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The Behavioral Impact of Knowledge on Breast Cancer Risk Reduction

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This is to certify that the doctoral dissertation by

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Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The purpose of this study was to investigate the behavioral impact of knowledge regarding the relationship between breast cancer, vitamin D supplementation, and sunlight exposure considering levels of self-efficacy and response-efficacy. The study was based on protection motivation theory, which attributes behavior change to cognitive processes related to perceived threats and has demonstrated efficacy in promoting breast cancer risk-reducing behaviors. The study employed a quasi-experimental research design based on a survey using SurveyMonkey. Participants were New York City-residing women ranging in age from 25 to 74 who were recruited via an invitation from SurveyMonkey. Correlation analysis and linear regression analysis were performed on the data extracted from the survey in order to better understand the relationship of the variables in this study, and to test if any of the independent variables were significant predictors of vitamin D intake through supplementation and sunlight exposure. The results of this analysis showed that knowledge regarding the reduction in risk of breast cancer from sunlight exposure and through vitamin D supplementation was not related to changes in behavior involving increases in sunlight exposure and vitamin D intake through supplementation. Further, the results showed that those participants with higher levels of self-efficacy and response-efficacy regarding sunlight exposure and vitamin D supplementation had an increased amounts of vitamin D intake through supplementation on a daily basis. The results of this study can be used to help medical professionals understand the complexity involved in how their clients may or may not take action to reduce the potential for reducing the risk of breast cancer.

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Chapter 1: Introduction to the Study

Introduction

Breast cancer is a significant health concern in the United States and worldwide, impacting millions of women at all ages and ethnicities. This type of cancer represents the second deadliest cancer for women in the United States, resulting in just over 40,000 deaths annually in recent years (Ma & Jemal, 2013). Approximately 260,000 women were expected to be diagnosed with this disease in 2010, which represents one in eight women in the United States (Centers for Disease Control and Prevention, 2010). Worldwide, 1.2 million women are diagnosed with breast cancer annually (World Health Organization, 2011).

Risk Factors

A number of factors are associated with increased and decreased risk of breast cancer among women. Hormonal and reproductive risk factors include early onset of menstruation, the duration of menstruation, and increased age at which menopause occurs (Dixon, 2012). While pregnancy at later ages is associated with increased risk of breast cancer, increasing numbers of live births and breastfeeding reduce the risk from this disease (Russo & Russo, 2011). Other factors relate not to internal aspects, but to acquired behaviors. For example, increases in body weight and body mass index are associated with greater risks, and a variety of diet and lifestyle factors can increase or decrease the risk (Poston, 2012). Hereditary factors play a role in the disease as well, as a family history of breast cancer, race, age, or a combination of specific genetic factors increases the risk (Perry, Otero, Palmer, & Gross, 2009).

Knowledge

Knowledge regarding changes in modifiable behaviors related to breast cancer risk may be effective in reducing that risk. Researchers have suggested that knowledge regarding risk factors for cancer can be effective in behavioral change leading to less risky behavior (Courneya, & Hellsten, 2001; Wood, 2008). Knowledge has also been demonstrated to promote positive behavioral changes related to clinical breast examination or mammograms (Bodurtha, et al., 2009; Livaudais et al., 2010; Shallwani, Ramji, Ali, & Khuwaja, 2010).

Researchers have also suggested that vitamin D intake and sunlight exposure may reduce the risk of breast cancer (Anderson, Cotterchio, Vieth, & Knight, 2010). However, unlike the other risk factors, little research has explored if knowledge of these issues leads to an increase in risk-reducing behaviors (Garland, Gorham, Mohr, & Garland, 2009). Since this behavioral change requires little cost, time, or effort when compared to other behavioral targets such as exercise or mammograms, it is worth investigating. A study aimed at assessing the link between knowledge regarding vitamin D intake and sunlight exposure as a means to reduce breast cancer risk and actual behaviors might provide insight into effective ways to foster health-promoting behavioral change through knowledge. A more detailed review of breast cancer risk and knowledge is presented in Chapter 2.

Statement of the Problem

Efforts to reduce the risk of breast cancer include providing those at risk with knowledge or ensuring they have access to the necessary information. The majority of widely available knowledge regarding early detection of breast cancer concerns mammograms and clinical breast examination. This knowledge can lead to changing beliefs and behaviors (Bodurtha, et al., 2009; Livaudais et al., 2010; Shallwani et al., 2010).

Other knowledge designed to reduce breast cancer risk has focused primarily on exercise and diet (Harvie et al., 2010). Researchers have suggested that, in addition to other modifiable risk factors such as clinical breast examinations, diet, exercise, and vitamin D intake is effective in reducing the risk of breast cancer (Guyton, Kensler, & Posner, 2003). In spite of the research implicating the role of vitamin D in reducing risk for breast cancer, a gap in the literature exists with regards to the effect of disseminating this information to the public. vitamin D intake, whether through supplementation or sunlight exposure, may be a less time consuming or costly way to reduce risk and thus be more appealing to women than other available interventions. While no research regarding knowledge pertaining to vitamin D dosage and its role in reducing breast cancer risk has been found, it is reasonable to expect similar positive outcomes if women accept the premise of its prophylaxes

Purpose of the Study

The purpose of this study was to investigate the behavioral impact of knowledge regarding breast cancer and breast cancer risk and the role of vitamin D and sunlight

exposure in reducing the risk for this disease. This study differed from previous studies regarding knowledge to reduce breast cancer risk in that it targeted knowledge regarding the effects of vitamin D and sunlight exposure. The theoretical framework for this study was that demonstrated knowledge is successful for positive behavioral changes (Helmes, 2002; Neuberger, Silk, Yun, Bowman, & Anderson, 2011), but this theory has not been applied to the issue of knowledge regarding vitamin D intake or sun exposure and their relationship to breast cancer. The goal in conducting this study was to determine the behavioral effects of knowledge regarding vitamin D supplementation or sunlight exposure in reducing the risk of breast cancer.

Nature of the Study

In the current study, I employed a quasi-experimental design that examined the effectiveness of knowledge and how it may affect behaviors related to reducing breast cancer risk. The study focused on vitamin D intake and sunlight exposure as a means to reduce the risk of breast cancer. A survey was administered to participants. This was used to measure multiple independent variables such as knowledge regarding how vitamin D intake and sunlight exposure can reduce breast cancer risk as well as the education level of the participants. The dependent variables were the behavior of the subjects with regard to reducing their chances of developing breast cancer. A more detailed discussion pertaining to the variables is presented in Chapter 3.

Research Questions and Hypotheses

In this study, I sought to answer the following three research questions by testing its associated hypothesis:

To what extent does knowledge regarding sunlight exposure or vitamin D supplementation affect behaviors related to breast cancer risk reduction? To what extent does response efficacy affect behaviors related to breast cancer risk reduction? To what extent does self-efficacy affect behaviors related to breast cancer risk reduction?

$H_0$1*:* Knowledge regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer risk reduction

H_a1: Knowledge regarding sunlight exposure or vitamin D supplementation affects behaviors related to breast cancer risk reduction

$H_0$2*:* Response efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer risk reduction

H_a2: Response efficacy regarding sunlight exposure or vitamin D supplementation affects behaviors related to breast cancer risk reduction

$H_0$3*:* Self-efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer risk reduction

H_a3: Self-efficacy knowledge regarding sunlight exposure or vitamin D supplementation affects behaviors related to breast cancer risk reduction.

Operational Definitions

Dependent Variables

Changes in vitamin D Intake: Participants will indicate the amount of daily vitamin D intake through supplementation. This number will be reported as International Units, or IU.

Changes in sunlight exposure: The total amount of daily and weekly sunlight exposure will be determined through information provided by the participant. The study subjects will indicate the number of hours spent outdoors on an average day and week.

Independent Variables

Knowledge regarding sunlight exposure or vitamin D supplementation related to breast cancer risk reduction: All participants will complete a survey regarding their knowledge about the relationship between vitamin D supplementation or sunlight exposure and breast cancer risk reduction.

Response efficacy: Response efficacy involves the perception that the response to the perceived threat will be effective. The survey, generated for this study and adapted from one used by Courneya and Hellsten (2001), consisted of 5-point Likert-type items, which asked the respondent to indicate how strongly she agrees with a given statement.

Self-efficacy of risk reduction: Self-efficacy refers to the level of confidence or perceived ability that one possesses with regards to performing a behavior. Self-efficacy is closely related to competence and motivation (Heale & Griffin, 2009). This was indicated by the survey responses. These data were collected through the use of Likert-

type questions in which the respondent was asked to identify, on a scale of 1 to 5, how strongly she agrees with a given statement.

Covariates

Educational level: Participants reported the highest level of education obtained, including high school, college, and postgraduate school. This variable was considered for use because of its potential impact upon the participants' ability to understand the subject. Statistical analysis was performed to determine if an association existed between educational level and knowledge. These data yielded insight into how effective information was with regards to behavior change for groups of individuals at different levels of education.

Family history of breast cancer: Participants reported the incidence of diagnosed breast cancer in first-degree family relatives, including parents, siblings, and children.

Other variables: The participants reported on a variety of other demographic variables as well. These included factors such as age, race, socioeconomic status, recent mammograms or clinical breast exams, and if the participant has a primary-care physician.

Definitions of Terms

The following definitions were used throughout the study:

International Unit (IU): The International Unit provides a measure of the biological activity of a vitamin. With regards to vitamin D, one IU is equivalent to 0.025 micrograms of cholecalciferol and ergocalciferol, which are two different forms of vitamin D (Buhler, 2001, p. 63).

Menopause: Menopause refers to the state of life when menstruation ceases, typically due to changes in the levels of the hormones produced by the ovaries (Dillaway, 2006).

Theoretical Foundation

Protection Motivation Theory (PMT)

PMT postulates that knowledge-based fear and persuasive communication can promote cognitive thought processes that lead to changes in behaviors. This fear often originates due to knowledge combining with environmental or interpersonal variables. The resulting thought processes, which include adaptive and maladaptive responses, lead to actions or the inhibition of actions (Rippetoe & Rogers, 1987).

Rogers' PMT was applied in the study of attitude and behavioral changes related to a variety of health threats. For example, studies have used this theory in the context of smoking, AIDS prevention, alcohol consumption, and compliance with medical treatment regimens. Other studies have used this theoretical framework to examine the reduction in cancer risk due to participation in exercise, clinical breast examination, and genetic testing (Helmes, 2002; Neuberger et al., 2011). A review of these studies is presented in Chapter 2.

Assumptions

It is assumed that participants provided honest answers to the survey questions. If an individual provided an answer in anticipation of what the researcher expected, it could represent a threat to the validity of the study. A second assumption is that all participants were able to receive some degree of sunlight exposure. Cases may exist in which a

participant was unable to be exposed to sunlight due to a health condition or intake of a medication that results in photosensitivity. Another assumption is that the participants did not possess any cognitive deficits that would significantly impair their ability to understand and apply the knowledge. The last assumption was that the protection motivation theory was the most appropriate theoretical framework from which to investigate this issue. Other studies have used this framework successfully with regards to knowledge and cancer risk-related behaviors (Courneya & Hellsten, 2001; Wood, 2008).

Limitations

One limitation was that I did not consider confounding variables related to the individual participants that might impact the study outcomes. These could have included deficits in cognitive abilities, which could impact the person's ability to understand and apply the information. In addition, psychological conditions that affect levels of anxiety or response to perceived threats could have heightened or dulled responses to the information concerning breast cancer risk.

A second limitation was the potential to be inaccurate when reporting the amount of vitamin D intake and sunlight exposure. Participants were asked to provide information concerning both variables. It is possible that their recall of this information was not accurate. Another limitation of this research was that the survey is relatively mono-thematic. It focused on breast cancer, vitamin D, and exposure to sunlight. By focusing solely on these themes, other important factors might have been missed. One is the degree to which individuals may have been conflicted by concerns about the potential

health issues surrounding over exposure to sunlight. Knowledge can only lead to behavior change if beliefs change, and in this case participants may exhibit knowledge of the topic, but due to conflicting information on sun exposure may not in fact change beliefs or behavior. Furthermore, the survey relies on self-reports of the participants. This method of gathering information can be unreliable. Finally, since a convenience sample was used, the subjects may not be representative of the general population of women who may be subject to breast cancer. In order to ensure that enough subjects were used, the study was subjected to a posthoc statistical power analysis.

Scope and Delimitations

The participants consisted of a group of 122 women between the ages of 25 and 74 living within New York City. The subjects were selected from a convenience sample provided by SurveyMonkey. While this had the disadvantage of being a nonprobability-based sampling approach, it was the least resource-intensive approach while still satisfying the research goals. Levels of sunlight vary according to geographic location and are impacted by latitude and climate. Since the participants were all from the same geographical setting and thus received the same levels of sunny days and potential sunlight exposure, results of this study may apply only to the population who lives in a similar geographical region.

Significance of the Study

This study filled a gap in the literature in two regards. First, epidemiological studies support the use of vitamin D supplementation or sunlight exposure in reducing the risk of breast cancer. While knowledge has been successful at modifying other risk

factors related to cancer, such as the use of clinical breast examinations, diet, and exercise, no studies that examine the effectiveness of knowledge pertaining to the modifiable risk factor of vitamin D intake or sunlight seem to exist. Additionally, while studies do exist in the literature that apply the protection motivation theory as a framework, few of these studies address breast cancer risk reduction (Blanchard et al., 2009; Gong et al., 2009). This particular theory is useful in investigating the impact of perceived risk and self-efficacy on the motivation of women to change health-related behaviors to reduce the risk of other cancers (Wood, 2008).

The results from this study inform the practice of public health. Should knowledge based upon the protection motivation theory be successful in motivating women to undertake behaviors that reduce the risk of breast cancer, then this theory may be applied to other health issues. Additionally, the study should provide insight into the effectiveness of health-related information in promoting behavior changes.

Ultimately, this study could result in positive social change within the population of women. Knowledge that motivates women to take specific steps to reduce breast cancer risk may be invaluable in creating a healthier population with reduced risk of this disease. If knowledge can be discovered that is effective in promoting positive behavior changes, this knowledge could be applied to a wide variety of health issues. Reducing the risk for a disease should reduce the population-wide incidence of that disease, leading to a population that is healthier and demonstrates reduced mortality. Of course, the benefits of direct sunlight should be weighed against their negative effects such as skin cancer.

While science can provide individuals with information regarding specific risks, it is ultimately the individual's choice regarding the behavior they engage in.

Summary

Breast cancer is a significant health issue impacting over 1 million women worldwide who are diagnosed annually with this disease. Numerous risk factors contributing to disease incidence have been identified, and a variety of interventions aimed at changing behaviors related to these risk factors have been successfully implemented. Two factors that present opportunities for understanding the link between knowledge and behaviors are vitamin D intake and sunlight exposure. Changes in behavior aimed at reducing breast cancer risk could result in the improved health of women at risk for this disease.

A review of research related to the role of vitamin D and sunlight exposure in breast cancer risk as well as knowledge fostering behavioral changes in women to reduce the risk of these and similar diseases will be presented in the next chapter. Chapter 3 provides a detailed description of the study and its implementation. Other key components of this chapter include a description of the sample population, the survey used to assess the study variables, and the statistical analysis methods used to assess the impact of the knowledge.

Chapter 2: Literature Review

Introduction

In this chapter, I establish the desirability of promoting new health behaviors among women with respect to vitamin D intake and sunlight exposure as one potential strategy for reducing breasts cancer risk, and it frames the salience of PMT for encouraging these new health behaviors. In order to locate information pertinent to knowledge and breast cancer risk reduction, a variety of databases were searched, including Academic Search Premier, Medline, PsychInfo, and Health Source: Nursing/Academic Edition. This search was limited to peer-reviewed, scholarly articles pertaining to breast cancer risk, knowledge, and PMT, and the abstracts of these materials were reviewed for relevance to this project. Finally, key articles that contributed to an understanding of the issues explored in this literature review were retrieved.

The review begins with an overview of breast cancer and breast cancer risk factors, treats the evidence concerning vitamin D intake and sun exposure as ways to mitigate population-based breast cancer risk, and progresses to a consideration of knowledge aimed at reducing the risk of the disease. A significant part of this review focuses on the theory underlying the knowledge and resulting behavior change: PMT. A brief discussion of the use of this theory with regards to intake of dietary supplements is included since the knowledge being investigated entails vitamin D supplementation. Following an examination of theory applications and limitations, I present information concerning the use of knowledge for providing behavioral options regarding reducing breast cancer risk. This discussion provides the opportunity to examine a variety of

knowledge based strategies used to promote changes in health behaviors. The literature review concludes with a brief discussion of the appropriateness of the particular study design chosen for this project.

Breast Cancer in Women

Prevalence and Mortality

Breast cancer represents a significant health threat worldwide. Aside from being the most commonly diagnosed cancer among women, it is the second-leading leading cause of cancer-related death among women in the Eastern Mediterranean Region (Miller, 2010). Approximately 1.2 million women are diagnosed with this disease throughout the world each year (World Health Organization, 2011). Within the United States, approximately 60,000 new cases are expected in 2015. This represents a decrease in incidence of 2.2% between the years 1999 and 2005. The current lifetime risk of developing breast cancer among women in the United States is 12.7% (Swart, 2011).

Breast cancer is a leading cause of death in women, second only to lung cancer. Within the United States, the probability that this disease will claim the life of a woman is 1 in 35 (Ma & Jemal, 2013). Approximately 40,000 women die annually in the United States from this disease (American Cancer Society, 2011). Mortality rates worldwide are greater than 10 times this figure, at 460,000 deaths annually. Deaths from this disease are predicted to reach 11 million by 2030 (World Health Organization, 2011). The high incidence and projected mortality rate for this disease necessitate measures to reduce the risk from this disease among women.

Risk Factors

A number of risk factors are associated with the development of breast cancer. These include increasing age, race, a family history of the disease, dietary factors, environmental factors, exposure to female reproductive hormones, and benign breast disease (Burnstein, Harris, & Morrow, 2008, p. 1606). The risk of developing the disease increases by up to three-fold for women with a first degree relative, such as a mother or sister, who have had breast cancer (Burnstein et al., 2008, p. 1607). Exposure to female reproductive hormones such as estrogen through hormone replacement therapy during menopause or the early onset of menarche increase disease risk. Additionally, dietary and environmental factors, such as alcohol consumption, obesity, polybrominated biphenyls from plastics (Hurley et al., 2011), and exposure to ionizing radiation or organochloride pesticides play a role in increased breast cancer risk (Burnstein et al., 2008, p. 1609).

The Role of Vitamin D and Sunlight Exposure

Researchers have suggested that vitamin D and sunlight exposure may play a role in reducing the risk of breast cancer. In a secondary analysis of data from over 4,100 cases of women with breast cancer and 4,100 controls, Anderson et al. (2010) reported vitamin D supplement intake greater than 400 International Units daily was associated with a small but statistically significant reduction in breast cancer risk. A meta-analysis of 21 studies concerning vitamin D intake and circulating vitamin D levels within the blood suggested a significant inverse relationship between disease risk and vitamin D intake, as women with the highest levels of circulating vitamin D demonstrated a 45% reduction in risk (Chen et al., 2010). Engel, Fagherazzi, Mesrine, Boutron-Ruault, and

Clavel-Chapelon (2011) reported similar findings in their longitudinal study of over 67,000 women. While dietary supplementation alone was not associated with decreased risk of breast cancer, women with high vitamin D intake who also lived in geographical regions characterized by high ultraviolet radiation exposure demonstrated a significant decrease in breast cancer risk.

Other studies presented evidence, to the contrary, suggesting no correlation between vitamin D intakes or sunlight exposure and the reduction in disease risk (Kuper et al., 2009). Researchers from one longitudinal study of over 41,000 women examined dietary vitamin D intake, frequency of sunburn, and the amount of vitamin D obtained from solar radiation and found no correlation among any of these with a reduction in risk (Edvardsen et al., 2011). Results from a randomized, controlled trial investigating the impact of vitamin D supplementation in conjunction with calcium did not support a relationship between reduced breast cancer risk and vitamin D supplementation (Chlebowski et al., 2008).

Overall, these studies suggest that the exact role of vitamin D and sunlight in the reduction in breast cancer risk is unclear. However, evidence does exist that supports this association, and it is this evidence that provides the impetus for this research project. Furthermore, in spite of unclear evidence, the purpose of this study is not to determine the impact of vitamin D supplementation or sunlight exposure on breast cancer risk, but rather to determine the effectiveness of knowledge in promoting behavior change. In other words, the complex risk factors involved with exposure to sunlight provide an opportunity to investigate the influence of knowledge on helping individuals make

informed decisions. The choices subjects make regarding situations in which there are unclear risks or benefits may be particularly informative regarding the more emotional aspects of behavioral decisions.

Protection Motivation Theory (PMT)

Theory Overview

This study is grounded in PMT, which postulates that knowledge appealing to one's fears promotes thought processes that ultimately lead to behavioral changes. Knowledge can activate the fear response by highlighting the personal consequences of an event, the likelihood of personal impact from an event, or responses effective in preventing an event. In response to these messages, several cognitive processes may result. An awareness of the potential personal consequences of an event leads to an appraisal of the event severity. Information pertaining to the likelihood of an event impacting an individual result in consideration of the probability of exposure to that event. Additionally, information regarding responses in preventing an event leads one to consider the effectiveness of those measures. These stimuli and their associated cognitive processes lead to protective motivation, a form of motivation that arouses the individual and guides future actions. If the individual believes that the event is likely to occur and be severe and that preventative measures will be effective, behavior change will occur (Rogers, 1975).

Researchers have suggested that relationships exist between response efficacy, self-efficacy, behavior change, and knowledge. Most notably, both response efficacy and self-efficacy correlate positively with changes in behavior aimed at reducing disease risk.

Increased self-efficacy is associated with increased likelihood to modify behaviors related to sun exposure, condom use for the prevention of HIV infection, and exercise to reduce health risks (Azzarello, Dessureault, & Jacobsen, 2006; Blanchard et al., 2009; Lwin, Stanaland, & Chan, 2010). Response efficacy also correlates with increased intent to change behaviors or actual behavior change (Blanchard et al., 2009; Cox, Koster, & Russel, 2004; Lwin et al., 2010;). In fact, according to Woods (2008), this variable is the greatest predictor of the desire to change health-related behaviors.

Increased knowledge is associated with increases in self-efficacy and behavior changes in some studies. For example, Mbeba et al. (2011) reported that an educational intervention aimed at increasing knowledge about HIV prevention resulted in increased knowledge, increased self-efficacy, and the performance of desired behaviors within the intervention group over the control group. Additionally, Shallwani et al. (2010) reported that increased knowledge concerning the importance of clinical breast examination was associated with increases in the actual performance of this risk-reducing behavior. However, Neil and Ballinger (2008) reported that increased knowledge concerning the willingness to use assistive devices for individuals with poor vision was not associated with self-efficacy or behavior change. Taken together, these studies suggest that a positive relationship exists between both response efficacy and self-efficacy and behavior changes. However, the relationship between knowledge and these three variables is less clear.

Application of PMT to Health Risks

PMT has served as the guiding principle in a number of interventions aimed at modifying behavior related to health risks. Azzarello et al. (2006) examined sun protection behavior among individuals whose first-degree relatives possessed a diagnosis of melanoma. Results suggested that greater perceived risk of sun exposure-induced cancer and greater self-efficacy at preventing that cancer were associated with increased demonstration of sun protective behaviors. Additionally, perceived risk served a mediating role between education concerning sun exposure and protective behaviors. Other researchers suggested that tailoring fear appeals to the individual may be effective in promoting behavior changes related to sun exposure. In a study of undergraduate students who sunbathed, McMath and Prentice-Dunn (2005) reported that fear appraisal messages were more effective than messages related to self-efficacy and that messages adapted to individual variables, such as concern for physical appearance, resulted in modest increases in motivation for behavior change.

PMT has been used successfully in fostering behavior changes related to AIDS prevention. Gong et al. (2009) evaluated three different interventions on the knowledge, intentions, and behaviors of sixth-grade students regarding HIV prevention. The interventions that employed PMT resulted in an increase in the perceived effectiveness and intended use of condoms in preventing infection. While actual behavior change related to sexual activity could not be measured, as the amount of activity was low among this study group, results suggested that this approach to educating adolescents may result in future behavior changes. Lwin et al. (2010) also used this theory to implement an

intervention aimed at encouraging condom use among men in Singapore to prevent HIV infection. Among homosexual men, perceived disease severity was a significant predictor of condom usage, while response efficacy was a predictor among heterosexual men. In both groups, self-efficacy predicted condom use.

In addition to sun protection and protection against HIV infection, this theory has also been applied to understanding motivation to engage in preventative measures related to cardiovascular disease and colon cancer. Tulloch et al. (2009) reported that PMT was an effective model for predicting exercise-related behaviors of individuals with coronary artery disease in the short-term but not the long-term. Self-efficacy, response efficacy, and perceived event severity were only modestly associated with intent to exercise. In contrast to these results, Blanchard et al. (2009) reported that response-efficacy and self-efficacy significantly predicted intention to exercise among patients undergoing home-based cardiac rehabilitation.

Individuals who believe they are at increased risk for colon cancer may also benefit from interventions based upon PMT. In a study of undergraduate students where the students were led to believe that their risk for developing the disease was high, researchers found that such individuals were more likely to exercise to reduce that risk if they believed in the efficacy of the exercise regimen (Courneya & Hellsten, 2001). Wood (2008) also reported that response efficacy had the greatest impact upon the desire to engage in exercise to reduce disease risk. These results suggest that the components of PMT are useful in predicting changes in behavior related to health risks.

Application of PMT to Consumption of Dietary Supplements

While the previously discussed studies addressed PMT in relation to performing a specific action, such as using sunscreen or exercising, one study used this theoretical foundation to predict the likelihood of taking vitamin supplements to improve health. Cox et al. (2004) investigated the intention of middle-aged consumers to use dietary supplements to improve memory. Subjects were categorized based upon perceived vulnerability to the threat of memory loss. Although results varied between genders with regards to the intention to use specific supplements, response efficacy and self-efficacy were the two most significant predictors of the intention to take dietary supplements. This study provides support for the use of PMT in predicting behavioral change related to intake of vitamin D to reduce breast cancer risk.

Application of PMT to Reduction in Breast Cancer Risk

The previously discussed, studies have demonstrated the utility of PMT in predicting behavior changes related to a variety of health risks. Literature has also suggested that this theory is useful in implementing interventions related to reducing the risk of breast cancer. Studies have applied PMT to promote genetic testing and mammography among women. As breast cancer contains a hereditary component, genetic testing for the defective gene may be an important means of screening for disease risk. However, women with low risk often forgo this type of testing, even when it may be beneficial. Helmes (2002) reported that PMT was useful in understanding women's motivation to receive testing. Specifically, motivation for testing was higher among

women who perceived a greater risk of the disease and perceived greater disadvantages to not being tested.

Mammography is another key test in assessing breast cancer risk. Naito, O'Callaghan, and Morrissey (2009) compared PMT to a similar theory, the theory of planned behavior, to understand factors related to women's decisions to receive mammographies. Results from this study suggested that PMT was not the most effective model for exploring mammography intentions and that factors predicting intention to undergo screening were related to beliefs concerning the consequences of the behavior.

Limitations of PMT

As discussed in Chapter 1, some limitations exist that may impact the utility of the theory as it applies to breast cancer risk reduction, vitamin D intake, and sunlight exposure. Consideration is not given to the amount of time that may pass between the presentation of the information and the occurrence of the threatening event. In the case of this study, many years could pass between the knowledge being acquired and a possible diagnosis of breast cancer. This knowledge of a potential diagnosis far into the future could impact components of the theory such as the perceived threat (Rogers, 1975). Cognitive or psychological impairments could also impact one's ability to receive and process fear related knowledge. Finally, persuasive messages should be used with caution in order to prevent unintentional behavior changes or undermine efforts to promote positive changes (Hagger & Chatzisarantis, 2005, p. 19).

The Use of Knowledge in Breast Cancer Risk Reduction

While the previously discussed studies highlighted the applicability of PMT to a variety of health risks, including breast cancer, it is important to also consider the different approaches to delivering knowledge and their general effectiveness at promoting change. Several knowledge delivery methods have directly addressed behavior changes related to reduction in breast cancer risk. Shallwani, Ramji, Ali, and Khuwaja (2010) implemented a community-based knowledge delivery in order to promote clinical breast examinations among women, as well as testicular self-examination among men. The knowledge delivery employed the teaching strategies of lectures and hands-on demonstrations, as well as brochures and other written material. Post-knowledge delivery results indicated that both men and women significantly increased their knowledge of the procedures as well as their practice.

Livaudais et al. (2010) implemented a community health knowledge delivery aimed at increasing Hispanic women's knowledge of mammography and breast cancer risk. Knowledge delivery strategies included guided discussions in an informal setting, visual displays, and a slide presentation. Results from this study suggested that at post-knowledge delivery, a greater percentage of subjects believed that the risk for breast cancer could be reduced, intended to have a mammogram in the upcoming months, and spoke to their doctors about the test. One notable detail of this study was that the majority of subjects possessed a reading level below that of an eighth grader. This suggests that researchers should be aware of such factors when designing knowledge delivery materials and adapt them accordingly.

One component of knowledge delivery based upon PMT is the risk-tailored message used to promote cognitive processes which may in turn lead to behavioral changes. Bodurtha et al. (2009) studied the impact of such messages on an educational intervention targeting breast health practices. Results indicated that informational messages containing risk-tailored information when compared to those containing general information did not impact the intention to screen for breast cancer at 18 months. However, among a subset of study subjects who worried more about breast cancer risk, risk-tailored messages were associated with higher mammography rates.

Overall, these studies suggest that community-based knowledge aimed at increasing knowledge regarding breast cancer risk-related behaviors can be successful. Additionally, persuasive communication and knowledge related closely to fear appeals, may only be effective under certain conditions, such as among those individuals who already perceive a greater threat from the disease or when prevention based activities are available.

Review of Methods

Of the studies addressed in this literature review, every study employed a quantitative approach. This type of study is appropriate in understanding if a specific approach impacts an outcome. The quantitative approach is most useful when determining the utility of knowledge delivery or understanding predictors of outcomes. This approach is also appropriate for testing a theory. In contrast, qualitative studies may be most beneficial when little research exists regarding a particular topic or theories have not yet been applied to a subject of interest (Cresswell, 2009, p. 18). In the case of this

study, PMT is well-documented in its applicability to predicting factors related to health behavior changes. Additionally, the goal of this study was to ascertain the effectiveness of knowledge in changing behaviors. For these reasons, a quantitative approach, rather than a qualitative approach, best addressed the research questions. Since this study did not involve the randomization of subjects, it was considered a quasi-experimental study and utilized a one-group survey format.

This study design conferred threats to validity. Since I utilized a survey to determine knowledge and beliefs in this study, it was possible that participants did not accurately answer questions (Cresswell, 2009). In order to minimize this threat, the wording of questions were carefully considered. Threats to external validity may include the inability to generalize the results to populations different in composition from the study sample. For example, if the study sample is comprised primarily of Caucasian women, the results may not be generalizable to the population of African-American women. The sample size was assessed using a statistical posthoc power analysis. The sampling technique of a convenience sample was carefully recorded. This allowed the reader to establish their own opinion regarding the generalizability of the findings. There was also a thorough discussion regarding the impact of convenience sampling on the psychometrics of the instruments used.

Summary

PMT is applicable to a wide range of health risks. Researchers have suggested that it is an effective foundation for examining and promoting behavioral changes related to reductions in risks associated with HIV infection, sun exposure, coronary heart

disease, and colon cancer. Additionally, this theory has been applied to breast cancer to encourage preventative screening measures, including genetic screening, mammography, and clinical breast examinations. Furthermore, at least one study suggests that the use of PMT as a knowledge delivery framework may be effective in promoting behavior change related to taking dietary supplements. Since this research study involved both dietary supplement intake and reduction in breast cancer risk, PMT is an appropriate theoretical foundation.

The literature surrounding PMT and reduction in health risks suggests several notable aspects for consideration. Self-efficacy and response efficacy appear to be the most influential factors in predicting behaviors related to health risks. Therefore, these two components of PMT were emphasized when designing the survey. Interestingly, risk-tailored messages may not always be effective in promoting behavior change among those who perceive a low level of threat. This suggests that persuasive communication and the delivering of information should be carefully designed to appeal to individuals with a wide range of beliefs and attitudes towards breast cancer risk. Additionally, successful knowledge described in the literature has utilized a variety of strategies, including informal discussions, visual presentations, and printed brochures. I examined the effects of knowledge, attitudes, and beliefs pertaining to the use of vitamin D supplementation and sunlight exposure in eliciting behaviors aimed at reducing the risk of breast cancer in the study. I included a description of the methodology used in the study in chapter 3.

Chapter 3: Research Method

Introduction

As described in previous chapters, this study addressed the potential for knowledge to encourage specific risk reduction behaviors, including maintenance of adequate levels of vitamin D. To this end, I used a survey to compare knowledge and behaviors among participants. In the current chapter, I describ the research design, sample selection, experimental procedure, data analysis, and ethical considerations.

Research Design

In this study, I used a survey. The subjects were provided by the SurveyMonkey (Surveymonkey.com, 2015) website, among nonrandomized samples of women aged 25 to 74 living in New York City. All participants completed the survey.

The nonrandomized design of this convenience sample was advantageous in that it enabled me to select experimental group participants for geographic proximity and control for regional differences in the amount of sunlight. The participants were recruited by SurveyMonkey. An a priori power analysis was performed to ensure a sufficient number of subjects have been included. An analysis indicating that there were an insufficient number of participants would have resulted in additional participants being requested from SurveyMonkey. There was also a posthoc power analysis done after completion of the study.

Participants

Potential participants in this study were women ranging in age from 25 to 74 who lived in New York City and were of a similar socioeconomic status. Similar geographic

location was desirable so that all participants would have the opportunity to be exposed to approximately the same amount of sunlight. Similar socioeconomic status was desirable in order to minimize differences in the ability to locate or afford vitamin D supplements. This particular age range was chosen because 25 years is the approximate age at which the incidence of breast cancer begins to increase in women, and 79 years is the approximate age that incidence begins to decrease (American Cancer Society, 2009). These statistics are similar for both white and African American women (American Cancer Society, 2009). Exclusion criteria included a previous diagnosis of breast cancer and sensitivity to sunlight or vitamin D. Additional exclusion criteria were women who have tested positive for a harmful mutation to the BRCA1 or BRCA2 gene.

A power analysis was used to determine the appropriate sample size. The first step in a power analysis is to determine the minimum desired effect size. Cohen (1992) described effect size as the difference between the null hypothesis and the alternate hypothesis tested in the experiment. Cohen used the conventions of small, medium, and large to categorize values. A medium effect size is likely to be observable, while a small effect size requires more careful discrimination to discern. The large and small effect sizes are equidistant from the medium category, although in opposing directions.

The value of the effect size should be based on current literature pertinent to the research topic. Courneya and Hellsten (2001) reported on cancer prevention and exercise motivation using the PMT. Hence, their study is very similar to this study with respect to subject, variables, and theoretical framework. In Courneya and Hellsten, an ANOVA for the variables of response efficacy and self-efficacy yielded 0.019 and 0.303 effect sizes,

respectively. A 0.019 response efficacy effect size is quite small, since any effect would be difficult to discern across a population (Cohen 1992). The 0.303 for self-efficacy approaches a medium effect size (Cohen 1992), since it represents a change that could more readily be observed. The present study embraces the medium effect size of 0.3 as representing a useful target for the change expected through a community educational program. Were the desired effect size any smaller, the results might not be persuasive enough to encourage interest in community education programs as a viable health knowledge delivery system. However, as shown by Courneya and Hellsten's work, a larger effect size may be unreasonable to expect.

The second major step in a power analysis is to determine the desired level of statistical reliability of the results. This second step entails determining both the significance criterion (the probability of a Type I error or rejecting the null hypothesis when it is true) and the power (the probability of a Type II error or accepting the null hypothesis although it is false at the minimum effect size level).

Sample size is a function of effect size, significance criterion, and power. Cohen (1992) recommended that the significance criterion be set at 0.05 and the power set at 0.80. The latter of these values allows for a four-fold possible occurrence of a Type II error, or false negative, over that of a Type I error, or false positive. Cohen explained that, while this number is somewhat arbitrary, it stresses the importance of avoiding false positives.

Procedures

Administration of the Survey

Data were collected through the use of a survey. The survey was sent by SurveyMonkey. The first page of the email consisted of the informed consent form. Participants were e-mailed a consent form, information about the study, and the survey.

Instrumentation and Materials

The instruments used in this study included a demographics questionnaire, an assessment of breast cancer knowledge, response efficacy and self-efficacy assessments, and the survey.

Demographics Questionnaire

Questions pertained to age, educational level attained, and family history of breast cancer diagnoses. Responses to educational level were analyzed in conjunction with the results of the assessment of breast cancer knowledge to ensure that differences in the results pertaining to this variable could not be attributed to differences in educational background. It was important that the reading level of the materials presented match the reading level of the participants so that participants were able to understand and use the information. Information pertaining to family history of breast cancer diagnoses was analyzed in conjunction with response efficacy to determine if increased worry about breast cancer risk was associated with increased response efficacy.

Assessment of Breast Cancer Knowledge

This component of the survey measured knowledge pertaining to breast cancer and breast cancer risk. Examples of questions from the breast cancer knowledge component of the survey included the following:

1. Which of the following is not a risk for breast cancer?

    A. Increasing age

    B. Family History

    C. High protein consumption

    D. Alcohol consumption

2. All women over the age of 40 should receive annual mammograms.

    True False

3. The lifetime risk of contracting breast cancer for the typical American woman is one in:

    A. 5

    B. 8

    C. 10

    D. 24

Assessment of Response Efficacy and Self-Efficacy

Additionally, the survey included questions pertaining to response efficacy and self-efficacy, two of the independent variables. In both cases, the participants were presented with a Likert-type scale and asked to circle a number that corresponds to her level of agreement with particular statements. Questions regarding response efficacy

were adapted from ones used in a study by Courneya and Hellsten (2001). Response efficacy was assessed using two 5-point items, with 1 corresponding to *strongly disagree* and 5 corresponding to *strongly agree*. A 5-point Likert scale was used since it has been shown to be equal to the longer 7-point choice system (Colman, Norris, & Preston, 1997). These items, which are presented below, are similar to those commonly used in research studies pertaining to PMT:

1. Personally, I feel that vitamin D supplementation will help me to reduce my risk of breast cancer.
2. I believe that weekly sunlight exposure will help me to reduce my risk of breast cancer.

Statements regarding self-efficacy were adapted from those developed by Ajzen (2007) used to measure perceived behavioral control, a concept similar to self-efficacy. Participants were asked to indicate their level of agreement based upon the same 5-point scale used for response efficacy. These questions included the following:

1. It is easy for me to take a daily vitamin D supplement.
2. It is easy for me to obtain sunlight exposure on a regular basis.
3. I am confident that I can take a regular vitamin D supplement.
4. I am confident that I can receive a safe level of sunlight exposure each week.

Data Analysis

This quasi-experimental design used a survey developed with the SurveyMonkey (Surveymonkey.com, 2015) website. Data analysis centered on the following independent variables: knowledge of breast cancer and methods of reducing its risk,

response efficacy, and self-efficacy. The covariates were sunlight exposure, vitamin D intake as well as the descriptive variables of education level and family history of breast cancer. A continuous measure was used for the following variables: knowledge of breast cancer (percentage of questions correct), sunlight exposure (hours per day and hours per week), and vitamin D intake (IU). Both response efficacy and self-efficacy were measured using a Likert-type response and thus can be measured on ordinal scales. Education level was measured along a nominal scale, with categories including high school completion, some college, undergraduate degree, and graduate degree.

The other covariate, family history, was a dichotomous variable in which the participant answered either "yes" or "no" to a question concerning first-degree relatives diagnosed with breast cancer. The statistical analysis involved multiple linear regressions. There were three independent variables and two dependent variables. The two dependent variables were behavioral changes including the amount of sunlight exposure and vitamin D intake through supplementation. The independent variables were knowledge regarding sunlight exposure or vitamin D supplementation as it relates to breast cancer, perceived levels of response efficacy, and self-efficacy. The covariates were educational level, family history of breast cancer, and demographic variables such as age, gender, race, mammograms or clinical breast exams, and having a designated primary care physician. The regression model indicated the amount of influence the independent variables have on each of the dependent variables.

Ethical Considerations

All pertinent information concerning this study was submitted to the Institutional Review Board at Walden University. Review and approval by this entity occurred prior to beginning data collection.

Additionally, all participants were required to sign an informed consent form. This form detailed the potential risks and benefits of participating in the study, described confidentiality procedures, and explained that participants may withdraw from the study at any time after signing the consent form without providing any explanation. The informed consent form was provided for all participants concurrently with the survey as a cover page. Participants were given the opportunity to ask me questions by e-mail prior to signing the form. Participants returned the consent form and survey by e-mail to SurveyMonkey. The responses from the subjects were stored in a file that was separate from the e-mail from which it originated. This meant there was no way of associating a specific participant with their responses, and complete anonymity was maintained. SSL encryption was used to protect the data of the participants. The IP address tracking was disabled to ensure that the subjects remained anonymous.

The participants were provided with information regarding a Walden University representative who could be contacted if there were any questions related to the subject's rights as a participant in the study. The consent and documents of the study were in the simplest language possible and clearly explained in order to ensure participants understood the study. There was nothing in the informed consent that even remotely suggested that subjects were waving any of their legal rights. This study involved no

medical treatment, which required alternative procedures or a statement that they were not receiving standard care. Furthermore, there was no additional cost to the subjects for their participation in the research.

Summary

The purpose of this study was to investigate the impact of knowledge on behaviors related to breast cancer risk based upon the PMT. The purpose of this chapter was to detail the study methods, including research design, participant selection, sample size determination, the survey and associated assessment instruments, data analysis strategies, and ethical considerations.

Chapter 4: Results

Introduction

The purpose of this chapter is to provide an explanation of the results of the statistical tests that were performed to answer the research questions put forth for this study. The research questions that are answered in the data are

- To what extent does knowledge regarding sunlight exposure or vitamin D supplementation affect behaviors related to breast cancer risk reduction?
- To what extent does response-efficacy affect behaviors related to breast cancer risk reduction?
- To what extent does self-efficacy affect behaviors related to breast cancer risk reduction?

In order to answer these research questions, a descriptive analysis of the data consisting of an explanation of the characteristics of the participants as well as correlations between the variables of interest for this study was conducted. In addition, two sets of linear regression analyses were performed with the dependent variables of interest: sunlight exposure and the amount of vitamin D intake through supplementation.

Descriptive Statistics

Before performing the statistical tests in order to answer the primary research question and test the hypotheses formulated for this study, it is useful to examine and discuss the characteristics of the participants and their responses to the variables of interest. Table 1 shows the means and standard deviations for the variables of age, educational attainment, and annual income. The age variable was coded as six

categories: 1 = 18 to 27 years old, 2 = 28 to 37 years old, 3 = 38 to 47 years old, 4 = 48 to 57 years old, and 6 = 68 years old and older. The mean of 3.46 for the age variable indicates that the mean age of the participants was in the category of 38 to 47 years old. In a similar manner, the education variable was coded into five categories with 1 = less than high school, 2 = high school, 3 = some college, 4 = graduated college, 5 = graduate or professional school. The mean of 4.11 for educational attainment indicates that the average level of education of the participants in the study was a college degree. Finally, the income variable was also coded into categories. The five categories of the income variable was 1 = less than $24,999, 2 = $25,000-$49,999, 3 = $50,000-$74,999, 4 = $75,000-99,999, and 5 = more than $100,000. The mean annual income of 3.24 indicates that the mean income of the participants was between $50,000 and $74,999.

Table 1

Descriptive Statistics of Ordinal Variables

	Mean	*S*.D
Age	3.46	1.41
Educational attainment	4.11	0.84
Annual income	3.24	1.21

Table 2 shows the racial and ethnic breakdown of the participants. A clear majority of the participants, about 82%, were White. About 7% of the participants were Hispanic, while another 5% were Black. Of the 122 participants who took part in the study, four were Asian/Pacific Islander, one was Native American, and three indicated that they were of some other race. The racial makeup of the participants is important because it may impact the ability to generalize the findings of this study to a larger

population of women. The racial demographics in this study do not match the racial demographics of women in the larger population of the United States.

One of the issues that must be considered in generalizing the findings of this study to the larger population of interest is whether racial characteristics might have some effect on the relationship between knowledge regarding sunlight exposure and vitamin D supplementation on behaviors related to breast cancer reduction. The race variable was included in the larger statistical analysis performed in this study. However, it is difficult to argue that the variable may have any real significance in the analysis given that 82% of the participants were White. There were so fewer participants who indicated that they were part of other racial and ethnic categories that any effect based on race might not be enough to be significant in the statistical analysis.

Table 2

Racial and Ethnic Characteristics of the Participants

	Frequency	Percent
White, Non-Hispanic	100	81.97
Black, Non-Hispanic	6	4.92
Hispanic	8	6.56
Asian/Pacific Islander	4	3.28
Native American	1	0.82
Other	3	2.46

The majority of participants in the study were white women. The predominance of white women in the study means that the findings of this study should not be generalized to other populations. The results of this study should be understood as only being representative of white women, and the conclusions drawn from the results of this

study should be examined and discussed within the context of the population that were represented by the participants.

Table 3 shows the percentage responses to the three dichotomous variables in which the participants were asked whether they had a family history of breast cancer, had received a mammogram or clinical breast exam in the past year, and whether they had a primary care physician. Of the participants in the study, 59% stated that they had a family history of breast cancer. Interestingly, however, only 22% had received a mammogram or clinical breast exam within the past year. This is particularly interesting given that the average age of the women in the study was between 38 and 47 years old, which is around the age when women are recommended to begin receiving yearly mammograms.

Table 3

Percentage Responses to Dichotomous Demographic Variables

	Yes	No
Do you have a family history of breast cancer	59.00%	41.00%
Mammogram or clinical breast examination in past year	22.10%	77.90%
Do you have a primary care physician	91.00%	9.00%

In addition, Table 3 shows that 91% of the women in the study stated that they had a primary care physician. The fact that 91% of the women stated that they had primary care physicians but only 22% had received a mammogram or clinical breast exam in the past year may provide some initial insights about how the women responded with regards to knowledge about breast cancer and behaviors to reduce the potential for breast cancer.

Table 4 shows the means and standard deviations for the dependent and independent variables of interest in this study. The knowledge variable is the percentage of correct responses of the participants to nine questions they were asked about behaviors and conditions about the risk factors of breast cancer and how to reduce the risk of breast cancer. The mean percentage of correct responses to the nine questions was about 63%. This means that, on average, the participants in this study answered about 6 of the questions correctly.

Table 4

Descriptive Statistics for the Independent and Dependent Variables

	Mean	*S.D.*
Knowledge	63.39	13.45
Sunlight intake	4.22	1.57
Response-efficacy	3.16	0.67
Self-efficacy	3.90	0.76
Daily vitamin D intake	2.99	1.58

The variable of sunlight intake was a variable created by adding the responses of the questions of the amount of daily sunlight intake and weekly sunlight intake. The total response to the variable was on an 8-point scale. The reason for adding the two questions together rather than creating an average was because the questions were not on the same scale. The daily sunlight intake question was asked using a 3-point scale, and the weekly sunlight intake question was asked using a 5-point scale. The mean value of the participants of 4.22 suggests a fairly low level of sunlight intake, perhaps less than 5 to 7 hours per week.

The response-efficacy variable was an average of two questions of each score on a 5-point scale: personally, I feel that vitamin D supplementation will help me to reduce my risk of breast cancer and I believe that weekly sunlight exposure will help me to reduce my risk of breast cancer. The mean score for this variable of 3.16 indicates that the women were uncertain about the potential impact of vitamin D to reduce the risk of breast cancer. Furthermore, the self-efficacy variable was an average of four questions scored on 5-point scales in which the participants were asked about their perceptions regarding the ease of obtaining sunlight exposure and taking vitamin D. The mean of 3.90 indicates that the women were more confident about obtaining sunlight exposure and taking vitamin D as compared to their perceptions of vitamin D being a way to reduce the risk of breast cancer. Finally, Table 3 shows that the mean daily vitamin D intake of the participants in the study was 2.99. This indicates that the women in the study stated that they took between 600 IU and 800 IU of vitamin D through supplementation on a daily basis.

Table 5 shows more specifically the amount of daily sunlight exposure that the women stated they receive. About 57% of the respondents stated that they receive less than 2 hours of sunlight intake per day. About 39% stated that they receive 2 to 5 hours of sunlight intake per day. Only 4% or 5 participants stated that they receive 5 to 7 hours of daily sunlight intake.

Table 5

Daily Sunlight Intake

	Frequency	Percent
Less than 2 hours	69	56.56
2-5 hours	48	39.34
5-7 hours	5	4.10

Table 6 shows the amount of weekly sunlight exposure that the women stated they receive. About 32% of the participants stated that they receive only 2 to 5 hours of sunlight exposure per week, while 15% stated that they receive less than 2 hours of sunlight exposure per week. About 25% of the participants in the study stated that they received 5 to 7 hours of sunlight exposure per week, with 21% receiving 7 to 14 hours of sunlight exposure per week and only 7% received more than 14 hours per week of sunlight exposure. While there was a fairly wide spread in the weekly sunlight exposure of the participants, it is difficult to argue that most of the participants received a great deal of weekly sunlight exposure. About half of the participants received 5 hours or less of sunlight exposure per week while about 45% of the participants received between 5 and 14 hours of sunlight exposure per week.

Table 6

Weekly Sunlight Exposure

	Frequency	Percent
Less than 2 hours	18	14.75
2-5 hours	39	31.97
5-7 hours	30	24.59
7-14 hours	26	21.31
More than 14 hours	9	7.38

Correlation

Table 7 shows the results of a correlation analysis performed on the five variables of primary interest for this study, along with the variables of age, educational attainment, and annual income. The other demographic variables were not included in this study because they were either categorical variables or dichotomous variables. Including those variables in the correlation analysis would have been inappropriate. The purpose of conducting the correlation analysis is to better understand the relationship of the variables in this study. First, the results of the correlation analysis show that even the significant correlations were very low at 0.34 or below. However, the results of the correlation analysis show that both response-efficacy and self-efficacy were significantly and positively correlated with breast cancer knowledge. This means that as perceptions of response-efficacy related to taking vitamin D and sunlight exposure as a means of reducing the risk of breast cancer increased as well as self-efficacy regarding confidence in obtaining sunlight exposure and taking vitamin D so too did knowledge about the behaviors and actions that can impact the risk of breast cancer. In addition, the results of the correlation analysis show that the amount of daily vitamin D intake through supplementation on the part of the participants was significantly and positively related to self-efficacy and response-efficacy. This means that as the response-efficacy and self-efficacy of the participants increased, the amount of daily intake of vitamin D through supplementation also increased.

Table 7

Correlation R-Squared Values

	1	2	3	4	5	6	7	8
Breast cancer knowledge (1)	1.00							
Sunlight exposure (2)	0.06	1.00						
Response-efficacy (3)	0.24**	0.14	1.00					
Self-efficacy (4)	0.21*	0.13	0.23*	1.00				
Please indicate the amount of daily vitamin D intake through supplementation (5)	0.17	-0.02	0.31**	0.34**	1.00			
Age (6)	0.03	0.16	0.13	0.08	0.18	1.00		
Educational attainment (7)	0.08	-0.02	-0.12	-0.06	-0.04	-0.12	1.00	
Annual income (8)	0.10	0.11	0.00	0.05	0.05	0.21*	0.32**	1.00

Note. *$p < 0.05$ **$p < 0.01$

Perhaps not surprisingly, the variables of response-efficacy and self-efficacy were also significantly and positively related to each other. As the response-efficacy of participants increased, their self-efficacy related to perceptions about the ease of taking vitamin D supplements and gaining exposure to sunlight also increased. However, another important finding from the correlation analysis was that the demographic variables of age, educational attainment, and annual income were not significantly correlated with breast cancer knowledge, response-efficacy, or self-efficacy. This is an important finding because the conclusion that can be drawn is that there is no association between breast cancer knowledge and the age, educational level, or income of the women who took part in this study. Having a higher level of education or a higher level of income, which were positively and significantly correlated for the participants in the study, was not significantly related to a greater level of knowledge about the behaviors that can impact the risk of breast cancer.

An assumption that might have been made is that women with higher levels of education would have had a significantly greater level of knowledge about the behaviors that can impact the risk of breast cancer. For the women in this study, this would not found to be the case. Based on this finding, one assumption that might be made for the more in-depth statistical analyses that are to follow is that age, educational attainment, and annual income will not be significant predictors of sunlight exposure or the amount of vitamin D intake among the women in this study. Instead, existing self-efficacy and response-efficacy may be significant predictors of the actual amount of sunlight exposure and the amount of vitamin D intake of women as a means of reducing the risk of breast cancer.

Regression Analysis

Sunlight Exposure

The first linear regression analysis that was performed was on the dependent variable of the amount of sunlight exposure. The linear regression analysis was performed in three stages. The first model only included the primary independent variables of interest: breast cancer knowledge, response-efficacy, and self-efficacy. In the second model, the variables of age, educational attainment, annual income, and race were added. In the third model, the dichotomous variables of whether the participants had a family history of breast cancer, whether they had received a mammogram or clinical breast exam in the past year, and whether they had a primary care physician were added.

The reason for performing this linear regression analysis in three stages was to better determine how different groups of variables might impact the ability to predict the amount of sunlight exposure a woman might receive as a means of reducing her chance of breast cancer. The first model included the independent variables that were of primary interest for this study. The second model contained what might be described as basic demographic variables. The third model contained variables that were about specific actions that might at least have some influence on the larger behavior of getting exposure to sunlight as a means of reducing the overall risk of breast cancer.

Table 8 shows the results of the linear regression analysis with the dependent variable of sunlight exposure regressed on the independent variables. What is immediately clear from the results is that the variables included in this study were not significant predictors of the amount of sunlight exposure of the women as a means of reducing the risk of breast cancer. In the first model, the variables of breast cancer knowledge, response-efficacy, and self-efficacy were not significant predictors of sunlight exposure. Even more, the r-squared value, or the amount of variance in the dependent variable explained by the independent variables, was less than 1%.

Table 8

Results of Sunlight Exposure Regressed on Independent Variables

	Model 1		Model 2		Model 3	
	Beta	*S.E.*	Beta	*S.E.*	Beta	*S.E.*
Breast cancer knowledge	0.00	0.01	0.00	0.01	0.00	0.01
Response-efficacy	0.26	0.22	0.24	0.23	0.26	0.23
Self-efficacy	0.22	0.20	0.19	0.20	0.24	0.20
Age			0.12	0.11	0.11	0.11
Educational attainment			-0.08	0.19	-0.09	0.19
Annual income			0.09	0.13	0.08	0.13
Race			-0.14	0.14	-0.16	0.14
Do you have a family history of breast cancer					0.04	0.31
Have you had any mammograms or clinical breast examination in the past year?					0.41	0.36
Do you have a primary care physician?					-0.83	0.52
(Constant)	2.48*	1.01	2.54	1.37	3.11*	1.43
R-squared	0.005		0.009		0.015	

Note. *$p < .05$

It is also important to note that the first model was actually not statistically significant. The ANOVA that was performed with the model in order to determine if the model was actually significant, meaning that the independent variables were significant predictors of the variance in the dependent variable, showed that the model was not significant. This means that in terms of the data collected for this study, breast cancer knowledge, response-efficacy, and self-efficacy, were in no way significant predictors of sunlight exposure.

In the second model with the demographic variables of age, educational attainment, annual income, and race added, the same results occurred. None of the independent variables that were included regarding breast cancer knowledge, response-efficacy, self-efficacy, or the demographic variables were significant predictors of

sunlight exposure. The adjusted *r*-squared value for the second model, or the amount of variance in the dependent variable explained by the independent variables was still less than 1%. However, this is not important because as with the first model, the ANOVA showed that the model was not statistically significant. The entire second model with the variables that were included did not explain the variance in the dependent variable.

The third model with the dependent variable of sunlight exposure included the dichotomous variables regarding a family history of breast cancer, whether the participants had received a mammogram or clinical breast exam within the past year, and whether they had a primary care physician. As with the other two models, none of the variables in the third model were significant predictors of sunlight exposure. Also, as with the other two models, the actual model itself was not significant as indicated by the results of the ANOVA.

Overall, the results of the first linear regression analysis were certainly not expected. None of the variables that were included in the models were significant predictors of the dependent variable of sunlight exposure. However, perhaps more surprising, the models were not statistically significant, meaning that the independent variables in no way explained the variance in the dependent variable.

One of the issues that was considered for this lack of significance of the model was that the dependent variable of sunlight exposure was created by adding the responses of the two variables on the survey that asked about sunlight exposure, which were daily sunlight exposure and weekly sunlight exposure. It was hypothesized that the variable might not have correctly identified the sunlight exposure of the participants. By adding

the daily and weekly sunlight exposure responses together, the variable may have in some way not be a valid measure of the sunlight exposure of the participants.

In order to determine if the problem with the models may have been the variable that was used, the linear regression analysis was performed again with the dependent variable of daily sunlight exposure. With the dependent variable of daily sunlight exposure, the same result occurred: none of the variables were significant predictors of sunlight exposure and the model was shown to be statistically insignificant. Changing the dependent variable to daily sunlight exposure and running all three stages of the model did not change the result that the mode was not a significant model in which the independent variables explained any the variance of the dependent variable.

The decision was made to use weekly sunlight exposure as the dependent variable. The idea was that by using a variable with more response options, it might be possible to obtain some useful information from the linear regression analysis. While the question that asked about daily sunlight exposure only had three response options, the question about weekly sunlight exposure had five response options. Furthermore, the idea of weekly sunlight exposure might simply have caused the participants to think more broadly about how much time they spend in the sun on a weekly basis, which might have yielded more valid responses.

Once again, all three stages of the linear regression analysis was performed. However, once again, the results were the same. With the dependent variable of weekly sunlight exposure, the model was found to not be significant based on the results of the ANOVA. Furthermore, none of the variables were statistically significant predictors of

the dependent variable of weekly sunlight exposure. Regardless of how the variable of sunlight exposure was included in the linear regression model, the results remained the same. In this regard, the outcome of the initial results of the linear regression analysis was not necessarily due to the way in which the sunlight exposure variable had been created.

While the results of the linear regression analysis were surprising, an additional explanation for the results might be found in the correlation analysis that was performed. The correlation analysis showed that none of the independent variables were significantly related to sunlight exposure. There was not a significant relationship between any of the demographic, knowledge, efficacy, or actual behavioral variables and sunlight exposure. In this way, the correlation analysis provided another way in which to understand why the entire linear regression model using sunlight exposure as the dependent variable was not statistically significant, and why none of the independent variables were significant predictors of the dependent variable. There was simply no relationship between any of the variables that were studied based on demographic backgrounds, breast cancer knowledge, or efficacy that had any relationship or impact on sunlight exposure.

One other issue that must be considered is that there are likely factors that do have a significant impact on the amount of sunlight exposure of women on a daily or weekly basis. The results of the linear regression analysis that was performed not only showed that the independent variables included in this study were in no way predictors of the sunlight exposure of the women who took part in this investigation, but also that there are other predictors that still need to be studied. The lack of statistical significance of the

model means that more work is needed to determine the factors that do impact the amount of sunlight exposure for women on a daily or weekly basis.

Based on the results of the linear regression analysis that was performed regarding sunlight exposure with three different independent variables that were used to measure the sunlight exposure of the participants, it can be concluded that the null hypothesis that knowledge regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction cannot be rejected. Furthermore, the null hypothesis that response efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction cannot be rejected. Finally, the null hypothesis that self-efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction cannot be rejected.

Vitamin D Intake

The second issue to be examined in this study was whether knowledge of breast cancer risk factors, response efficacy, self-efficacy, demographic variables, or variables about a family history of breast cancer, receiving a mammogram or clinical breast exam in the past year, or having a primary care physician were significant predictors of the amount of vitamin D intake on the part of the participants on a daily basis. A linear regression analysis was performed with the dependent variable of daily vitamin D intake through supplementation regressed on a series of independent variables. The regression analysis was performed in three stages. The first model included the primary independent variables of interest in this study, which were breast cancer knowledge,

response-efficacy, and self-efficacy. In the second model, the demographic variables of age, educational attainment, annual income, and race were added. In the third model, the dichotomous variables of family history of breast cancer, whether the participants had received a mammogram or clinical breast exam in the past year, and whether the participants had a primary care physician.

Table 9 shows the results of the linear regression analysis. Unlike in the previous linear regression analysis with the dependent variable of sunlight exposure, this model was shown to be statistically significant according to the ANOVA. In addition, the results showed that both of the efficacy variables were significant predictors of the amount of daily vitamin D intake through supplementation. The beta coefficients for both the response-efficacy variable and self-efficacy variable are positive, which means that as response efficacy and self-efficacy as measured using the 5-point Likert scale increased, the amount of daily vitamin D intake also increased on the part of the participants.

Table 9

Daily vitamin D Intake through Supplementation Regressed on Independent Variables

	Model 1		Model 2		Model 3	
	Beta	*S.E.*	Beta	*S.E.*	Beta	*S.E.*
Breast cancer knowledge	0.01	0.01	0.01	0.01	0.00	0.01
Response-efficacy	0.55*	0.21	0.53*	0.21	0.53*	0.21
Self-efficacy	0.58**	0.18	0.57**	0.18	0.56**	0.18
Age			0.12	0.10	0.11	0.11
Educational attainment			0.05	0.18	0.01	0.18
Annual income			-0.02	0.12	-0.01	0.12
Race			-0.08	0.13	-0.08	0.13
Do you have a family history of breast cancer					0.42	0.29
Have you had any mammograms or clinical breast examination in the past year?					-0.65	0.33
Do you have a primary care physician?					0.12	0.48
(Constant)	-1.42	0.94	-1.75	1.28	-1.72	1.33
R-squared	0.155		0.143		0.163	

Note. * $p < 0.05$ ** $p < 0.01$

The adjusted *r*-squared, or the amount of variance in the dependent variable explained by the independent variables in Model 1 was 15.5%. About 16% of the variance in the amount of vitamin D intake from supplements on a daily basis on the part of the participants was explained by the three independent variables in Model 1. However, it was response-efficacy and self-efficacy that were the significant predictors of daily vitamin D intake from supplements. This finding is not entirely surprising given that these two variables were significantly related with daily vitamin D intake in the correlation analysis.

The results of Model 2 in which the demographic variables were added showed the same result of response-efficacy and self-efficacy being statistically significant predictors of daily vitamin D intake from supplements. Once again, the beta coefficients

of both variables were positive, which means that as response-efficacy and self-efficacy increased, the amount of vitamin D intake from supplementation on a daily basis also increased. The adjusted *r*-squared value for the second model was 14.3%, meaning that 14.3% of the variance in the amount of daily vitamin D intake from supplementation among the participants was explained by the independent variables in the model.

The fact that none of the demographic variables were significant predictors of the amount of daily vitamin D intake on the part of the participants mirrors the results of the correlation analysis that showed no significant relationship between any of the four demographic variables and daily vitamin D intake through supplementation. Age, educational attainment, annual income, or race were not found to have a significant impact on whether the participants increased or decreased their amount of daily vitamin D intake through supplementation. Instead, those participants who perceived that vitamin D supplementation and weekly exposure to sunlight reduced their risk of breast cancer were likely to have increased levels of actual vitamin D supplementation on a daily basis. At the same time, those participants who perceived that it was easy to obtain sunlight and vitamin D through supplementation, as well as those that believed they could easily take vitamin D on a daily basis and receive a safe level of sunlight exposure each week were more likely to actually obtain higher levels of vitamin D through supplementation on a daily basis.

The results of the linear regression analysis with Model 3 in which the three dichotomous variables were added yielded the same outcome as the previous two models. The two variables that were significant predictors of daily vitamin D intake through

supplementation were response-efficacy and self-efficacy. The dichotomous variables did not result in different variables being significant predictors of vitamin D intake through supplementation. The adjusted *r*-squared value for the third model was 16.3%.

Beyond the specific results of the linear regression model with daily vitamin D intake through supplementation, it is important to note that the results of this model were vastly different from the results of the linear regression model with sunlight exposure as the dependent variable. First, each of the models with the dependent variable of vitamin D intake through supplementation were statistically significant. The ANOVA for each model showed that the models were significant, meaning that the independent variables explained the variance in the dependent variable. This is certainly in contrast to the first linear regression analysis in which the model was not statistically significant by itself, and certainly not of the independent variables were shown to be significant predictors of sunlight exposure.

However, it should also be noted that the overall amount of variance explained by the full model of the second linear regression analysis with the dependent variable of daily vitamin D intake through supplementation was only 16.3%. This is a fairly low amount of the variance in the dependent variable to be explained by the independent variables that were studied. A total of 83.7% of the variance in daily vitamin D intake through supplementation was not explained by the variables included in the final model. The reality is that there are other factors that may have a much greater impact on the overall variability of the amount of vitamin D that women intake each day through supplements.

In the end, based on the results of the linear regression analysis of daily vitamin D intake through supplementation, the null hypothesis that knowledge regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast can risk reduction cannot be rejected. The null hypothesis that response efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer risk reduction can be rejected based on the results of the linear regression analysis. The alternative hypothesis that response efficacy regarding sunlight exposure or vitamin D supplementation does affect behaviors related to breast cancer risk reduction can be accepted. Finally, the null hypothesis that self-efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer risk reduction can be rejected and the alternative hypothesis that self-efficacy regarding sunlight exposure or vitamin D supplementation does affect behaviors related to breast cancer risk reduction can be accepted.

Summary

The purpose of this chapter was to present the findings of the analysis of the data collected in order to answer the research question of whether knowledge about vitamin D supplementation and sunlight exposure in reducing the risk of breast cancer had a behavioral impact on women. The participants who took part in this study were around the age in which women are suggested to begin having yearly mammograms or clinical breast exams. However, only about one-fifth of the women in the study reported that they had received a mammogram or clinical breast exam in the previous year. In

addition, the participants had only a medium level of knowledge about the effects of vitamin D supplementation and sunlight exposure in reducing the risk of breast cancer.

In terms of testing the hypotheses that were put forth for this study, the results of the linear regression analyses that were performed provided somewhat unexpected results. A linear regression analysis was performed to determine which variables were significant predictors of the amount of sunlight exposure of the women in the study. The results of the regression analysis showed that none of the variables included in this study were significant predictors of sunlight exposure. Even more, the ANOVA that accompanied the linear regression analysis showed that the entire model was insignificant. Based on these results, it was not possible to reject the null hypotheses that were put forth that breast cancer knowledge about sunlight exposure and vitamin D supplementation, self-efficacy, and response efficacy did not affect behaviors related to breast cancer reduction.

In contrast, the results of the second linear regression analysis that was performed using the dependent variable of the daily amount of vitamin D taken through supplementation provided more concrete information. In each of the three stages of the regression analysis that was performed using the dependent variable of daily vitamin D intake through supplementation, the variables of self-efficacy and response-efficacy were statistically significant. However, breast cancer knowledge about sunlight exposure or vitamin D supplementation was not a significant predictor of actual daily vitamin D intake through supplementation. Furthermore, none of the other demographic or dichotomous variables were significant in the model.

The results of the second linear regression analysis did not allow for the null hypothesis that knowledge regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction to be rejected. The results, however, did allow for the null hypothesis that response-efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction to be rejected and the alternative hypothesis that response-efficacy regarding sunlight exposure or vitamin D supplementation does affect behaviors related to breast cancer reduction to be accepted. In addition, the null hypothesis that that self-efficacy regarding sunlight exposure or vitamin D supplementation does not affect behaviors related to breast cancer reduction to be rejected and the alternative hypothesis that self-efficacy regarding sunlight exposure or vitamin D supplementation does affect behaviors related to breast cancer reduction to be accepted.

In the end, behaviors related to breast cancer reduction regarding sunlight exposure were not affected by any of the independent variables in this study. Behaviors related to vitamin D intake through supplementation were affected by response-efficacy and self-efficacy. Participants who had greater response-efficacy and self-efficacy were likely to report higher levels of daily vitamin D intake through supplementation.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to investigate the behavioral impact of knowledge regarding breast cancer and breast cancer risk and the role of vitamin D and sunlight exposure in reducing the risk for this disease. This study was conducted in order to fill the gap that exists with regards to the understanding of the effectiveness of knowledge pertaining to the benefits of vitamin D and sunlight exposure in reducing the risk of breast cancer actually resulting in changes in personal behaviors. While there is existing research on the impact of knowledge on modifying other risk factors related to cancer, such as the use of clinical breast examinations, diet, and exercise, no studies that examine the effectiveness of knowledge pertaining to the modifiable risk factor of vitamin D intake or sunlight seem to exist. Furthermore, while studies do exist in the literature that apply the protection motivation theory as a framework, few of these studies address breast cancer risk reduction (Blanchard et al., 2009; Gong et al., 2009). The current study was conducted to specifically examine the relationship of knowledge about vitamin D and sunlight exposure related to the reduction in risk of breast cancer.

Three specific research questions were formulated for this study:

- To what extent does knowledge regarding sunlight exposure or vitamin D supplementation affect behaviors related to breast cancer risk reduction?
- To what extent does response-efficacy affect behaviors related to breast cancer risk reduction?

- To what extent does self-efficacy affect behaviors related to breast cancer risk reduction?

The results of this study showed that knowledge regarding sunlight exposure or vitamin D supplementation did not affect behaviors related to breast cancer reduction. In fact, the results showed that none of the variables that were included in this study were significant predictors of sunlight exposure or vitamin D supplementation. However, the results did allow for the conclusion that response efficacy and self-efficacy behaviors regarding sunlight exposure and vitamin D supplementation did affect behaviors related to breast cancer risk reduction, such as spending more time in the sun or obtaining higher amounts of vitamin D through supplementation.

Interpretation of the Findings

Properly interpreting the results of this study requires that the results be placed within the context of the theoretical foundation chosen for this investigation as well as understanding the generalizability of the findings based on the sample of participants. The theoretical foundation for this study was the PMT, which is based on the idea that knowledge that appeals to a person's fears will result in personal behavioral changes (Rogers, 1975). In this case, knowledge about how the changes of having breast cancer can be reduced should result in changes in behaviors to achieve that risk reduction. However, the results of this study did not confirm that theory.

One reason for the lack of confirmation of the PMT may be explained by theories of behavioral health changes in which researchers have explained that behavioral changes related to health conditions cannot be fully explained by health knowledge (Prochaska,

DiClemente, & Norcorss, 1992). In order for behaviors to change related to health conditions, people must also have the skills to change, such as the skills to deal with the withdrawal symptoms that come from stopping smoking (Bandura, 2004). Even more, people must also see value in changing their behaviors. For example, individuals who are overweight need to change how they think about themselves and want to achieve a change, such as not being obese, in order to truly begin the process of changing their actions and behaviors related to the specific health condition (Prochaska & DiClemente, 1983).

In the case of the participants in this study, knowledge about the reduction of the changes of breast cancer by increasing sunlight exposure and vitamin D intake through supplementation may not have been associated with actual increases in sunlight exposure and vitamin D intake through supplementation because there was a lack of desire to commit to this change. The participants may not have reached a stage in which they truly desired to have an affect on their own risks for breast cancer by changing a behavior that could have an impact on reducing that risk.

The data collected from the participants in this study were not significant predictors of changes in behaviors based on knowledge regarding the reduction in risk of breast cancer from sunlight exposure and vitamin D supplementation. Even more, the entire regression model that was used to examine the relationship between knowledge regarding the risk reduction of breast cancer through sunlight exposure and vitamin D supplementation was insignificant. Factors such as knowledge about the benefits of

sunlight and vitamin D supplementation, education level, age, annual income, and race were simply insignificant in predicting changes in behavior.

One way in to interpret these results might be to argue that there are other social and personal factors that impact changes in behavior with regards to knowledge about sunlight exposure and vitamin D supplementation reducing the risk of breast cancer that were not studied. Given the fact that this is an area in which there is little research, it may not be surprising that important variables were not included in this investigation. Simply having a higher level of education or a higher level of income, which might be related to being more health conscious and having the ability to engage in healthier behaviors, may not impact women's behaviors with regards to reducing their risks for breast cancer.

However, another interpretation of these results might be that the sample of participants was simply not diverse enough to reflect the actions and behaviors of the larger population of women in the United States. All of the women chosen for this study were from New York City and generally had the same socioeconomic status. The lack of economic or geographic diversity may have influenced the results in a way that is not reliable or valid for all women across the country. A sample that included women of a range of income levels and socioeconomic classes from different cities across the country might have yielded different results.

One of the interesting findings of this study was that only 22% of the women who were surveyed indicated that they had received a mammogram in the past year, which is far below the national average of 50% of women who get mammograms every year

(Subar, Lust, & Lin, 2010). This is an important statistic given that the average age for the women in this study was between 38 and 47 years old, which is the age range in which women should be having mammograms on a yearly basis. Even more, 91% of the women in the study stated that they had a primary care physician. This would be an indication that the women had access to medical care and that not receiving a mammogram was not a function of being unable to afford or lacking access to routine healthcare.

Based on the access to healthcare for the women in this study and the lack of receiving mammograms, the assumption could be made that the women in this study were simply not concerned with their risks for having breast cancer. The findings of this study may have been a function of the lack of concern of the women who were surveyed about their own potential risks for having breast cancer. Once again, a different sample that included a greater number of women who had received a mammogram in the past year might have yielded different results.

One other interpretation is possible for the lack of significance regarding the relationship of the demographic variables included in this study and behaviors based on knowledge of the reduction in risk of breast cancer through sunlight exposure and vitamin D supplementation: a lack of concern for a disease that does not yet exist for the women in this study. In previous studies in which the protection motivation theory had been used to examine changes in behaviors related to the prevention of HIV, researchers found that knowledge related to HIV prevention did indeed result in changes in actual behavior (Azzarello et al., 2006; Blanchard et al., 2009; Lwin et al., 2010; Mbeba et al.,

2011). HIV is a disease that is widely present, both in the lives of many people and through continued information presented on television, the Internet, and in publications. In addition, many people, particularly people in the gay community, came to learn of the dangers of HIV as well as the deadly outcomes of the disease.

In contrast, while women are often told on television and in publications of the dangers of breast cancer, portrayals of women dying of the disease certainly seem less graphic as compared to portrayals of people dying of HIV/AIDS. In addition, HIV/AIDS is a disease that can be prevented, or at least greatly reduced, by changing specific personal behaviors. In contrast, breast cancer seems to be presented to the public as a disease that cannot be entirely prevented but that has certain risk factors that can be addressed. In other words, women are going to get breast cancer if the cancer cells are in their bodies regardless of their own actions and behaviors.

The issue may be less about knowledge about ways in which to reduce the risk for breast cancer leading to changes in actual behavior related to sunlight exposure and vitamin D supplementation, but about the way in which women view breast cancer. While breast cancer is certainly deadly for women and represents a real medical threat, women may treat it as other types of cancer, which is something that can only be checked for but not really prevented on a personal level. In comparison with HIV/AIDS, cancer may be viewed as something that is genetic that cannot truly be prevented, while HIV/AIDS is viewed as something that can largely be prevented through changes in sexual activities and behaviors.

There are many issues and assumptions about why there was a lack of statistical significance in predicting changes in behavior related to sunlight exposure and vitamin D supplementation in this study that cannot be addressed with the data that were collected. What is demonstrated is that this is an important area of research and investigation that needs more attention and more investigation within academia. Possessing knowledge about the risk factors associated with breast cancer does not mean that changes in behaviors will occur in order to reduce those risk factors.

Unlike the lack of statistical significance in the findings regarding the affect of knowledge on sunlight exposure and vitamin D supplementation to reduce the risk of breast cancer, the results of the statistical analyses that were performed did show that response efficacy and self-efficacy did affect behaviors related to vitamin D intake through supplementation to reduce the risk of breast cancer. The women in this study who had higher levels of response efficacy and self-efficacy in relation to taking vitamin D supplements.

From a broad perspective, these findings may not be that surprising given the behavior change theory of health that has already been discussed. In addition, while self-efficacy is an important component of behavioral changes related to health conditions, it has been noted that self-efficacy is influenced by other thoughts and ideas with regards to actual changes. A person who believes that she can indeed increase her sunlight exposure on a regular basis or increase vitamin D intake by taking supplements on a regular basis is likely to engage in such behavior. However, once actual obstacles come into play, such as not having a routine that makes it easy to take a vitamin D supplement

at the same time everyday, then self-efficacy may not translate into actual changes in behavior (Bandura, 2004).

Previous research has shown that increased knowledge on a subject is related to increases in self-efficacy and behavioral changes (Mbeba et al., 2011). In this investigation, knowledge regarding the affect of sunlight exposure and vitamin D supplementation to reduce the risk of breast cancer was significantly correlated with both response efficacy and self-efficacy. In this way, the results of the current study provide confirmation for the findings of other studies about the association between knowledge and response efficacy and self-efficacy. In addition, higher levels of response-efficacy and self-efficacy were significantly correlated with taking increased amounts of vitamin D through supplementation.

The significance of the variables of response efficacy and self-efficacy may actually help to understand why knowledge regarding breast cancer and the ability to reduce the risk of breast cancer through sunlight exposure and vitamin D supplementation was not associated with behavioral changes in this study. Response efficacy and self-efficacy were not significantly correlated with the other independent variables in this study, such as age, educational attainment, or income. Possessing a higher level of education or having a higher level of income, at least according to the findings in this study, were not associated with increases in response efficacy or self-efficacy about taking vitamin D through supplementation. However, those who had higher levels of response efficacy and self-efficacy engaged in taking more vitamin D through supplementation.

The important variables for this study, and similar studies that might be conducted in the future, might not be variables such age, education, or income, but response efficacy and self-efficacy about engaging in the behavior that is desired, such as increasing vitamin D intake through supplementation. Understanding why some people have higher levels of response efficacy and self-efficacy related to taking vitamin D supplementation might be the key in understanding and determining actual behavioral changes.

It is also important to note that response efficacy and self-efficacy in this study was significantly correlated with taking increased amounts of vitamin D through supplementation but not increases in sunlight exposure. The fact that one behavior related to a reduction in the risk of breast cancer was impacted by increases in response efficacy and self-efficacy but not the other behavior is worth considering. One assumption might be that women, and people in general, have come to fear increased sunlight exposure because of information about the risk of skin cancer. If this is the case, then it would explain why the women in this study with increased response efficacy and self-efficacy had increased vitamin D intake through supplementation but no significance change in sunlight exposure.

However, another factor that might have caused no significant relationship between response efficacy, self-efficacy, and sunlight exposure might have been the fact that all of the women were from New York City. While there are certainly many public spaces in New York City to allow people to get sunlight exposure, many people in that city work long hours in offices and do not have the time to get sunlight exposure. The

location from which the sample was drawn may have been a factor in these results. A sample of women from another city might have yielded different results.

Overall, interpreting the results of this study truly requires a consideration for how the data were obtained, perhaps more than in some other studies because of the relatively limited diversity in the participants. If the participants had been drawn from a variety of cities and locations across the country, then broader generalizations with more certainty could have been made about the significant variables and relationships that were found to exist from the statistical tests that were performed. The participants were drawn from a single city and lacked much diversity in terms of income and education. In this regard, it is certainly not possible to argue that the participants are representative of women across the United States. Even more, it is not possible to argue that the women in this study are representative of women who live in New York City.

Because of the nature of the sample of this study, the findings are best interpreted in terms of assumptions that can be used to make recommendations for future studies on this subject. This is certainly not an indication of a lack of importance or relevance on the part of this study. In fact, quite the opposite is true about the importance of this study. This is one of the few studies in which the relationship between knowledge and behavioral change has been conducted regarding sunlight exposure, vitamin D intake, and breast cancer. The interpretations and assumptions about the importance of response efficacy and self-efficacy, combined with the interpretations and assumptions about the potential that preconceived notions about the ability to control and prevent breast cancer are important because they are worth further investigation and examination.

The most important interpretation of the findings of this study may be that much more research is necessary in order to truly understand the issue in question. The results of this study should not be taken as a definitive answer about the importance or lack of importance of the PMT in explaining behavioral changes in women related to knowledge about breast cancer risk reduction. Instead, the results of this study allow for some refinement to occur in thinking about the issue, which is that response efficacy and self-efficacy may need to be studied more directly with regards to behavioral changes in women in relation to reducing the risks of breast cancer. The way in which women think about their abilities to take vitamin D through supplementation on a regular basis and to get enough vitamin D through this method seems to be important in actual behavioral outcomes.

Limitations

While some of the limitations of this study have been discussed in relation to the interpretation of the findings, it is important to specifically discuss the full range of limitations of this investigation. The first limitation of this study is the sample of participants from which the data were collected. The women who took part in this study showed little diversity with regards to socioeconomic status, age, or income. These are three demographic variables that are key to determining whether a sample is representative of the larger population of interest. The findings of this study showed that these variables were not important with regards to actual behaviors related to sunlight exposure or vitamin D intake through supplementation. While no research exists to

suggest, a sample with greater diversity in these variables might have resulted in those variables being significant predictors of behavioral outcomes, it is worth considering.

Another limitation of this study was that all of the women in the study lived in New York City. The lack of geographic diversity is important because the lifestyle of most people who live in New York City is vastly different from people who live in other parts of the United States. Even people who live in other large cities, such as Los Angeles, Chicago, or Atlanta, likely have very different lifestyles and living conditions that those who live in New York City. The lack of geographic diversity might not seem as important as the lack of diversity with regards to education, age, or income, but it may have been important in this study.

One of the variables of interest in this study was sunlight exposure. For many people who live in New York City, large numbers of hours a day are spent inside office buildings or apartments. The large urban nature of New York City is not conducive for people to get outside and spend several hours a day or week getting sunlight exposure. Even compared to Los Angeles, the lifestyle of many New Yorkers, even though the citizens of both cities live in large urban areas, are vastly different. A sample of 122 women taken from Los Angeles might have shown a higher level of sunlight exposure simply as a function of where they live and not necessary in relation to knowledge about the ability to reduce the risk of breast cancer through sunlight exposure.

An argument can be made that recruiting participants from the same geographic location is desirable for a study such as this because they are likely to face similar circumstances and conditions with regards to the ability to have sunlight exposure.

However, this does limit the ability to make inferences beyond the population of women who live in that particular city or geographic location.

Another limitation of this study is that self-reports were used to gather the data about sunlight exposure and vitamin D intake through supplementation. It is possible that the women were not accurate in reporting how many hours a day or week they spent in the sun, or how much vitamin D intake occurred on a daily basis through supplementation. A better approach to gathering those data would have been to monitor the daily sunlight exposure of the women and their daily vitamin D intake through supplementation.

The difficulties in observing the daily behaviors of the women in the study as compared to using self-reports must also be understood. Conducting a study in which the daily behaviors of the women were monitored would have required a great deal of time and money. Financial resources would be needed to be able to hire people to observe the women throughout their daily schedules for a period of several days or several weeks. It should be obvious that without a large amount of financial resources, such study could not be conducted.

The use of self-reports is indeed a limitation. However, it is a limitation that could not be overcome in this study, and likely could not be overcome in many studies. Instead, the realty that self-reports allow these types of studies to be conducted must be recognized, while also understanding that there is a limitation. It is always possible that the people who were surveyed were not accurate or even not honest in the information that they provided. Some of the participants may have attempted to indicate daily and

weekly sunlight exposure that they believed was correct in relation to the purpose of this investigation. Furthermore, they may have indicated daily vitamin D intake based on what they thought was the correct daily amount rather than their actual daily intake levels.

The way in which the survey was administered also represents a potential limitation to this study. The survey was administered online rather than in a face-to-face manner. The participants completed the surveys on their own time, which may have meant that some of the surveys were completed in noisy offices or at home while trying to take care of children or interact with family members. It is possible that the participants were not fully concentrating on their answers, or even rushed through the survey in order to complete it. An effort was made to reduce the amount of time required to complete the survey by limiting the questions on the survey. In addition, the participants had to be in front of computers or other devices connected to the Internet in order to complete the survey, which hopefully means that they were focused on taking the survey.

Even with the efforts that were made to reduce the potential for the participants to rush to complete the survey or not fully think about their responses, there is always a risk with surveys that are not conducted in a controlled environment for the participants to not fully consider their responses. However, attempting to conduct this investigation by requiring the women to visit a specific location at a specific time to complete the survey in a controlled environment would have been difficult. The women who were included in this study generally had jobs and other activities that filled their days. Even more, travel

in New York City is not like travel in other cities. That being said, perhaps in the new reality of the Internet world people are more accustomed to and comfortable with on line surveys and evaluations.

The participants who took part in the study were not screened in any way to determine if they had any deficits in cognitive functioning, or if they could fully understand the questions that were included on the survey. Any cognitive deficits in the participants would have impacted their ability to understand the questions and provide accurate responses. Furthermore, psychological conditions could have also causes anxiety among the participants with regards to the information that they provided to the survey questions.

While the issue of the cognitive abilities of the participants is certainly important, attempting to screen for cognitive deficits was certainly beyond the scope of this investigation. Any attempt to discern the cognitive abilities of the participants in order to judge whether they should have been included in the investigation would have raised both ethical and validity issues. From an ethical standpoint, attempting to screen participants for cognitive functioning would have required a method that was deemed appropriate in survey form, and would have required a person to examine those responses with a background in that area of research and investigation. From the standpoint of validity, it seems unlikely that a survey would be considered appropriate to evaluate the cognitive functionality of potential participants, and certainly not without someone with knowledge in that area.

The survey that was used in this investigation was relatively monothematic in nature. It focused on breast cancer, vitamin D, and exposure to sunlight. By focusing solely on these themes, other important factors might have been missed. One important factor that might have been missed was the degree to which individuals may have been conflicted by concerns about the potential health issues surrounding over exposure to sunlight. Knowledge can only lead to behavior change if beliefs change and in this case participants may exhibit knowledge of the topic, but due to conflicting information on sun exposure, may not in fact change beliefs or behavior.

The results of the data analyses that were performed showed that response efficacy and self-efficacy about vitamin D intake through supplementation and sunlight exposure were only significantly correlated with increases in vitamin D intake through supplementation. There was no significant correlation between response efficacy, self-efficacy, and sunlight exposure. This may indeed be an indication that perceptions about sunlight exposure, and the fear of too much sunlight exposure, was more important to the participants in the study than the effects of sunlight exposure to reduce the risk for breast cancer.

Overcoming this limitation would have required that the participants be asked about their perceptions of sunlight exposure. In addition, the participants could have been asked how much sunlight exposure per day or per week they believed was appropriate before increasing their risk for skin cancer. By asking those questions, it would have been possible to examine the relationship between perceptions about the risk of skin cancer from sunlight exposure and sunlight exposure as a means of reducing the

risk for breast cancer. If the participants in the study received an average daily or weekly sunlight exposure that was equal to what they perceived to be a healthy limit, then the conclusion might have been that the women believed they were receiving enough sunlight exposure without creating an increased risk for skin cancer. Alternatively, if the women reported an average daily or weekly sunlight exposure that was less than what they indicated to be a safe level of sunlight exposure, then other factors could have been considered, such as not having time to be in the sun because of work or other activities.

One other limitation of this study was that the health conditions of the women were not known. The participants were asked whether there was a history of breast cancer in their families, and whether they have received a mammogram in the past year. The participants were also asked if they had received a previous diagnosis of breast cancer, they had sensitivity to sunlight or vitamin D, and whether they had tested positive for a harmful mutation to the BRCA1 or BRCA2 gene. However, beyond those questions, the participants were not asked to indicate whether they had any other serious medical conditions at the time they completed the surveys, or whether they had ever had any other type of cancer. As with the information about fears of sunlight exposure, information about current or previous medical conditions might have also allowed for more insight into the beliefs and behaviors of the women with regards to sunlight exposure and vitamin D supplementation. For some of the women, taking supplements, including vitamin D supplements, might have been a result of needing to take them for other medical conditions. The women might have been advised to take vitamin supplements in general, or vitamin D supplements specifically, by their physicians. In

other cases, the women might not have been able or might not have desired to take such supplements because of current or past medical conditions.

The medical conditions of the women who took part in the study may have also impacted their daily and weekly sunlight exposure. It is possible that some of the participants in the study had medical conditions that necessitated a reduced amount of sunlight exposure, or even an increase in sunlight exposure. Once again, more information about the women would have allowed for a more thorough analysis of behaviors in relation to both breast cancer knowledge and their personal beliefs and medical conditions that might have impacted their behaviors. The lack of information about the full range of medical conditions of the women does not mean that the information they provided about sunlight exposure and vitamin D intake through supplementation was incorrect. Instead, more information would have indeed been useful to understand the results that were found as part of this investigation.

Recommendations

Based on the interpretations of the findings of this study and the limitations that have been discussed, it is possible to make several recommendations for future studies on the subject of knowledge about the benefits of sunlight exposure and vitamin D supplementation to reduce the risk of breast cancer. The first recommendation is for this study to be replicated with a random sample that is representative of a larger population within the United States. Future research would be greatly improved by attempting to put together a sample of participants that is more geographically diverse, as well as

consisting of participants who are randomly selected in order to attempt to have a sample that is representative of the population of women in the entire United States.

Another recommendation for replicating this study with a greater level of validity is to screen the participants for perceptions about sunlight exposure and about current and past medical conditions that might be related to cancer, sunlight exposure, or vitamin D supplementation. By including these variables and issues within the context of the investigation, the results can be grounded in both the lifestyles and conditions of the participants, as well as the effects of knowledge related to reducing the risk of developing breast cancer.

Beyond simply improving upon the limitations that have been identified in the methods used to conduct this study, there are other ways in which future investigations on this topic can expand upon the limited knowledge that presently exists. First, future research should be conducted with a greater focus on response efficacy and self-efficacy. From the findings of this study, response efficacy and self-efficacy were the two variables of greatest importance with regards to actual behaviors in reducing the risk of breast cancer. More research is needed about the factors that are related to response efficacy and self-efficacy. Response efficacy and self-efficacy are likely impacted by other intervening variables. It would be useful to understand the variables that effect response efficacy and self-efficacy, which, in turn, affect behaviors related to sunlight exposure and vitamin D intake through supplementation.

It is also recommended that researchers focus more attention on the perceptions and attitudes of women about sunlight exposure. A great deal of attention has been given

to the idea that too much sunlight exposure is negative because of the increased threat of developing skin cancer. However, sunlight exposure has also been shown as a way to reduce the risk for developing breast cancer because of vitamin D. The results of this study showed that there was no correlation between response efficacy, self-efficacy, and sunlight exposure. The lack of significant correlation between those variables may not have been a function of response efficacy or self-efficacy, but a function of concerns about too much sunlight exposure on the part of the participants.

Researchers need to investigate whether perceptions and beliefs about the dangers of sunlight exposure have an affect on whether women are willing to increase sunlight exposure as a means of reducing the risk for developing breast cancer. This might be investigated by asking the participants how many hours per day and per week they believe is the maximum amount of sunlight exposure that is acceptable before their increase their risks for developing skin cancer. In addition, researchers might ask the participants if they would be willing to increase their sunlight exposure beyond what they believe to be the maximum safe level in order to reduce the risk for developing breast cancer.

These types of questions would serve to allow researchers to understand if women have a perception of the maximum level of sunlight exposure per week that is lower or higher than what has been found to be acceptable without increasing the risk of developing skin cancer. At the same time, asking questions about actual sunlight exposure per day and per week would allow for an understanding of whether the participants receive as much sunlight exposure as they perceive to be the maximum level

that is safe, as well as much sunlight exposure as researchers have found to be safe levels of sunlight exposure. The goal in all of this would be to determine if fears about sunlight exposure as a means of reducing the risk for developing breast cancer among women are grounded in reality, or whether they are grounded in incorrect beliefs. This type of research might indicate that more educational outreach is needed to help women feel safer increasing sunlight exposure as a means of decreasing the risk for breast cancer.

An issue that was discussed in interpreting the findings of this study was whether women were proactive in attempting to reduce their risks for breast cancer, or whether they perceived breast cancer as something that was beyond their control. More research is needed to understand if women, even those with knowledge that sunlight exposure and increases in vitamin D intake through supplementation can reduce the risk for developing breast cancer, may believe that such efforts are actual futile. In this study, a relatively small percentage of the participants had received a mammogram in the previous year even though most of them reported having a primary care physician. The disconnect between having a primary care physician and actually receiving a mammogram is not something that should be ignored or overlooked.

Women may have a perception that attempting to change their behaviors to reduce the risk of breast cancer may have a minimal effect on the actual risk of developing breast cancer. If this is indeed the case, then it would be an indication that more educational outreach is needed to help women understand that their risks for developing breast cancer can be reduced by increasing vitamin D intake through sunlight exposure. However, if women generally believe that they can change their behaviors to have an effect on their

risks for developing breast cancer, then this also needs to be understood because it would indicate that some other factor is at work.

The theory of PMT has been used in studies involving a variety of medical conditions and diseases as the foundation for understanding changes in behaviors to reduce the risk of developing or contracting those conditions and diseases. Much more needs to be known about whether this theory is an appropriate foundation for investigating behavioral changes in women with regards to reducing the risk for developing breast cancer. This need to test the theory of protection motivation relates to sunlight exposure and vitamin D intake through supplementation, as well as in relation to breast cancer in general.

While conditions such as HIV/AIDS and other illnesses have been examined in relation to this theory in great detail, it seems breast cancer reduction through behavioral changes, and particularly reducing the risk of breast cancer through increases in vitamin D intake, is an area that has been ignored or overlooked within the academic literature. It is highly recommended that more attention be given to whether women are adjusting or changing their behaviors to reduce the risk of breast cancer with regards to all types of risk reduction factors related to the disease. The focus of this study was on sunlight exposure and vitamin D intake through supplementation, which is clearly an area where much more research and investigation is needed. However, the larger idea of behavioral change to reduce the risk of breast cancer also seems like a general area in which there is a gap in the academic literature.

Researchers need to take the effort to investigate whether women are changing their behaviors with regards to ways in which the risk of developing breast cancer can be reduced. Furthermore, researchers need to investigate why women may not be engaging in changes in behavior that could result in the reduction in risk for developing breast cancer. With a condition that is the leading cause of death for women, it only makes sense to investigate why women may not be trying to increase their vitamin D intake, or even why so many seem to not be getting the yearly mammograms they need to identify if they have breast cancer.

Significance of the Study

The true importance and significance of this study is that many questions have been raised based on the results that have been presented. These questions should not be used to reduce the importance of this study. Instead, it is the many questions that have been raised that is an indication of the importance of this study. There is clearly a lack of information and knowledge on this area of investigation, which researchers need to help improve so that physicians and even women can increase their knowledge and understanding of the subject.

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Appendix A: Informed Consent

You are invited to participate in a research study concerning health behaviors associated with decreased risk of breast cancer. You have been chosen, as it is possible you have knowledge regarding the topic. This study will help to fulfill the requirements for a doctoral degree in Public Health at Walden University. The purpose of this study is to investigate the behavioral impact of knowledge regarding the relationship between breast cancer, vitamin D supplementation and sunlight exposure considering levels of self-efficacy and response efficacy. There are no known risks to participants in this study. The information you provide by participating may increase understanding of how to design effective information programs that help people adopt healthy behaviors. You will then be asked to complete a survey online administrated by SurveyMonkey. The entire process should take less than an hour.

You will be asked to complete a demographic questionnaire as well. You will be contacted via email directly from SurveyMonkey. The email will contain a link to use to access the survey. The survey will be conducted in accordance with SurveyMonkey's Terms of Service, and may include a charitable contribution made to a selected charity of your choosing. You will also be entered into a drawing through SurveyMonkey for a chance to win a $100 Amazon Gift Card. Your contact information and other personal information will not be shared with any other parties. All information given by you in accordance with this study will remain completely confidential. SurveyMonkey will not retain your personal information, nor use or share that information unless you expressly permit the company to do so. Should you have any questions regarding this research you can contact a Walden University representative at 001-612-312-1210 or irb@waldenu.edu. Please feel free to keep a copy of this form consent form. Should you need to contact the researcher with any questions you may have and this contact information is included in the email. This information will be maintained in a secure computer file to which only the researcher has access.

Your participation in this study is voluntary. You are free to withdraw from this study, without penalty, at any time without providing any reason for the withdrawal.

This study has been approved by the Institutional Review Board at Walden University. The approval number for this study is 03-03-15-0132784 and it expires March 3, 2016.

Participant's Agreement:

I have read the information provided above. I voluntarily agree to participate in this study.

_____

Signature of Research Participant Date

_____

Printed Name of Research Participant