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Factors Associated With Patient Portal Utilization, Preventive Services Utilization, and Health Promoting Behaviors Among Adults in the United States

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FACTORS ASSOCIATED WITH PATIENT PORTAL UTILIZATION, PREVENTIVE SERVICES UTILIZATION, AND HEALTH PROMOTING BEHAVIORS AMONG ADULTS IN THE UNITED STATES

by

ELIZABETH AYANGUNNA

(Under the Direction of Gulzar Shah)

ABSTRACT

Background: Nearly 60% of adults in the United States are estimated to have one or more chronic conditions, necessitating strategies to improve the health status of persons with chronic disease. Given that health information technology (HIT) is considered highly valuable for superior disease management, it is imperative to examine how HIT use can improve health behaviors, which can in turn improve health status. This study aimed to examine if there was an association between patient portal utilization and the use of preventive services & health-promoting behaviors. Also, this study examined the influence of self-efficacy on preventive health behaviors among adults in the United States.

Methods: This study analyzed secondary data from the nationally representative Health Information National Trends Survey 5 combined dataset from 2017 to 2020. Data analysis was restricted to respondents who had used their patient portals in the past year and the sample size was 14,103. Binomial & multinomial logistic regression models were conducted for this study.

Results: Patient portal utilization was significantly associated with preventive health behaviors such as pap smear testing, mammogram screening, non-smoking, levels of participation in physical activities, and muscle-strengthening activities. Self-efficacy was significantly associated with mammogram screening and the levels of participation in physical and muscle-strengthening activities.

Conclusion: The study provides information that suggests that stakeholders need to encourage the population to use their patient portals. Also, optimizing the patient portals for not just clinical care but preventive care may reduce the incidence and cost of chronic diseases.

INDEX WORDS: Patient portal utilization, Preventive health behaviors, Health promoting behaviors, Pap smear, Mammogram, Self-efficacy, Non-smoking, Physical activities, Muscle-strengthening

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DOCTOR OF PUBLIC HEALTH

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STATES

by

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DEDICATION

This dissertation is dedicated to Yeshua Hamashiach, the God who has kept me this far. Thank you Jesus for everything.

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CHAPTER 1

INTRODUCTION

Background of Problem

Prevention is always preferred to cure because it reduces unnecessary morbidity and mortality. The cost of healthcare associated with chronic diseases can be mitigated with preventive behaviors. Preventive health behaviors are actions taken by a person who is believed to be healthy with the aim of disease prevention and early detection of a disease before it becomes symptomatic (Rosenstock, 1974).

Preventive health behaviors impact an individual's health outcomes, including the reducing risk of developing chronic diseases. People engage in these activities to improve their health or maintain their good health. Unlike a doctor's recommendation or behavioral adjustments for a known diagnosis, preventive behaviors may not be taken as seriously (Werle, 2011). The immediate benefits of engaging in preventive behaviors may not be seen, and studies have shown there is a need for self-efficacy. Factors associated with preventive health behaviors include self-efficacy, individual characteristics, insurance, and social desirability (Werle, 2011; Simon et al., 2017). For this study, I will discuss preventive health behaviors under two sections: health-promoting behaviors and preventive health services.

In the United States, about 60% of adults have a chronic disease and 40% of these adults have at least 2 chronic diseases (CDC, 2021). Heart disease, diabetes, stroke, cancer, and chronic kidney disease are examples of chronic diseases (CDC, 2021). These conditions contribute the most to the country's health costs of more than $4 trillion every year (CDC, 2021). The prevention of chronic diseases will lead to reduced health costs and improved health outcomes for the population (CDC,2021).

Patient portals allow patients to have online access to their medical records so they can take responsibility for their healthcare and also increase healthcare access. This portal allows bidirectional communication between patients and providers, reviews results, and requests medication refills (Reed et al., 2019). Although patient portals have been in existence since the 1990s, they got increased attention

for adoption and usage in 2006 after the government passed the HITECH act (Beal et al., 2021). The use of a patient portal has reduced clinic visits, and improved medication adherence and patient satisfaction which resulted in better health outcomes (Huang et al., 2019; Reed et al., 2019; Beal et al., 2021; Turner et al., 2019). Patient portals encourage self-management which is essential for chronic disease management (Huang et al., 2019).

Statement of the Problem

There has been a steady rise in the prevalence of chronic conditions (Winkleby & Cubbin, 2004; Buttorff et al., 2017; Lee et al., 2020; Giri & Kumaresan, 2021). The presence of one chronic condition increases the chances of developing multiple chronic conditions (Buttorff et al., 2017). People with multiple chronic conditions have a higher likelihood of healthcare utilization and cost when compared to healthy people (Buttorff et al., 2017). Although many chronic conditions are largely preventable, non-communicable diseases are major causes of disability and mortality in the United States (CDC, 2021). Certain risky behaviors such as smoking, binge drinking, physical inactivity, and poor nutrition are associated with an increased risk of chronic conditions (Winkleby & Cubbin, 2004; World Health Organization, 2018; CDC, 2021). Promoting lifestyle modifications that encourage healthy behaviors as part of daily activities can prevent chronic diseases and four health behaviors associated with increased longevity are not smoking, eating healthy, being physically active, and avoiding heavy drinking (CDC,2021). Reducing the risk of chronic conditions requires a proactive population that involves the use of preventive care services for a holistic approach.

Studies have shown that health promotion behaviors and preventive care can reduce the occurrence of chronic conditions while other studies have examined the role of self-management education and increased self-efficacy in relation to improved health outcomes (Lorig et al., 2001; Winkleby & Cubbin, 2004; Ahn et al., 2013; Lin et al., 2013; Pishkar Mofrad et al., 2015; Barrett et al., n.d.; Liu et al., 2016; Jan et al., 2018; Lee et al., 2020). Other studies have been conducted on cues to

promote health behavior using text messages (Prestwich et al., 2010; Shaw et al., 2013; Yan et al., 2015; Fournier et al., 2016; Suffoletto, 2016; Sandrick et al., 2017; Willcox et al., 2019).

Researchers have examined and found an association between patient portal utilization and improved health outcomes including patient satisfaction with health services (Huang et al., 2019; Reed et al., 2019; Turner et al., 2019). Another study assessed the role of the patient portal and health behavior using hospital system health records and reported the promotion of health behavior with portal utilization (Huang et al., 2019). None of the studies have used a nationally representative dataset to evaluate associations between patient portal use and health-promoting behaviors and preventive services. This study provided new information on the role of patient portal use in the adoption of healthy behaviors and preventive care utilization.

Purpose of the Study

The purpose of this study is four-fold, to examine —(a) the social determinants of health associated with patient portal utilization, (b) the association of patient portal utilization with preventive services utilization, (c) the association of patient portal utilization with health-promoting behaviors, (d) and the role of an individual's self-efficacy in the association between patient portal utilization and preventive health behaviors. The study findings provided new knowledge and can inform decision-making regarding advocacy and current practices for patient portal utilization among the population, clinicians, public health workers, insurance companies, and policymakers.

Research Questions

The research questions for this study are as follows:

1. Which social determinants of health are associated with patient portal utilization?

2. Is patient portal utilization associated with preventive health service utilization?

3. Is patient portal utilization associated with health-promoting behaviors?

4. What is the role of self-efficacy in the association between patient portal utilization and preventive health behaviors?

Hypotheses

This study will test the following hypotheses:

To determine if there is an association between social determinants of health and patient portal utilization

H1: Educational level is positively associated with patient portal utilization

H2: Health insurance is positively associated with patient portal utilization

H3: Having a regular health provider is positively associated with patient portal utilization

H4: Household income is positively associated with patient portal utilization

H5: Rurality is positively associated with patient portal utilization

H6: Internet access is positively associated with patient portal utilization

To determine if there is an association between patient portal utilization and preventive health services utilization

H7: Patient portal utilization is positively associated with pap smear testing

H8: Patient portal utilization is positively associated with mammogram screening

To determine if there is an association between patient portal utilization and health behaviors

H9: Patient portal utilization is positively associated with the level of participation in physical activity

H10: Patient portal utilization is positively associated with the level of participation in muscle-strengthening activities

H11: Patient portal utilization is positively associated with current non-smoking behavior

To determine the role of self-efficacy in the association between patient portal utilization and preventive health behaviors

H12: Self-efficacy is positively associated with preventive health behaviors (pap smear testing, mammogram screening, level of participation in physical activity, level of participation in muscle-strengthening activities, and current non-smoking behavior)

Study Significance

There is a gap in the knowledge on examining the association between patient portal utilization and preventive health behaviors. Preventive health behaviors are being encouraged by health workers and insurance companies to reduce health costs and improve health outcomes. A doctor's visit usually includes counseling on adopting these behaviors however in recent times due in part to efforts to minimize contact due to the COVID-19 pandemic, only essential visits require a visit to the doctor. A patient portal is supposed to improve communication between healthcare providers and consumers and visiting the patient portal for health needs may be cheaper than in-person visits and more patient-centric. Its utilization may serve as a cue or reminder of health-promoting behaviors and aid in booking an appointment for hospital preventive services. Using patient portals for preventive care is likely to reduce the cost of healthcare for the payers including the patients, government, and health insurance companies. Patient portals have the potential to offer important cost- and time savings to patients, that may ultimately result in improving the quality of their medical care and health.

Many chronic diseases are preventable and nudging from the patient portals can increase the adoption of lifestyle practices that reduce the chances of developing these diseases. Lifestyle

modifications and the use of preventive services can also reduce complications that can occur after a chronic disease has been diagnosed.

Study Scope

Using a quantitative approach, this study used the nationally representative Health Information National Trends Survey to evaluate if patient portal utilization was associated with health behaviors and the use of preventive services. The National Cancer Institute administers the Health Information National Trends Survey (HINTS). This dataset is nationally representative with a sample population derived from adults aged 18 years and older. Although the survey is conducted to collect information on health information trends about cancer prevalence, some items on the survey measure patient portal access and utilization. This study combines datasets from 4 cycles- 2017 to 2020.

Outline of the Remaining Chapters

The remaining chapters of this dissertation will be as follows:

Chapter 2 will review the current literature on patient portal utilization and its role in promoting wellness behaviors and preventive health services. The chapter will also examine the social determinants of health associated with patient portal utilization and the current gaps in the literature about the subject. I will also discuss the conceptual framework and theories used in analyzing this study in this chapter. The study design and methodology that describes the recruitment and data analysis will be discussed in Chapter 3. The results of the study will be discussed in chapter 4 and chapter 5 discusses the results compared to current literature and the public health recommendations to policymakers, researchers, and practitioners. I will also discuss the strengths and limitations in chapter 5 which is the final chapter.

CHAPTER 2

LITERATURE REVIEW

Background

Chronic Diseases

Public health advancements such as vaccination, antibiotic use, and improved sanitation led to a reduction in the incidence rate and subsequently reduced mortality rates of infectious diseases (Anderson & Durstine, 2019; Barrett et al., n.d.). Globally, the burden and attention have shifted from infectious diseases to chronic diseases. Despite this switch, several developing countries still experience the double burden of both infectious and noninfectious diseases (Anderson & Durstine, 2019).

Chronic disease is any medical condition that lasts for at least one year and can affect anyone irrespective of age, gender, or race (Anderson & Durstine, 2019; CDC, 2021). These diseases require continuous medical care and can limit daily living activities (CDC,2021). Chronic diseases can also be known as noncommunicable diseases and are caused by genetic, environmental, behavioral, and physiological factors (World Health Organization, 2018). Chronic diseases are usually not curable and are usually found in the elderly (National Cancer Institute, 2011). More than 60% of global deaths recorded annually are attributable to chronic diseases and the number of deaths is expected to increase by 2030 (Jan et al., 2018). Although the majority of the deaths occur in developing countries, developed countries are not exempt from the burden of these diseases (Jan et al., 2018; Anderson & Durstine, 2019).

About sixty percent (60%) of adults in the United States have one chronic disease and forty percent (40%) have two or more chronic diseases (CDC, 2021). The current chronic disease prevalence shows an increase in rates from previous years (Raghupathi & Raghupathi, 2018; Giri & Kumaresan, 2021). Heart disease, hypertension, cancer, stroke, obesity, arthritis, and diabetes are examples of chronic diseases. More than 80% of deaths from chronic diseases are a result of four major diseases: cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes (World Health Organization, 2018). With a prevalence of 42% that has been consistent over the years, older adults especially those 65

years and older, are more likely to have more than one chronic disease; additionally, being diagnosed with multiple chronic conditions is more common among non-Hispanic Whites (Buttorff et al., 2017).

Risk Factors Associated with Chronic Diseases

Risk factors associated with chronic diseases can be modifiable or non-modifiable. The major modifiable behavioral risk factors associated with chronic diseases are physical inactivity, unhealthy diets, excess alcohol intake, and tobacco smoking (Anderson & Durstine, 2019; CDC, 2021; World Health Organization, 2018). Other modifiable risk factors include educational level, socioeconomic status, and employment status. An individual's age, race, and genetic composition are non-modifiable risk factors although genes can be affected by the environment (Anderson & Durstine, 2019).

Impact of Chronic Diseases on Health and the Economy

While chronic diseases are major causes of death and disability globally, these groups of diseases have also been associated with increased healthcare costs, loss of productivity, and economic loss (Jan et al., 2018; Hajat & Stein, 2018; Centers for Disease Control and Prevention, 2019). The manifestations and implications of chronic diseases affect individuals, families, organizations, and nations.

On the individual level, people with chronic diseases have more hospital visits, utilize more healthcare services, use more prescription drugs and so have more health-related costs as compared to those who are healthy (Anderson & Durstine, 2019; Buttorff et al., 2017). They are also less productive due to the disease-related disability and the time spent away from work to attend clinic visits (Anderson & Durstine). The higher the number of chronic diseases an individual has been diagnosed with, the more difficulty they have carrying out their daily living activities (Buttorff et al., 2017). The economic impact chronic diseases have on families varies due to insurance, healthcare access, and family support (Jan et al., 2018).

Every year the United States's healthcare expenditure is more than $4 trillion and chronic diseases contribute significantly to this cost (Centers for Disease Control and Prevention, 2019). The

prevention of chronic diseases will reduce costs and provide funds that can be used for other public health interventions.

The target of chronic disease prevention is to reduce the individual modifiable risk factors associated with these diseases and ensure optimal management including early detection, screening, and treatment of the diseases (World Health Organization, 2018).

Social Determinants of Health and Chronic Diseases

Social determinants of health (SDOH) are the "conditions in which people are born, live, and work that influence the individual's daily living activities" (CDC, 2022). They are grouped into healthcare access and quality, education access, and quality, social and community context, neighborhood and built environment, and economic stability (CDC,2022). These are the non-medical factors existing outside the clinic that contribute to an individual's health outcomes. It is said that more than 50% of an individual's health outcomes are determined by the SDOH (Whitman et al., 2022). The differences in an individual's SDOH can influence their health behaviors and ultimately the health disparities across different population groups. Evidence suggests that SDOH affects the prevalence of chronic diseases through its impact on the distribution of behavioral risk factors, environmental exposures, and access to preventive care (Marmot & Bell, 2019).

The family in which a child grows up determines the available nutritional choices and physical activity levels which in turn affect the chances of the child being obese or not (Marmot & Bell, 2019). Obesity has been linked with several chronic diseases such as hypertension, diabetes, and cancer. People in a low-income population are more likely to be exposed to air pollutants such as tobacco which is a risk factor for chronic diseases (Marmot & Bell, 2019). The prevention and control of chronic diseases require addressing the social determinants of health that are associated with the risk factors.

Preventive Health Behaviors

   With the increasing prevalence of chronic diseases and their associated costs, prevention is an important concept to consider. While Parkerson defined health behaviors as the "actions of individuals, groups, and organizations, as well as their determinants, correlates, and consequences, including social change, policy development, and implementation, improved coping skills, and enhanced quality of life", Gochman focused on the individual perspective and defined it "those personal attributes such as beliefs, expectations, motives, values, perceptions, and other cognitive elements; personality characteristics, including affective and emotional states and traits; and overt behavior patterns, actions, and habits that relate to health maintenance, to health restoration, and to health improvement" (Parkerson et al., 1993; Gochman, 1997; Glanz et al., 2008).

   Health behaviors can be grouped into three: preventive health behavior, illness behavior, and sick-role behavior. Individuals consider themselves to be healthy in preventive health behavior however, in illness & sick-role behavior the individuals consider themselves to be ill with the sick-role behavior requiring the assistance of healthcare providers to achieve health (Glanz et al., 2008).

   Preventive health behaviors are actions both within and outside the hospital system or health provider care that people take to maintain or improve their health. Kasl and Cobb defined preventive health behaviors as "any activity undertaken by a person believing himself to be healthy for the purpose of preventing disease or detecting it in an asymptomatic state" (Kasl & Cobb, 1966). Preventive behaviors can also be spontaneous engagement in any practice or the incentivization to perform a practice to reduce the impact of potential environmental risks and hazards. Other schools of thought believe the definition is not comprehensive as these preventive health behaviors can also be undertaken by sick people and can include activities not routinely recommended by health workers (Kirscht, 1983).

   Prevention can be viewed through different lenses such as the individual, biomedical, and psychosocial (Langlie, 1977). Viewing through the individual lens would be the belief system and other

factors that make people choose the healthy path due to the consequences associated with not taking these actions (Langlie, 1977; Kirscht, 1983). The biomedical lens view prevention as primary, secondary, or tertiary. Prevention is primary if done before the disease condition occurs, secondary when the disease is detected early & treated, and tertiary when the approach is to reduce the effects of a disease after it has occurred. Preventive health behaviors examples include immunizations, regular checkups, and engaging in physical activity. The psychosocial lens views prevention as the behavioral steps and processes needed to carry out preventive practices (Langlie, 1977). The psychosocial perspective considers the motivations and belief systems that are responsible for an individual's health habits and approach to dealing with environmental hazards (Kirscht,1983). Preventive behaviors can also be classified based on the extent of medical supervision needed to act. Preventive behaviors such as immunization and pap smear require the participation of a healthcare provider, unlike physical activity where the individual is fully responsible for taking the action.

Preventive Health Behaviors and Chronic Diseases

Although other factors such as social support, family influence, and finance are important in preventive health care, up to 40% of untimely deaths are attributed to health behaviors making them very important factors that can reduce the likelihood of developing many chronic diseases thereby prolonging life (Jayanti & Burns, 1998; Cory et al., 2010; Lee et al., 2020). Ensuring behavioral risk factors such as smoking, physical inactivity, and poor diet are avoided and the utilization of preventive screening including cancer screenings have been linked to preventing chronic diseases (González et al., 2017; Lee et al., 2020). Despite the promotion of preventive health behaviors, there has been low adoption of these healthy behaviors indicating the need to increase population engagement (Winkleby & Cubbin, 2004; Chowdhury et al., 2016; Liu et al., 2016; Lee et al., 2020).

Recommended Preventive Health Behaviors

The United States Preventive Services Task Force (USPSTF) has an "A" grade recommendation for women aged 21 to 65 years which is the age group at risk for cervical cancer to get screened every three years with cytology (pap smear) (USPSTF, 2018). For breast cancer screening in women, there are conflicting recommendations with the USPSTF advising women aged 40 to 49 years should screen based on their individual decision and women aged 50 to 74 years should be screened every two years. On the other hand, the American Cancer Society recommends that women 45 to 54 years get annual mammograms while those aged 55 and older get a mammogram annually or once in two years (USPSTF, 2016; American Cancer Society, 2021; Barsouk et al., 2022). Examples of recommended preventive health behaviors are not smoking or quitting if already started, getting at least 150 minutes of moderate-intensity physical activity every week & 2 days a week of muscle-strengthening activity, at least 7 hours of daily sleep for adults, and conducting screening tests for chronic conditions such as diabetes and cancer (CDC, 2019).

Patient Portals

A patient portal is a health organization-managed website that gives patients secure access to their health information (Beal et al., 2021). According to HealthIT.gov, a patient portal is a "secure online website that gives patients convenient, 24-hour access to personal health information from anywhere with an Internet connection" (Office of the National Coordinator for Health Information Technology (ONC), n.d.). The California Health Care Foundation defines a patient portal as an online platform that enables the interaction of patients with their health information and healthcare providers without visiting the clinic (California Health Care Foundation, 2022). It can also be defined as a website that promotes an individual's healthcare (Talking HealthTech, 2022). While the health organizations oversee the portal, patients need a computer and internet access to use their patient portals and their healthcare provider usually provides the initial access information (Beal et al., 2021; Talking HealthTech, 2022).

Patient portals have been in existence since the 1990s but became more popular and adopted in 2006 (Irizarry et al., 2015; Weitzman et al., 2009). Two years later, about 90% of healthcare organizations offered their patients access to the portal (PatientEngagementHIT, 2018). A major push for the advancement and adoption of patient portals came as a result of the $30 billion incentive for patient-centered care programs, which was a part of the 2009 American Recovery and Reinvestment Act (Beal et al., 2021; Turner et al., 2019). The goal of this program was to improve health outcomes in the United States through increased patient engagement supported by the electronic exchange of health information (Beal et al., 2021; Irizarry et al., 2015; Turner et al., 2019). As part of the meaningful use criteria to earn the financial incentive, the patient portals had to provide secure messaging between patients and providers, allow patients to view and download their data as well as provide a summary after each clinic visit for the patient (Beal et al., 2021; Irizarry et al., 2015; Turner et al., 2019).

Patient Portal Uses

Patient portals enable patients to get more involved in their healthcare and the portals help patients access information regarding their clinic visits, lab results, medications, and immunization history (Office of the National Coordinator for Health Information Technology (ONC), n.d.). Some patient portals have extra capacities that allow patients to send secure messages to their providers, request prescription refills, schedule appointments, and read health education materials (Office of the National Coordinator for Health Information Technology (ONC), n.d.). Healthcare providers can also diagnose and treat minor illnesses through this platform (Talking HealthTech, 2022).

Patient Portals and Social Determinants of Health

Past studies have identified some factors associated with patient portal use as age, gender, race, income, having a chronic disease, having internet access, having a regular provider, having healthcare providers with electronic health records, and being resident in a rural area (Hoogenbosch et al., 2018; Turner et al., 2021; Clarke et al., 2020; Hong et al., 2020). While age was an inconsistent predictor in

patient portal utilization (Hoogenbosch et al., 2018; Hong et al., 2020; Turner et al., 2021), being male, having lower levels of education & household income, those who identified as being non-white, uninsurance, and staying in a rural area were less likely to use patient portals (Turner et al., 2021; Hong et al., 2020). Internet access, having a regular provider, and the presence of multiple chronic conditions were factors associated with higher odds of patient portal utilization (Hong et al., 2020).

Patient Portals and Cues to Action

One of the newer constructs added to the Health Belief Model is the cues to action which is an important determinant of behavior (Orji et al., 2012). Cues to action can be internal when it occurs due to symptoms and signs from an illness while external cues can be activities, environmental factors, and people that promote behavioral change (Orji et al., 2012). When the individual has existing needed beliefs, cues to action can be required to initiate a behavior (Orji et al., 2012). The notifications and reminders from patient portals can act as external triggers that prompt people to start or change their health behaviors. With the increasing proportion of the population using patient portals with as much as 90% in some organizations (PatientEngagementHIT, 2018), the ability of the portals to send reminders via the bidirectional communication platform between providers and patients can serve as a cue to action regarding preventive wellness behaviors. Some researchers have explored this possibility and found that patient portal reminders can increase mammography, influenza vaccination rates, pap smears, Medicare wellness visits, well-child care visits, COVID-19 vaccination, and preventive care (Coughlin et al., 2017; Szilagyi et al., 2020; Liang et al., 2022; Berset et al., 2022; Ueberroth et al., 2021; Nagykaldi et al., 2012).

Patient Portal and Personal Health Record: Differences and Similarities

While sometimes used interchangeably, patient portals and personal health records are different tools for patient engagement. A collection of medical records that the patient maintains is a personal health record, but the health organization maintains the patient portal. They are similar in that they help patients get more involved in their health management. A personal health record can become a patient

portal when it is connected to the electronic health record (EHR). The patient portal is also distinct from the personal health record because the patient portal is connected to the electronic health records maintained by the clinicians (PatientEngagementHIT, 2017).

Role of Patient Portal in Improving Health Outcomes

Patient portal use has been associated with improving patient engagement which ensures increased participation in health management and better satisfaction (Price-Haywood & Luo, 2017; Masterson Creber et al., 2016). This is an advantage for patients with chronic diseases who need self-management for good results (McAlearney et al., 2016; Dendere et al., 2019). Patient portals have the potential to reduce the cost of healthcare and improve the quality of services, especially with the role it plays in chronic disease management (Irizarry et al., 2015; Sarkar et al., 2014). Individuals who use patient portals are more likely to comply with their treatment regimen and have better patient-provider communication. (Kruse et al., 2015; Dendere et al., 2019; Beal et al., 2021)

Theoretical Frameworks of the Study

Two popular frameworks used to study health behaviors and healthcare utilization: the Health Belief Model and the Anderson Model of Healthcare Utilization were used as the theoretical basis for this study.

Health Belief Model

The Health Belief Model is one of the most popular models used in the study of changes and maintenance related to health behavior. It was first developed by the United States Public Health Service psychologists in their bid to explain the factors associated with people not participating in preventive programs. Over the years, this model has been expanded to accommodate an individual's behavioral response to symptoms and diagnosed illness.

The key constructs that make up the Health Belief Model are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Perceived susceptibility is an individual's belief regarding their chances of getting a disease. Using immunization as an example, you need to believe that there is a likelihood you can get infected with the flu for you to take the flu shot. Perceived severity is how serious an individual feels the disease is and the subsequent consequences on one's health and social life if the disease is not treated. Perceived susceptibility and perceived severity are sometimes grouped as perceived threats. An individual must believe there are gains associated with taking preventive actions and this is the perceived benefits construct. The perception of benefits could be health related such as not contracting the disease or non-health-related, such as social acceptance. Perceived barriers are what an individual considers to be impediments to carrying out a preventive action despite the benefits associated with it. Triggers that can initiate health activities is a construct called cues to action in the Health Belief Model. The latest construct added to the Health Belief Model is self-efficacy and this is the individual's belief in their ability to implement a health-promoting behavior (Rosenstock, 1974; Langlie, 1977; Glanz et al., 2008).

In the context of this model, behavior comprises perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy (Langlie, 1977; Rosenstock). Behavior can be affected by cues to action and modifying factors such as age, race, and gender (Langlie, 1977; Rosenstock). The Health Belief Model has been used to evaluate several preventive behaviors, including breast cancer screening, colorectal screening, weight management, and safe sex behaviors (Langlie, 1977; Rosenstock, 1974; Lee Champion, 1985; Daddario, 2007; Hiltabiddle, 1996).

The Health Belief Model will be used to assess the individual psychological characteristics that explain why they use or do not use health care services.

Self- efficacy and Chronic Disease Management

Self-efficacy is an individual's belief in their ability to carry out certain behaviors (Bandura, 1994; Bandura, 1997). Self-efficacy refers to people's belief in a health behavior's benefits and how there is a need for self-motivation and confidence before they can act on their behavior. Self-efficacy can be developed through mastery experiences, social model experiences, social persuasion, and reduction of stress reactions (Bandura, 1994). Improved outcomes have been reported among patients with chronic diseases with high self-efficacy (Wu et al., 2016). The management of chronic diseases requires self-management which is an essential component of self-efficacy (Clark & Dodge, 1999; CHAN, 2021). Healthy behaviors such as physical exercise and good nutrition which are important for the prevention and control of chronic diseases need interventions targeted to self-efficacy.

Andersen's Behavioral Model of Health Services Use

Andersen's Behavioral Model of Health Services Use can project or explain healthcare utilization. It examines the factors that affect access and utilization of health services. Andersen's Behavioral Model of Health Services Use is based on the framework that an individual uses healthcare due to their predisposition, enabling or barrier factors, and their healthcare needs (Andersen & Newman, 1973; Andersen, 1995).

The predisposing factors associated with healthcare utilization can be grouped into demographic factors, social structure, and beliefs. Examples of predisposing characteristics according to groups are demographic characteristics- age, gender, marital status; social structure- race, education, occupation, religion, and family size; beliefs- the individual's values regarding health and illness and their attitudes toward health services (Andersen & Newman, 1973; Andersen, 1995).

Enabling factors must be present at the individual or community level for healthcare utilization to occur. At the individual level, health insurance, income, and having a regular healthcare provider can be

enabling factors, while it can be rurality, cost of care, and the ratio of health workers to the population at the community level (Andersen & Newman, 1973; Andersen, 1995).

Having a health need in the form of an illness is usually the major factor that determines healthcare utilization. An individual's need for care can be perceived or evaluated. Perceived need is based on the individual's perception of an illness and can be measured by self-reported general health status, symptoms, and the number of disability days. Evaluated need due to an illness usually requires a healthcare worker's assessment and this assessment determines the type of care needed (Andersen & Newman, 1973; Andersen, 1995).

Andersen's Behavioral Model of Health Services Use was adopted in this study to assess the predisposing, and need, and identify enabling factors affecting patient portal utilization for preventive behaviors.

Figure 1

Conceptual Framework
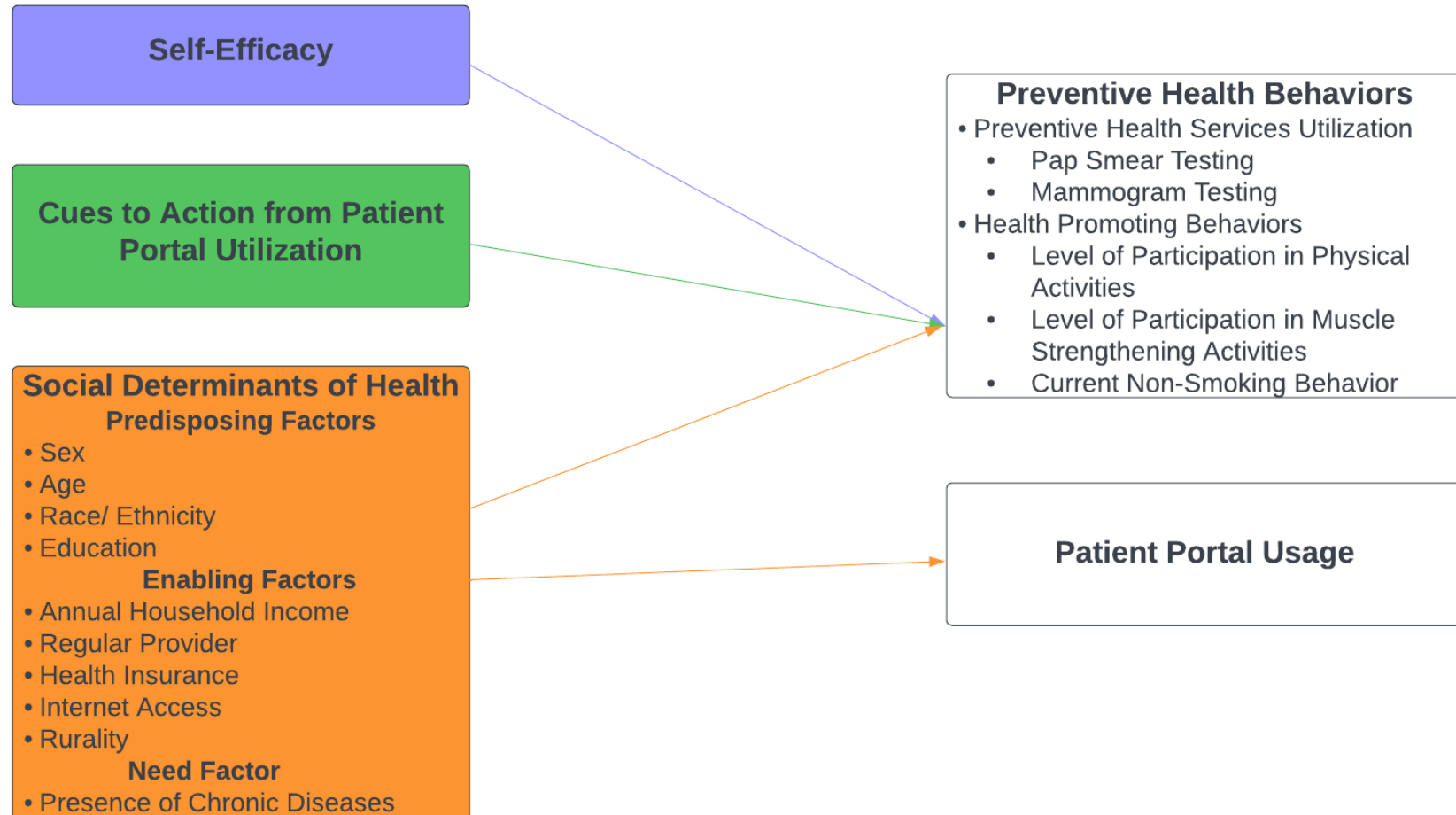
Conceptual Framework

The conceptual framework for this study (Figure 1) utilizes both the Health Belief Model and Andersen's Behavioral Model of Health Services Use.

My working hypothesis is that there is a positive and significant association between patient portal utilization and preventive health behaviors and that self-efficacy mediates this association. For this study, preventive health behaviors will be discussed under two sections: health-promoting behaviors and preventive health services.

The Health Belief Model which was originally developed to assess preventive health behaviors will be used as part of the conceptual framework. The health belief model is a popular theoretical framework used in investigating health behaviors based on an individual's belief system. The six major constructs used in this model are perceived susceptibility, perceived severity, benefits to action, barriers to action, self-efficacy, and cues to action.

The concepts of interest from the Health Belief Model that were operationalized for this study are cues to action and self-efficacy. Cue to action is operationalized by patient portal utilization and this is based on the assumption that when patients access their patient portal they are provided with health promotion messages and notifications on when to go for their preventive care check-ups. I assessed the role of self-efficacy as a mediator between patient portal utilization and preventive health behaviors. Perceived barriers are similar to the enabling factors in Andersen's Behavioral Model of Health Services Use and will be discussed in the following subsection. Perceived susceptibility, severity, and benefits are not part of this conceptual framework because the dataset does not have variables that operationalize these concepts.

Andersen's Behavioral Model of Health Services Use was used to evaluate the factors affecting patient portal utilization under the predisposing, enabling, and needs factors. Predisposing factors (age, gender, race, education), enabling factors (insurance, internet, household income, regular provider), and

need factors (presence of chronic diseases) acted as confounders in the study. It is important to note that the predisposing and enabling factors of Andersen's Behavioral Model of Health Services Use are social determinants of health.

Gaps in the literature

Preventive health behaviors are critical to improving health outcomes globally and in the United States. Previous researchers have examined the utilization of preventive health services, factors that predict preventive health behaviors, the role of preventive behaviors, and patient portal in chronic disease management (Kirscht, 1983; Langlie, 1977; Winkleby & Cubbin, 2004; Lee et al., 2020; Liu et al., 2016; Pishkar Mofrad et al., 2015; Raghupathi & Raghupathi, 2018; Reed et al., 2019). The COVID-19 pandemic brought up the exploration of health technology tools that could improve health outcomes with no or minimal human or health provider in-person visits. There is a need to examine the use of health technology such as patient portals in the promotion of preventive health behaviors. Therefore, this study contributes new knowledge on the role of patient portal utilization in improving preventive health behaviors. It also explores the importance of self-efficacy in carrying out preventive health measures and how the social determinants of health predict patient portal utilization.

Chapter Summary

In summary, this chapter discussed existing literature on chronic disease prevention and patient portals. The theoretical and conceptual framework for the study and how it applies to the hypothesis was also discussed in this chapter.

The study design, methodology, and data analysis will be discussed in chapter 3.

CHAPTER 3

METHODOLOGY

This chapter presents the research methodology and will discuss the study design, data collection method, hypothesis, and data analytical approach used. This study used a quantitative approach to analyze the data for assessing the association between patient portal use and health behaviors & preventive services.

Research Questions and Hypotheses

The research questions for this study are as follows:

1. Which social determinants of health are associated with patient portal utilization?

2. Is patient portal utilization associated with preventive health service utilization?

3. Is patient portal utilization associated with health-promoting behaviors?

4. What is the role of self-efficacy in the association between patient portal utilization and preventive health behaviors?

This study will test the following hypotheses:

To determine if there is an association between social determinants of health and patient portal utilization

H1: Educational level is positively associated with patient portal utilization

H2: Health insurance is positively associated with patient portal utilization

H3: Having a regular health provider is positively associated with patient portal utilization

H4: Household income is positively associated with patient portal utilization

H5: Rurality is positively associated with patient portal utilization

H6: Internet access is positively associated with patient portal utilization

To determine if there is an association between patient portal utilization and preventive health services utilization

H7: Patient portal utilization is positively associated with pap smear testing

H8: Patient portal utilization is positively associated with mammogram screening

To determine if there is an association between patient portal utilization and health behaviors

H9: Patient portal utilization is positively associated with the level of participation in physical activity

H10: Patient portal utilization is positively associated with the level of participation in muscle-strengthening activity

H11: Patient portal utilization is positively associated with current non-smoking behavior

To determine the role of self-efficacy in the association between patient portal utilization and preventive health behaviors

H12: Self-efficacy is positively associated with preventive health behaviors (pap smear testing, mammogram screening, level of participation in physical activity, level of participation in muscle-strengthening activities, and current non-smoking behavior)

Research Design

Data

This study used 4 pooled cycles of the Health Information National Trends Survey (HINTS) dataset from 2017 to 2020, which is a cross-sectional retrospective study design (National Cancer Institute, n.d.). This survey was first administered in 2003 by the National Cancer Institute and was created to monitor the trends and changes in health communication among residents in the United States.

The HINTS dataset is nationally representative data about how Americans use cancer-related information and provides information on current communication trends and practices.

Sampling Design

The study sample comprises adults aged 18 or older who are civilians and noninstitutionalized in the United States. There was a $2 incentive for completing the survey and the self-administered survey was collected by mail for all 4 waves of the survey.

This study used the most recent versions with cycle 1 conducted from January to May 2017 and resulting in 3,285 completed surveys, cycle 2 conducted from January to May 2018 having 3,504 completed surveys, cycle 3 conducted from January to April 2019 having 5,438 completed surveys, and cycle 4 conducted from February to June 2020 having 3,865 completed surveys. The total sample size for the entire cycles 1 to 4 was 16,092. The response rates for cycles 1 to 4 are 32.4%, 32.9%, 32.4%, and 37% respectively.

The survey used a two-stage sampling design where a stratified representative of addresses was identified from residential addresses in the first stage and each sampled household had an adult response to the survey. The adult that responded in each household was randomly selected from within the household and the survey instrument assisted in the process by suggesting the adult with the next birthday. The Marketing Systems Group database of addresses was used as a sampling frame. The sampling strata comprised 2 groups of addresses: one with high concentrations of minority populations and the other with low concentrations of minority populations. Each address had an equal chance of being selected.

Data Collection

The surveys for all cycles were collected exclusively by mail with a $2 incentive for participation. Following the modified Dillman approach, four postal mail were scheduled for all participating households but only non-responding households received all the postal mail while other households

received only the first and reminder postcards. Questionnaires that were not completed, had incomplete responses, and were duplicates from the same household were deemed not eligible.

Sample Weights

Full sample weights and a set of 50 replicate weights as provided by the dataset owners were assigned to every adult that responded to the questionnaire. The sample weighting was applied in the analysis to ensure the survey response from the sample population can be generalized to the national population.

Variables

Dependent Variables

Patient Portal Usage

The variable 'patient portal usage' was operationalized by the survey item "How many times did you access your online medical record in the last 12 months?". The response categories were recoded into the dichotomous categories of No for those who responded 0 times and Yes for those that responded 2 times, 3 to 5 times, 6 to 9 times, and 10 or more times.

Preventive Health Services Utilization

The dependent variables representing preventive health services utilization are pap smear testing and mammogram.

Pap Smear Testing

The variable 'pap smear testing' was operationalized through the survey item that asked women, "How long ago did you have your most recent Pap test to check for cervical cancer?". The original categories are a year ago or less; More than 1, Up to 2 years ago; More than 2, Up to 3 years ago; More than 3, Up to 5 years ago; More than 5 years ago; and I have never had a Pap test. The response categories

were recoded into two categories: did not have a Pap test in the past 12 months (coded as 1) and had a Pap test in the past 12 months (coded as 2).

Mammogram Screening

The variable 'mammogram screening' was operationalized through the survey item that asked women, "When did you have your most recent mammogram to check for breast cancer, if ever? The original response categories were a year ago or less; More than 1, up to 2 years ago; More than 2, up to 3 years ago; More than 3, up to 5 years ago; More than 5 years ago; and I have never had a mammogram. For this research, the response categories were re-coded as did not have a mammogram in the past 12 months (coded as 1) and had a mammogram in the past 12 months (coded as 2).

Health Promoting Behaviors

Level of Participation in Physical Activity

The variable 'level of participation in physical activity' was operationalized through the survey item that asked "In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, and swimming at a regular pace (do not include weightlifting)?" The response categories were none, 1 day per week, 2 days per week, 3 days per week, 4 days per week, 5 days per week, 6 days per week, and 7 days per week. The response categories were recoded into 0-2 days per week as low level, 3-4 days per week as moderate level, and 5-7 days per week as high level.

Level of Participation in Muscle Strengthening Activity

The variable 'level of participation in muscle strengthening activity' was operationalized through the survey item that asked "In a typical week, outside of your job or work around the house, how many days do you do leisure-time physical activities specifically designed to strengthen your muscles such as lifting weights or circuit training (do not include cardio exercise such as walking, biking, or

swimming)?". The response categories were none, 1 day per week, 2 days per week, 3 days per week, 4 days per week, 5 days per week, 6 days per week, and 7 days per week. The response categories were recoded into 0-2 days per week as low level, 3-4 days per week as moderate level, and 5-7 days per week as high level.

Current Non-Smoking Behavior

The variable 'current non-smoking behavior' was operationalized through the survey item that asked "How often do you now smoke cigarettes?" from those that answered yes to a screening question that asked about a history of having smoked at least 100 cigarettes in their lifetime. The response categories were recoded into non-smoking and smoking from the original categories of every day, some days, and not at all.

Independent Variables

Patient Portal Utilization

The independent variable of interest is patient portal utilization and this was operationalized by the survey item "How many times did you access your online medical record in the last 12 months?". The response categories were recoded into None for those who responded 0 times, 1-2 times for those that responded 1-2 times, and 3 or more times for those that responded 3 to 5 times, 6 to 9 times, and 10 or more times.

Self-efficacy

The variable 'self-efficacy' was operationalized by the survey item "Overall, how confident are you about your ability to take good care of your health?" and the response categories were reverse-coded such that the highest number reflects the highest level of confidence. The recoded response categories are Completely confident (coded as 4), Very confident (coded as 3), Somewhat confident (coded as 2), A little confident (coded as 1), and Not confident at all (coded as 0).

Social Determinants of Health

The social determinants of health that will be assessed are education, health insurance, regular healthcare provider, household income, internet, and rurality.

The variable 'education' had the response categories of less than high school (coded as 1), high school graduate (coded as 2), some college (coded as 3), and college graduate and higher (coded as 4). The variables 'health insurance' and 'a regular healthcare provider' had the dichotomous response categories of yes (coded as 1) or no (coded as 0). Household income had the response categories of <$20,000 (coded as 1), $20,000-$35,000 (coded as 2), $35,000-$50,000 (coded as 3), $50,000 - $75,000 (coded as 4), and >$75,000 (coded as 5). The variable 'rurality' is a derived variable from the 2013 USDA rural/ urban designation of counties using metropolitan or non-metropolitan classification. Rurality was coded as 1 if non-metropolitan and coded as 0 if metropolitan.

Control Variables

Using Andersen's behavioral model of health services use, the control variables that will be added to all regression models:

- Predisposing factors: age, gender, race, education

- Enabling factors: Health insurance, internet, household income, regular healthcare provider

- Need factors: the presence of chronic conditions

Table 1 shows the variables used for this study and their measures:

Table 1

Description of the Study Variables and their Measures

Research Question	Variable Name	Original Response Categories	Recoded Response Categories

Research Question 1: What social determinants of health are associated with patient portal utilization?	Patient Portal Usage	None	No
		1-2 times 3-5 times 6-9 times 10 or more times	Yes
Research Question 2: Is there an association between patient portal utilization and preventive health service utilization?	Patient Portal Utilization	None	None
		1-2 times	1-2 times
		3-5 times 6-9 times 10 or more times	3 or more times
	Pap Smear Testing in the Past 12 months (N=8044)	A year ago or less	Pap Smear Testing in the Past 12 months (No)
		More than 1, up to 2 years ago More than 2, up to 3 years ago More than 3, up to 5 years ago More than 5 years ago I have never had a pap test	Pap Smear Testing in the Past 12 months (Yes)
	Mammogram Testing (N=8094)	More than 1, up to 2 years ago	Mammogram Testing in the Past 12 months (No)
		More than 2, up to 3 years ago More than 3, up to 5 years ago More than 5 years ago I have never had a mammogram	Mammogram Testing in the Past 12 months (Yes)
Research Question 3: Is there an association between patient portal utilization and health-promoting behaviors?	Level of Participation in Physical Activities	0	Low level (0-2)

		1	
		2	
		3	Moderate level (3-4)
		4	
		5	High level (5-7)
		6	
		7	
	Level of Participation in Muscle Strengthening	0	Low level (0-2)
		1	
		2	
		3	Moderate level (3-4)
		4	
		5	High level (5-7)
		6	
		7	
Research Question 4: What is the role of self-efficacy in the association between patient portal utilization and preventive health behaviors?	Self- efficacy	Not confident at all	
		A little confident	
		Somewhat confident	
		Very confident	
		Completely confident	
Control Variables			
	Age	18-34 years	
		35-49 years	
		50-64 years	
		65-74 years	
		> 75 years	
	Sex	Female	
		Male	
	Race/ Ethnicity	Non-Hispanic White	
		Non-Hispanic Black or African American Hispanic	
		Non-Hispanic Asian	
		Non-Hispanic Others	

	Educational Level	Less than High School	
		High School Graduate	
		Some College	
		College graduate or higher	
	Health Insurance	Yes	
		No	
	Internet access	Yes	
		No	
	Annual Household Income	< $20,000	
		$20,000-$35,000	
		$35,000- $50,000	
		$50,000- $75,000	
		>$75,000	
	Regular Provider	Yes	
		No	
	Presence of Chronic Condition	Diabetes or high blood sugar (Yes) High blood pressure or hypertension (Yes) Heart attack, angina, or congestive heart failure (Yes) Chronic lung disease, asthma, emphysema, or chronic bronchitis (Yes) Depression or anxiety disorder (Yes)	Yes
		Diabetes or high blood sugar (No) High blood pressure or hypertension (No) Heart attack, angina, or congestive heart failure (No) Chronic lung disease, asthma, emphysema, or chronic bronchitis (No) Depression or anxiety disorder (No)	No

Data Analysis

Data analysis was conducted on the secondary data from the HINTS survey cycle 1 to cycle 4 to evaluate patient portal utilization and preventive health behaviors. Variables were recoded and various regression models were conducted to assess the relationship between the variables based on the type of dependent variables. The statistical significance for this study was set at $p \leq 0.05$ and STATA statistical software version 16 was used in the analysis. The svy jackknife command in STATA was used in the analysis to ensure the complex survey design and sampling weights were accounted for. The analysis was restricted to the dataset with participants who responded to the use of a patient portal in the last 12 months.

A descriptive analysis was done to describe the participants' characteristics. Descriptive statistics such as frequencies, mean, and percentages were calculated to describe the characteristics of the study population.

Research Question 1: What social determinants of health are associated with patient portal utilization?

To determine the association between the social determinants of health – education, health insurance, regular provider, household income, internet, and rurality- and patient portal usage, binomial logistic regression was conducted.

Research Question 2: Is there an association between patient portal utilization and preventive health service utilization?

Binomial logistic regression was conducted to assess the association between patient portal utilization and pap smear and mammography.

Research Question 3: Is there an association between patient portal utilization and health-promoting behaviors?

Multinomial logistic regression was conducted to assess the relationship between patient portal utilization and the dependent variables- level of participation in physical activity and muscle strengthening. Binomial logistic regression was conducted to assess the relationship between patient portal utilization and the dependent variable- current smoking behavior.

Research Question 4: What is the role of self-efficacy in the association between patient portal utilization and preventive health behaviors?

Depending on the type of preventive health behaviors, binomial logistic regression or multinomial regression models were conducted to assess the role of self-efficacy in carrying out preventive health behaviors.

Institutional Review Board

Secondary data was used for this study and approval by the Georgia Southern University Institutional Review Board was received under study protocol H23189.

Summary of Chapter

The study methodology and data analytical plan were described in this chapter. The next chapter will present the results of the study.

CHAPTER 4

RESULTS

This chapter presents the results from the data analysis showing the descriptive statistics and the

regression models. The demographic characteristics of the respondents are first presented followed by the

descriptive characteristics of the dependent variables and then the regression model results.

Descriptive Statistics

Table 2 presents the demographic characteristics of the respondents and the descriptive statistics

of the dependent variables.

Table 2

Demographic Characteristics of Respondents

Variables	N (unweighted)	%(weighted)
Dependent Variables		
Patient Portal Usage		
No	8337	59%
Yes	5766	41%
Pap Smear Testing in the Past 12 months (N=8044)		
No	4753	55%
Yes	3291	45%
Mammogram Testing in the Past 12 months (N=8094)		
No	3872	54%
Yes	4222	46%
Level of Physical Activity		
Low	6429	46%
Moderate	3965	29%
High	3487	25%
Number of Muscle Strengthening Days		
Low	9717	75%
Moderate	2178	17%
High	1054	8%

Current Non-Smoking Behavior		
No	1628	38%
Yes	3606	62%
Independent Variables		
Patient Portal Utilization		
None	8337	59%
1-2 times	2538	18%
3 or more times	3228	23%
Self-Efficacy		
Not confident at all	165	1%
A little confident	481	3%
Somewhat confident	3314	26%
Very confident	6567	46%
Completely confident	3429	24%
Predisposing Factors		
Sex		
Male	5402	48%
Female	7584	52%
Race/Ethnicity		
Non-Hispanic White	8114	66%
Non-Hispanic Black or African American	1736	10%
Hispanic	1900	16%
Non-Hispanic Asian	581	5%
Non-Hispanic Other	453	2%
Age		
18-34 years	1725	23%
35-49 years	2692	28%
50-64 years	4416	29%
65-74 years	3064	12%
75+ years	1810	7%
Educational Level		
Less than High School	855	8%
High School Graduate	2448	22%
Some College	4066	36%
College Graduate or More	6370	34%
Enabling Factors		
Annual Household Income		
< $20,000	2210	15%

$20,000- < $35,000	1627	11%
$35,000- <$50,000	1641	13%
$50,000-<$75,000	2265	19%
$75,000 or more	4902	42%
Rural Residence		
No	12455	87%
Yes	1648	13%
Regular Provider		
No	3970	33%
Yes	9925	67%
Health Insurance		
No	684	8%
Yes	13278	92%
Internet Access		
No	2564	14%
Yes	11495	86%
Need Factor		
Presence of Chronic Conditions		
No	4811	41%
Yes	9045	59%

Note. Total N=14,103

Demographic Characteristics of Respondents

More than half of the respondents were female (51%) and the majority identified their race as Non-Hispanic White (Table 2). The average age of respondents was 49 + 0.2 years. Twenty-nine percent (29%) of the respondents were within the 50-64 years age group and were closely followed by the 35-49 years age group with 28% of the respondents. Seventy percent (70%) had at least some college degree and almost half (41%) of the respondents had a household income of at least $75,000. The majority of the respondents live in urban areas (87%), had internet access (86%), had a regular healthcare provider (67%), and had some form of health insurance (92%). Almost sixty percent (59%) of the respondents reported having at least one type of chronic condition. While 46% were very confident about taking care of their health, only 26% were completely confident in their ability to take good care of their health.

The majority (60%) of the respondents had not used their patient portal within the past year, 19% used it 1-2 times and 12% had used it 3-5 times within the past year. More than half of the female respondents had not done a pap smear test (55%) or mammogram (54%) in the past year of interest. While 26% of the respondents had zero number of days that they carried out physical activity, fifty percent (50%) had zero number of days that they carried out a muscle-strengthening activity. Among those with a history of smoking at least 100 cigarettes in the past, sixty-two percent (62%) were currently not smoking.

Social Determinants of Health Associated with Patient Portal Utilization

Compared to males, females had higher odds (adjusted odds ratio [AOR]= 1.56; confidence interval [CI], 1.32-1.83) to use a patient portal (Table 3). Hispanics have lower odds (AOR=0.75; CI, 0.58-0.96) of using a patient portal when compared to Non-Hispanic Whites. Compared to people with less than a high school, college graduates or those with higher degrees had higher odds (AOR= 2.23; CI, 1.29- 3.83) of accessing their patient portal (vs none). Respondents whose annual household income was $75,000 or more had higher odds (AOR= 1.59; CI, 1.18-2.15) to use a patient portal compared to those in the < $20,000 category. Compared to those residing in urban areas, rural residents had lower odds (AOR=0.72; CI,0.54-0.95) of using a patient portal. Those with a regular healthcare provider vs no regular healthcare provider (AOR= 2.88; CI, 2.35-3.52) and health insurance vs no health insurance (AOR= 2.88; CI, 1.55-5.35) had higher odds of patient portal utilization. Respondents with internet access had higher odds (AOR= 3.7; CI, 2.68-5.12) to access their patient portal at least once (vs none) when compared to those with no internet access.

Table 3

Social Determinants of Health and Patient Portal Usage

Patient Portal Usage	AOR	95% CI		p-level
		LL	UL	
Predisposing Factors				
Sex				
Male	(Ref.Category)			
Female	**1.56**	1.32	1.83	<0.001
Race				
Non-Hispanic White	(Ref.Category)			
Non-Hispanic Black or African American	0.99	0.77	1.25	0.88
Hispanic	**0.75**	0.58	0.96	0.02
Non-Hispanic Asian	1.16	0.78	1.74	0.45
Non-Hispanic Other	0.98	0.58	1.67	0.94
Age				
18-34 years	(Ref.Category)			
35-49 years	1.22	0.91	1.64	0.17
50-64 years	1.02	0.79	1.32	0.88
65-74 years	0.92	0.67	1.26	0.59
75+ years	0.77	0.52	1.14	0.19
Educational Level				
Less than High School	(Ref.Category)			
High School Graduate	1.15	0.66	2.00	0.61
Some College	1.5	0.85	2.64	0.16
College Graduate or More	**2.23**	1.29	3.83	0.005
Enabling Factors				
Annual Household Income				
< $20,000	(Ref.Category)			
$20,000- < $35,000	0.83	0.54	1.29	0.4
$35,000- <$50,000	1.33	0.91	1.95	0.14
$50,000-<$75,000	1.22	0.91	1.64	0.19
$75,000 or more	**1.59**	1.18	2.15	0.003
Rural Residence				
No	(Ref.Category)			
Yes	**0.72**	0.54	0.95	0.02
Regular Provider				

No	(Ref.Category)			
Yes	**2.74**	2.19	3.44	<0.001
Health Insurance				
No	(Ref.Category)			
Yes	**2.81**	1.46	5.41	0.003
Internet Access				
No	(Ref.Category)			
Yes	**3.54**	2.55	4.93	<0.001

Note: AOR- Adjusted Odds Ratio; CI- Confidence Interval; Ref. Category- Reference Category; LL=

lower limit; *UL*= upper limit. Boldened variables are significant at p≤0.05

Patient Portal Utilization and Preventive Health Service Utilization

Table 4 showed that respondents who accessed their patient portals 1-2 times (AOR= 1.45;

CI,1.06-1.99) and 3 or more times (AOR= 1.65; CI,1.29-2.12) compared to those that did not access their

patient portal had higher odds of getting pap smear testing within the 12 months before the survey (Table

3). Compared with those in the 18-34 years age group, respondents in the 65-74 years (AOR= 0.25;

CI,0.17-0.37) and 75 years and older (AOR=0.16; CI, 0.10-0.26) had lower odds to get pap smear testing

in the past 12 months. Respondents with a college degree or higher had higher odds (AOR=2.09; CI,1.16-

3.77) of getting a pap smear test than those with less than a high school degree. Compared to those with

no regular provider and no health insurance, respondents with a regular provider (AOR= 1.51; CI,1.17-

1.96) and health insurance (AOR= 1.94; CI,1.08-3.45) had higher odds to get a pap smear testing in the

past 12 months.

Respondents who accessed their patient portals 3 or more times when compared to those that

accessed 0 times (AOR= 1.44; CI,1.07-1.93) had higher odds to get a mammogram done in the past 12

months. Compared to Non-Hispanic Whites, Non-Hispanic Blacks or African Americans had higher odds

(AOR= 1.41; CI,1.05-1.88) of getting a mammogram done in the past 12 months. Respondents in the 35-

49 years (AOR= 6.66; CI, 4.19- 10.59), 50-64 years (AOR= 16.17; CI, 10.19-25.66), 65-74 years (AOR=

16.46; CI,9.79-27.64), and 75+ years (AOR= 6.81; CI, 3.78-12.28) age groups had higher odds of getting

a mammogram done in the past 12 months than those in the 18-34 years age group.

Compared to households with an annual income of less than $20,000, respondents with a household income of $35,000- <$50,000 (AOR= 0.54; CI,0.33-0.88) had lower odds of getting a mammogram done in the past 12 months. Compared to those with no regular provider and no health insurance, respondents with a regular provider (AOR= 1.67; CI,1.28-2.18) and health insurance (AOR= 2.06; CI,1.02-4.18) had lower odds of getting a mammogram testing in the past 12 months.

Table 4

Patient Portal Utilization and Preventive Health Services Utilization

	Pap Smear Testing in the Past 12 months				Mammogram Testing in the Past 12 months			
	AOR	95% CI		p-level	AOR	95% CI		p-level
		LL	*UL*			*LL*	*UL*	
Patient Portal Utilization								
None	(Ref.Category)				(Ref.Category)			
1-2 times	**1.45**	1.06	1.99	0.02	1.34	0.99	1.81	0.05
3 or more times	**1.65**	1.29	2.12	<0.001	**1.44**	1.07	1.93	0.02
Predisposing Factors								
Race								
Non-Hispanic White	(Ref.Category)				(Ref.Category)			
Non-Hispanic Black or African American	1.24	0.87	1.77	0.23	**1.41**	1.05	1.88	0.02
Hispanic	1.29	0.87	1.9	0.19	0.95	0.69	1.29	0.72
Non-Hispanic Asian	0.68	0.35	1.32	0.25	0.95	0.54	1.65	0.84
Non-Hispanic Other	1.20	0.73	1.99	0.46	1.19	0.63	2.22	0.59
Age								
18-34 years	(Ref.Category)				(Ref.Category)			
35-49 years	1.01	0.71	1.44	0.96	**6.66**	4.19	10.59	<0.001
50-64 years	0.89	0.65	1.23	0.48	**16.17**	10.19	25.66	<0.001
65-74 years	**0.25**	0.17	0.37	<0.001	**16.46**	9.79	27.64	<0.001
75+ years	**0.16**	0.10	0.26	<0.001	**6.81**	3.78	12.28	<0.001
Educational Level								
Less than High School	(Ref.Category)				(Ref.Category)			
High School Graduate	1.38	0.84	2.26	0.20	1.15	0.60	2.23	0.67
Some College	1.47	0.93	2.31	0.09	1.15	0.56	2.35	0.70
College Graduate or More	**2.09**	1.16	3.77	0.02	1.26	0.61	2.62	0.53
Enabling Factors								
Annual Household Income								
< $20,000	(Ref.Category)				(Ref.Category)			
$20,000- < $35,000	0.77	0.52	1.15	0.19	0.99	0.65	1.49	0.95
$35,000- <$50,000	0.78	0.52	1.15	0.20	**0.54**	0.33	0.88	0.02
$50,000-<$75,000	0.81	0.53	1.26	0.35	0.90	0.56	1.45	0.65
$75,000 or more	0.90	0.61	1.34	0.61	0.91	0.62	1.33	0.61
Regular Provider								
No	(Ref.Category)				(Ref.Category)			

	AOR	LL	UL	p	AOR	LL	UL	p
Yes	**1.51**	1.17	1.96	0.002	**1.67**	1.28	2.18	<0.001
Health Insurance								
No	(Ref.Category)				(Ref.Category)			
Yes	**1.94**	1.08	3.45	0.03	**2.06**	1.02	4.18	0.05
Internet Access								
No	(Ref.Category)				(Ref.Category)			
Yes	0.79	0.55	1.12	0.17	1.09	0.74	1.60	0.65
Need Factor								
Presence of Chronic Conditions								
No	(Ref.Category)				(Ref.Category)			
Yes	0.88	0.72	1.08	0.21	1.02	0.78	1.32	0.90

Note. AOR- Adjusted Odds Ratio; CI- Confidence Interval; Ref. Category- Reference Category; *LL*= lower limit; *UL*= upper limit; Boldened variables are significant at p≤0.05

Patient Portal Utilization and Health-Promoting Behaviors

Table 5 shows that when compared to respondents who did not access their patient portal, those that accessed 3 or more times had a 26% higher likelihood (Relative Risk Reduction [RRR]= 1.26; CI,1.02-1.57) of a moderate level of participation in physical activities (vs low level). Compared to the 18-34 years age group, respondents in the 75+ years age group had lower chances (RRR= 0.63; CI,0.4-1.0) of having a moderate level of participation in physical activities (vs low level). Respondents who had a college degree or more (RRR=2.06; CI,1.15-3.68) were more likely to have a moderate level of participation in physical activities (vs low level) when compared to those with less than a high school degree. Compared to respondents with less than $20,000 annual household income, those earning $35,000- <$50,000 (RRR= 1.74; CI,1.23-2.47) and $75,000 or more (RRR= 1.6; CI,1.23-2.11) had a higher likelihood of a moderate level of participation in physical activities (vs low level). Respondents who had a chronic condition (RRR=0.72; CI,0.62-0.84) were less likely to of a moderate level of participation in physical activities (vs low level) when compared to those with no chronic conditions.

When compared to respondents who did not access their patient portal, those that accessed 3 or more times had a 37% higher likelihood (RRR= 1.37; CI,1.07-1.76) of a high level of participation in physical activities (vs low level). Compared to male respondents, females were less likely (RRR=0.71; CI,0.59-0.86) to have a high level of participation in physical activities (vs low level). Respondents who identified as Non-Hispanic Asian (RRR= 0.46; CI,0.28-0.76) were less likely to have a high level of participation in physical activities (vs low level) when compared to those that identified as Non-Hispanic White. Compared to the 18-34 years age group, respondents in the 75+ years age group had lower chances (RRR= 0.51; CI,0.31-0.85) to have a high level of participation in physical activities (vs low level). Respondents who had some college (RRR= 1.67; CI,1.02-2.75) and a college degree or more (RRR=1.91; CI,1.12-3.26) were more likely to have a high level of participation in physical activities (vs low level) compared to those with less than a high school degree. Respondents who had a chronic

condition (RRR=0.66; CI,0.52-0.85) were less likely to have a high level of participation in physical activities (vs low level) compared to those with no chronic conditions.

Respondents who accessed their patient portal 3 or more times were more likely (RRR=1.35; CI,1.1-1.66) to have a moderate level of participation in muscle strengthening (vs low level) when compared to those that did not access their patient portal. Compared to male respondents, females were less likely (RRR=0.71; CI,0.57-0.88) to have a moderate level of participation in muscle strengthening (vs low level). Respondents who identified as Non-Hispanic Black or African American (RRR= 1.71; CI,1.2-2.45) were more likely to have a moderate level of participation in muscle strengthening (vs low level) compared to those that identified as Non-Hispanic White. Compared to the 18-34 years age group, respondents in the 75+ years age group had lower odds (RRR= 0.56; CI,0.34-0.93) of having to have a moderate level of participation in muscle strengthening (vs low level). Respondents who had internet access (RRR= 0.56; CI,0.36-0.88) were less likely to have a moderate level of participation in muscle strengthening (vs low level) when compared to those with no internet access. Respondents who had a chronic condition (RRR=0.71; CI,0.59-0.86) were less likely to have at to have a moderate level of participation in muscle strengthening (vs low level) compared to those with no chronic conditions.

Compared to male respondents, females were less likely (RRR=0.65; CI,0.46-0.91) to have a high level of participation in muscle strengthening (vs low level). Respondents who identified as Non-Hispanic Black or African American (RRR= 1.08; CI,0.54-2.15) were more likely to have a high level of participation in muscle strengthening (vs low level) compared to Non-Hispanic White. Compared to the 18-34 years age group, respondents in the 34 -49 years (RRR=0.44; CI,0.26-0.75) and 50-64 years age group were less likely (RRR= 0.6; CI,0.36-0.99) to have a moderate level of participation in muscle strengthening (vs low level). Respondents who had a chronic condition (AOR=0.65; CI,0.43-0.96) were less likely to have at to have a moderate level of participation in muscle strengthening (vs low level) compared to those with no chronic conditions.

Table 5

Patient Portal Utilization and Health Promoting Behaviors- Level of Participation in Physical Activities and Muscle-strengthening Activities

	Level of Participation in Physical Activities												Level of Participation in Muscle-Strengthening											
	Moderate vs Low level				High vs Low level								Moderate vs Low level				High vs Low level							
	RRR	95% CI		p-level	RRR	95% CI		p-Level					RRR	95% CI		p-Level	RRR	95% CI		p-Level					
		LL	UL			LL	UL							LL	UL			LL	UL						
Patient Portal Utilization																									
None	(Ref.Category)				(Ref.Category)								(Ref.Category)				(Ref.Category)							
1-2 times	1.18	0.88	1.57	0.26	1.06	0.76	1.48	0.71					1.19	0.83	1.72	0.34	1.24	0.76	2.01	0.38					
3 or more times	**1.26**	1.02	1.57	0.04	**1.37**	1.07	1.76	0.01					**1.34**	1.02	1.75	0.04	1.59	0.96	2.62	0.07					
Predisposing Factors																									
Sex																									
Male	(Ref.Category)				(Ref.Category)								(Ref.Category)				(Ref.Category)							
Female	0.89	0.74	1.07	0.20	**0.71**	0.59	0.86	0.001					**0.71**	0.57	0.88	0.003	**0.65**	0.46	0.91	0.01					
Race																									
Non-Hispanic White	(Ref.Category)				(Ref.Category)								(Ref.Category)				(Ref.Category)							
Non-Hispanic Black or African American	1.15	0.84	1.57	0.38	1.01	0.73	1.39	0.97					**1.71**	1.20	2.45	0.004	**1.08**	0.54	2.15	0.83					
Hispanic	0.86	0.60	1.25	0.43	0.75	0.53	1.07	0.11					0.83	0.55	1.26	0.38	1.03	0.64	1.67	0.90					
Non-Hispanic Asian	0.71	0.44	1.12	0.14	**0.46**	0.28	0.76	0.003					0.81	0.50	1.31	0.37	0.79	0.34	1.85	0.59					
Non-Hispanic Other	0.69	0.39	1.21	0.19	0.67	0.41	1.10	0.12					0.96	0.52	1.78	0.90	0.57	0.26	1.23	0.15					
Age																									
18-34 years	(Ref.Category)				(Ref.Category)								(Ref.Category)				(Ref.Category)							
35-49 years	1.07	0.77	1.5	0.67	0.74	0.51	1.08	0.11					0.89	0.64	1.24	0.49	**0.44**	0.26	0.75	0.003					
50-64 years	0.94	0.70	1.28	0.7	0.79	0.58	1.08	0.13					0.89	0.62	1.26	0.50	**0.60**	0.36	0.99	0.05					
65-74 years	1.05	0.75	1.46	0.78	0.90	0.63	1.28	0.54					0.83	0.57	1.22	0.34	0.54	0.28	1.03	0.06					
75+ years	**0.63**	0.40	1.00	0.05	**0.51**	0.31	0.85	0.01					**0.56**	0.34	0.93	0.02	0.53	0.24	1.17	0.11					
Educational Level																									

	RRR	LL	UL	p	RRR	LL	UL	p	RRR	LL	UL	p	RRR	LL	UL	p
Less than High School	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
High School Graduate	1.09	0.61	1.96	0.77	1.10	0.64	1.89	0.72	1.32	0.70	2.49	0.38	0.81	0.26	2.54	0.72
Some College	1.59	0.86	2.94	0.14	**1.67**	1.02	2.75	0.04	1.47	0.80	2.69	0.21	0.99	0.40	2.45	0.98
College Graduate or More	**2.06**	1.15	3.68	0.02	**1.91**	1.12	3.26	0.02	1.69	0.88	3.27	0.11	1.22	0.43	3.44	0.70
Enabling Factors																
Annual Household Income																
< $20,000	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
$20,000- < $35,000	0.99	0.68	1.46	0.99	0.90	0.65	1.24	0.51	1.38	0.81	2.36	0.22	0.71	0.35	1.43	0.33
$35,000- <$50,000	**1.74**	1.23	2.47	0.002	0.96	0.66	1.39	0.83	0.96	0.58	1.60	0.88	0.59	0.30	1.18	0.14
$50,000-<$75,000	1.30	0.88	1.94	0.18	1.18	0.84	1.64	0.33	1.08	0.71	1.65	0.70	0.60	0.30	1.18	0.13
$75,000 or more	**1.60**	1.23	2.11	0.001	1.25	0.95	1.66	0.11	1.23	0.82	1.87	0.31	0.86	0.44	1.68	0.66
Regular Provider																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	1.14	0.89	1.46	0.28	0.86	0.68	1.10	0.22	0.99	0.74	1.32	0.94	0.80	0.53	1.22	0.30
Health Insurance																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	1.13	0.58	2.22	0.71	0.97	0.60	1.58	0.91	1.54	0.86	2.77	0.14	1.26	0.53	2.98	0.59
Internet Access																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	0.89	0.63	1.26	0.50	0.96	0.67	1.38	0.82	**0.56**	0.36	0.88	0.01	0.72	0.46	1.13	0.15
Need Factor																
Presence of Chronic Conditions																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	**0.7**	0.56	0.88	0.003	**0.66**	0.52	0.85	0.001	**0.71**	0.59	0.86	0.001	**0.65**	0.43	0.96	0.03

Note. RRR- Relative Risk Reduction; CI- Confidence Interval; Ref. Category- Reference Category; LL= lower limit; UL= upper limit; Boldened variables are significant at p≤0.05

Respondents who identified as Non-Hispanic Black or African American (AOR=0.53; CI,0.30-0.96) had lower odds of a non-smoking status when compared to those that identified as Non-Hispanic White (Table 6). Compared to the 18-34 years age group, respondents in the 50-64 years (AOR=1.22; CI,1.34-3.68), 65- 74 years (AOR=4.34; CI,2.53-7.45), and 75+ years age (AOR=15.59; CI,7.35-33.1) groups had higher odds of being non-smokers. Respondents with an annual household income of $35,000-<$50,000 (AOR=2.33; CI,1.35-4.0) and $75,000 or more (AOR=2.93; CI,1.67-5.14) had higher odds to be non-smokers than those in the <$20,000 income bracket. Compared to those with no health insurance, respondents with health insurance (AOR=2.98; CI,1.31-6.77) had higher odds of being non-smokers.

Table 6

Patient Portal Utilization and Health Promoting Behaviors- Current Non-Smoking Status

	Current Non-Smoking Behavior			
	AOR	**95% CI**		**p-Level**
		LL	*UL*	
Patient Portal Utilization				
None	(Ref.Category)			
1-2 times	1.20	0.84	1.72	0.32
3 or more times	1.47	0.92	2.34	0.10
Predisposing Factors				
Sex				
Male	(Ref.Category)			
Female	0.94	0.72	1.25	0.68
Race				
Non-Hispanic White	(Ref.Category)			
Non-Hispanic Black or African American	**0.53**	0.3	0.96	0.04
Hispanic	0.98	0.58	1.65	0.94
Non-Hispanic Asian	0.56	0.23	1.35	0.19
Non-Hispanic Other	1.34	0.64	2.83	0.43
Age Group				
18-34 years	(Ref.Category)			

	AOR	LL	UL	p
35-49 years	1.21	0.67	2.22	0.52
50-64 years	**1.22**	1.34	3.68	0.003
65-74 years	**4.34**	2.53	7.45	<0.001
75+ years	**15.59**	7.35	33.05	<0.001
Educational Level				
Less than High School	(Ref.Category)			
High School Graduate	1.12	0.48	2.60	0.78
Some College	1.19	0.55	2.57	0.66
College Graduate or More	2.12	0.92	4.87	0.08
Enabling Factors				
Annual Household Income				
< $20,000	(Ref.Category)			
$20,000- < $35,000	1.05	0.61	1.79	0.87
$35,000- <$50,000	**2.33**	1.35	4.00	0.003
$50,000-<$75,000	1.48	0.77	2.85	0.23
$75,000 or more	**2.93**	1.67	5.14	<0.001
Regular Provider				
No	(Ref.Category)			
Yes	1.17	0.74	1.85	0.50
Health Insurance				
No	(Ref.Category)			
Yes	**2.98**	1.31	6.77	0.01
Internet Access				
No	(Ref.Category)			
Yes	1.43	0.84	2.46	0.18
Need Factor				
Presence of Chronic Conditions				
No	(Ref.Category)			
Yes	0.95	0.65	1.40	0.80

Note. AOR- Adjusted Odds Ratio; CI- Confidence Interval; Ref. Category- Reference Category; *LL*= lower limit; *UL*= upper limit; Boldened variables are significant at p≤0.05

Role Of Self-Efficacy in the Association Between Patient Portal Utilization and Preventive Health

Behaviors

Respondents who accessed their patient portals 3 or more times vs 0 times (AOR= 1.5; CI,1.08-

1.93) had higher odds of getting a mammogram done in the past 12 months (Table 7). Respondents who

were a little confident (AOR=4.0; CI,1.35-11.9), somewhat confident (AOR=4.3; CI,1.63-11.5), very

confident (AOR=5.9; CI,2.15-16) and completely confident (AOR=6.8; CI, 2.43-19.2) about their self-

efficacy had higher odds of getting a mammogram in the past 12 months than those that were not

confident at all. Compared to Non-Hispanic Whites, Non-Hispanic Blacks or African Americans had

higher odds (AOR= 1.4; CI,1.02-1.82) of getting a mammogram done in the past 12 months. Respondents

in the 35-49 years (AOR= 6.9; CI, 4.33- 11.1), 50-64 years (AOR= 17; CI, 10.7-26.9), 65-74 years

(AOR= 16; CI,9.78-27.5), and 75+ years (AOR= 7; CI, 3.89-12.7) age groups had higher odds of getting

a mammogram done in the past 12 months than those in the 18-34 years age group. Compared to

households with an annual income of less than $20,000, respondents with a household income of

$35,000- <$50,000 (AOR= 0.5: CI,0.31-0.86) had lower odds of getting a mammogram done in the past

12 months. Compared to those with no regular provider, respondents with a regular provider (AOR= 1.7;

CI,1.28-2.19) had 1.7 times higher odds of getting mammogram testing in the past 12 months.

Table 7

Self-Efficacy and Preventive Health Behaviors- Pap smear, Mammogram testing, and Current Non-smoking Behavior

Variables	Pap Smear Testing				Mammogram Testing				Current Non-Smoking Behavior			
	AOR	95% CI		p-Level	AOR	95% CI		p-Level	AOR	95% CI		p-Level
		LL	UL			LL	UL			LL	UL	
Patient Portal Utilization												
None	(Ref.Category)				(Ref.Category)				(Ref.Category)			
1-2 times	**1.40**	1.03	1.97	0.03	1.30	0.97	1.79	0.08	1.18	0.82	1.70	0.37
3 or more times	**1.60**	1.28	2.12	<0.001	**1.50**	1.08	1.93	0.01	1.45	0.90	2.30	0.12
Self-Efficacy												
Not confident at all	(Ref.Category)				(Ref.Category)				(Ref.Category)			
A little confident	1.60	0.39	6.51	0.51	**4.00**	1.35	11.90	0.01	1.55	0.32	7.60	0.58
Somewhat confident	1.60	0.51	4.81	0.43	**4.30**	1.63	11.50	0.004	2.00	0.50	8.00	0.32
Very confident	1.80	0.64	5.34	0.25	**5.90**	2.15	16.00	0.001	2.37	0.56	10.00	0.24
Completely confident	2.40	0.76	7.39	0.14	**6.80**	2.43	19.20	<0.001	2.17	0.51	9.30	0.29
Predisposing Factors												
Sex												
Male	N/A				N/A				(Ref.Category)			
Female	N/A				N/A				0.93	0.71	1.20	0.62
Race												
Non-Hispanic White	(Ref.Category)				(Ref.Category)				(Ref.Category)			
Non-Hispanic Black or African American	1.20	0.85	1.74	0.29	**1.4**	1.02	1.82	0.04	**0.53**	0.30	1.00	0.03
Hispanic	1.30	0.89	1.92	0.17	1.00	0.69	1.30	0.75	0.98	0.59	1.60	0.95
Non-Hispanic Asian	0.70	0.35	1.41	0.32	1.00	0.58	1.78	0.95	0.56	0.23	1.40	0.19
Non-Hispanic Other	1.20	0.72	2.05	0.45	1.20	0.65	2.27	0.54	1.40	0.65	3.00	0.38
Age Group												
18-34 years	(Ref.Category)				(Ref.Category)				(Ref.Category)			

	OR	LCI	UCI	p	OR	LCI	UCI	p	OR	LCI	UCI	p
35-49 years	1.00	0.71	1.47	0.91	**6.90**	4.33	11.10	<0.001	1.25	0.69	2.30	0.46
50-64 years	0.90	0.65	1.25	0.53	**17.00**	10.70	26.90	<0.001	**2.25**	1.36	3.70	0.002
65-74 years	**0.20**	0.16	0.37	<0.001	**16.00**	9.78	27.50	<0.001	**4.32**	2.50	7.50	<0.001
75+ years	**0.20**	0.11	0.26	<0.001	**7.00**	3.89	12.70	<0.001	**15.8**	7.36	34.00	<0.001
Educational Level												
Less than High School	(Ref.Category)				(Ref.Category)				(Ref.Category)			
High School Graduate	1.40	0.83	2.26	0.22	**1.10**	0.60	2.18	0.69	1.07	0.44	2.60	0.89
Some College	1.50	0.91	2.30	0.11	**1.10**	0.54	2.31	0.75	1.12	0.49	2.50	0.79
College Graduate or More	**2.10**	1.14	3.69	0.02	1.20	0.58	2.51	0.61	1.97	0.82	4.80	0.13
Enabling Factors												
Annual Household Income												
< $20,000	(Ref.Category)				(Ref.Category)				(Ref.Category)			
$20,000- < $35,000	0.80	0.52	1.14	0.18	1.00	0.65	1.47	0.90	1.02	0.60	1.70	0.95
$35,000- <$50,000	0.80	0.51	1.14	0.19	**0.50**	0.31	0.86	0.01	**2.23**	1.29	3.90	0.01
$50,000-<$75,000	0.80	0.50	1.19	0.24	0.80	0.51	1.33	0.41	1.40	0.73	2.70	0.31
$75,000 or more	0.90	0.58	1.30	0.48	0.80	0.56	1.23	0.34	**2.79**	1.59	4.90	0.001
Regular Provider												
No	(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	**1.50**	1.15	1.94	0.003	**1.70**	1.28	2.19	<0.001	1.18	0.75	1.90	0.47
Health Insurance												
No	(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	**1.90**	1.04	3.33	0.04	1.90	0.96	3.91	0.07	**2.87**	1.26	6.60	0.01
Internet Access												
No	(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	0.80	0.57	1.15	0.23	1.10	0.77	1.64	0.54	1.47	0.87	2.50	0.15
Need Factor												
Presence of Chronic Conditions												
No	(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	0.90	0.76	1.16	0.55	1.10	0.85	1.43	0.46	0.98	0.67	1.50	0.93

Note: AOR- Adjusted Odds Ratio; CI- Confidence Interval; Ref. Category- Reference Category; LL= lower limit; UL= upper limit; Boldened variables are

significant at p≤0.05; N/A- Not Applicable

When compared to respondents who did not access their patient portal, those that accessed 3 or more times had a 27% higher likelihood (RRR= 1.27; CI,1.04-1.55) of a moderate level of participation in physical activities (vs low level) (Table 8). Compared to those not confident at all, respondents that were a little confident (RRR=37.17; CI,18.39-75.13), somewhat confident (RRR= 48.98; CI,26.84-89.38), very confident (RRR=69.6; CI,39.69-122.1), and completely confident (RRR= 79.45; CI, 42.04-150.2) were more likely to have a moderate level of participation in physical activities (vs low level). Respondents who had a college degree or more (RRR=2.06; CI,1.15-3.68) were more likely to have a moderate level of participation in physical activities (vs low level) when compared to those with less than a high school degree. Compared to respondents with less than $20,000 annual household income, those earning $35,000- <$50,000 (RRR= 1.67; CI,1.18-2.36) and $75,000 or more (RRR= 1.48; CI,1.12-1.96) had a higher likelihood of a moderate level of participation in physical activities (vs low level). Respondents who had a chronic condition (AOR=0.76; CI,0.61-0.95) were less likely to have a moderate level of participation in physical activities (vs low level) when compared to those with no chronic conditions.

When compared to respondents who did not access their patient portal, those that accessed their portal 3 or more times had a 38% higher likelihood (RRR= 1.38; CI,1.07-1.77) of a high level of participation in physical activities (vs low level). Compared to those not confident at all, completely confident respondents (RRR= 7.76; CI, 1.23-49.08) were more likely to have a high level of participation in physical activities (vs low level). Compared to male respondents, females were less likely (RRR=0.7; CI,0.58-0.84) to have a high level of participation in physical activities (vs low level). Respondents who identified as Non-Hispanic Asian (RRR= 0.5; CI,0.3-0.85) were less likely to have a high level of participation in physical activities (vs low level) when compared to those that identified as Non-Hispanic White. Compared to the 18-34 years age group, respondents in the 75+ years age group had lower chances (RRR= 0.53; CI,0.32-0.87) to have a high level of participation in physical activities (vs low level). Respondents who had a college degree or more (RRR=1.78; CI,1.01-3.13) were more likely to have a high level of participation in physical activities (vs low level) compared to those with less than a

high school degree. Respondents who had a chronic condition (RRR=0.74; CI,0.58-0.95) were less likely to have a high level of participation in physical activities (vs low level) compared to those with no chronic conditions.

Compared to those not confident at all, completely confident respondents (RRR= 7.15; CI, 1.88-27.26) were more likely to have a high level of participation in muscle-strengthening activities (vs low level). Compared to male respondents, females were less likely (RRR=0.63; CI,0.44-0.9) to have a high level of participation in muscle strengthening (vs low level). Compared to the 18-34 years age group, respondents in the 35 -49 years (RRR=0.46; CI,0.27-0.78) age group were less likely to have a high level of participation in muscle strengthening (vs low level).

Table 8

Self- Efficacy and Preventive Health Behaviors- Level of Participation in Physical Activities and Muscle- Strengthening Activities

	Level of Participation in Physical Activities								Level of Participation in Muscle Strengthening							
	Moderate vs Low level				High vs Low level				Moderate vs Low level				High vs Low level			
	RRR	95% CI		p-level	RRR	95% CI		p-level	RRR	95% CI		p-level	RRR	95% CI		p-level
		LL	UL			LL	UL			LL	UL			LL	UL	
Patient Portal Utilization																
None	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
1-2 times	1.16	0.87	1.54	0.31	1.04	0.74	1.47	0.82	1.17	0.81	1.69	0.38	1.19	0.74	1.92	0.47
3 or more times	**1.27**	1.04	1.55	0.02	**1.38**	1.07	1.77	0.01	**1.34**	1.02	1.77	0.04	1.62	0.98	2.66	0.06
Self-Efficacy																
Not confident at all	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
A little confident	**37.17**	18.39	75.1	<0.001	1.50	0.20	11.45	0.69	14.43	0.06	3610.0	0.34	0.86	0.13	5.76	0.88
Somewhat confident	**48.98**	26.84	89.40	<0.001	3.88	0.65	23.17	0.13	12.83	0.05	3268.0	0.36	1.80	0.46	7.02	0.39
Very confident	**69.6**	39.69	122.00	<0.001	5.06	0.88	29.25	0.07	20.21	0.08	5087.0	0.28	3.09	0.81	11.8	0.10
Completely confident	**79.45**	42.04	150.00	<0.001	**7.76**	1.23	49.08	0.03	25.98	0.11	6299.0	0.24	**7.15**	1.88	27.3	0.01
Predisposing Factors																
Sex																
Male	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Female	0.87	0.72	1.06	0.16	**0.70**	0.58	0.84	<0.001	**0.70**	0.56	0.87	0.002	**0.63**	0.44	0.90	0.01
Race																
Non-Hispanic White	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Non-Hispanic Black or African American	1.12	0.81	1.54	0.50	0.96	0.70	1.32	0.80	**1.65**	1.13	2.39	0.01	0.95	0.49	1.84	0.88
Hispanic	0.88	0.61	1.27	0.48	0.76	0.52	1.09	0.13	0.84	0.55	1.29	0.42	1.05	0.65	1.69	0.85
Non-Hispanic Asian	**0.76**	0.47	1.23	0.26	0.50	0.30	0.85	0.01	0.87	0.53	1.42	0.57	0.89	0.37	2.15	0.79
Non-Hispanic Other	0.78	0.46	1.33	0.36	0.78	0.48	1.25	0.30	1.09	0.60	1.96	0.78	0.69	0.32	1.50	0.34
Age Group																
18-34 years	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			

	OR			p	OR			p	OR			p	OR			p
35-49 years	1.10	0.79	1.50	0.56	0.78	0.53	1.14	0.19	0.90	0.65	1.25	0.53	**0.46**	0.27	0.78	0.01
50-64 years	0.94	0.70	1.28	0.70	0.81	0.59	1.12	0.19	0.88	0.62	1.26	0.48	0.62	0.37	1.05	0.08
65-74 years	1.01	0.73	1.42	0.93	0.88	0.62	1.25	0.46	0.80	0.55	1.18	0.26	0.52	0.27	1.01	0.06
75+ years	0.64	0.40	1.01	0.05	**0.53**	0.32	0.87	0.01	**0.56**	0.34	0.91	0.02	0.54	0.24	1.23	0.14
Educational Level																
Less than High School	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
High School Graduate	1.08	0.66	1.76	0.77	1.09	0.62	1.92	0.76	1.31	0.70	2.48	0.39	0.80	0.26	2.45	0.69
Some College	1.54	0.93	2.55	0.09	1.60	0.95	2.71	0.08	**1.44**	0.79	2.63	0.23	0.90	0.36	2.23	0.82
College Graduate or More	**1.93**	1.19	3.13	0.01	**1.78**	1.01	3.13	0.05	**1.61**	0.84	3.10	0.15	1.11	0.41	3.04	0.84
Enabling Factors																
Annual Household Income																
< $20,000	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
$20,000- < $35,000	0.97	0.66	1.43	0.89	0.88	0.64	1.20	0.41	1.35	0.79	2.33	0.26	0.66	0.33	1.33	0.24
$35,000- <$50,000	**1.67**	1.18	2.36	0.004	0.91	0.61	1.37	0.65	0.96	0.58	1.58	0.86	0.58	0.29	1.17	0.13
$50,000-<$75,000	1.21	0.82	1.79	0.34	1.09	0.78	1.53	0.60	1.04	0.67	1.59	0.87	0.55	0.28	1.08	0.08
$75,000 or more	**1.48**	1.12	1.96	0.01	1.14	0.83	1.55	0.41	**1.16**	0.75	1.78	0.50	0.76	0.39	1.48	0.41
Regular Provider																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	1.14	0.89	1.47	0.29	0.85	0.67	1.08	0.18	0.99	0.74	1.32	0.93	0.76	0.50	1.15	0.19
Health Insurance																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	1.08	0.57	2.02	0.81	0.92	0.55	1.55	0.76	1.44	0.80	2.60	0.22	1.14	0.48	2.68	0.76
Internet Access																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	0.91	0.64	1.30	0.61	1.00	0.68	1.46	0.10	**0.57**	0.36	0.90	0.02	0.73	0.45	1.18	0.20
Need Factor																
Presence of Chronic Conditions																
No	(Ref.Category)				(Ref.Category)				(Ref.Category)				(Ref.Category)			
Yes	**0.76**	0.61	0.95	0.02	**0.74**	0.58	0.95	0.02	**0.78**	0.64	0.95	0.01	**0.78**	0.52	1.17	0.22

Note: RRR- Relative Risk Reduction; CI- Confidence Interval; Ref. Category- Reference Category; *LL*= lower limit; *UL*= upper limit;Boldened variables are significant at p≤0.05

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This study aimed to characterize the factors associated with patient portal utilization, preventive services utilization, and health-promoting behaviors among adults in the United States. The study identified the social determinants of health associated with patient portal utilization. The role of an individual's self-efficacy in the association between patient portal utilization and preventive health behaviors was also evaluated.

Summary and Interpretation of Findings

The study found that being female, having a college degree or more, and coming from a household with an annual income of at least $75,000 were associated with patient portal utilization. This supports the study hypothesis that social determinants of health were associated with patient portal utilization. Other factors associated with the use of patient portals were having a regular provider, health insurance coverage, and internet access.

The results are consistent with the study hypothesis and showed that patient portal utilization, age, having a regular provider, and health insurance coverage were associated with preventive health services such as pap smear testing and mammogram. While the educational level was associated with pap smear testing, identifying as Non-Hispanic Black or African American and annual household income were associated with a mammogram. Respondents that were 65 years and above were less likely to get a pap smear, however, while respondents 35 years and older had higher odds to get a mammogram the odds peaked and eventually reduced with increasing age.

In this study, the use of patient portals with 3 or more times access per year was significantly associated with the health-promoting behaviors of interest which are the levels of participation in physical and muscle-strengthening activities. Other factors associated with health-promoting behaviors were race and age. While higher levels of education were associated with the level of participation in physical

activity, high annual household income was associated with both the level of participation in physical activity and current non-smoking status. The presence of a chronic condition was associated with lower odds of having a moderate or high level of participation in physical and muscle-strengthening activities. Although internet access was associated with less likelihood of having a moderate level of participation in the muscle-strengthening activity, having insurance coverage was associated with being a non-smoker.

This study supports that self-efficacy was associated with only one of the two preventive services-mammogram testing and with two of the three health-promoting behaviors- level of participation in physical and number of muscle-strengthening activities.

Social Determinants of Health Associated with Patient Portal Utilization

The finding that females were more likely to use a patient portal is consistent with a previous study (Hong et al., 2020; Turner et al., 2021) and this may be because women are more likely to be caregivers which places them in a position to access their relatives' health records (Sharma et al., 2016). The identified social determinants of health in the study- education, and income were similar to those found in studies (Hong et al., 2020; Turner et al., 2021) and individuals with higher levels of education may have more information on the benefits of using the patient portal utilization and were also likely to be high-income earners. Since patient portals were managed by the health provider and/or health organization, it is logical and consistent with a study by Turner et al., 2020 that having a regular healthcare provider and health insurance coverage will be positively associated with patient portal utilization. Our study finding is similar to a recent study that found rural residents were less likely to use their patient portal (Bhavsar et al., 2022). This could be a result of not being offered patient portal access by their health provider or other issues such as internet access (Bhavsar et al., 2022). Internet is needed to access a patient portal and our result is consistent with past findings that found that the internet was a strong predictor of patient portal utilization (Hong et al., 2020; Turner et al., 2021).

Patient Portal Utilization and Preventive Health Service Utilization

The results showed that patient portal utilization was a strong predictor of pap smear testing and mammogram testing which is similar to past studies where researchers found that health maintenance reminders from the patient portal can lead to increased rates of cervical and breast cancer screenings (Wright et al., 2011; Krist et al., 2012; Liang et al., 2022). Receiving health maintenance messages from the patient portal can nudge women to book the clinic appointments needed for preventive services. This study found that Non-Hispanic Black/ African American women were more likely to get a mammogram and this is different from previous studies where African American women were less likely to get a mammography and thus had higher mortality rates (Burns, 1996). This might be due to the increased awareness of breast cancer screening among African American women due to the disparity in outcomes. African American women might also get a mammogram done when symptoms appear and a study found that young African American women 40-45 years may detect breast cancer at the first mammogram (Richardson et al., 2016; Wilkerson et al., 2023).

The United States Preventive Services Task Force does not recommend cervical cancer screening for women older than 65 years except if they are at high risk and this study is consistent with the recommendation as women 65 years older had lower odds of getting a pap smear test (USPSTF, 2018). The study results are consistent with mammogram recommendations based on the increasing risk of breast cancer with age after which the risk reduces after the woman is aged 75 and older (USPSTF, 2016). Women with a college degree or more were likely to understand the benefits of undertaking a pap smear and would be able to access the needed care (Damiani et al., 2015). A study by Barton et al found that higher annual household incomes had higher odds of getting a mammogram however the study results showed those with middle income in the range of $35,000 -< $50,000 were less likely to get a mammogram (Barton et al., 2001). Middle-class income families such as those in the $35,000 -< $50,000 in this study often are not eligible for health insurance and cannot afford to pay the premium making them miss out on preventive care (Aron-Dine, 2019).

Women with a regular healthcare provider are more likely to be informed of the need to get their preventive care and this supports our study finding that a regular provider is a strong predictor of women's preventive services utilization of pap smears and mammograms. Although there are conflicting reports on the association between health insurance and women's preventive services with few studies finding no association (Alharbi et al., 2019; A. Alharbi et al., 2019) and another finding that health insurance could increase the likelihood of getting the screenings done (Yelena & Nazik, 2021), this study found that having health insurance coverage increased the odds of using preventive screening services.

Patient Portal Utilization and Health-Promoting Behaviors

The results showed that the use of the patient portal 3 or more times in a year was associated with respondents having moderate levels of participation in physical and muscle-strengthening activities. Patient portals usually have health education materials that increase awareness of the benefits of physical activity and accessing the portal may remind and encourage users to adopt the lifestyle.

Although many adults in the United States do not meet the required level of physical activity, women still lag behind men and this study supports past findings that women are less likely to participate in physical and muscle-strengthening activities (Edwards & Sackett, 2016; Buková et al., 2017; The Lancet Public Health, 2019). Several reasons have been postulated as the cause of this disparity including gender norms from early childhood, not finding physical activity interesting, lack of self-efficacy, the feeling of body insecurities, and their role as primary caregivers in the family (Edwards & Sackett, 2016; The Lancet Public Health, 2019).

There are disparities in physical activity among the different races and ethnic groups in the United States. The finding that Non-Hispanic Asians are less likely to have a high level of participation in physical activity is consistent with past studies and maybe because they are at low risk of developing chronic conditions such as hypertension due to their body composition (Kao et al., 2015; Yi et al., 2015). There might also be low awareness of the health benefits of physical activity due to language or cultural

barriers from healthcare providers. Although a study found no racial differences in muscle-strengthening activities (Watson et al., 2021), the result findings found that Non-Hispanic Blacks or African-Americans were more likely to have a moderate level of participation in the muscle-strengthening activity. This could be because of the social desirability to have a specific muscle physique that fits into the current social media narrative.

Despite the health benefits associated with physical activity in older adults, the study finding is consistent with past studies that found low participation in physical activities among older adults (Sun et al., 2013; McPhee et al., 2016). Older adults who have chronic conditions and/or mobility-associated issues are unlikely to be enthusiastic about engaging in physical activities. While physical and muscle-strengthening activities reduce the incidence of chronic conditions, individuals with chronic diseases are less likely to engage in these activities and this study supports that notion (Almutary & Tayyib, 2020; Dempsey et al., 2021; Ashe et al., 2009). The presence of chronic conditions may reduce the individual's confidence in their ability to carry out the recommended activities and the chronic condition might have been complicated by a physical disability that impedes physical or muscle-strengthening activities.

The results support past studies that found that higher levels of education and annual household income were associated with greater levels of participation in physical activities (Shaw & Spokane, 2008; Eime et al., 2018; Stalsberg & Pedersen, 2010; Silva et al., 2015). Individuals with higher levels of education are likely to be health literate and aware of the benefits associated with physical activity. These individuals are also likely to have high socio-economic status due to their increased income power. Internet access may encourage a sedentary lifestyle due to the increased time spent on social media and this study found lower odds of moderate level of participation in muscle-strengthening activities among those with internet access.

Although this study found that patient portal utilization was not associated with non-smoking behavior, another study that found non-smokers were more likely to use their portals (Liu et al., 2022). Smokers who access patient portals may receive messages encouraging them to quit and also link them to

smoking cessation programs (Singrey et al., 2016; May et al., 2020). Studies show that there are various barriers to Blacks/ African Americans quitting smoking and this study supports this as Non-Hispanic Blacks or African Americans were less likely to be non-smokers (Centers for Disease Control and Prevention, 2022). Non-Hispanic Blacks/ African Americans are less likely to receive advice to quit smoking, use cessation medications, get counseling, or contact call centers (Centers for Disease Control and Prevention, 2022).

The study findings that individuals older than 50 years are more likely to be non-smokers with increasing age is consistent with a CDC statistic that the highest rate of individuals that were currently smoking was between 25-64 years (Centers for Disease Control and Prevention, 2020). Older adults are likely to quit smoking when they develop other co-morbid conditions that could be complicated by their smoking behavior. The result is consistent with a past study that found that individuals from households with high incomes were less likely to smoke (Truth Initiative, 2016; Casetta et al., 2017). High levels of household income are usually associated with higher educational levels and this could mean increased health literacy on the risks and benefits of smoking. Individuals who identify as smokers are liable to a tobacco surcharge on their health insurance premium as a means to encourage quitting and it is not surprising that the results showed that having health insurance increased the chances of being a non-smoker (Madison et al., 2013; Friedman et al., 2016).

Role Of Self-Efficacy in the Association Between Patient Portal Utilization and Preventive Health Behaviors

The higher the level of self-efficacy the more likely women were to get a mammogram and this supports past study findings that self-efficacy is key in this preventive health behavior (Jerome-D'Emilia & Suplee, 2014; Lee et al., 2015; Ezema et al., 2021). The study found no association between self-efficacy and pap smear testing. Pap smear testing is largely dependent on the healthcare provider, unlike mammograms where the patient can carry out a self-breast examination before the test is done. There also

appears to be more awareness about breast cancer than cervical cancer and these could be the reasons for the non-significant association.

Past researchers found that an individual's self-efficacy predicts their adoption and maintenance of participation in physical activities and this study is consistent with the findings (McAuley & Jacobson, 1991; McAuley, 1993; Oman & King, 1998; Bray et al., 2001; Lewis et al., 2015). Physical activity and muscle-strengthening activities can be demanding high levels of self-efficacy may be needed for an individual to engage in these, as observed in this study (Smith et al., 2020). No significant association between self-efficacy and non-smoking behavior after a history of smoking was observed in this study. This could be because there is a need for external support in terms of cessation programs and counseling to quit smoking.

Strengths and Limitations

This study has provided new information that is nationally representative of the association between patient portal utilization and preventive health behaviors. The pooled cycles of data provide a robust sample size that makes the results reliable and generalizable to the general population.

A limitation of the study is that it does not establish causality between the variables of interest due to the cross-sectional study design of the HINTS survey. Due to the self-reported nature of the survey, the respondents are subject to a recall bias regarding activities done within the 12 months before the survey. Another limitation is that female preventive health services such as pap smear testing and mammogram may not be required annually so the survey item question's time range of 12 months may not apply to them.

Public Health Implications and Recommendations

With the rising health cost and increasing use of health information technology to improve population health outcomes, there is a need to explore how to maximize existing technology capabilities without necessarily increasing cost. The effective use of patient portals for preventive care may reduce healthcare expenditure over time through the prevention of chronic diseases. This study is of importance to policymakers, public health researchers, and practitioners.

Despite the increased availability and adoption of patient portals by health systems, the study findings suggest that there is a need to improve the population use and engagement of patient portals through increased awareness of the benefits and providing incentives for use. Health providers, health organizations, and insurance companies should continue to educate their patients on the use and advantages of patient portals. The patient portals should also be made user-friendly so that every population demographic can access and use them. Also, addressing the underlying social determinants of health may increase patient portal utilization.

Based on the study findings, public health practitioners should engage stakeholders on how best to improve self-efficacy based on age and race disparities in their target population. Feedback from the engagement would enable them to develop programs and toolkits on how to improve self-efficacy for preventive health behaviors.

Recommendations on preventive health behaviors need to be synchronized and made easy for the population to understand and carry out as the study found more respondents carrying out physical activities than muscle-strengthening activities despite both activities being required to meet the recommended dose.

Conclusion

In summary, the study findings showed that patient portal utilization can be a strong predictor of preventive health behaviors and that self-efficacy is needed for many individuals to carry out these

activities. Patient portal utilization should be encouraged among the population so that the benefits can be fully maximized in terms of the possible cost savings from preventive health behaviors.

The study provides more opportunities to conduct future research such as a qualitative study on the facilitators and barriers encountered by users that attempt to use the patient portal for preventive purposes. More investigation on the role of incentives for carrying out preventive care following nudges from the patient portal would be helpful for health systems. There is also a need for further research using control trials on the best nudging behaviors that will make people carry out preventive activities. The next steps for research would be to examine how linking patient portal notifications to mobile phone and email can maximize reach as well as the appropriate message framing that encourage the adoption and maintenance of health behaviors.

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