 (7.7)	293 (6.5)	164 (16.4)
Income[b]				
<1 (< $13,000)	952 (10.4)	279 (20.9)	395 (7.2)	278 (21.5)
1 - < 2 (< $25,870)	1,300 (17.4)	304 (24.9)	703 (14.7)	293 (27.8)
2 - < 3 (< $38,870)	1,072 (16.2)	197 (17.6)	699 (15.8)	176 (17.0)
3 - < 4 (< $51,870)	855 (14.6)	136 (13.5)	608 (15.0)	111 (12.8)
4 or more (>= $51,870)	2,155 (41.5)	225 (23.1)	1,750 (47.4)	179 (20.9)
Transportation Delay				
Yes	210 (2.5)	66 (5.5)	100 (1.9)	44 (3.6)
No	6,120 (97.5)	1,075 (94.5)	4,054 (98.1)	991 (96.4)
Health Insurance				
Yes	5,497 (88.2)	976 (85.4)	3,750 (90.7)	771 (74.0)
No	824 (11.8)	165 (14.6)	395 (9.3)	264 (26.0)
Perceived Health Status				
Excellent/Very Good/Good	5,060 (83.4)	790 (71.5)	3,503 (86.1)	767 (77.1)
Fair/Poor	1,268 (16.6)	350 (28.5)	648 (13.9)	270 (22.9)

Note. Study sample n = 6,321 – 6,334; six independent variables had missing responses or were not asked these questions; weighted percentages shown. Yr = Year.

[a]AA = African American. [b]Income categories indicate income and resource ratio of family income to poverty threshold (PT) set as an annual expenditure; Yr 2009 PT of $13,000 for a family of two used, below which, a family was considered poor.

Tables 4.3 and 4.4 provide mammography utilization frequencies, by age strata and race for the sample along with unadjusted logistic regression results. The logistic regression results in Table 3 show women in the 50-64 and 65-79 age strata had greater odds of both recent and long-term mammography utilization than women in the 43-49

age strata. Table 4 show Non-Hispanic White women had greater odds of long-term mammography utilization than African American women, while Hispanic women had lower odds of long-term mammography than African American women.

Table 4.3

Recent and Long-Term Mammography Utilization by Age Strata

Age Strata	Recent YES p<0.01				Long-term YES p<0.01			
	%	n	OR	95% CI	%	n	OR	95% CI
43-49 yr (n=1,523)*	66.0	991	1.00	-	54.8	802	1.00	-
50-64 yr (n=3,019)	72.8	2,149	**1.38**	**1.17-1.63**	69.9	2,069	**1.92**	**1.65-2.23**
65-79 yr (n=1,792)	70.3	1,246	**1.22**	**1.03-1.44**	68.0	1,194	**1.76**	**1.47-2.10**
TOTAL N=6334	4,386				4,065			

Note. (*) Represents reference group. Weighted percentages shown. Statistically significant in boldface. CI= 95 % Confidence interval. OR= Unadjusted odds ratio. Yr = Year. Recent: women who had a mammogram within the last two years; Wald F(2,299=7.52, p<0.01. Long-term: women who had three or more mammograms over the past six years; Wald F(2, 299)=38.04, p<0.01. Total includes analysis for both yes and no for mammography utilization.

Table 4.4

Sample Characteristics: Recent and Long-term Mammography Utilization by Race/ Ethnicity

Race	Recent YES p=0.09				Long-term YES p<0.01			
	%	n	OR	95% CI	%	n	OR	95% CI
Hispanic (n=1.037)	67.1	686	0.88	0.73-1.07	56.6	597	**0.78**	**0.63-0.95**
White (n=3,019)	71.0	2,911	1.06	0.90-1.24	67.2	2,760	**1.23**	**1.04-1.45**
AA[a] * (n=1,792)	69.8	789	1.00	-	62.6	780	1.00	-
TOTAL N=6,334	4,386				4,065			

Note. (*) Represent reference group. Weighted percentages shown. Statistically significant in boldface. OR= Unadjusted odds ratio. CI=95% Confidence interval. Recent: women who had a mammogram within the last two years; Wald F(2, 299)=2.40, p=0.09. Long-term: women who had three or more mammograms over the past six years; Wald F(2, 299)=19.43, p<0.01. Total includes analysis for both yes and no for mammography utilization.
[a]AA = African American.

4.7.1 African American Mammography Utilization Rates by Age Strata

To determine if there were differences in mammography utilization rates for African American women by age strata, logistic regression results and recent and long-term mammography utilization rates by age strata for African American women were

examined (Table 4.5). Women in the older two African American age strata had greater odds of long-term mammography than women in the 43-49 age strata. Weighted percentages indicate 69.1% had recent mammography utilization and 62.1% had long-term mammography utilization.

Table 4.5

African American Logistic Regression and Mammography Utilization Rates by Age Strata

Age Group	Recent p=0.12 OR/ (95% CI)		Recent YES (% / n)		Long-term p<0.01 OR/ (95% CI)		Long-term YES (% / n)	
43-49 yr (n=299)*	1.00	-	64.8	194	1.00	-	52.8	148
50-64 yr (n=551)	1.51	1.00-2.27	73.5	400	**1.80**	**1.24-2.62**	66.8	369
65-79 yr (n=291)	1.15	0.77-1.71	67.8	195	**1.75**	**1.18-2.59**	66.1	191
TOTAL n=1,141			69.1	789			62.1	708

Note. (*) Represent reference group. OR = Unadjusted odds ratio. CI = Confidence Interval. Statistically significant in boldface. Weighted percentages shown. Yr = Year. Recent: women who had a mammogram within the last two years; Wald F(2, 299)=2.13, p=0.12. Long-term: women who had three or more mammograms over the past six years; Long-Term: Wald F(2, 299)=5.64, p<0.01. Total includes analysis for both yes and no for mammography utilization.

4.7.2 Comparison of Unadjusted and Adjusted Model Variables

To address research questions 2-4 examining the relationships between all or key predictor variables on mammography utilization, logistic regression using the adjusted and unadjusted model variables to determine their relationship in predicting recent and long-term mammography utilization for the entire sample was performed. Using all model variables, Table 4.6 provides the logistic regression results for both recent and long-term mammography utilization without age stratification. The overall adjusted models for mammography utilization were statistically significant. For the unadjusted recent mammography models, p values were statistically significant for all variables except race/ethnicity. Table 4.6 more comprehensively evaluates the model variables'

effect on mammography. Experiencing homelessness (p=0.12) and transportation delays (p=46) did not contribute to recent mammography significantly in the adjusted model; however, homelessness did contribute significantly in the adjusted model for long-term mammography utilization. Transportation delays (p=0.21) also did not contribute significantly to long-term mammography utilization in the adjusted model. Race/ethnicity (p=0.09) was the only variable that did not contribute significantly to recent mammography utilization in the unadjusted model. All variables contributed significantly to long-mammography utilization in the unadjusted model.

4.7.3 Between Group Differences for Recent Mammography

Between group differences for recent mammography were further outlined in Table 4.6. Women in the 50-64 age strata had greater odds of recent mammography utilization than women in the 43-49 age strata in both the adjusted and unadjusted models (Table 4.6) (AOR: 1.28, OR: 1.38, p<0.01). Women in the 65-79 age strata only had greater odds of recent mammography utilization than women in the 43-49 age strata in the unadjusted model (OR: 1.22, p<0.01). Racial differences were found in the adjusted model only, with Non-Hispanic White women having lower odds of recent mammography utilization than African Americans (AOR: 0.71, p<0.01). There were similar statistically significant results of greater odds of recent mammography utilization in both the adjusted and unadjusted models for the following variables: married (AOR: 1.22, OR: 1.63 p<0.01); elevated Gail risk (AOR: 1.62, OR: 1.72, p<0.01); having a regular source of care (AOR: 3.28, OR: 5.51, p<0.01); having health insurance (AOR: 2.91, OR: 5.00, p<0.01), and having an excellent/very good/good perceived health status

(AOR: 1.30, OR: 1.67, p<0.01). Homelessness (OR: 0.43, p<0.01) and transportation delays (OR: 0.58, p<0.01) were only statistically significant in the unadjusted model, revealing lower odds of recent mammography utilization. Each category of the income variable was statistically significant for both the adjusted and unadjusted models, with all having lower odds of recent mammography utilization than women in the highest income category.

4.7.4 Between Group Differences for Long-Term Mammography

Between group differences for long-term mammography are also provided in Table 4.6. Women in the 50-64 age strata (AOR: 1.84, OR: 1.92, p<0.01), and 65-79 age strata (AOR: 1.30, OR: 1.76, p<0.01) had greater odds of long-term mammography utilization than women in the 43-49 age strata. Racial differences were found among adjusted and unadjusted models for both Hispanic and Non-Hispanic White women. Hispanic women (OR: 0.78, p<0.01) had lower odds of long-term mammography utilization than African American women in the unadjusted model only. Non-Hispanic White women (AOR: 0.81, p=0.01) had lower odds of long-term mammography utilization than African American women in the adjusted model. Conversely, Non-Hispanic White women (OR: 1.23, p<0.01) had greater odds of long-term mammography utilization than African American women in the unadjusted model. There were similar statistically significant results of greater odds of long-term mammography utilization for both adjusted and unadjusted models for the following variables: married (AOR: 1.23, OR: 1.61, p<0.01); elevated Gail risk score (AOR: 1.82, OR: 2.16, p<0.01); having a regular source of care (AOR: 3.16, OR: 5.29 p<0.01); having health insurance (AOR: 2.60, OR: 4.92, p<0.01), and having an excellent/very good/good perceived health status

(AOR: 1.33, OR: 1.74, $p<0.01$). Women who experienced homelessness (AOR: 0.63, $p=0.02$, OR: 0.37, $p<0.01$) had lower odds of long-term mammography utilization in the

Table 4.6

Relationship of Unadjusted and Adjusted Model Variables on Mammography Utilization

Independent Variables (n=6,296)[+]	Recent				Long-Term			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Age Strata	<0.01		<0.01		<0.01		<0.01	
43 – 49yr *	1.00		1.00		1.00		1.00	
50 – 64yr	**1.38(1.17-1.63)**		**1.28(1.07-1.55)**		**1.84(1.56 - 2.19)**		**1.92(1.65-2.23)**	
65 – 79yr	**1.22(1.03-1.44)**		0.89(0.72-1.10)		**1.30(1.04 - 1.62)**		**1.76(1.47-2.10)**	
Race/Ethnicity	0.09		<0.01		0.01		<0.01	
Hispanic	0.88(0.73-1.07)		1.18(0.96-1.46)		1.00(0.80 - 1.25)		**0.78(0.63-0.95)**	
White	1.06(0.90-1.24)		**0.71(0.60- 0.85)**		**0.81(0.67 - 0.97)**		**1.23(1.04-1.45)**	
AA[a]*	1.00		1.00		1.00		1.00	
Marital Status	<0.01		0.01		<0.01		<0.01	
Married	**1.63(1.44-1.85)**		**1.22(1.05 -1.41)**		**1.23(1.08 - 1.41)**		**1.61(1.44-1.81)**	
Not Married*	1.00		1.00		1.00		1.00	
5-yr Gail Risk	<0.01		<0.01		<0.01		<0.01	
>=1.67%	**1.72(1.49 - 1.99)**		**1.62(1.37-1.92)**		**1.82(1.54 - 2.15)**		**2.16(1.87-2.49)**	
< 1.67%*	1.00		1.00		1.00		1.00	
Homelessness	<0.01		0.12		0.02		<0.01	
Yes	**0.43(0.31 - 0.60)**		0.75(0.52-1.08)		**0.63(0.44 - 0.91)**		**0.37(0.27-0.51)**	
No*	1.00		1.00		1.00		1.00	
Regular Source of Care	<0.01		<0.01		<0.01		<0.01	
Yes	**5.51(4.40 - 6.91)**		**3.28(2.54-4.24)**		**3.16(2.41 - 4.13)**		**5.29(4.17-6.71)**	
No*	1.00		1.00		1.00		1.00	
Income	<0.01		<0.01		<0.01		<0.01	
less than 1	**0.28(0.22 - 0.34)**		**0.44(0.34-0.57)**		**0.42(0.32 - 0.55)**		**0.25(0.21-0.31)**	
1- < 2	**0.30(0.25 - 0.37)**		**0.46(0.37-0.58)**		**0.49(0.40 - 0.61)**		**0.33(0.27-0.39)**	
2- < 3	**0.48(0.40 - 0.58)**		**0.62(0.50-0.76)**		**0.67(0.55 - 0.83)**		**0.54(0.45-0.65)**	
3- < 4	**0.63(0.51 - 0.71)**		**0.72(0.58-0.90)**		0.82(0.64 - 1.05)		**0.73(0.57-0.93)**	
4 or greater*	1.00		1.00		1.00		1.00	

Independent Variables (n=6,296)[+]	Recent				Long-Term			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Transportation Delay	<0.01		0.46		0.21		<0.01	
Yes	**0.58(0.41 - 0.81)**		0.87(0.60-1.26)		0.80(0.56 - 1.13)		**0.50(0.36-0.69)**	
No*	1.00		1.00		1.00		1.00	
Health Insurance	<0.01		<0.01		<0.01		<0.01	
Yes	**5.00(4.16 - 6.03)**		**2.91(2.32-3.63)**		**2.60(2.06 - 3.28)**		**4.92(4.10-5.90)**	
No*	1.00		1.00		1.00		1.00	
Perceived Health Status	<0.01		<0.01		<0.01		<0.01	
Excellent/Very Good/ Good	**1.67(1.44 - 1.93)**		**1.30(1.10-1.54)**		**1.33(1.11 - 1.59)**		**1.74(1.50-2.02)**	
Fair/Poor*	1.00		1.00		1.00		1.00	

Note. (*) Represent reference group. Statistically significant in boldface. CI = 95% Confidence interval. Recent: women who had a mammogram within the last two years; Adjusted model: Wald F(15, 286)=34.01, p<0.01. Long-term: women who had three or more mammograms over the past six years; Adjusted model: Wald F(15, 286)=36.77, p<0.01. ([+]) Denotes final sample size due to missing values.
[a]AA = African American.

adjusted and unadjusted models. Only women in the lower three income categories (<$38,870) had statistically significant lower odds of long-term mammography utilization in the adjusted model. Women in all four of the lower income categories (<$51,870) had statistically significant lower odds of long-term mammography utilization in the unadjusted model.

4.7.5 Comparison of Model Variables by Race and Age

In examining if there is a difference in Gail risk scores on mammography utilization by race, both variable interactions for recent mammography utilization were not statistically significant, neither between age strata and the 5-yr Gail risk score, Wald $F(2, 299)=0.03$, $p=0.96$; nor between age strata and race, Wald $F(4, 297)=0.99$, $p=0.41$. Similarly, both variable interactions for long-term mammography utilization were not statistically significant: between age strata and the 5-yr Gail risk score, Wald $F(2, 299)=1.92$, $p=0.15$; nor between age strata and race, Wald $F(4, 297)=0.57$, $p=0.69$.

Tables 4.7 (recent mammography) and 4.8 (long-term mammography) provide logistic regression results and comparison between the nine adjusted and unadjusted model variables stratified by age strata. There are similar differences seen between the adjusted and unadjusted models when stratified by age strata, as well as several different effects among the variables (between unadjusted and adjusted models) than what is seen when variables are not stratified by age.

Having a regular source of care were statistically significant across all three age strata in both the adjusted and unadjusted models for recent and long-term mammography utilization: recent 43-49 yr, (AOR: 2.98; OR: 5.32), 50-64 yr, (AOR: 2.96; OR: 5.44), 65-79 yr, (AOR: 7.82; OR: 8.71), and long-term: 43-49 yr, (AOR: 2.56; OR: 4.47), 50-64 yr,

(AOR: 3.00; OR: 5.30), 65-79 yr, (AOR: 8.27; OR: 9.18), p<0.01. Inclusion in the lower two income categories (<$25,870) were statistically significant across all three age strata in both the adjusted and unadjusted models for recent and long-term mammography utilization: recent 43-49 yr, (AOR: 0.48, 0.45, p=0.01); (OR: 0.29, 0.29, p<0.01), 50-64 yr, (AOR: 0.42, 0.49; OR: 0.26, 0.27), 65-79 yr, (AOR: 0.39, 0.42; OR: 0.29, 0.35), p<0.01, and long-term: 43-49 yr, (AOR: 0.40, 0.44; OR: 0.23, 0.29), 50-64 yr, (AOR: 0.42, 0.53; OR: 0.24, 0.29), 65-79 yr (AOR: 0.42, 0.47; OR: 0.27, 0.36), p<0.01. Having health insurance was statistically significant across all three age strata in both the adjusted and unadjusted models for recent and long-term mammography utilization except for long-term mammography for the 65-79 age strata adjusted model: recent 43-49 yr, (AOR: 2.60; OR: 4.76), 50-64 yr, (AOR: 3.26; OR: 5.78), p<0.01, 65-79 yr, (AOR: 4.3, p=0.04); (OR: 7.76, p<0.01), and long-term: 43-49 yr, (AOR: 2.09; OR: 4.10), 50-64 yr, (AOR: 3.08; OR: 5.60), p<0.01, 65-79 yr, (AOR: 3.16, p=0.10), (OR: 6.97, p<0.01). Perceived health status was only statistically significant in both the adjusted and unadjusted models for the 65-79 age strata (AOR: 1.46, p=0.02; OR: 1.79, p<0.01) for recent mammography, and the 50-64 age strata (AOR: 1.35, p=0.03; OR: 1.93, p<0.01) for long-term mammography. An elevated Gail risk score was statistically significant in both the adjusted and unadjusted models for all age strata for recent and long-term mammography utilization except for the 43-49 age strata: recent, 43-49 yr, (AOR: 1.78, p=0.08); (OR: 2.16, p=0.01), 50-64 yr, AOR: 1.62; OR: 1.74), 65-79 yr, (AOR: 1.64; OR: 1.74), p<0.01, and long-term: 43-49 yr, (AOR: 3.15; OR: 3.62), 50-64 yr, (AOR: 1.89; OR: 2.06), 65-79 yr, (AOR: 1.59; OR: 1.77), p<0.01.

4.7.6 Between Group Differences for Recent by Age Strata

The overall logistic regression models for each age strata were statistically significant (Table 4.7). For the adjusted and unadjusted age strata models, woman in all age strata with a regular source of care: 43-49 yr, (AOR: 2.98; OR: 5.32), 50-64 yr, (AOR: 2.96; OR: 5.44), 65-79 yr, (AOR: 7.82; OR: 8.71), $p<0.01$, and health insurance: 43-49 yr, (AOR: 2.60; OR: 4.76), 50-64 yr, (AOR: 3.26; OR: 5.78), $p<0.01$, 65-79 yr, (AOR: 4.3, $p=0.04$); (OR: 7.76, $p<0.01$), had greater odds of recent mammography utilization. As shown in Table 4.7 for the 43-49 age strata, being married (OR: 1.67 $p<0.01$); having an elevated Gail risk score (OR: 2.16, $p=0.01$), experienced homelessness (OR: 0.49, $p=0.01$), and an excellent/ very good/ good perceived health status (OR: 1.57, $p=0.01$) contributed statistically significantly to the unadjusted model, but not to the adjusted model. Women who experienced homelessness had lower odds of recent mammography utilization in the unadjusted model for the 43-49 (OR: 0.49, $p=0.01$) and 50-64 (OR: 0.42, $p<0.01$) age strata. Women in the lower three income categories had lower odds of recent mammography utilization across all three age strata for both adjusted and unadjusted models: 43-49 yr, (AOR: 0.48, 0.45, 0.58, $p=0.01$); (OR: 0.29, 0.29, 0.44, $p<0.01$), 50-64 yr, (AOR: 0.42, 0.49, 0.60; OR: 0.26, 0.27, 0.45), 65-79 yr, (AOR: 0.39, 0.42, 0.62; OR: 0.29, 0.35, 0.57), $p<0.01$. For women in the 50-64 age strata, Non-Hispanic White women (AOR: 0.62, $p<0.01$) had lower odds of recent mammography utilization than African American women. Women who were married had greater odds of recent mammography utilization for women in the 50-64 (OR: 1.61, $p<0.01$) and 65-79 (AOR: 1.40, $p=0.02$, OR: 1.78, $p<0.01$) age strata. Women with an elevated Gail risk score had greater odds of recent mammography utilization for the 50-

64 (AOR: 1.62, OR: 1.74, p<0.01) and 65-79 (AOR: 1.65, OR: 1.74, p<0.01) age strata. Women in the 50-64 age strata with transportation delays (OR: 0.57, p=0.02) had lower odds of recent mammography utilization. Women with an excellent/ very good/ good perceived health status in the 43-49 (OR: 1.57, p=0.01), 50-64 (OR: 1.75, p<0.01) and the 65-79 (AOR: 1.46, p=0.02, OR: 1.79, p<0.01) age strata had greater odds of recent mammography utilization.

4.7.7 Between Group Differences for Long-Term by Age Strata

Non-Hispanic White women in the 50-64 age strata (AOR: 0.76, p=0.03) had lower odds of long-term mammography utilization than African American women (Table 4.8). Women with an elevated Gail risk score: 43-49 yr, (AOR: 3.15; OR: 3.62), 50-64 yr, (AOR: 1.89; OR: 2.06), 65-79 yr, (AOR: 1.59; OR: 1.77), p<0.01, and a regular source of care: 43-49 yr, (AOR: 2.56; OR: 4.47), 50-64 yr, (AOR: 3.00; OR: 5.30), 65-79 yr, (AOR: 8.27; OR: 9.18), p<0.01, had greater odds of long-term mammography utilization in the adjusted and unadjusted models across all three age strata. The Gail risk score was more predictive for women in their 40s (AOR: 3.15, OR: 3.62, p<0.01) than for women in the other two groups. Incomes in the lower two categories: 43-49 yr, (AOR: 0.40, 0.44; OR: 0.23, 0.29), 50-64 yr, (AOR: 0.42, 0.53; OR: 0.24, 0.29), 65-79 yr (AOR: 0.42, 0.47; OR: 0.27, 0.36), p<0.01, had lower odds of long-term mammography across the three age strata. Having health insurance had greater odds of long-term mammography utilization except in the adjusted model for women in the 65-79 (AOR: 3.16, p=0.10) age strata. Having an excellent/ very good/ good perceived health status had greater odds of long-term mammography in both the adjusted and unadjusted models for the 50-64 age

strata (AOR: 1.35, p=0.03, OR: 1.93, p<0.01). Women across all three age strata with transportation delays: 43-49 yr, (OR: 0.41, p=0.02), 50-64 yr, (OR: 0.55, p=0.01), 65-79

Table 4.7

Relationship of Unadjusted and Adjusted Model Variables on Recent Mammography Utilization by Age Strata

Independent Variables	**43 – 49 yr** (n=1,519)				**50 – 64 yr** (n=2,996)				**65 – 79 yr** (n=1,781)			
	Unadjusted		Adjusted		Unadjusted		Adjusted		Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Race/Ethnicity	0.53		0.03		0.19		<0.01		0.70		0.06	
Hispanic		0.93(0.63- 1.37)		1.31(0.85-2.02)		0.80(0.59-1.08)		0.99(0.69-1.42)		1.12(0.72-1.75)		1.48(0.90-2.45)
White		1.10 (0.78-1.55)		0.78(0.53-1.16)		0.99(0.76-1.28)		**0.62(0.46-0.83)**		1.14(0.84-1.54)		0.87(0.62-1.21)
AA[a]*		1.00		1.00		1.00		1.00		1.00		1.00
Marital Status	<0.01		0.38		<0.01		0.20		<0.01		0.02	
Married		**1.67(1.29-2.15)**		1.14(0.84-1.55)		**1.61(1.33-1.95)**		1.15(0.93-1.43)		**1.78(1.41-2.25)**		**1.40(1.07-1.82)**
Not Married*		1.00		1.00		1.00		1.00		1.00		1.00
5-yr Gail Risk	0.01		0.08		<0.01		<0.01		<0.01		<0.01	
>=1.67%		**2.16(1.18-3.96)**		1.78(0.94-3.36)		**1.74(1.39-2.18)**		**1.62(1.27-2.06)**		**1.74(1.39-2.17)**		**1.65(1.30-2.09)**
< 1.67%*		1.00		1.00		1.00		1.00		1.00		1.00
Homelessness	0.01		0.44		<0.01		0.25		0.05		0.26	
Yes		**0.49(0.28-0.85)**		0.79(0.44-1.43)		**0.42(0.27-0.65)**		0.75(0.46-1.22)		0.35(0.12-1.00)		0.55(0.19-1.57)
No*		1.00		1.00		1.00		1.00		1.00		1.00
Regular Source of Care	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	
Yes		**5.32(3.75-7.54)**		**2.98(1.94-4.57)**		**5.44(3.94-7.51)**		**2.96(2.05-4.30)**		**8.71(4.75-15.96)**		**7.82(4.12-14.82)**
No*		1.00		1.00		1.00		1.00		1.00		1.00
Income	<0.01		0.01		<0.01		<0.01		<0.01		<0.01	
less than 1		**0.29(0.19-0.42)**		**0.48(0.29-0.81)**		**0.26(0.19-0.36)**		**0.42(0.29-0.63)**		**0.29(0.19-0.45)**		**0.39(0.24-0.65)**
1- < 2		**0.29(0.20-0.43)**		**0.45(0.27-0.74)**		**0.27(0.20-0.36)**		**0.49(0.34-0.70)**		**0.35(0.24-0.52)**		**0.42(0.28-0.65)**
2- < 3		**0.44(0.30-0.66)**		**0.58(0.38-0.90)**		**0.45(0.34-0.59)**		**0.60(0.44-0.81)**		**0.57(0.38-0.85)**		**0.62(0.41-0.95)**
3- < 4		0.67(0.43-1.04)		0.79(0.50-1.25)		**0.59(0.43-0.81)**		0.72(0.51-1.01)		0.63(0.40-1.01)		0.62(0.39-1.00)
4 or greater*		1.00		1.00		1.00		1.00		1.00		1.00
Transportation Delay	0.05		0.43		0.02		0.57		0.23		0.99	
Yes		0.48(0.23-1.01)		0.73(0.34-1.58)		**0.57(0.36-0.91)**		0.86(0.51-1.45)		0.68(0.37-1.28)		1.00(0.49-2.03)
No*		1.00		1.00		1.00		1.00		1.00		1.00
Health Insurance	<0.01		<0.01		<0.01		<0.01		<0.01		0.04	
Yes		**4.76(3.45-6.57)**		**2.60(1.72-3.93)**		**5.78(4.53-7.37)**		**3.26(2.47-4.30)**		**7.76(2.19-27.54)**		**4.30(1.12-16.51)**
No*		1.00		1.00		1.00		1.00		1.00		1.00

Independent Variables	**43 – 49 yr** (n=1,519)				**50 – 64 yr** (n=2,996)				**65 – 79 yr** (n=1,781)			
	Unadjusted		Adjusted		Unadjusted		Adjusted		Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Perceived Health Status	0.01		0.32		<0.01		0.12		<0.01		0.02	
Excellent/Very Good/Good	**1.57(1.12-2.20)**		1.23(0.82-1.83)		**1.75(1.41-2.17)**		1.24(0.94-1.64)		**1.79(1.34-2.38)**		**1.46(1.06-1.99)**	
Fair/Poor*	1.00		1.00		1.00		1.00		1.00		1.00	

Note. (*) Represent reference group. Statistically significant in boldface. CI = 95% Confidence Interval. Yr = year. AOR = Adjusted Odds Ratio. OR = Odds Ratio. Recent: women who had a mammogram within the last two years; Adjusted models: (43-49 age strata) Wald F(13, 288)=10.86, p<0.01, (50-64 age strata) Wald F(13, 288)=23.43, p<0.01, and (65-79 age strata) Wald F(13, 288)=10.07, p<0.01.

[a]AA = African American.

Table 4.8

Relationship of Unadjusted and Adjusted Model Variables on Long-Term Mammography Utilization by Age Strata

Independent Variables	**43 – 49 yr** (n=1,519)				**50 – 64 yr** (n=2,996)				**65 – 79 yr** (n=1,781)			
	Unadjusted		Adjusted		Unadjusted		Adjusted		Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Race/Ethnicity	0.02		0.45		0.01		0.03		0.03		0.64	
Hispanic		0.78(0.53-1.15)		0.99(0.65-1.51)		0.88(0.64-1.20)		1.07(0.76-1.51)		0.73(0.47-1.12)		0.86(0.53-1.41)
White		1.18(0.86-1.62)		0.84(0.59-1.20)		1.23(0.95-1.59)		**0.76(0.59-0.99)**		1.15(0.84-1.60)		0.85(0.60-1.20)
AA[a]*		1.00		1.00		1.00		1.00		1.00		1.00
Marital Status	<0.01		0.60		<0.01		0.33		<0.01		<0.01	
Married		**1.59(1.26-2.00)**		1.08(0.82-1.41)		**1.60(1.32-1.94)**		1.12(0.90-1.40)		**2.11(1.67-2.66)**		**1.66(1.28-2.16)**
Not Married *		1.00		1.00		1.00		1.00		1.00		1.00
5-yr Gail Risk	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	
>=1.67%		**3.62(2.01-6.50)**		**3.15(1.71-5.83)**		**2.06(1.65-2.58)**		**1.89(1.48-2.41)**		**1.77(1.39-2.25)**		**1.59(1.23-2.06)**
< 1.67%*		1.00		1.00		1.00		1.00		1.00		1.00
Homelessness	<0.01		0.01		<0.01		0.15		0.14		0.60	
Yes		**0.30(0.17-0.54)**		**0.45(0.25-0.83)**		**0.42(0.27-0.64)**		0.71(0.45-1.12)		0.46(0.16-1.31)		0.75(0.26-2.20)
No*		1.00		1.00		1.00		1.00		1.00		1.00
Regular Source of Care	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	
Yes		**4.47(2.98-6.69)**		**2.56(1.56-4.18)**		**5.30(3.87-7.26)**		**3.00(2.11-4.27)**		**9.18(4.84-17.42)**		**8.27(4.11-16.61)**
No*		1.00		1.00		1.00		1.00		1.00		1.00
Income	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	
less than 1		**0.23(0.16-0.34)**		**0.40(0.25-0.64)**		**0.24(0.18-0.32)**		**0.42(0.29-0.60)**		**0.27(0.18-0.43)**		**0.42(0.25-0.70)**
1- < 2		**0.29(0.20-0.42)**		**0.44(0.28-0.68)**		**0.29(0.22-0.38)**		**0.53(0.39-0.72)**		**0.36(0.25-0.51)**		**0.47(0.31-0.70)**
2- < 3		**0.52(0.36-0.74)**		0.67(0.45-1.00)		**0.49(0.37-0.65)**		**0.66(0.48-0.90)**		**0.57(0.37-0.87)**		0.64(0.40-1.00)
3- < 4		0.85(0.56-1.28)		1.00(0.67-1.51)		**0.58(0.41-0.83)**		0.71(0.49-1.02)		0.79(0.47-1.33)		0.80(0.47-1.35)
4 or greater*		1.00		1.00		1.00		1.00		1.00		1.00
Transportation Delay	0.02		0.44		0.01		0.72		0.01		0.23	
Yes		**0.41(0.19-0.88)**		0.73(0.33-1.61)		**0.55(0.36-0.86)**		0.91(0.55-1.51)		**0.45(0.24-0.84)**		0.65(0.32-1.32)
No*		1.00		1.00		1.00		1.00		1.00		1.00
Health Insurance	<0.01		<0.01		<0.01		<0.01		<0.01		0.10	
Yes		**4.10(2.95-5.70)**		**2.09(1.38-3.16)**		**5.60(4.38-7.15)**		**3.08(2.32-4.10)**		**6.97(1.94-25.04)**		3.16(0.83-11.98)
No*		1.00		1.00		1.00		1.00		1.00		1.00

Independent Variables	**43 – 49 yr** (n=1,519) Unadjusted		Adjusted		**50 – 64 yr** (n=2,996) Unadjusted		Adjusted		**65 – 79 yr** (n=1,781) Unadjusted		Adjusted	
	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)	p value	OR (CI)	p value	AOR (CI)
Perceived Health Status	<0.01		0.19		<0.01		0.03		<0.01		0.08	
Excellent/Very Good/Good	**1.87(1.35-2.60)**		1.30(0.88-1.91)		**1.93(1.55-2.39)**		**1.35(1.03-1.76)**		**1.76(1.35-2.30)**		1.33(0.97-1.83)	
Fair/Poor*	1.00		1.00		1.00		1.00		1.00		1.00	

Note. (*) Represent reference group. Statistically significant in boldface. CI = 95% Confidence Interval. Yr = year. AOR = Adjusted Odds Ratio. OR = Odds Ratio. Long-term: women who had three or more mammograms over the past six years; Adjusted models: (43-49 age strata) Wald F(13, 288)=10.08, p<0.01, (50-64 age strata) Wald F(13, 288)=24.77, p<0.01, and (65-79 age strata) Wald F(13, 288)=10.36, p<0.01.

[a]AA = African American.

yr, (OR: 0.45, p=0.01), had lower odds of long-term mammography utilization in the unadjusted model. Homelessness was only statistically significant for women in the 43-49 (AOR: 0.45, p=0.01, OR: 0.30, p<0.01) and 50-64 (OR: 0.42, p<0.01) age strata. Being married was a statistically significant contributor in both the adjusted and unadjusted models only in the 65-79 age strata (AOR: 1.66, OR: 2.11, p<0.01). Being married was statistically significant in the unadjusted model for the 43-49 (OR:1.59, p<0.01) and 50-64 (OR: 1.60, p<0.01) age strata. Homelessness was a statistically significant contributor in the adjusted and unadjusted models for the 43-49 (AOR: 0.45, p=0.01, OR: 0.30, p<0.01) age strata, yet only contributed to the unadjusted model for the 50-64 (OR: 0.42, p<0.01) age strata.

4.7.8 Gail Risk Scores on Mammography by Race

Interactions were tested between race and the 5-yr Gail risk score for both recent and long-term mammography utilization. The interactions were not statistically significant for recent mammography, Wald F(2, 299)=1.76, p=0.18, nor for long-term mammography adherence, Wald F(2, 299)=0.58, p=0.56.

4.8 Discussion

The results of this study confirm previous mammography findings. The study results provided new information on mammography behaviors of Non-Hispanic White women and African American women in their 40s. This was the first study to use calculated Gail risk scores from the 2010 NHIS data, as well as the first study to use the temporary homelessness variable in predicting mammography utilization using national-level data.

These study findings confirm that race/ethnicity, age, and socioeconomic (income) disparities still exist in mammography screening utilization (American Cancer Society, 2017; Centers for Disease & Prevention, 2012; Rakowski et al., 2004; White et al., 2017). Fewer women in the 43-49 age strata utilized mammography, which may be attributed to prominent mammography guidelines not promoting mammography commencement at 40 due to the mammography controversy (Bjurstam et al., 2003; Nystrom et al., 1993; U. S. Preventive Services Task Force, 2009). At the time of study data collection, mammography guidelines did not aggressively promote individualized risk assessment. Therefore, as expected overall among all ages, women in the older two age strata had greater odds of both recent and long-term mammography utilization than women in their 40s, which aligned with the preponderance of screening guidelines recommending regular mammography begin at age 50 (Nash et al., 2007; Rakowski et al., 2006; Siu et al., 2016; Smith et al., 2013). Higher odds of both recent and long-term mammography for women in the 50-64 age strata prevailed throughout logistic regression testing of unadjusted and adjusted, which has been prevalent in previous studies (Centers for Disease Control and, 2012; Legler, Breen, Meissner, Malec, & Coyne, 2002; Rakowski et al., 2004). In this study, women in the older two age strata participated most in mammography, and more heavily in continued long-term mammography; with the older 65-79 age strata having the higher odds of long-term mammography. This was an improvement over earlier studies using the NHIS data, which indicated women in the older group participated less in mammography (Hiatt et al., 2002; Legler et al., 2002; Swan, Breen, Coates, Rimer, & Lee, 2003).

African American patterns of long-term mammography utilization aligned with general long-term mammography utilization for all three races together, with the two older age strata having greater odds of long-term mammography than African American women in their 40s. This finding may be attributed to the cross-sectional nature of the study, and the mammography controversy with its associated ambiguity surrounding commencement for younger women. Since study findings indicate that fewer African American women in their 40s are continuing with long-term mammography, an evaluation of their individual risk along with an understanding of the timeframes between mammograms is warranted due to the aggressive cancer morphology of some breast cancer in this population. Should long-term mammography trends in this population continue to decline, a more widened breast cancer mortality disparity could be seen (Carey et al., 2006; Ooi et al., 2011; Rahman, Dignan, & Shelton, 2003; Rawl et al., 2000; van Ravesteyn et al., 2012). A potential positive improvement in mammography behaviors for African American in their 40s was seen, with participation in recent mammography utilization rates not statistically significantly different than the other races.

A key finding of this study, which is consistent with more recent analyzed 2015 NHIS data, was mammography utilization behaviors of Non-Hispanic White women, in which adjusted results showed lower odds of recent and long-term mammography for this group as compared African American women (White et al., 2017). Although previous studies using 2005 or earlier NHIS or other national-level data show a converse result, these updated results could indicate targeted efforts in the African American community

in mitigating screening disparities (Amirikia et al., 2011; Rakowski et al., 2004; Rakowski et al., 2006; Samson et al., 2016; Swan et al., 2003).

Another key finding of this study was that Non-Hispanic White women in the 50-64 age strata had lower odds of both recent and long-term mammography utilization as compared to African American women in the same age strata. This finding is different from previous national-level data studies showing Non-Hispanic White women in the 50-64 age strata with the highest recent mammography rates among ethnicities included (Rakowski et al., 2006; Rao, Breen, & Graubard, 2016; Swan et al., 2003). This finding is consistent with recent 2015 NHIS data analysis (White et al., 2017). This could signal that women of color are better understanding their breast cancer risk.

All independent variables contributed as predictors for recent mammography in the adjusted model except for homelessness and transportation, while only transportation did not contribute to the adjusted long-term model. Although these results were consistent with the literature for mammography predictors, homelessness and transportation delay were statistically significant contributors in the unadjusted models (Hiatt et al., 2002; Rakowski et al., 2006; White et al., 2017). The prevailing literature guided the selection of the variables, thus this study confirmed the validity of each as a predictor of mammography in the unadjusted model (Rakowski et al., 2004).

Gail risk score was a predictor for all age strata in both adjusted models for recent and long-term mammography except for the recent 43-49 age strata. Regular source of care and income were the only two predictors that contributed statistically significantly to both recent and long-term mammography utilization for all age strata, which is consistent with previous studies (Rakowski et al., 2004; Rakowski et al., 2006; Rao et al., 2016).

Women in the youngest age strata who had experienced homelessness had lower odds of long-term mammography in both unadjusted and adjusted models. These finding related to homelessness is consistent with the literature that suggests that women will delay preventive health needs to meet their basic necessity challenges (shelter, food, clothing, etc.) (Chau et al., 2002; Gelberg et al., 2000; Moxley & Washington, 2016).

Women in the older age strata who reported excellent or good perceived health were more likely to report recent mammography. Women in the middle age strata who reported an excellent or good perceived health were more likely to report long-term mammography. This is born out in the literature that having an excellent or good perception of one's health would lead to greater mammography participation (Rakowski et al., 2004; Rao, Graubard, Breen, & Gastwirth, 2004). Marital status was only a mammography utilization predictor with the oldest age strata in the adjusted model, verifying the importance of partner support for this age strata, suggesting perhaps motivation for improved quality of life and preventive health services with the presence of a spouse (Allen, Stoddard, & Sorensen, 2008; Farmer, Reddick, D'Agostino, & Jackson, 2007; Mobley, Kuo, Clayton, & Evans, 2009).

Lower income was negatively associated with less mammography utilization in this study. Including financial resources as a sociodemographic predictor for mammography utilization has been associated throughout the literature (Rakowski et al., 2004; Rakowski et al., 2006; Rao et al., 2016). This might signal that the youngest and oldest age strata might be aware of community resources to meet their mammography needs. For the oldest age strata, they do contend with lowered and fixed incomes, which might inform their decision to delay mammography (Jennings-Dozier & Lawrence, 2000;

Kolb, 2006; Rakowski et al., 2006). Having health insurance was less of a factor for long-term mammography utilization for the oldest age strata. Although this study data was obtained pre-Patient Protection and Affordable Care Act (ACA), health insurance may not have been a barrier for the older age strata due to Medicare coverage, a free health insurance for older Americans beginning at age 65.

Although study participants did not know their Gail risk score, questions from the NHIS allowed Gail risk score calculations ex post facto, which provided a rare element to this study. These study findings were able to show that there was no difference in 5-year Gail risk score across age strata and races. Study findings also showed that an elevated 5-year Gail was a recent mammography utilization predictor for the two older age strata, and a long-term mammography utilization predictor for all three age strata. These findings support the importance of women knowing their individual breast cancer risk, informing their mammography utilization (Anderson, 2010; Antill et al., 2006; Pace & Keating, 2014).

4.8.1 Strengths

This hypothesis-driven secondary data analysis study offered several strengths. The large national dataset provided optimal power, extensive variables, and generalizability of study results. The conceptual tenets of the BMVP were strengths of the study that allowed for evaluation of vulnerable population domains (Austin et al., 2008; Babitsch, Gohl, & von Lengerke, 2012; Gelberg et al., 2000; Oser, Bunting, Pullen, & Stevens-Watkins, 2016). The vast number of variables within the 2010 NHIS allowed the Gail risk score to be calculated. Although study participants did not know their individual breast cancer risk and did not make mammography utilization decisions using

knowledge of their risk, utilization of the Gail risk score was both a strength and limitation of this study. Had women known their Gail risk, it would have factored into their mammography decisions. Another limitation of the Gail risk score in the NHIS is that it does not account for women with atypical ductal hyperplasia (ADH), which is only diagnosed with screening mammography. Since ADH is a risk factor for developing breast cancer, women in the study may have potentially had ADH but were not noted as such in this study (Howard-McNatt, 2017; Purcell & Norris, 1998).

4.8.2 Limitations

Limitations of this study included its secondary data analysis design, income variable complexities, and participant self-report. Secondary data analysis has inherent design limitations, in that, the original data was not collected for the specific purpose of this study, as there are capture and collection limits of multi-purpose survey data. Therefore, design of a new study would allow for greater specific information on mammography utilization. Even though secondary data presented inherent limitations, the data set was extremely well suited for my research questions through its specific design to study mammography. Calculations for the income variable were a limitation, as multiples of the 2009 poverty threshold for a family of two ($13,000) was used irrespective of whether women were from a family of < or > three, which may have caused some inherent variance. Additionally, the five sets of the multiple income variable complicated regression analysis computations. Yet, without the imputed income, the data would have included 20% missing income data, significantly impacting analysis. Self-report data also has intrinsic limitation factors: recall problems, overestimation, and telescoping (Caplan, Mandelson, Anderson, & Health Maintenance, 2003; Cronin et al.,

2009; King, Rimer, Trock, Balshem, & Engstrom, 1990; Paskett et al., 1996). Despite the innate parameters surrounding self-report, it is still shown to be accurate and reliable (Mack, Pavao, Tabnak, Knutson, & Kimerling, 2009; Newell, Girgis, Sanson-Fisher, & Savolainen, 1999). Lastly, while this study data is not as recent, it does still offer valuable insight into mammography utilization dynamics that should be further explored.

4.8.3 Research and Practice Implications

This study findings show that greater mammography among younger African American women is not increasing the incidence of breast cancer seen in the literature. It is not clear if younger African American women are aware of their breast cancer risk, breast cancer incidence, and treatment or mortality rates. This study results show that there is no statistically significant difference in mammography utilization by age strata for African American women that differed in what is seen when Non-Hispanic White, African American, and Hispanic women were compared together. Therefore African American women in the different age strata are using mammography similarly as women in other races and age strata.

There are still unresolved questions that should be further explored. Temporary and long-term homelessness should be further explored in the context closer to the expressed mammography behavior, to better determine its effect. Delays in transportation also should be further explored to determine its effect in an adjusted model. Further research is needed to determine how much younger women should be participating in mammography after they have explored their risk with their provider.

It is encouraging to see that mammography use among African American and Hispanics women increasing; however it is concerning that non-Hispanic White women

have lower mammography use than in previous iterations of the NHIS (Rakowski et al., 2004; Rakowski et al., 2006; Rao et al., 2016; Swan et al., 2003). Future research is needed to explore why Non-Hispanic White women have lowered mammography utilization. It is also recommended that future breast cancer and mammography disparity research focus in the following areas: predictors inherent to vulnerable populations; individual breast cancer risk tools like the Gail; how risk tools can improve mammography utilization and breast cancer health disparities; race and mammography; mammography adherence using current recommended mammography guidelines; and continued utilization of individualized breast cancer risk tools that may include evaluation of women with ADH. Continual testing of mammography predictors is needed as systems and national healthcare policies change, and translation of that knowledge into practice (Kearney & Murray, 2009; Warnecke et al., 2008).

4.8.4 Conclusion

Mammography screening has a vital place in the continuum of early breast cancer detection and in assisting in mitigating breast cancer health disparities. For African American women, despite mammography's increased utilization by the two older age strata, it is important for women in their 40s to know their risk and consult with their health provider concerning commencement, frequency, and adjunct detection modalities. As new dynamics and interactions present, it is important to continue studying their impact on mammography utilization, so that continued improvements, knowledge, and breast cancer health disparity mitigation strategies can be garnered.

4.9 References

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