Walden University

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Walden University
2019

Abstract

Health Awareness on High Blood Pressure, High Cholesterol, and Risk for Cardiovascular Disease

by

Innocent Bibi

MD, Windsor University, 2017

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health—Epidemiology

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Abstract

Cardiovascular disease (CVD) is responsible for 25% of the annual deaths in the United States and represents a major public health burden, as patients often require screening and lifestyle changes related to multiple risk factors such as high blood pressure and high cholesterol. The purpose of this quantitative correlational study was to determine if there was a statistically significant association between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcomes (angina pectoris, coronary heart disease, and heart attack). The theoretical framework that guided this study was the health belief model. Data from adults over the age of 18 from the 2017 National Health and Nutrition Examination Survey dataset were used for this study. Logistic regression was used to analyze data. Results showed no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. There was also no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. This study may contribute to positive social change through an increase in individuals' level of awareness of their medical condition, which could lead to a reduction in the burden of cardiovascular disease.

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Chapter 1: Introduction to the Study

Introduction

Cardiovascular disease (CVD) is responsible for 25% of the annual deaths in the United States (Nishimura et al., 2017) and is a major public health burden because patients often require screening and lifestyle changes related to multiple risk factors such as high blood pressure and high cholesterol. Understanding the importance of addressing these modifiable risk factors also requires an adequate level of health awareness in the disease epidemiology (Hajar, 2017). Many researchers have shown that patients with CVD who have a low level of health awareness are less likely to adhere to therapy, and this is most likely what resulted in their CVD condition (Hajar, 2017). Similarly, lack of high blood pressure control and cholesterol management is also most likely to be associated with inadequate or marginal health awareness about the disease process leading to acute coronary syndrome (ACS; Hajar, 2017). Little information is available about health awareness and primary prevention of ACS based on race, age, level of education, and acculturation (Richtering et al., 2017). Given the deadly nature of CVD, any attempts to reduce CVD could be of benefit to society (Richtering et al., 2017). It is important to investigate modifiable coronary artery disease (CAD) risk factors according to individuals' race, age, level of education, and acculturation because individuals can optimally manage their health if they have an adequate level of understanding and awareness about their condition and associated screening or management strategies (Abeit & Peinemann, 2017). This study could result in positive social change through increased levels of health awareness in individuals related to their medical condition, which could lead to reduction in the burden of CVD.

The topic of this quantitative, correlational study was the relationship between health knowledge and CVD. I conducted this study to fill a gap in the existing literature about the relationship between health knowledge and CVD—a gap that might prevent health-belief-promoting programs from receiving greater funding and attention. The remainder of Chapter 1 contains a discussion of the problem and a contextualization of how the problem was addressed through a quantitative research method. Specifically, the problem statement, purpose statement, research questions, nature of the study, assumptions, scope and delimitations, and limitations are presented.

Background

CVD is one of most prevalent forms of disease in the world, particularly in developed countries (Nishimura et al., 2017; Richtering et al., 2017). CVD is associated with health conditions such as high blood pressure (Ena, Perez, Argente, & Lozano, 2017; Mair et al., 2015; Nii et al., 2016) and high cholesterol (Murray et al., 2003; Ruth et al., 2013); therefore, it is possible that individuals who have knowledge of their high blood pressure and high cholesterol conditions might take actions capable of reducing their risk of being diagnosed with, suffering from, or even dying as a result of one of the forms of CVD. The focus of this quantitative, correlational study was on the relationship between knowledge of the health states of high blood pressure and high cholesterol as predictors of being diagnosed with at least one form of CVD.

The research literature suggests that health beliefs and health knowledge are partly determinative of how people look after their health (C. J. Jones, Smith, & Llewellyn, 2014; C. L. Jones et al., 2015; Lambert, Azuero, Enah, & McMillan, 2017; Lee et al., 2015; O'Connor, Martin, Weeks, & Ong, 2014). The simplest form of health knowledge is knowing that one has a disease, as knowledge can be a precursor of disease management behaviors. The gap in the literature is epidemiological in nature; although numerous scholars (Cronin et al., 2018; Galvin, 2015; Kamran, Ahari, Biria, Malpour, & Heydari, 2014; Mellor, McCabe, Ricciardelli, Mussap, & Tyler, 2016) have investigated the relationship between the health beliefs or knowledge and medical status of small samples, no previous studies appear to have calculated the epidemiological odds of CVD as a function of health knowledge. The implications of this gap in knowledge are significant. If there is a relationship between health knowledge and lower odds of CVD, such knowledge will provide justification for increasing budgetary commitments to initiatives designed to raise the health knowledge of Americans, particularly with respect to the common health conditions of high blood pressure and high cholesterol. If there is no relationship between health knowledge and lower odds of CVD, such knowledge might forestall added expenditure on health knowledge-building efforts. This study was needed because, in order to fund and pursue programs related to health knowledge, local, state, and national authorities require a real-world justification as to the extent to which increasing an individual's health knowledge is associated with lower odds of having CVD.

Problem Statement

CVD is a major cause of morbidity and mortality in the United States and throughout the world (Nishimura et al., 2017). The underlying pathology CAD develops over many years, and by the time the first symptom occurs, the disease is already at an advanced stage, resulting in a public health burden (Nishimura et al., 2017). The public health burden occurs as individuals develop CAD that could have been prevented if individuals at risk of CAD knew how to prevent a cardiovascular event by understanding and avoiding modifiable risk factors (Nishimura et al., 2017). According to the American College of Cardiology guidelines, the risk of developing CAD increases with age, particularly at ages greater than 45 years in men and 55 years in women (Nishimura et al., 2017).

There are numerous risk factors for developing CAD, but high blood pressure, high cholesterol, diabetes mellitus, and a family history of early heart disease are by far the major causes (Nishimura et al., 2017). ACS, including angina pectoris and heart attack, frequently occurs suddenly and is often fatal before medical care can be provided (Hajar, 2017). The association between cholesterol levels and the development of coronary heart disease (CHD) has been reported and confirmed in many epidemiological studies, with a strong relationship between hypercholesterolemia, particularly the low-density lipoprotein cholesterol (LDL-C) component, and cardiovascular risk (Nishimura et al., 2017). It is also documented by clinicians and epidemiologists that serum and plasma cholesterol levels are associated with changes in the CVD incidence rate, with the prevalence of CAD totally dependent on LDL-C (Nishimura et al., 2017). Health screening, and management of LDL –C levels in young adulthood, predict development of CVD later in life (Nishimura et al., 2017). Managing the other component of cholesterol (high-density lipoprotein cholesterol) has become an accepted therapeutic strategy for decreasing the CHD incidence rate (Nishimura et al., 2017).

It is universally accepted by clinicians and epidemiologists that high blood pressure increases CVD incidence and predisposes individuals to clinical manifestations of CHD, including ACS, and sudden death (Nishimura et al., 2017). A major public health concern is health awareness, management, and primary prevention of modifiable risk factors such as high blood pressure and high cholesterol (Richtering et al., 2017). Understanding the risks associated with high blood pressure and high cholesterol can be helpful in preventing the development of CVD (Richtering et al., 2017). Knowledge about an individual's age, race, acculturation, and level of education in the prevention of CAD is a potential area to address, particularly when a health care disparity may exist in relation to the prevention and management of CAD (Lewis et al., 2015). Therefore, addressing the gap in the literature pertaining to the role of health awareness in preventing and managing high blood pressure, high cholesterol, and ACS, with angina as a predictor of CAD, could mitigate the public health burden of modifiable risk factors (high blood pressure and high cholesterol) in preventing a future cardiovascular event (Khanal et al., 2017).

Purpose of the Study

The purpose of this study was to determine if there was a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, heart attack) based on race, age, level of education, and acculturation.

Research Questions and Hypotheses

The research questions and hypotheses of this study were as follows:

RQ1: Is there a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

HI_0: There is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HI_A: There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

RQ2: Is there a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H2_0$: There is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

$H2_A$: There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

Theoretical Framework

The theoretical framework that guided this study was the health belief model (HBM). Researchers apply the HBM in seeking to explain and predict health behaviors by focusing on the attitudes and beliefs of individuals (Stichler et al., 2008). The HBM was first proposed in 1952 (Hochbaum, Rosenstock, & Kegels, 1952). The HBM suggests that beliefs and knowledge about health are correlated with health status. Specifically, Hochbaum et al. (1952) suggested that there is a connection between knowing about one's health and forming beliefs about the changeability of one's health, with such beliefs leading, in turn, to improvement in health status. Hochbaum et al. thus suggested that individuals who did not have deeper knowledge of their health conditions would be more likely to be in disease states than comparable individuals who had deeper knowledge of their health conditions. This conclusion has also been reached by other scholars who have used the HBM in their studies (C. J. Jones et al., 2014; C. L. Jones et al., 2015; Lambert et al., 2017; Lee et al., 2015; O'Connor et al., 2014). The HBM has been used to focus on ACS (angina pectoris) epidemiology, health literacy and awareness, and health policy aimed at understanding how to address modifiable risk factors for ACS (high blood pressure and cholesterolemia) in improving cardiovascular health (Stichler et al., 2008). If the HBM is applied in the management of ACS in the context of the effort to understand and prevent these modifiable risk factors, it could help decrease the public health burden of CVD and increase overall cardiovascular benefit for participants (Stichler et al., 2008).

Nature of the Study

A quantitative, correlational design was chosen for this study because calculating the odds of having CVD as a function of health knowledge cannot be achieved without (a) using quantified data and (b) correlating the independent and dependent variables in a manner consistent with the generation of odds ratios. Data were collected from the 2017 National Health and Nutrition Examination Survey (NHANES) database and analyzed through logistic regression with odds-ratio reporting. The population for this study consisted of adult (over 18) residents of the United States. The independent variables were knowledge of the health states of high blood pressure and high cholesterol. The dependent variables were cardiovascular health outcomes as indicated by a positive diagnosis of angina pectoris, CHD, or heart attack. The covariates were race, age, education level, and acculturation.

Definitions

Acculturation: According to NHANES (2017), speaking a language other than English at home constitutes membership in another culture. NHANES's name for *acculturation* is ACQBOX1.

Cardiovascular disease (CVD): The presence of any of the diagnosed conditions of angina pectoris, CHD, or heart attack (Brehm, Seeley, Daniels, & D'Alessio, 2013).

High blood pressure awareness: Individual knowledge of having consistent blood pressure readings of over 140/90 (Brehm et al., 2013).

High cholesterol awareness: Individual knowledge of having a total cholesterol level at or greater than 240 mg/dL (Brehm et al., 2013).

Assumptions

The assumptions of this study were also assumptions of the NHANES dataset. It was assumed that NHANES consisted of a representative cross-section of adults residing in the United States. It was also assumed that the answers given by NHANES participants to the NHANES questionnaire were accurate and truthful. It was assumed that the variable of health knowledge can be validly inferred from the fact of a participant having discussed his or her diagnostic status with a doctor.

Scope and Delimitations

The scope of the study extended to adult residents of the United Stated, of both genders and all races, who agreed to participate in NHANES data collection. The variable of health knowledge was delimited to a measure of whether or not participants in the NHANES dataset had discussed their diagnostic statuses of high blood pressure or high cholesterol level with a doctor. Because NHANES does not contain data on time to mortality, but only data on whether or not a participant has been diagnosed with a disease, the study's measurement of disease was delimited to a dichotomous measurement encompassing the absence or presence of the disease state. Similarly, because of the nature of the NHANES questionnaire itself, health knowledge and health beliefs had to be delimited to a simple operational definition based on whether or not study participants discussed their health states with their doctors. Children (people under 18) were excluded, because they were not sampled by NHANES. Applicable theory was delimited to the HBM, which is defined and discussed in detail in Chapter 2. The theory of planned behavior was considered but rejected, because there is more support for health beliefs as precursors of personal health management (Stichler et al., 2008). The generalizability of the findings was likely to be high given the cross-sectional magnitude of the NHANES dataset, as discussed at greater length in Chapter 3.

Limitations

One of the main limitations of the study was that of nonresponse bias. According to Massey (2012), non-response bias is a major consideration in empirical studies, because relatively small changes in response rates can lead to higher levels of bias in findings. One of the inherent limitations of the NHANES dataset was the high nonresponse rate, which, from question to question, varied from 40% to 60%. The existence of a high nonresponse rate introduced a greater likelihood of bias into the study.

Another limitation of the study was the absence of a longitudinal component. NHANES asked participants if they had discussed their conditions with doctors, as well as whether they had been diagnosed with certain conditions, but NHANES did not indicate which of these data were collected first. The HBM, as discussed further in Chapter 2, suggests that knowledge about health leads to future health states; in the context of the NHANES data, it is impossible to determine whether participants' knowledge of disease states was formed either prior to or after knowledge of an actual diagnosis. As such, the NHANES cross-sectional format might compromise the ability to reach conclusions about the HBM through the statistical analyses described in greater detail in Chapter 3.

A third limitation of the study was the limited inclusion of disease covariates. The literature reviewed in Chapter 2 suggests that types of CVD often co-occur with each other, as well as with other similar diseases; similarly, high blood pressure and high cholesterol can be comorbid with each other and with different conditions. No other disease states have been included in the model because of issues raised by the cross-sectional nature of the NHANES dataset. If, for example, a disease other than CVD is included as a control variable, it cannot be inferred whether that disease preceded, brought about, or was itself caused by some aspect of CVD. Although the inclusion of disease covariates might increase the internal validity of the study, the limitations of

NHANES's cross-sectional data create an important barrier to any such inclusion. These limitations could not be addressed, because the limitations are inherent to the NHANES dataset.

Significance

Health knowledge is an important goal in many settings, including the settings of public health policy and clinical practice. The assumption behind the dissemination of health knowledge through campaigns as well as through local efforts is that (a) giving people knowledge, or encouraging people to gain knowledge, related to their health states can prompt them to be more active in the defense and management of their own good health; and (b) the formation of positive beliefs and behaviors related to one's own healthcare management is likely to lead to a reduction in actual states. As one out of four Americans dies from some variation of CVD, the question of how—or whether—to promote more specific knowledge of CVD among prospective and current sufferers carries great importance.

However, in the absence of more accurate information about the relationship between health knowledge and CVD health outcomes, public health agencies, local health clinics, and other stakeholders have limited data on which to base decisions related to the promotion of health knowledge. If there is no significant relationship between (a) the independent variables of individual knowledge of high blood pressure and high cholesterol and (b) the dependent variable of cardiovascular health outcome, then there would be reduced justification for large public health campaigns designed to promote disease knowledge or for local clinics to invest more resources into the production of informative booklets and other materials designed to increase health knowledge. While the promotion of some form of healthcare knowledge is an intrinsic goal for public policy as well as for local clinical practice, there would be substantial added justification for dedicating more resources to health knowledge-building efforts if, in fact, there is a positive correlation between knowledge of a health factor (such as high blood pressure or high cholesterol) and CVD outcome. The significance of this quantitative, correlational study based on archived NHANES data lies in being able to calculate and report the relationship between (a) knowledge of high blood pressure and CVD diagnosis, and (b) knowledge of high cholesterol and cardiovascular health outcome in a manner that can inform knowledge-building actions and initiatives undertaken by public health agencies, local clinics, and other stakeholders in the fields of healthcare and policy. The positive social change implications of this study derive from its potential contribution to lowering the prevalence of CVD by providing a case for more intensive patient education programs. As CVD kills millions of people (Brehm et al., 2013), reducing CVD mortality is itself a positive social change.

Summary

CVD remains a major problem in the United States and globally. Chapter 1 comprised an introduction to the focus and objective of the study, which was guided by a quantitative, correlational assessment of the relationship between (a) the independent variables of knowledge of the health states of high blood pressure and high cholesterol; and (b) the dependent variable of cardiovascular health outcome, as indicated by positive diagnosis of angina pectoris, CHD, or heart attack while controlling for (c) the covariates of race, age, education, and acculturation. Chapter 1 provided a brief overview of CVD, disease states, health knowledge, and health beliefs. The chapter also included a discussion of the nature, significance, assumptions, scope and delimitations, and limitations of the study. Chapter 2 provides an overview of the literature review and theoretical framework for this study.

Chapter 2: Literature Review

Introduction

CVD is a major cause of morbidity and mortality in the United States. and throughout the world (Nishimura et al., 2017). The underlying pathology of CAD develops over many years, and by the time the first symptom occurs, the disease is already at an advanced stage (Nishimura et al., 2017). The public health burden of CAD may be mitigated if individuals at risk of CAD know how to prevent a cardiovascular event by understanding and avoiding modifiable risk factors (Nishimura et al., 2017). According to American College of Cardiology guidelines, the risk of developing CAD increases with age, particularly at ages greater than 45 years in men and 55 years in women (Nishimura et al., 2017).

There are numerous risk factors for developing CAD, but high blood pressure, high cholesterol, diabetes mellitus, and a family history of early heart disease are by far the major causes (Nishimura et al., 2017). ACS, including angina pectoris and heart attack, frequently occurs suddenly and is often fatal before medical care can be provided (Hajar, 2017). The association between cholesterol levels and the development of CHD has been reported and confirmed in many epidemiological studies, with a strong relationship between hypercholesterolemia, particularly the LDL-C component, and cardiovascular risk (Nishimura et al., 2017). It has also been documented by clinicians and epidemiologists that serum and plasma cholesterol levels are associated with changes in CVD incidence rate, with the prevalence of CAD totally dependent on LDL-C (Nishimura et al., 2017). Health screening and management of LDL –C levels in young adulthood predict development of CVD later in life (Nishimura et al., 2017). Managing the other component of cholesterol (high-density lipoprotein cholesterol) has become an accepted therapeutic strategy for decreasing the CHD incidence rate (Nishimura et al., 2017).

It is universally accepted by clinicians and epidemiologists that high blood pressure increases CVD incidence and predisposes individuals to clinical manifestations of CHD, including ACS, and sudden death (Nishimura et al., 2017). A major public health concern is health awareness, management, and primary prevention of modifiable risk factors such as blood pressure and cholesterol control (Richtering et al., 2017). Understanding the risks associated with high blood pressure and high cholesterol can be helpful in preventing the development of CVD (Richtering et al., 2017). In the effort to prevent CAD, it may be productive to gather knowledge about an individual's age, race, acculturation, and level of education, especially when health care disparities may exist concerning the prevention and management of CAD (Lewis et al., 2015). Addressing the gap in the literature on the role of health awareness in preventing and managing high blood pressure, high cholesterol, and ACS, with angina as a predictor of CAD, could mitigate the public health burden of modifiable risk factors (high blood pressure and high cholesterol), thereby supporting the prevention of future cardiovascular events (Khanal et al., 2017).

The purpose of this study is to determine if there is a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, heart attack) based on race, age, level of education, and acculturation. This chapter contains a discussion of both (a) theories relevant to the relationship between knowledge of an ailment and health status and (b) empirical studies relevant to high blood pressure, high cholesterol, and cardiovascular health.

Search Strategies

Empirical articles included in the literature review were chosen based on several search strings input into selected academic databases. The databases chosen for the literature search fell into three categories: general academic databases, academic databases focused on health, and academic databases focused on psychology. The following databases were searched in each category:

- *General academic databases*: Academic Search (EBSCO Publishing), Web of Science, JSTOR, Google Scholar, IngentaConnect, JournalSeek, Mendeley, Microsoft Academic
- *Academic databases dedicated to health*: MEDLINE, Pub Med, Cochrane Library
- *Academic databases dedicated to psychology*: PsycINFO, PubPsych

The following search strings were used:

- "Health knowledge" AND "health outcomes" AND "health belief model"
- "Health information" AND "health outcomes" AND "health belief model"
- "Health knowledge" AND "health outcome" AND "health belief model"
- "Health information" AND "health outcome" AND "health belief model"
- "Health knowledge" AND "health outcomes" AND "health beliefs"

- "Health information" AND "health outcomes" AND "health beliefs"
- "Health knowledge" AND "health outcome" AND "health beliefs"
- "Health information" AND "health outcome" AND "health beliefs"
- Health knowledge" AND "health outcomes" AND "health belief model" AND "heart disease"
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- "Health knowledge" AND "health outcome" AND "health beliefs" AND "heart disease"
- "Health information" AND "health outcome" AND "health beliefs" AND "heart disease"
- "Health knowledge" AND "health outcomes" AND "health belief model" AND "cardiovascular disease"

- “Health information” AND “health outcomes” AND “health belief model” AND “cardiovascular disease”
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- “Health information” AND “health outcome” AND “health beliefs” AND “cardiovascular disease”
- “Health knowledge” AND “health outcomes” AND “health belief model” AND “high cholesterol”
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- “Health knowledge” AND “health outcome” AND “health belief model” AND “high cholesterol”
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- "Health knowledge" AND "health outcomes" AND "health beliefs" AND "high cholesterol"
- "Health information" AND "health outcomes" AND "health beliefs" AND "high cholesterol"
- "Health knowledge" AND "health outcome" AND "health beliefs" AND "high cholesterol"
- "Health information" AND "health outcome" AND "health beliefs" AND "high cholesterol"

Article searches included the filters of recency (2013-present), peer-reviewed status, and publication in English. After conducting searches, I read the brief descriptions of articles on the first page of each set of results, and then I read entire abstracts of potentially relevant articles. Articles where abstracts gave sufficient evidence of relevance to the study topic were read in their entirety and, if still deemed applicable to the study, were included in the final review of empirical studies.

The review of literature was divided into separate literature searches on the following topics: (a) disease states and (b) possible links between healthcare awareness/ knowledge and disease states. For subsection (a) of the literature search, over 50 research articles were identified. These articles were sorted into thematic categories related to high blood pressure, CVD, and high cholesterol. These categories were used to derive appropriate knowledge and to support key claims about the disease states. For sub section (b) of the literature search, over 20 empirical studies were identified, and these studies were discussed in the larger context of what is known about the relationship between health knowledge/health awareness and disease states.

Theoretical Framework

The chosen theoretical framework for this study was the health belief model (HBM), which was first formulated in 1952 (Hochbaum et al., 1952) and has become an extremely influential theory over time (C. J. Jones et al., 2014; C. L. Jones et al., 2015; Lambert et al., 2017; Lee et al., 2015; O' Connor et al., 2014). The HBM is based on predicting the likelihood of health-promoting behaviors, which are themselves held to emerge from a combination of individual perceptions, the nature of the environment, and modifying factors (Hayden, 2013). The current understanding of the HBM, according to Hayden (2013), is as follows: "according to the Health Belief Model, modifying variables, cues to action, and self-efficacy affect our perception of susceptibility, seriousness, benefits, and barriers and, therefore, our behavior" (p. 35). Table 1: Elements of the HBM presents definitions of these constructs as they appear in the HBM.

Table 1

Elements of the HBM

HBM component	Definition
Perceived susceptibility	An individual's assessment of his or her chances of getting the disease.
Perceived benefits	An individual's conclusion as to whether the new behavior is better than what he or she is already doing.
Perceived barriers	An individual's opinion as to what will stop him or her from adopting the new behavior.
Perceived seriousness	An individual's judgment as to the severity of the disease.
Modifying variables	An individual's personal factors that affect whether the new behavior is adopted.
Cue to action	Those factors that will start a person on the way to changing behavior.
Self-efficacy	Personal belief in one's own ability to do something.

Note. Table adapted from *Introduction to Health Behavior Theory* (p. 35), by J. Hayden, 2013, New York, NY: Jones & Bartlett. Copyright 2019 by Innocent Bibi

The HBM, in addition to representing a novel theory for analyzing health behaviors, is a synthesis of several concepts and theories (Arnold, 2018). First, the HBM's premise that there is a connection between knowledge and action is itself indebted to at least two major theories that both predated the HBM itself, that is, the theories of utility-based action and operant conditioning. The theory of operant conditioning—which, along with classical conditioning, is one of the two main learning theories associated with behaviorism—is that learning is itself a function of consequences (Eaton, Libey, & Fetz, 2016; Maffei, Santos-Pata, Marcos, Sánchez-Fibla, & Verschure, 2015; Paret, Hoesterey, Kleindienst, & Schmahl, 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018).

In operant conditioning, health behaviors, like any sufficiently complex behaviors, can be described as resulting from a knowledge of the consequences of such behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). The experimental basis of operant conditioning was the finding that animals would engage in certain behaviors (such as pushing levers in a Skinner box) after they came to realize that doing so triggered certain positive consequences, such as the dispensing of food (or, conversely, if doing so reduced or eliminated the presence of a negative stimulus; Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). Understood in human terms—and, specifically, in terms of health behavior—operant conditioning suggests that actions relevant to health are undertaken or not undertaken because of the rewards or lack of rewards associated with such behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). In the HBM, this influence from operant conditioning and other aspects of behavioral learning theory is represented in the categories of perceived benefits and perceived barriers (Arnold, 2018).

Functionally, the overall premise of the HBM is that, if the various benefits and motivators of taking action outweigh the various costs and demotivators of taking action, then the individual will undertake the action (Hochbaum et al., 1952). This logic explicitly represents a version of cost-benefit analysis (CBA);(Arnold, 2018). CBA arose, in its incipient format, in the work of the economist Adam Smith, who described the relationship between costs and benefits as a determinant of economic action (Smith, 2010). After Adam Smith, neoclassical economists (Ross, 2002; Swanson, 1996; Zafirovski, 2008) generated and generalized a theory of action based on the CBA, and, some years before the HBM, Von Neumann and Morgenstern mathematically formalized a theory of human action based on the CBA (Von Neumann & Morgenstern, 2007). The HBM's assumption that people will act if perceived costs outweigh perceived benefits is aligned with both the general idea of the CBA as an explanatory factor in human action and Von Neumann and Morgenstern's utility theorem (Von Neumann & Morgenstern, 2007).

Next, the self-efficacy component of the HBM is itself a later addition to the model, one owed to the work of psychologist Albert Bandura. Bandura described self-efficacy as

> A generative capability in which cognitive, social, emotional, and behavioral sub skills must be organized and effectively orchestrated to serve innumerable purposes. There is a marked difference between possessing sub skills and being able to integrate them into appropriate courses of action and to execute them well under difficult circumstances. People often fail to perform optimally even though they know full well what to do and possess the requisite skills to do it. (Bandura, 1997, pp. 36-37).

In reference to the HBM, the theory of self-efficacy essentially predicts that knowledge is an insufficient spur to action; individuals must possess not only knowledge related to diseases or health states, but also the ability to unite their knowledge and other capabilities and apply them to an actual change in behavior. There is substantial empirical evidence for self-efficacy as a distinct factor in behavioral decision making (Alessandri, Borgogni, Schaufeli, Caprara, & Consiglio, 2015; Fallah, 2017; Jiang, Song, Lee, & Bong, 2014; Klassen & Tze, 2014; Skaalvik, Federici, & Klassen, 2015; Skaalvik & Skaalvik, 2014; Torres & Turner, 2016).

The HBM's category of perceived susceptibility is related to the field of heuristics, which also predates the HBM itself. Heuristic theories (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger, Flanagin, & Medders, 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007) indicate that people can interpret information in radically different ways; thus, for example, some people actually susceptible to a disease might underestimate their susceptibility whereas others less susceptible to a disease might overestimate their susceptibility (Hayden, 2013). Human decision-making and perception are, according to various theories of heuristics, biased and imprecise (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger et al., 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007), and this potential inaccuracy is taken into account in the HBM. The fact that four of the HBM's variables explicitly account for perception is itself a reflection of the possibility that human decision-making can be, as represented by heuristic theories (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger et al., 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007), inaccurate.

The HBM's attention to cues to action as part of the theory is another influence from behaviorism. In operant conditioning in particular, there is an emphasis on shaping, which is a process of aligning initially off-target behaviors with desired on-target behaviors that depends on changing the environment (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). Even in the absence of a second party shaping behavior, the principle of shaping suggests that, as cues change, so will behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018)—which is one of the predictions also made by the HBM. Thus, for example, people who actually have heart attacks will likely have much stronger cues for altering health beliefs and behaviors than individuals who have not yet suffered adverse health consequences.

Ultimately, therefore, the HBM is a synthesis of influences from behaviorism, cognitive psychology, and social psychology brought to bear on the domain of health beliefs and behaviors (Arnold, 2018). The HBM can be applied to both of the research questions of the study, which are as follows: (1) is there a significant relationship between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation? (2) Is there a significant relationship between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

The HBM suggests that health outcomes are themselves strongly influenced by health behaviors, which, in turn, are influenced by health knowledge. Thus, if applied to the two research questions of the study, the HBM would support the following predictions:

1. There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. The association will be such that high blood pressure awareness is associated with better cardiovascular health outcomes—and, conversely, that the absence of high blood pressure awareness is associated with worse cardiovascular health outcomes. The HBM also suggests that race, age, level of education, and acculturation represent potential modifying variables that can (a) be statistically modeled as mediators or moderators of the association between high blood pressure awareness and cardiovascular health outcome or (b) treated as covariates to increase the internal validity of the association between blood pressure awareness and cardiovascular health outcomes.
2. There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. The association will be such that high cholesterol awareness is associated with better cardiovascular health outcomes—and, conversely, that the absence of high cholesterol awareness is associated with worse cardiovascular health outcomes. The HBM also suggests that race, age, level of education, and acculturation represent potential modifying variables that can (a) be statistically modeled as mediators

or moderators of the association between high cholesterol awareness and cardiovascular health outcome or (b) treated as covariates to increase the internal validity of the association between cholesterol awareness and cardiovascular health outcomes.

Henderikus (2010) argued that a good theory should be richly descriptive, strongly explanatory, and supportive of empirical predictions. The HBM meets each of these criteria when applied to the research questions of the study. First, the HBM describes the phenomenon of health outcomes in terms of behaviors that are themselves closely related to individual perceptions, social influences, and behavior-shaping environments. Second, the HBM explains health outcomes in terms of chosen behaviors and the underlying influencers of such behaviors. Third, the HBM predicts that, after controlling for other relevant factors, there will be a positive relationship between health knowledge and better health outcomes. For these three reasons, the HBM is an appropriate theoretical framework for the study.

Review of the Literature

The research questions of the study are based on the concepts of (a) high blood pressure, (b) cardiovascular health, (c) high cholesterol, (d) the relationship between high blood pressure awareness and cardiovascular health outcomes, and (e) the relationship between high cholesterol awareness and cardiovascular health outcomes. Based on these concepts, the review of literature has been divided into two main sub-sections. The first sub-section of the review of literature consists of a discussion of high blood pressure, cardiovascular disease, and high cholesterol. The second sub-section of the review of literature consists of a discussion and synthesis of studies relevant to the relationship between health awareness / health knowledge and health outcomes.

Overview of Relevant Diseases

The three disease states most relevant to the current study are (a) high blood pressure, (b) cardiovascular disease, and (c) high cholesterol. Each of these disease states has been discussed in greater detail below. Each discussion contains a definition and overview of the disease state as well as discussions of types, risk factors, prevention, and management.

High blood pressure. High blood pressure, also known as hypertension, is a disease in which the pressure of blood within blood vessels is too high (Bosse et al., 2013; McManus et al., 2014). High blood pressure is established on the basis of measuring both systolic and diastolic blood pressure, with systolic blood pressure being the pressure within blood vessels as the heart beats and diastolic blood pressure being the pressure within the heart as blood courses through the vessels (D. W. Brown, Giles, & Greenlund, 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba, Ibrahim, & Rizk, 2001; Severcan et al., 2013). For the U.S. government, high blood pressure is defined as having a systolic blood pressure at or over 140 millimeters of mercury (mmHg) and a diastolic blood pressure at or over 90 mmHg (Bosse et al., 2013; Soltani, Shirani, Chitsazi, & Salehi-Abargouei, 2016; Stevens, Iliev, de Jong, Grobeiu, & Hommer, 2016). Because of the possibility of fluctuations in blood pressure over the course of a day, the diagnosis of high blood pressure requires frequency obtained readings; a single elevated reading might be an anomaly, but readings that are consistently in the diagnostic range for high blood pressure are more reliable (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013).

High blood pressure can damage the heart and brain, leading to instant death. The existence of high blood pressure indicates that the blood flow is compromised; in particular, high blood pressure leads to hardened arteries, which, in turn, make it more difficult for blood to reach the heart and brain through the arteries that are designed to carry blood to these vital organs (Ena et al., 2017; Mair et al., 2015; Nii et al., 2016). If insufficient blood reaches the heart, the heart can fail, leading to instant death or, in variant cases, chest pain or heart failure that can be addressed through medical interventions (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). If insufficient blood reaches the brain, the brain can enter into a stroke (A. W. Brown, Therneau, Schultz, Niewczyk, & Granger, 2015; Ebinger et al., 2015; Fridriksson, Bonilha, & Rorden, 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan, Zheng, Marchina, Norton, & Schlaug, 2014). A stroke occurs because the cells of the brain are failing to receive sufficient oxygen as transported by blood (A. W. Brown et al., 2015; Ebinger et al., 2015; Fridriksson et al., 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan et al., 2014). Strokes can be instantly fatal or leave the stroke sufferer paralyzed (A. W. Brown et al., 2015; Ebinger et al., 2015; Fridriksson et al., 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan et al., 2014).

High blood pressure can often be asymptomatic (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). Many people with high blood pressure do not feel any symptoms, and even the chest pain that can be a symptom of advanced high blood pressure can be mistaken for muscle soreness or a symptom of some disease state other than high blood pressure (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). For this reason, blood pressure should be frequently monitored, as even people with high blood pressure might not be aware of their disease in the absence of regular measurements of both systolic high blood pressure and diastolic high blood pressure (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013).

As many as a third of all Americans suffer from high blood pressure, making high blood pressure one of the most prevalent diseases in the country. High blood pressure can exist because of many risk factors, including genetic, environmental, and behavioral risk factors (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). In some cases, high blood pressure can be genetic, as in the cases of people who are born with abnormally narrow arteries or a weakened heart (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). In the majority of cases, however, high blood pressure is a lifestyle disease, one whose risk factors include overnutrition (that is, the habitual consumption of significantly more calories than necessary to support individuals given their lifestyles, metabolic profiles, and other characteristics) and sedentary lifestyles (Ehlers & Kaufmann, 2010; Nemoto et al., 2012; Salyers Jr, Mansour, El-Haddad, Golbeck, & Kallail, 2007; Thorburn, Macia, & Mackay, 2014). Overnutrition is closely associated with the overconsumption of salt and fat, both of which further narrow the arteries and therefore increase high blood pressure (Astrup & Finer, 2000; Colagiuri, 2010; Dixon, Pories, O'Brien, Schauer, & Zimmet, 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg, Leibel, & Tortoriello, 2008). Similarly, overnutrition and sedentary behavior (that is, the lack of sufficient exercise) are routinely comorbid, in that contemporary American life is characterized by a combination of overeating and physical underactivity (Astrup & Finer, 2000; Colagiuri, 2010; Dixon et al., 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg et al., 2008). In light of the risk factors of overnutrition and sedentarism, high blood pressure can often be prevented simply by (a) habitually consuming calories that are close to the daily thermal energy expenditure of the individual, (b) improving the quality of consumed food by reducing its salt and fat content, and (c) adding cardiovascular exercise to daily activity.

High blood pressure can be pharmaceutically managed, even though such pharmaceutical management is often part of a medically recommended lifestyle change incorporating appropriate nutrition and exercise (Astrup & Finer, 2000; Colagiuri, 2010; Dixon et al., 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg et al., 2008). Various prescription drugs can reduce high blood pressure (Dvonch et al., 2009; Ena et al., 2017; McManus et al., 2014; Murray et al., 2003). If high blood pressure leads to heart failure, heart attack, or stroke, survival depends on the rapid conveyance of the patient to a hospital for an appropriate surgical intervention (Dvonch et al., 2009; Ena et al., 2017; McManus et al., 2014; Murray et al., 2003).

High cholesterol. Cholesterol is a fatty substance, with the consistency of wax, that appears in every human cell (Murray et al., 2003; Ruth et al., 2013). Cholesterol is made by the body and is necessary for digestion, hormonal support, the production of vitamin D, and other crucial needs (Murray et al., 2003; Ruth et al., 2013). There are two kinds of cholesterol in the human body: Low-density lipoproteins (LDL) and high-density lipoproteins (HDL) (Murray et al., 2003; Ruth et al., 2013). As a disease state, high cholesterol is based on the presence of LDL, not HDL; for this reason, LDL can be considered bad cholesterol, whereas HDL can be considered good cholesterol (Murray et al., 2003; Ruth et al., 2013). In this respect, the disease state of high cholesterol is different from high blood pressure, which is not based on any type of substance, but on an overall measure of the pressure on blood as it courses through blood vessels, arteries, and the heart.

One of the functions of HDL is to remove excess cholesterol into the liver, where it is disposed of (Murray et al., 2003; Ruth et al., 2013). On the other hand, LDL is cholesterol that accumulates in the body (Murray et al., 2003; Ruth et al., 2013). LDL accumulated in the blood vessels reduces the ability of blood to travel through these vessels (Murray et al., 2003; Ruth et al., 2013). LDL results in hardened, fatty deposits within blood vessels that impede blood flow (Murray et al., 2003; Ruth et al., 2013). The condition of obstructed arteries is known as atherosclerosis, which can be diagnostically identified through the insertion of cameras into blood vessels (Ena et al., 2017; Nii et al., 2016). However, long before the need for utilizing such intrusive methods of diagnosis atherosclerosis arises, LDL can be measured through a simple blood test (Murray et al., 2003; Ruth et al., 2013).

In the United States, an LDL level below 100 milligrams per deciliter (mg/dL) is considered to be ideal (Murray et al., 2003; Ruth et al., 2013). A range at or above 100 mg/DL, but less than 130 mg/dL is not considered ideal, but it is not considered dangerous (Murray et al., 2003; Ruth et al., 2013). Diagnoses of high cholesterol began at or above the level of 130 mg/dL (Murray et al., 2003; Ruth et al., 2013). Between 130 and 159 130 mg/dL, LDL is considered borderline high, with diagnoses of high beginning at 160 mg/dL and diagnoses of very high beginning at over 189 mg/dL (Murray et al., 2003; Ruth et al., 2013). When heart disease of some kind (including high blood pressure) is also present, even lower values of LDL can be considered dangerous (Murray et al., 2003; Ruth et al., 2013).

Similar to high blood pressure, high cholesterol is considered a lifestyle disease, even though there are certain genetic conditions and predispositions that can bring about high cholesterol regardless of lifestyle (Murray et al., 2003; Ruth et al., 2013). Levels of LDL increase in proportion to the consumption of saturated and trans fats, both of which convert to LDL in the body (Murray et al., 2003; Ruth et al., 2013). Therefore, the most appropriate means of preventing high cholesterol is to reduce the consumption of saturated fats and trans fats (Murray et al., 2003; Ruth et al., 2013). Once an individual suffers from high cholesterol, this state can still be managed through an appropriate reduction in daily consumption of saturated fats and trans fats (Murray et al., 2003; Ruth et al., 2013). However, in addition to recommending permanent dietary changes, physicians might also prescribe prescription drugs designed to reduce LDL (Murray et al., 2003; Ruth et al., 2013).

LDL often occurs comorbidly with high blood pressure, cardiovascular disease, and diabetes (Astrup & Finer, 2000; Colagiuri, 2010; Dixon et al., 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg et al., 2008). The four disease states of high cholesterol, high blood pressure, cardiovascular disease, and diabetes have sometimes been described as a single disease state that represents a characteristic response of the body to consistent overnutrition and under-exercise (Astrup & Finer, 2000; Colagiuri, 2010; Dixon et al., 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg et al., 2008). Among aboriginal populations—that is, people who subsist on diets of non-processed food and engage in regular hunting and gathering activity—the diseases of high cholesterol, high blood pressure, cardiovascular disease, and diabetes are almost unknown (Daniel, Rowley, McDermott, & O'dea, 2002; Dunstan et al., 2002; O'dea, 1984; Simpson, Shaw, & Zimmet, 2003; S. J. Thompson & Gifford, 2000). In Oceania, scientists following the outcomes of aboriginal populations that became settled discovered that the disease states of high cholesterol, high blood pressure, cardiovascular disease, and diabetes appeared among these peoples within a single generation (Daniel et al., 2002; Dunstan et al., 2002; O'dea, 1984; Simpson et al., 2003; S. J. Thompson &

Gifford, 2000), strongly supporting the hypothesis that high cholesterol, high blood pressure, cardiovascular disease, and diabetes are diseases associated with a lifestyle of sedentarism and overnutrition (Astrup & Finer, 2000; Colagiuri, 2010; Dixon et al., 2005; Farag & Gaballa, 2011; Schmidt & Duncan, 2003; Weisberg et al., 2008).

Cardiovascular disease. Cardiovascular disease, also known as heart disease, is closely related to atherosclerosis, which is itself a result of high LDL (that is, high cholesterol) (Brehm et al., 2013; Brook et al., 2010; Clifton, Condo, & Keogh, 2014; Garcia, Mulvagh, Merz, Buring, & Manson, 2016; Lello, Capozzi, & Scambia, 2015; Manson & Bassuk, 2015; Pittman, Chen, Bowlin, & Foody, 2011; Psaltopoulou et al., 2017; Santos, Esteves, da Costa Pereira, Yancy Jr, & Nunes, 2012; Suzuki, Wilcox, & Wilcox, 2001). The narrowing and hardening of the arteries due to deposits of LDL leads to decrease blood flow back to the heart, which, in turn, leads to cardiovascular disease (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001). One of the most deadly manifestations of cardiovascular disease is a heart attack, which takes place when blood flow to a particular part of the heart is completely blocked, leading to the death of some part of the heart muscle (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001). Short of heart failure, cardiovascular disease can also manifest itself as heart disease, a state in which the heart continues to work but insufficient blood and oxygen are supplied to the remainder of the body (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001). Strokes are another manifestation of cardiovascular disease (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001).

Cardiovascular disease, like high blood pressure and high cholesterol, is a disease state related to lifestyle, that is, the combination of overnutrition and sedentarism that characterizes contemporary life in many parts of the world (Daniel et al., 2002; Dunstan et al., 2002; O'dea, 1984; Simpson et al., 2003; S. J. Thompson & Gifford, 2000). For this reason, cardiovascular disease can be prevented or managed through modifications of diet and lifestyle that are also recommended for high blood pressure and high cholesterol (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001). In terms of medical management, cardiovascular disease can be addressed by prescription drugs (including drugs that manage atherosclerosis and high blood pressure), surgical intervention, and, in specific cases, through the use of stents or other mechanical means, including artificial hearts, to improve the function of the heart itself (Brehm et al., 2013; Brook et al., 2010; Clifton et al., 2014; Garcia et al., 2016; Lello et al., 2015; Manson & Bassuk, 2015; Pittman et al., 2011; Psaltopoulou et al., 2017; Santos et al., 2012; Suzuki et al., 2001).

Health Knowledge and High Blood Pressure

A quantitative study conducted by Kamran et al. (Kamran et al., 2014) examined the relationship between health beliefs and adherence to hypertension medication among rural patients in Iran. Kamran et al. analyzed outcomes related to hypertension medication adherence among 671 Iranian patients in order to determine whether there was a statistically significant relationship between health beliefs and medication adherence. Similar to Cronin et al. (2018), Kamran et al. modeled the relationship between health beliefs and adherence to hypertension medication among rural patients through the use of *OR* statistics.

One point of interest in Kamran et al.'s study (2014) was the authors' reporting of *OR*s associated with each of the elements of the HBM (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy). Kamran et al. subdivided scores on each of these components into low, moderate, and high categories. In their subsequent analyses, Kamran et al. reported *OR*s based on comparisons of (a) low HBM to high HBM in a particular component and (b) moderate HBM to high HBM in a particular component. Furthermore, Kamran et al. defined the dependent variable as non-adherence to hypertension medication. Based on this categorization of variables, Kamran et al. reported the following statistically significant (at $p < .01$) results:

- Individuals who perceived themselves as being moderately susceptible to hypertension were 3.1 times as likely not to adhere to hypertension medication as individuals who perceived themselves as being highly susceptible to hypertension.

- Individuals who perceived themselves as being lowly susceptible to hypertension were 52.5 times as likely not to adhere to hypertension medication as individuals who perceived themselves as being highly susceptible to hypertension.
- Individuals who perceived their hypertension as moderately severe were 2.4 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension as highly severe.
- Individuals who perceived their hypertension as lowly severe were 57.5 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension as highly severe.
- Individuals who perceived their hypertension medication as having a moderate perceived benefit were 2.7 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension medication as having a high-perceived benefit.
- Individuals who perceived their hypertension medication as having a low perceived benefit were 19.9 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension medication as having a high-perceived benefit.
- Individuals who perceived high barriers to taking their hypertension medication were 4.6 times as likely not to adhere to

hypertension medication as individuals who perceived low barriers to taking their hypertension medication.

- Individuals with moderate self-efficacy were 1.6 times as likely not to adhere to hypertension medication as individuals with high self-efficacy.
- Individuals with moderate self-efficacy were 51 times as likely not to adhere to hypertension medication as individuals with low self-efficacy.

Therefore, Kamran et al.'s (2014) findings provided strong support for the claim that individuals who have more informed or engaged health beliefs are also more likely to take their hypertension medication. On the presumption that more frequent consumption of hypertension medication is likely to be associated with better hypertension outcomes, Kamran et al.'s study also provides indirect support for the likelihood of a positive correlation between HBM-related health knowledge and the positive outcome of better hypertension management or outcomes. More generally, Kamran et al. found that individuals who perceived themselves as being healthy were 13.9 times more likely to adhere to the consumption of hypertension medication. Therefore, both in terms of the specific HBM components and a general perception of healthy status—which, itself, is conceptually related to having knowledge about health—Kamran et al. found positive correlations between health knowledge and health outcomes, specifically health outcomes related to hypertension.

Health Knowledge and Sickle Cell Disease

Cronin et al. (2018) conducted a quantitative research study designed to examine the relationship between health beliefs, treated as a kind of health knowledge, and missed clinic appointments among individuals suffering from sickle cell disease. Thus, the dependent variable in Cronin et al.'s model was missed appointments. Cronin et al. coded the variable of missed appointments dichotomously, so that 1 = missed appointment, 0 = kept appointment. Cronin et a. utilized an odds ratio (*OR*) approach to measure both the statistical significance and practical strength of the association between numerous predictor variables and the odds of missing clinic appointments among 211 individuals who either suffered from sickle cell disease or who were caretakers of individuals with sickle cell disease. Only one of the independent variables in Cronin et al.'s model, that of health literacy, was related to missed clinic appointments. Cronin et al. found that the *OR* for the relationship between health literacy and missed clinic appointments was 4.64, with a 95% confidence interval between 1.33 and 16.15, and this *OR* was statistically significant at $p < .01$. The interpretation of this *OR* is that individuals who possessed low levels of health literacy were 4.64 times as likely to miss a clinic appointment (or cause the person for whom they were caring to miss a clinic appointment) in comparison with individuals who possessed high levels of health literacy. This finding of Cronin et al.'s strongly suggests that individuals with a higher level of health knowledge, conceptual defined as health literacy, are significantly less likely to miss clinic appointments. Given the *a priori* likelihood that attending clinic appointments is likely to result in improvements to the symptoms of sickle cell disease, it can be concluded that individuals with greater health knowledge are, through the mediation or moderation of more frequently kept clinic appointments, likely to experience better outcomes to sickle cell disease management.

Health Knowledge and Alzheimer's Disease

A quantitative study (Galvin, 2015) of the relationship between various forms of health knowledge and the outcome of patient intention to initiate screening for Alzheimer's disease suggested the possibility that cultural differences might be responsible for the relationships between health knowledge and outcomes related to Alzheimer's disease. On the basis of data collected from 1,039 non-demented American adults, and using an *OR* approach, Galvin found that white people were 4.28 times as likely to initiate screening for Alzheimer's disease as compared to African-Americans. In addition, Galvin found that individuals who had the self-efficacy to be able to discuss memory problems were 2.72 times more likely to initiate screening, whereas individuals who knew that their doctors could test memory were 1.7 times more likely to initiate requests for Alzheimer's screening. Galvin's findings thus suggested that the mere knowledge that memory can be medically tested significantly increases the odds of requesting a screening for Alzheimer's disease, a clear illustration of a connection between a form of health knowledge and a form of health outcome (on the assumption that earlier detection of Alzheimer's disease is likely to correlate positively with the improved management of Alzheimer's disease). Galvin interpreted the race-related finding as suggesting that white Americans were more likely to be worried about Alzheimer's disease, to believe that the disease was preventable or manageable, and to believe that aging need not necessarily be associated with dementia. Galvin's study was of particular importance because of its identification of the variables of race and culture as influencing the relationship between health knowledge and health outcomes, in particular, health outcomes related to Alzheimer's disease and possibly other forms of dementia.

Health Knowledge and General Health Outcomes

A study conducted by Mellor et al. (2016) was similar to that of Galvin (2015) in terms of its racial and cultural dimensions. Mellor et al. were particularly interested in the relationship between health knowledge and poor health outcomes in a particular sub-population, that of indigenous men in Australia. Applying a qualitative research approach, Mellor et al. conducted 40 interviews and reached the following interesting conclusion about the relationship between health knowledge and poor health outcomes among indigenous Australian men:

> Participants recognized that their indigenous status placed them in a vulnerable position with regard to health, and that there might be serious consequences of failing to follow a good diet and engage in appropriate exercise. However, they delineated a number of barriers to engaging in such health behaviors. These perceived barriers require addressing at a range of policy levels within government, with a focus on social structures and institutionalized discrimination, as well as unemployment, poverty, dispossession, and cultural oppression (Mellor et al., 2016, p. 1949).

Mellor et al.'s (2016) findings were of interest because of their qualitative exploration of the possible reasons for the cultural and racial dimensions of the relationship between health knowledge and health outcomes identified, but not contextually explored, in the work of Galvin (2015). Based on the work carried out by both Galvin and Mellor et al., it appears appropriate to conclude that the relationship between health knowledge and health outcomes is culturally mediated. In particular, based on the qualitative findings obtained by Mellor et al., it seems likely that individuals who are racial or cultural minorities are, even if possessed of the same health knowledge as individuals from the majority culture, less likely to act on this knowledge by engaging in health behaviors (such as adherence to medication schedules, initiation of screenings, and adoption of better diets and more exercise) that are likely to lead to improved health outcomes. In the case of the sub-population of indigenous Australian men, Mellor et al.'s findings suggest a collective depression and hopelessness, themselves the products of historical and ongoing oppression that prevent individuals from acting positively on their health knowledge. Galvin's study suggests that, in other cases, individuals who belong to a minority group might not possess the same amount of health knowledge as individuals in the majority group. Therefore, it is possible that individuals from vulnerable minority groups will lack either health knowledge or the motivation to act upon their health knowledge.

A meta-analysis carried out by DeWalt et al. (2004) contained an estimate of the *OR* of literacy on the dependent variable of health outcomes. Based on data extracted from tens of thousands of patients in over 100 studies, DeWalt et al. estimated that individuals with poor literacy were, in the 95% confidence interval of the *OR*, between 1.5 and 3 times as likely as literate individuals to obtain positive health outcomes.

Although this study was conducted on a large number of subjects, with a sample size approaching that of an epidemiological dataset, the study did not include covariates such as health status. It is possible, for example, that individuals with low levels of literacy are less likely to experience positive health outcomes because, for example, individuals with low levels of literacy are also more likely to suffer from certain structural disadvantages (such as disadvantages related to race and socioeconomic status) that might not be related to literacy. Thus, although DeWalt et al.'s findings provided a useful, novel analysis of the relationship between general literacy and health outcomes, the absence of covariates related to race and socioeconomic status was an important limitation of this study. Finally, in settings in the developed world, literacy might be uniformly high, making health literacy a more useful predictor of health outcomes and health behaviors.

The analysis provided by Nayga (2000) was that the variables of health literacy, health knowledge, general literacy, and schooling all provided the same protective factor, that of knowledge, against poor health outcomes. Based on an empirical analysis of the effects of schooling, health literacy, and obesity among a sample of Americans, Nayga concluded that obesity—which, because of its designation as a disease and correlation with various other diseases represents both a direct and indirect measure of negative health outcomes (Cawley & Meyerhoefer, 2012; Heymsfield & Wadden, 2017; Medehouenou et al., 2015; Shelton & Knott, 2014; Sinha, 2018; Swencionis & Rendell, 2012; Wells, 2013)—is the result of individual ignorance. In particular, Nayga argued that individuals who are ignorance of obesity as a disease state—information that is itself a basic component of health literacy—are the individuals who are most likely to be obese. In this respect, Nayga claimed the existence of a close and positive association between health ignorance and a particular health outcome, that of obesity.

Discrepant Views of Health Knowledge-Health Behavior Relationship

It is not clear, however, if ignorance is an important predictor of health-related decision making. The results of several experiments (Campbell & Mohr, 2011; McFerran, Dahl, Fitzsimons, & Morales, 2009; Minas, Poor, Dennis, & Bartelt, 2016) suggest the possibility that, in the particular case of obesity, the disease state itself is not a result of the absence of knowledge, but of the suppression of knowledge. For example, several experiments have indicated that, when people are exposed to the site of obese people eating before they themselves are given the opportunity to eat *ad libitum*, they will eat significantly less. This priming effect does not support Nayga's (2000) general claim about the relationship between ignorance and the negative health outcome of overeating / obesity; rather, priming effects suggest that individuals of various health literacy are already aware of the unhealthiness of obesity, but that they do not take actions based on this perception until some environmental cue—typically, in experimental situations, that of a larger person consuming food in front of them—sways their behavior.

Rebar et al. (2015) suggested that neither knowledge nor any other conscious process could explain the full spectrum of health-related behaviors by itself, proposing an interactive model that is more complex than that proposed by Nayga (2000):

> We propose that physical activity is a complex behavior determined by an interaction of the two [conscious and unconscious decisions. For example, an individual may make a quick, spontaneous, non-deliberative decision to exercise

> on the basis of the presentation of a well-learned cue (e.g., viewing their exercise program on the wall upon waking), but the knock-on effect of the decision may bring multiple well-learned but consciously-directed decisions into play (e.g., deciding to run or swim, choosing to do it alone or with others). Therefore, a non-conscious process may set in motion a series of more consciously controlled processes leading to action. (Rebar, Loftus, & Hagger, 2015, p. 124).

Health knowledge could, in the explanatory scheme presented by Rebar et al., constitute one possible explanation for the kinds of behaviors that lead to, or are associated with, better health outcomes. The presence of health consciousness—for example, in the form of declarative knowledge—could explain why people engage in certain health-related behaviors such as, in Kamran et al.'s (2014) study on hypertension medical adherence, Galvin's (2015) study on patient initiation of Alzheimer's screening, or Cronin et al.'s (2018) study on clinic appointments among individuals with sickle cell disease. However, Rebar et al. suggested that knowledge, as one example of a conscious process, is unlikely to be the sole explanatory factor vis-à-vis health behaviors. It is more likely, according to Rebar et al., that conscious and unconscious processes interact and alternate in their formation of health-related behaviors, and, therefore, health-related outcomes. Rebar et al.'s theory of health behaviors is likely to be difficult to test because of the combination of conscious and unconscious explanatory factors, the latter of which might not be susceptible to measurement and data analysis.

Gap in the Literature

There are numerous gaps in the empirical literature justifying further study on the topic of the relationship between health knowledge and health outcomes. One gap is the comparative lack of data analysis based on epidemiological datasets. Several of the empirical studies discussed in the literature review are based on relatively small samples. It is possible that these studies lack the reliability, validity, and explanatory power than might be obtained with the use of epidemiological rather than small-sample datasets. Another gap in the literature is the use of covariates in *OR* analysis. An *OR* coefficient can be presented either in isolation—that is, as the product of a bivariate analysis in which a single dependent variable is regressed on a single independent variable—or in the context of several covariates (Szumilas, 2010). Some of the literature reviewed in this chapter presented *OR*s that were analyzed as part of one-to-one analyses rather than alongside covariates.

Another gap in the literature, a gap whose existence is suggested by Rebar et al.'s (2015) interactive health model, pertains to the apparent absence of models that have tested the interaction of conscious and unconscious processes in forming health behaviors. Truly interactive models would be difficult to test because of the intrinsic difficulty in measuring and analyzing the kinds of unconscious processes that, according to Rebar et al., are among the precursors to the formation and execution of health behaviors. It is possible that the use of brain imaging techniques in combination with well-designed experiments could help to identify the possible combinations of conscious and unconscious processes that inform health-related behaviors.

Summary

The literature review contained both a discussion of theories relevant to the relationship between knowledge of an ailment and health status and empirical studies quantifying the relationship between knowledge of an ailment and health status. First, the HBM was described and justified as constituting an appropriate theoretical framework for the study. Second, relevant empirical studies were described, discussed, analyzed, and synthesized. The studies suggested that the significance and magnitude of the link between health awareness and health outcomes tends to vary depending on the population and disease of interest, Third, gaps in the empirical literature were noted. The methodology described in Chapter 3 is designed to address some of the key gaps in the empirical literature. Chapter 3 will include a discussion of the relevant aspects of methodology and study design required to address the identified gap in the literature.

Chapter 3: Research Method

Introduction

The purpose of this study was to determine if there was a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcomes (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. This chapter contains a discussion of the research design and rationale, methodology, population, sampling and sampling procedures, data collection, instrumentation and operationalization of constructs, data analysis plan, threats to validity, and ethical procedures.

Research Design and Rationale

The study was conducted as a quantitative correlational study. Correlational research is nonexperimental research that allows the researcher to measure at least two variables and assess the statistical relationship between them with little/no effort to control extraneous variables. Correlational studies are often used when it is expected that a relationship is causal but manipulation of the independent variable cannot occur due to impossibility, impracticality, or ethics (Blattberg, Kim, & Neslin, 2008). This study design is appropriate for determining the type of relationship that exists between naturally occurring variables. This design was beneficial for the current study because of the use of naturally occurring variables, which meant that I did not manipulate any variable, in that I was limited to observing what occurred. The correlational design was related to the research questions because I wanted to determine whether or not there was a relationship between two or more variables. However, it is important to understand that, in a correlational study, the researcher is passively searching for relationships, which renders this type of study unable to ascertain the cause-and-effect relationship between variables. Correlation can only show that there is or is not a relationship; it cannot determine the exact nature of the relationship (Singh, 2015). No time or resource constraints were anticipated with this design for the present study. The independent variable for the first research question was high blood pressure awareness. The dependent variables for the first research question were the presence of angina pectoris, CHD, or heart attack. The covariates for the first research question were race, age, education, and acculturation. The independent variable for the second research question was high cholesterol awareness. The dependent variables for the second research question were the presence of angina pectoris, CHD, or heart attack. The covariates for the second research question were race, age, education, and acculturation.

Methodology

The present study was conducted as a quantitative study. This selection was made because calculating the odds of having cardiovascular disease as a function of health knowledge cannot be achieved without the use of quantified data and correlating independent and dependent variables consistent with the generation of odds ratios. I used secondary data; other researchers can replicate this quantitative study using different data or variables.

Population

It is estimated that there are about 78 million adults with high blood pressure (John Hopkins Medicine Health Library, 2019) and about 95 million adults with high cholesterol (Centers for Disease Control and Prevention, 2019). Data were obtained from the 2017 NHANES database, which contains approximately 15,350 records. The population for the present study consisted of adults over 18 years of age within the United States.

Sampling and Sampling Procedures

Sampling for the present study was based on a cohort. In the medical field, cohort studies are used because they do not involve any type of intervention and, instead, involve "histories" or "snapshots" of segments of populations. The control for such a study occurs through the inclusion of other common characteristics, such as demographic variables (as in this study). Because the time period of interest was 2017, the cohort study was retrospective, making it difficult to reduce confounding and bias, because the data already existed (Carlson & Morrison, 2009). Data were obtained from the 2017 NHANES database. Given that the data were secondary, all data obtained from the dataset were expected to be used, provided that participants were over 18 years of age and had a history of CVD. Because the dataset could be manipulated to exclude those under 18 years of age and determine the presence of CVD, it was expected that a large dataset would be available. Data were exported from the database. Generally, a power level of 0.80 and 0.05 alpha level are acceptable (Sink & Mvududu, 2010). The effect size was 0.97, representing a large effect size. These parameters were selected because the power level and alpha level are standard for statistical tests, while the effect size was estimated (Tzoulaki et al., 2012). Based on this information, the sample size from *G**

Power was 988. However, all records from the NHANES dataset that met the inclusion criteria for the study were used.

Data Collection Procedures

The data to be collected for the present study were archival and secondary. Therefore, recruitment was not required. The information collected pertained to high blood pressure awareness, high cholesterol awareness, the presence of angina pectoris, the presence of CHD, and/or the presence of heart attack. The demographic variables for which data were collected were race, age, education, and acculturation. These data were collected for all individuals in the dataset who were over 18 years of age. Because the data were already publicly available, neither informed consent nor organizational permission was required.

The needed dataset was obtained from the NHANES database at the Centers for Disease Control and Prevention. This information is publicly available, so permissions were not required. Because the dataset was from a governmental organization, it was deemed reputable. The Centers for Disease Control and Prevention conduct many studies each year, which leads to the expectation that the organization follows ethical procedures in the collection of data. The data were originally collected using surveys, phone interviews, and in-home observations.

Instrumentation and Operationalization of Constructs

The independent variable for the first research question was high blood pressure awareness. The dependent variables for the first research question were the presence of angina pectoris, CHD, or heart attack. The covariates for the first research question were race, age, education, and acculturation. The independent variable for the second research question was high cholesterol awareness. The dependent variables for the second research question were the presence of angina pectoris, CHD, or heart attack. The covariates for the second research question were race, age, education, and acculturation. All variables were operationalized by showing the frequency of occurrence. Table 2 shows the variables.

Table 2

Variables

Variable	Type	Questionnaire	Question and response
High blood pressure awareness	Nominal	Blood pressure	BPQ.020 Question: {Have you/Has SP} ever been told by a doctor or other health professional that {you/s/he} had hypertension (hy-per-ten-shun), also called high blood pressure? IF HIGH BLOOD PRESSURE ONLY DURING PREGNANCY, CODE NO. BP.020 Responses: Yes, No, Refused, Don't know
Presence of angina pectoris, CHD, or heart attack	Nominal	Medical conditions	MCQ.160 Question: Has a doctor or other health professional ever told {you/SP} that {you/s/he} have/had (c) coronary heart disease? (d) angina pectoris? (e) heart attack (also called myocardial infarction)? MCQ.160 Responses: Yes, No, Refused, Don't know
High cholesterol awareness	Nominal	Blood pressure	BP.080 Question: {Have you/Has SP} ever been told by a doctor or other health professional that {your/his/her} blood cholesterol level was high? BP.080 Responses: Yes, No, Refused, Don't Know
Race	Nominal	Demographic	DMQ.253 Question: Please look at the categories on this card. What race or races {do you/does SP} consider {yourself/himself/herself} to be? Please select one or more. DMQ.253 Responses: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, Other, Don't Know, Refused
Age	Nominal	Screener Module 1	SCQ.300 Question: About how old {are you/is {NAME}}? SCQ.300 Responses: 0-11 mos, 1-2 yrs, 3-5 yrs, 6-11 yrs. 12-19 yrs, 20-39 yrs, 40-49 yrs, 50-59 yrs, 60-69 yrs, 70-79 yrs, 80+ yrs.
Education	Nominal	Demographic background	DMQ.141 Question: What is the highest grade or level of school {you have/NON-SP HEAD/NON-SP SPOUSE has} completed or the highest degree {you have/he/she has} received? DMQ.141 Responses: None or Kindergarten only, 1st grade, 2nd grade, 3rd grade, 4th grade, 5th grade, 6th grade, 7th grade, 8th grade, 9th grade, 10th grade, 11th grade, 12th grade, High school graduate, GED or equivalent, Some college, Associate degree, Bachelor's degree, Master's degree, Professional school degree, Doctoral degree, Refused, Don't know
Acculturation	Nominal	Acculturation	ACQ.049 Question: What language(s) {do you/does SP} usually speak at home? ACQ.049 Responses: English, Chinese, Farsi/Persian, Spanish, Hindi, Japanese, Khmer/Cambodian, Korean, Tagalog/Filipino, Vietnamese, Other, Refused, Don't know

Data Analysis Plan

The data were analyzed using RealStats, an Excel add-on statistical analysis program that is capable of handling very large datasets. Data screening occurred to ensure that only those over 18 years of age were included. The research questions and hypotheses of this study were as follows:

RQ1: Is there a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_1$: There is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_1: There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

RQ2: Is there a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_2$: There is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_2: There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

For both research questions, data analysis occurred through logistic regression with odds-ratio reporting for interpretation purposes. This test was used to determine the likelihood of having the cardiovascular outcome based on high blood pressure and/or cholesterol awareness. There are several assumptions associated with logistic regression analysis. First, a linear relationship between the independent and dependent variables is not required. The error terms are not required to have a normal distribution, nor is there a requirement for homoscedasticity across the sample. The dependent variable is an interval or ratio (Lalkhen & McCluskey, 2008). Covariates are based on demographic information and were used to provide responses to the research questions based on different subgroups of the sample using demographics. For no relationship, the odds ratio is 1, because this means that the exposure (the covariates) has no impact on the outcome. If the odds ratio was greater than or less than 1, the alternative hypothesis was true, showing either higher odds of outcome (greater than 1) or lower odds of outcome (less than 1). Therefore, the null hypothesis was accepted if the odds ratio was 1 but rejected if the odds ratio was higher or lower than 1.

Threats to Validity

Threats to external validity involved the specificity of variables, where it may be difficult to obtain the data based on the variables established. External validity threats included the accuracy of data and reliability of responses. Because the data had already been collected, there was no way to definitively confirm this with the participants. However, validation information was provided with the dataset.

Internal validity threats were associated with obtaining an accurate dataset with the required variables. This meant that there were potential concerns with the exportation of the data, which might have yielded inaccurate data if programs for exportation were not compatible. There were also concerns regarding the effectiveness of using the data to answer the research questions.

There were also threats regarding statistical regression because the data accuracy could not be verified. There were also concerns regarding the effectiveness of the data for answering the research questions using the prescribed statistical tests. Finally, there were concerns regarding the accuracy of the results due to potential data inaccuracy.

Ethical Procedures

This study was approved by the Walden University Institutional Review Board (#08-05-19-0381998). Data to be used in this study were from a public database. Therefore, no agreements were needed for participant or data access. Moreover, as the data had already been gathered, it was assumed that the data were gathered in an ethical manner. Data were anonymous and are publicly available. Data have been maintained in an encrypted password-protected Excel file for storage purposes to maintain the confidentiality of the study, despite the absence of personal data. The only people with access to the data are me and the research team (including supervisors). Data used for the study will be destroyed after 5 years. However, it is recognized that the data will be publicly available through the Centers for Disease Control and Prevention.

Summary

The study was conducted as a correlational quantitative study using logistic regression and odds ratio for hypothesis testing. The purpose of this study was to determine if there was a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcomes (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. Chapter 4 contains the results of the study.

Chapter 4: Research Results

Introduction

The purpose of this study was to determine if there is a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcomes (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. The research questions and hypotheses of this study were as follows:

RQ1: Is there a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_1$: There is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_1: There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

RQ2: Is there a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_2$: There is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_2: There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

The remainder of this chapter contains information about data collection and the results of the statistical testing.

Data Collection

Data were obtained from the NHANES database based on the criteria presented in Table 2 (see the prior chapter). The required sample size was 988. Therefore, the first 988 results were selected. It was found that there were 401 males and 582 females. There were 435 participants with high blood pressure awareness and 553 with no blood pressure awareness. There were 433 participants with CVD awareness and 555 with no CVD awareness. There were 419 participants with high cholesterol awareness and 569 with no cholesterol awareness.

There was equal representation of the races, with 278 White participants, 247 American Indian participants, 222 Asian participants, and 241 Black participants. For the age ranges, there were 141 participants who were 18-19 years of age, 135 participants were 20-29 years of age, 141 participants were 30-39 years of age, 133 participants were 40-49 years of age, 147 participants were 50-59 years of age, 142 participants were 60-69 years of age, and 149 participants were 70-79 years of age. In relation to education, 95 participants had only completed the ninth grade, 94 participants had only completed the 10th grade, 89 participants had only completed the 11th grade, 72 participants had only completed part of their 12th grade year, 87 participants had a high school diploma, 69 participants had a GED, 77 participants had an associate's degree, 67 participants had some college, 78 participants had a bachelor's degree, 90 participants had a master's degree, 85 participants had a professional degree, and 85 participants had a doctorate. There were 101 English-speaking participants, 110 Chinese-speaking participants, 95 Farsi-speaking participants, 102 Spanish-speaking participants, 110 Hindi-speaking participants, 100 Japanese-speaking participants, 94 Khmer-speaking participants, 90 Korean-speaking participants, 96 Tagalog-speaking participants, and 90 Vietnamese-speaking participants.

Results

Data were analyzed using RealStats to answer two research questions. Logistic regression was used for statistical analyses.

Research Question 1

RQ1: Is there a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_1$: There is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_1: There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

The ROC curve shows the odds ratio in relation to the usefulness of the test. In this case, the ROC curve presents a large space. The ROC curve is shown in Figure 1.

The ROC curve has an upward slope in relation to the odds ratio. These are shown in Table 3.

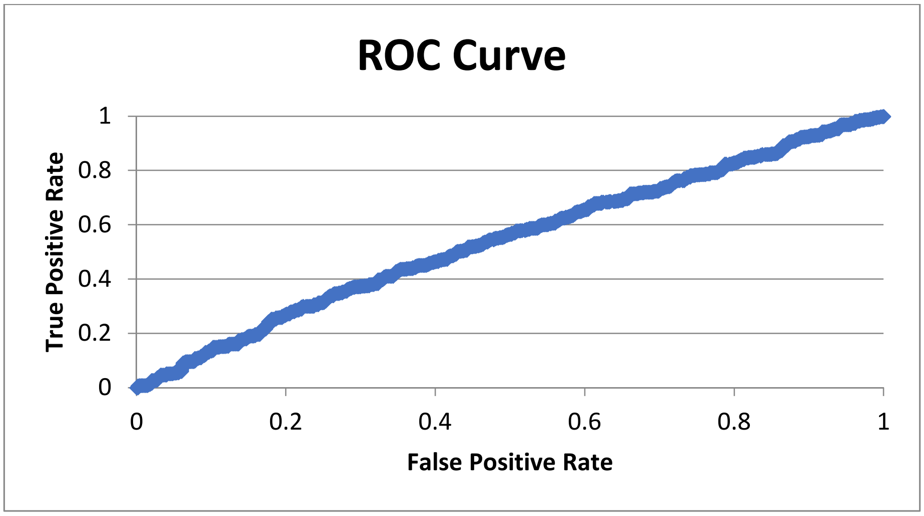

Figure 1. ROC curve for blood pressure awareness on cardiovascular disease.

Table 3

Logistic Regression for Hypothesis Test 1

Covariance matrix						
0.0764	-0.0099	-0.0080	-0.0080	-0.0041	-0.0020	-0.0028
-0.0099	0.0164	0.0008	0.0002	-0.0001	0.0001	0.0002
-0.0080	0.0008	0.0164	0.0002	-0.0001	0.0000	-0.0001
-0.0080	0.0002	0.0002	0.0032	0.0000	-0.0001	0.0001
-0.0041	-0.0001	-0.0001	0.0000	0.0010	0.0000	0.0000
-0.0020	0.0001	0.0000	-0.0001	0.0000	0.0003	0.0000
-0.0028	0.0002	-0.0001	0.0001	0.0000	0.0000	0.0005
Converge			Suc-Obs	Fail-Obs		
0.0000		Suc-Pred	238	210	448	
0.0000		Fail-Pred	252	288	540	
0.0000			490	498	988	
0.0000						
0.0000		Accuracy	0.4857	0.5783	0.5324	
0.0000						
0.0000		Cutoff	0.5			
LL0	-684.7970					
LL1	-681.9924					
Chi-Sq	5.6093					
Df	6					
p-value	0.4683					
alpha	0.05					
Sig	No					
R-Sq (L)	0.0041					
R-Sq (CS)	0.0057					
R-Sq (N)	0.0075					
Hosmer	951.7478					
Df	954					
p-value	0.5145					
alpha	0.05					
Sig	No					

Based on the results in Table 3, there is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. Therefore, the null hypothesis cannot be rejected.

Research Question 2

RQ2: Is there a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation?

$H0_2$: There is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

HA_2: There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation.

The ROC curve shows the odds ratio in relation to the usefulness of the test. In this case, the ROC curve presents a large space. The ROC curve is shown in Figure 2.

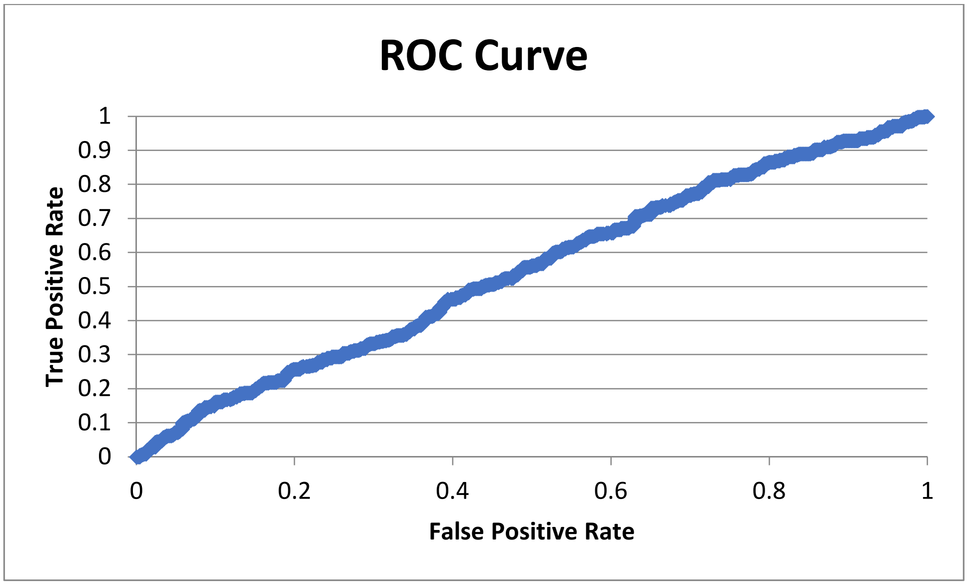

Figure 2. ROC curve for cholesterol awareness on cardiovascular disease.

As shown in Figure 2, the curve has an upward slope in relation to the odds ratio. These are shown in Table 4.

Table 4

Logistic Regression for Hypothesis Test 2

Covariance matrix						
0.0745	-0.0081	-0.0079	-0.0078	-0.0041	-0.0019	-0.0028
-0.0081	0.0165	0.0006	-0.0001	-0.0001	0.0000	0.0001
-0.0079	0.0006	0.0164	0.0001	-0.0001	0.0000	-0.0001
-0.0078	-0.0001	0.0001	0.0032	0.0000	-0.0001	0.0001
-0.0041	-0.0001	-0.0001	0.0000	0.0010	0.0000	0.0000
-0.0019	0.0000	0.0000	-0.0001	0.0000	0.0003	0.0000
-0.0028	0.0001	-0.0001	0.0001	0.0000	0.0000	0.0005
Converge			Suc-Obs	Fail-Obs		
0.0000		Suc-Pred	242	216	458	
0.0000		Fail-Pred	248	282	530	
0.0000			490	498	988	
0.0000						
0.0000		Accuracy	0.4939	0.5663	0.5304	
0.0000						
0.0000		Cutoff	0.5			
LL0	-684.7970					
LL1	-681.1856					
Chi-Sq	7.2229					
df	6					
p-value	0.3007					
alpha	0.05					
sig	No					
R-Sq (L)	0.0053					
R-Sq (CS)	0.0073					
R-Sq (N)	0.0097					
Hosmer	958.4918					
df	948					
p-value	0.3992					
alpha	0.05					
sig	No					

Based on the results in Table 4, there is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. Therefore, the null hypothesis cannot be rejected.

Summary

Clinicians and epidemiologists agree that high blood pressure increases CVD incidence and predisposes individuals to clinical manifestations of CHD. A major public health concern is health awareness, management, and primary prevention of modifiable risk factors such as high blood pressure and high cholesterol (Richtering et al., 2017). The results of this study show that there is no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. There is no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. Chapter 5 provides a discussion of the study findings, study limitations, implications for social change, and recommendations for future research.

Chapter 5: Conclusions

Introduction

CVD is a major cause of morbidity and mortality in the United States and throughout the world (Nishimura et al., 2017). The underlying pathology of CAD develops over many years, and by the time the first symptom occurs, the disease is already at an advanced stage (Nishimura et al., 2017). The public health burden of CAD may be mitigated if individuals at risk of CAD know how to prevent a cardiovascular event by understanding and avoiding modifiable risk factors (Nishimura et al., 2017). According to American College of Cardiology guidelines, the risk of developing CAD increases with age, particularly at ages greater than 45 years in men and 55 years in women (Nishimura et al., 2017). The purpose of this study was to determine if there is a significant relationship between high blood pressure and high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, heart attack) based on race, age, level of education, and acculturation. Key findings of this study showed no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. There was also no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation.

Interpretation of the Findings

The study showed that there was no statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation. There was also no statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, CHD, and heart attack) based on race, age, level of education, and acculturation.

The findings of the present study confirm the findings of Cronin et al. (2018), who conducted a quantitative study to examine the relationship between health beliefs, treated as a kind of health knowledge, and missed clinic appointments among individuals suffering from sickle cell disease. Only one of the independent variables in Cronin et al.'s model, that of health literacy, was related to missed clinic appointments. Cronin et al. found that the OR for the relationship between health literacy and missed clinic appointments was 4.64, with a 95% confidence interval between 1.33 and 16.15, and this OR was statistically significant at $p < .01$. The interpretation of this OR is that individuals who possessed low levels of health literacy were 4.64 times as likely to miss a clinic appointment (or cause the person for whom they were caring to miss a clinic appointment) in comparison with individuals who possessed high levels of health literacy. This finding of Cronin et al.'s study strongly suggests that individuals with a higher level of health knowledge, conceptually defined as health literacy, are significantly less likely to miss clinic appointments.

The findings of the present study also confirm the findings of Kamran et al. (2014), who conducted a quantitative study to examine the relationship between health beliefs and adherence to hypertension medication among rural patients in Iran. Kamran et al. analyzed outcomes related to hypertension medication adherence among 671 Iranian patients in order to determine whether there was a statistically significant relationship between health beliefs and medication adherence. Kamran et al. (2014) reported nine significant findings. First, individuals who perceived themselves as being moderately susceptible to hypertension were 3.1 times as likely not to adhere to hypertension medication as individuals who perceived themselves as being highly susceptible to hypertension. Second, individuals who perceived themselves as having low susceptibility to hypertension were 52.5 times as likely not to adhere to hypertension medication as individuals who perceived themselves as being highly susceptible to hypertension. Third, individuals who perceived their hypertension as moderately severe were 2.4 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension as highly severe (Kamran et al., 2014). Fourth, individuals who perceived their hypertension as having a low level of severity were 57.5 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension as highly severe. Fifth, individuals who perceived their hypertension medication as having a moderate benefit were 2.7 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension medication as having a high level of benefit. Sixth, individuals who perceived their hypertension medication as having a low perceived benefit were 19.9 times as likely not to adhere to hypertension medication as individuals who perceived their hypertension medication as having a high perceived benefit (Kamran et al., 2014). Seventh, individuals who perceived high barriers to taking their hypertension medication were 4.6 times as likely not to adhere to hypertension medication as individuals who perceived low barriers to taking their hypertension medication. Eighth, individuals with moderate self-efficacy were 1.6 times as likely not to adhere to hypertension medication as individuals with high self-efficacy. Finally, individuals with moderate self-efficacy were 51 times as likely not to adhere to hypertension medication as individuals with low self-efficacy (Kamran et al., 2014).

Therefore, Kamran et al.'s (2014) findings provided strong support for the claim that individuals who have more informed or engaged health beliefs are also more likely to take their hypertension medication. On the presumption that more frequent consumption of hypertension medication is likely to be associated with better hypertension outcomes, Kamran et al.'s study also provides indirect support for the likelihood of a positive correlation between HBM-related health knowledge and the positive outcome of better hypertension management or outcomes. More generally, Kamran et al. (2014) found that individuals who perceived themselves as being healthy were 13.9 times more likely to adhere to the consumption of hypertension medication. Therefore, both in terms of the specific HBM components and a general perception of healthy status—which, itself, is conceptually related to having knowledge about health—Kamran et al. (2014) found positive correlations between health knowledge and health outcomes, specifically health outcomes related to hypertension.

A meta-analysis carried out by DeWalt et al. (2004) contained an estimate of the *OR* of literacy on the dependent variable of health outcomes. Based on data extracted from tens of thousands of patients in over 100 studies, DeWalt et al. estimated that individuals with poor literacy were, in the 95% confidence interval of the *OR*, between 1.5 and 3 times as likely as literate individuals to obtain positive health outcomes. Although this study was conducted on many subjects, with a sample size approaching that of an epidemiological dataset, the study did not include covariates such as health status. It is possible, for example, that individuals with low levels of literacy are less likely to experience positive health outcomes because, for example, individuals with low levels of literacy are also more likely to suffer from certain structural disadvantages (such as disadvantages related to race and socioeconomic status) that might not be related to literacy. Thus, although DeWalt et al.'s findings provided a useful, novel analysis of the relationship between general literacy and health outcomes, the absence of covariates related to race and socioeconomic status was an important limitation of this study. Finally, in settings in the developed world, literacy might be uniformly high, making health literacy a more useful predictor of health outcomes and health behaviors (De Walt et al., 2004).

A quantitative study by Galvin (2015) of the relationship between various forms of health knowledge and the outcome of patient intention to initiate screening for Alzheimer's disease suggested the possibility that cultural differences might be responsible for the relationships between health knowledge and outcomes related to Alzheimer's disease. On the basis of data collected from 1,039 nondemented American adults, and using an *OR* approach, Galvin found that White people were 4.28 times as likely to initiate screening for Alzheimer's disease as compared to African Americans. In addition, Galvin found that individuals who had the self-efficacy to be able to discuss memory problems were 2.72 times more likely to initiate screening, whereas individuals who knew that their doctors could test memory were 1.7 times more likely to initiate requests for Alzheimer's screening. Galvin's findings thus suggested that the mere knowledge that memory can be medically tested significantly increases the odds of requesting a screening for Alzheimer's disease, a clear illustration of a connection between a form of health knowledge and a form of health outcome (on the assumption that earlier detection of Alzheimer's disease is likely to correlate positively with the improved management of Alzheimer's disease). Galvin interpreted the race-related finding as suggesting that White Americans were more likely to be worried about Alzheimer's disease, to believe that the disease was preventable or manageable, and to believe that aging need not necessarily be associated with dementia. Galvin's study was of particular importance because of its identification of the variables of race and culture as influencing the relationship between health knowledge and health outcomes, in particular health outcomes related to Alzheimer's disease and possibly other forms of dementia.

The analysis provided by Nayga (2000) was that the variables of health literacy, health knowledge, general literacy, and schooling all provided the same protective factor, that of knowledge, against poor health outcomes. Based on an empirical analysis of the effects of schooling, health literacy, and obesity among a sample of Americans, Nayga concluded that obesity—which, because of its designation as a disease and correlation with various other diseases represents both a direct and indirect measure of negative health outcomes (Cawley & Meyerhoefer, 2012; Heymsfield & Wadden, 2017; Medehouenou et al., 2015; Shelton & Knott, 2014; Sinha, 2018; Swencionis & Rendell, 2012; Wells, 2013)—is the result of individual ignorance. In particular, Nayga argued that individuals who are ignorant of obesity as a disease state—information that is itself a basic component of health literacy—are the individuals who are most likely to be obese. In this respect, Nayga claimed the existence of a close and positive association between health ignorance and a health outcome, that of obesity.

It is not clear, however, if ignorance is an important predictor of health-related decision making. The results of several experiments (Campbell & Mohr, 2011; McFerran, Dahl, Fitzsimons, & Morales, 2009; Minas, Poor, Dennis, & Bartelt, 2016) suggest the possibility that, in the particular case of obesity, the disease state itself is a result not of the absence of knowledge, but of the suppression of knowledge. For example, several experiments have indicated that, when people are exposed to the sight of obese people eating before they themselves are given the opportunity to eat ad libitum, they will eat significantly less. This priming effect does not support Nayga's (2000) general claim about the relationship between ignorance and the negative health outcome of overeating/ obesity; rather, priming effects suggest that individuals of various levels of health literacy are already aware of the unhealthiness of obesity, but that they do not take actions based on this perception until some environmental cue—typically, in experimental situations, that of a larger person consuming food in front of them—sways their behavior.

A study conducted by Mellor et al. (2016) was similar to that of Galvin (2015) in terms of its racial and cultural dimensions. Mellor et al. were particularly interested in the relationship between health knowledge and poor health outcomes in a particular subpopulation, that of indigenous men in Australia. Applying a qualitative research approach, Mellor et al. conducted 40 interviews and reached the following interesting conclusion about the relationship between health knowledge and poor health outcomes among indigenous Australian men: Participants recognized that their indigenous status placed them in a vulnerable position with regard to health, and that there might be serious consequences of failing to follow a good diet and engage in appropriate exercise. However, they delineated several barriers to engaging in such health behaviors. These perceived barriers need to be addressed at a range of policy levels within government, with a focus on social structures and institutionalized discrimination, as well as unemployment, poverty, dispossession, and cultural oppression (Mellor et al., 2016, p. 1949).

Mellor et al.'s (2016) findings were of interest because of their qualitative exploration of the possible reasons for the cultural and racial dimensions of the relationship between health knowledge and health outcomes that had been identified, but not contextually explored, in the work of Galvin (2015). Based on the work carried out by both Galvin and Mellor et al., it appears appropriate to conclude that the relationship between health knowledge and health outcomes is culturally mediated. In particular, based on the qualitative findings obtained by Mellor et al., it seems likely that individuals who are racial or cultural minorities are, even if possessed of the same health knowledge as individuals from the majority culture, less likely to act on this knowledge by engaging in health behaviors (such as adherence to medication schedules, initiation of screenings, and adoption of better diets and more exercise) that are likely to lead to improved health outcomes. In the case of the sub population of indigenous Australian men, Mellor et al.'s findings suggest a collective depression and hopelessness, themselves the products of historical and ongoing oppression that prevent individuals from acting positively on their health knowledge. Galvin's study suggests that, in other cases, it is possible that individuals who belong to a minority group will not possess the same amount of health knowledge as individuals in the majority group. Therefore, it is possible that individuals from vulnerable minority groups will lack either health knowledge or the motivation to act upon their health knowledge.

Health knowledge could, in the explanatory scheme presented by Rebar et al., constitute one possible explanation for the kinds of behaviors that lead to, or are associated with, better health outcomes. The presence of health consciousness—for example, in the form of declarative knowledge—could explain why people engage in certain health-related behaviors such as, in Kamran et al.'s (2014) study on hypertension medical adherence, Galvin's (2015) study on patient initiation of Alzheimer's screening, or Cronin et al.'s (2018) study on clinic appointments among individuals with sickle cell disease. Rebar et al. (2015) suggested that neither knowledge nor any other conscious process could explain the full spectrum of health-related behaviors by itself. Rebar et al. suggested that knowledge, as one example of a conscious process, is unlikely to be the sole explanatory factor vis-à-vis health behaviors. It is more likely, according to Rebar et al., that conscious and unconscious processes interact and alternate in their formation of health-related behaviors, and, therefore, health-related outcomes. The HBM is based on predicting the likelihood of health-promoting behaviors, which are themselves held to emerge from a combination of individual perceptions, the nature of the environment, and modifying factors (Hayden, 2013). The current understanding of the HBM, according to Hayden, is as follows: "according to the health belief model, modifying variables, cues to action, and self-efficacy affect our perception of susceptibility, seriousness, benefits, and barriers and, therefore, our behavior" (Hayden, 2013, p. 35). The HBM is, in addition to a novel theory for analyzing health behaviors, a synthesis of several concepts and theories (Arnold, 2018). First, the HBM's premise that there is a connection between knowledge and action is itself indebted to at least two major theories that both predated the HBM itself, that is, the theories of utility-based action and operant conditioning. The theory of operant conditioning—which, along with classical conditioning, is one of the two main learning theories associated with behaviorism—is that learning is itself a function of consequences (Eaton, Libey, & Fetz, 2016; Maffei, Santos-Pata, Marcos, Sánchez-Fibla, & Verschure, 2015; Paret, Hoesterey, Kleindienst, & Schmahl, 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018).

In operant conditioning, health behaviors, like any sufficiently complex behaviors, can be described as resulting from a knowledge of the consequences of such behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). The experimental basis of operant conditioning was the finding that animals would engage in certain behaviors (such as pushing levers in a Skinner box) after they came to realize that doing so triggered certain positive consequences, such as the dispensing of food (or, conversely, if doing so reduced or eliminated the presence of a negative stimulus); (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). Understood in human terms—and, specifically, in terms of health behavior—operant conditioning suggests that actions relevant to health are undertaken or not undertaken because of the rewards or lack of rewards associated with such behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). In the HBM, this influence from operant conditioning and other aspects of behavioral learning theory is represented in the categories of perceived benefits and perceived barriers (Arnold, 2018).

Functionally, the overall premise of the HBM is that, if the various benefits and motivators of taking action outweigh the various costs and demotivators of taking action, then the individual will undertake the action (Hochbaum et al., 1952). This logic explicitly represents a version of cost-benefit analysis (CBA) (Arnold, 2018). CBA arose, in its incipient format, in the work of the economist Adam Smith, who described the relationship between costs and benefits as a determinant of economic action (Smith, 2010). After Adam Smith, neoclassical economists (Ross, 2002; Swanson, 1996; Zafirovski, 2008) generated and generalized a theory of action based on the CBA, and, some years before the HBM, Von Neumann and Morgenstern mathematically formalized a theory of human action based on the CBA (Von Neumann & Morgenstern, 2007). The HBM's assumption that people will act if perceived costs outweigh perceived benefits is aligned both with the general idea of the CBA as an explanatory factor in human action and Von Neumann and Morgenstern's Utility Theorem (Von Neumann & Morgenstern, 2007).

In reference to the HBM, self-efficacy essentially predicts that knowledge is an insufficient spur to action; individuals must possess not only knowledge related to diseases or health states but also the ability to unite and apply their knowledge and other capabilities to an actual change in behavior. There is substantial empirical evidence for self-efficacy as a distinct factor in behavioral decision-making (Alessandri, Borgogni, Schaufeli, Caprara, & Consiglio, 2015; Fallah, 2017; Jiang, Song, Lee, & Bong, 2014; Klassen & Tze, 2014; Skaalvik, Federici, & Klassen, 2015; Skaalvik & Skaalvik, 2014; Torres & Turner, 2016).

The HBM's category of perceived susceptibility is related to the field of heuristics, which also predates the HBM itself. Heuristic theories (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger, Flanagin, & Medders, 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007) indicate that people can interpret information in radically different ways; thus, for example, some people actually susceptible to a disease might underestimate their susceptibility whereas others less susceptible to a disease might overestimate their susceptibility (Hayden, 2013). Human decision-making and perception are, according to various theories of heuristics, biased and imprecise (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger et al., 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007), and this potential inaccuracy is taken into account in the HBM. The fact that four of the HBM's variables explicitly account for perception is itself a reflection of the possibility that human decision-making can be, as represented by heuristic theories (Gigerenzer & Gaissmaier, 2011; McCann, 2005; Metzger et al., 2010; Schwaighofer et al., 2017; Thaler & Benartzi, 2007), inaccurate.

The HBM's attention to cues to action as part of the theory is another influence from behaviorism. In operant conditioning in particular, there is an emphasis on shaping, which is a process of aligning initially off-target behaviors with desired on-target behaviors that depends on changing the environment (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018). Even in the absence of a second party shaping behavior, the principle of shaping suggests that, as cues change, so will behaviors (Eaton et al., 2016; Maffei et al., 2015; Paret et al., 2016; Skinner, 2014; A. K. Thompson & Wolpaw, 2015; Vorster & Born, 2017, 2018)—which is one of the predictions also made by the HBM. Thus, for example, people who actually have heart attacks will likely have much stronger cues for altering health beliefs and behaviors than individuals who have not yet suffered adverse health consequences.

Henderikus (2010) argued that a good theory should be richly descriptive, strongly explanatory, and supportive of empirical predictions. The HBM meets each of these criteria when applied to the research questions of the study. First, the HBM describes the phenomenon of health outcomes in terms of behaviors that are themselves closely related to individual perceptions, social influences, and behavior-shaping environments. Second, the HBM explains health outcomes in terms of chosen behaviors and the underlying influencers of such behaviors. Third, the HBM predicts that, after controlling for other relevant factors, there will be a positive relationship between health knowledge and better health outcomes. For these three reasons, the HBM was an appropriate theoretical framework for the study. Ultimately, therefore, the HBM is a synthesis of influences from behaviorism, cognitive psychology, and social psychology brought to bear on the domain of health beliefs and behaviors (Arnold, 2018). The HBM suggests that health outcomes are themselves strongly influenced by health behaviors, which, in turn, are influenced by health knowledge. Thus, when applied to the two research questions of the study, the HBM supported the findings. There is a statistically significant association between high blood pressure awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. The association will be such that high blood pressure awareness is associated with better cardiovascular health outcomes—and, conversely, that the absence of high blood pressure awareness is associated with worse cardiovascular health outcomes. The HBM also suggests that race, age, level of education, and acculturation represent potential modifying variables that can (a) be statistically modeled as mediators or moderators of the association between high blood pressure awareness and cardiovascular health outcome or (b) treated as covariates to increase the internal validity of the association between blood pressure awareness and cardiovascular health outcomes. There is a statistically significant association between high cholesterol awareness (prevention and management) and cardiovascular health outcome (angina pectoris, coronary heart disease, and heart attack) based on race, age, level of education, and acculturation. The association will be such that high cholesterol awareness is associated with better cardiovascular health outcomes—and, conversely, that the absence of high cholesterol awareness is associated with worse cardiovascular health outcomes. The HBM also suggests that race, age, level of education, and acculturation represent potential modifying variables that can (a) be statistically modeled as mediators or moderators of the association between high cholesterol awareness and cardiovascular health outcome or (b) treated as covariates to increase the internal validity of the association between cholesterol awareness and cardiovascular health outcomes.

Limitations of the Study

One of the main limitations of the study was that of non-response bias. According to Massey (2012), non-response bias is a major consideration in empirical studies, because relatively small changes in response rates can lead to higher levels of bias in findings. One of the inherent limitations of the NHANES dataset is the high non-response rate, which, from question to question, varies from between 40% to 60%. The existence of a high non-response rate introduces a greater likelihood of bias into the study.

Another limitation of the study was the absence of a longitudinal component. NHANES asks participants if they have discussed their conditions with doctors and if they have been diagnosed with certain conditions, but NHANES does not indicate which of these data are collected first.

A third limitation study was the limited inclusion of disease covariates. The literature suggests that types of CVD often co-occur with each other, as well as with other similar diseases; similarly, high blood pressure and high cholesterol can be comorbid with each other and with different conditions. No other disease states have been included in the research model because of issues raised by the cross-sectional nature of the NHANES dataset. If, for example, a disease other than CVD is included as a control variable, it cannot be inferred whether that disease preceded, brought about, or was itself caused by some aspect of CVD. Although the inclusion of disease covariates might increase the internal validity of the study, the limitations of NHANES's cross-sectional data create an important barrier to any such inclusion. These limitations could not be addressed, because the limitations are inherent to the NHANES dataset.

Recommendations

Current literature shows that high blood pressure can damage the heart and brain, leading to instant death. The existence of high blood pressure indicates that the blood flow is compromised; in particular, high blood pressure leads to hardened arteries, which, in turn, make it more difficult for blood to reach the heart and brain through the arteries that are designed to carry blood to these vital organs (Ena et al., 2017; Mair et al., 2015; Nii et al., 2016). If insufficient blood reaches the heart, the heart can fail, leading to instant death or, in variant cases, chest pain or heart failure that can be addressed through medical interventions (D. W. Brown et al., 2007; Dvonch et al., 2009; Gurubhagavatula et al., 2013; Marin et al., 2012; Noecker et al., 2003; Saba et al., 2001; Severcan et al., 2013). If insufficient blood reaches the brain, the brain can enter into a stroke (A. W. Brown, Therneau, Schultz, Niewczyk, & Granger, 2015; Ebinger et al., 2015; Fridriksson, Bonilha, & Rorden, 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan, Zheng, Marchina, Norton, &

Schlaug, 2014). A stroke occurs because the cells of the brain are failing to receive sufficient oxygen as transported by blood (A. W. Brown et al., 2015; Ebinger et al., 2015; Fridriksson et al., 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan et al., 2014). Strokes can be instantly fatal or leave the stroke sufferer paralyzed (A. W. Brown et al., 2015; Ebinger et al., 2015; Fridriksson et al., 2007; Koch et al., 2016; Raglio et al., 2016; Saji et al., 2015; Saver et al., 2013; Turkeltaub et al., 2014; Wan et al., 2014). A quantitative study could be conducted to assess the risk of CVD and cholesterol-related problems. This may be done using questionnaires for individuals.

One of the functions of HDL is to remove excess cholesterol into the liver, where it is disposed of (Murray et al., 2003; Ruth et al., 2013). On the other hand, LDL is cholesterol that accumulates in the body (Murray et al., 2003; Ruth et al., 2013). LDL accumulated in the blood vessels reduces the ability of blood to travel through these vessels (Murray et al., 2003; Ruth et al., 2013). LDL results in hardened, fatty deposits within blood vessels that impede blood flow (Murray et al., 2003; Ruth et al., 2013). The condition of obstructed arteries is known as atherosclerosis, which can be diagnostically identified through the insertion of cameras into blood vessels (Ena et al., 2017; Nii et al., 2016). However, long before the need for utilizing such intrusive methods of diagnosis atherosclerosis arises, LDL can be measured through a simple blood test (Murray et al., 2003; Ruth et al., 2013). Considering this knowledge, it would be beneficial to increase awareness of whether or not the general population is aware of the functions of HDL and LDL, which may be conducted using a qualitative study.

Similar to high blood pressure, high cholesterol is considered a lifestyle disease, even though there are certain genetic conditions and predispositions that can bring about high cholesterol regardless of lifestyle (Murray et al., 2003; Ruth et al., 2013). Levels of LDL increase in proportion to the consumption of saturated and trans fats, both of which convert to LDL in the body (Murray et al., 2003; Ruth et al., 2013). Therefore, the most appropriate means of preventing high cholesterol is to reduce the consumption of saturated fats and trans fats (Murray et al., 2003; Ruth et al., 2013). Once an individual suffers from high cholesterol, this state can still be managed through an appropriate reduction in daily consumption of saturated fats and trans fats (Murray et al., 2003; Ruth et al., 2013). However, in addition to recommending permanent dietary changes, physicians might also prescribe prescription drugs designed to reduce LDL (Murray et al., 2003; Ruth et al., 2013). In this context, it would be beneficial for future studies to be conducted regarding the different aspects of maintaining healthy cholesterol, including issues that cause high cholesterol and how it can be prevented/treated. This would be best served as a mixed-methods study utilizing both quantitative and qualitative data.

Implications

Health knowledge is an important goal in many settings, including the settings of public health policy and clinical practice. The assumption behind the dissemination of health knowledge through campaigns as well as through local efforts is that (a) giving people knowledge, or encouraging people to gain knowledge, related to their health states can prompt people to be more active in the defense and management of their own good health; and (b) the formation of positive beliefs and behaviors related to one’s own healthcare management is likely to lead to a reduction in actual states. As one out of four Americans dies from some variation of CVD (Stichler et al., 2008), the question of how—or whether—to promote more specific knowledge of CVD among prospective and current sufferers carries great importance. However, in the absence of more accurate information about the relationship between health knowledge and CVD health outcomes, public health agencies, local health clinics, and other stakeholders have limited data on which to base decisions related to the promotion of health knowledge. If there is no significant relationship between (a) individual knowledge of high blood pressure and high cholesterol, and (b) cardiovascular health outcome, then there would be reduced justification for large public health campaigns designed to promote disease knowledge or for local clinics to invest more resources into the production of informative booklets and other materials designed to increase health knowledge. While the promotion of some form of healthcare knowledge is an intrinsic goal for public policy as well as for local clinical practice, there would be substantial added justification for dedicating more resources to health knowledge-building efforts if, in fact, there is a positive correlation between knowledge of a health factor (such as high blood pressure or high cholesterol) and CVD outcome. The significance of this quantitative, correlational study based on archived NHANES data lies in being able to calculate and report the relationship between (a) knowledge of high blood pressure and CVD diagnosis, and (b) knowledge of high cholesterol and cardiovascular health outcome in a manner that can inform knowledge-building actions and initiatives undertaken by public health agencies, local clinics, and other stakeholders in the fields of healthcare and policy. The positive social change implication of this study is lowering the prevalence of CVD by providing a case for more intensive patient education programs. As CVD kills millions of people (Brehm et al., 2013), reducing CVD mortality is itself a positive social change.

Conclusion

As many as a third of all Americans suffer from high blood pressure, making high blood pressure one of the most prevalent diseases in the country. High blood pressure can exist because of many risk factors, including genetic, environmental, and behavioral risk factors. In some cases, high blood pressure can be genetic, as in the cases of people who are born with abnormally narrow arteries or a weakened heart. In most cases, however, high blood pressure is a lifestyle disease, one whose risk factors include overnutrition (that is, the habitual consumption of significantly more calories than necessary to support individuals given their lifestyles, metabolic profiles, and other characteristics) and sedentary lifestyles. Overnutrition is closely associated with the overconsumption of salt and fat, both of which further narrow the arteries and therefore increase high blood pressure. Similarly, overnutrition and sedentary behavior (that is, the lack of sufficient exercise) are routinely comorbid, in that contemporary American life is characterized by a combination of overeating and physical underactivity. In light of the risk factors of overnutrition and sedentarism, high blood pressure can often be prevented simply by (a) habitually consuming calories that are close to the daily thermal energy expenditure of the individual, (b) improving the quality of consumed food by reducing its salt and fat content, and (c) adding cardiovascular exercise to daily activity.

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