ABSTRACT

The Impact of Health Literacy on Health Behaviors of Waco Residents

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Literacy, especially health literacy, is lacking in the U.S. adult population, especially among people of low socioeconomic status. According to the 2003 National Assessment of Adult literacy, 36% of adults have below average competence in interpreting and acting upon health information. Low health literacy has been linked to poor patient outcomes and higher rates of negative health behaviors, but results of studies examining the association of health literacy with smoking behavior and alcohol consumption have been mixed. Furthermore, few, if any, studies have investigated the relationship of health literacy with health anxiety. In this study, we measured health literacy among adults at the Waco Family Health Center using the Newest Vital Sign tool. Smoking and alcohol use behaviors were gathered from EPIC medical records as reported by patients to their primary care physician. Health anxiety was tested using a shortened Whiteley Index. The data were then analyzed for correlations between health literacy and each variable separately, controlling for demographic factors such as race and socioeconomic status. Results indicate that smoking is associated with lower health literacy, but no relationship was found between health literacy and alcohol consumption. There was no statistically significant relationship between health literacy and health anxiety; however, trends in the data indicate that lower health literacy may be associated with higher health anxiety. The relationship between health literacy and risky health behavior like smoking highlights the importance of adequate health literacy education and indicates a potential benefit of screening for health literacy in a primary care setting.

The Impact of Health Literacy on Health Behaviors of Waco Residents

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CHAPTER ONE

Background and Introduction

Literacy in the United States

The ability to communicate via written word, or literacy, is of vital importance in an increasingly fast-paced and interconnected world. In fact, the U.S. Department of Education's National Center for Education Statistics revised the definition of literacy in order to reflect the functional importance of this skill. In the 1992 National Adult Literacy Survey, the definition was broadened to: "Using printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential" (Kirsch, Jungeblut, Jenkins, & Kolstad, 1993, p. 2).

Low literacy continues to be a growing problem among American adults. The 1992 National Adult Literacy Survey (NALS) assessed literacy on a five-level scale, with the lowest two out of the five levels corresponding to inability to integrate complex verbal or mathematic information (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Results from the survey indicated that 48% of adults scored in the lowest two out of five levels on prose literacy and 51% scored in the lowest two levels on document literacy (Kirsch et al., 1993). For adults 65 years of age and older, 85% scored in the bottom two levels and 0% scored in the highest level of proficiency (Kirsch et al., 1993).

Furthermore, results from the 2012 and 2014 Program for the International Assessment of Adult Competencies (PIAAC) indicated that overall levels of literacy have improved little over time (Rampey et al., 2016). The investigators conducting the PIAAC used an updated version of the NALS scale, and results revealed that 46% of US adults

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scored in the bottom two levels of the scale, with an additional 4% scoring "Below level 1" (Rampey et al., 2016). Among adults over 65 years old, 59% scored in the bottom two levels and 8% scored below level one (Rampey et al., 2016). It is clear that low literacy remains a large problem in the United States.

Health Literacy in the United States

Definition of Health Literacy

Health literacy is a specific type of literacy that is especially relevant today. Millions of Americans will soon need to navigate the health care system in order to obtain new health care coverage. Health literacy is defined by the National Library of Medicine as, "The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (U.S. Department of Health and Human Services, 2000, p. 2). Similarly, the Agency for Healthcare Research and Quality defines health literacy as "a constellation of skills that constitute the ability to perform basic reading and numerical tasks for functioning in the health care environment and acting on health care information" (Berkman et al., 2004, p. 1). Health literacy is required to follow a doctor's instructions and to navigate the health care system effectively.

Levels of Health Literacy

Levels of health literacy for the entire U.S. population are similar to levels of overall literacy. On a scale of Below Basic, Basic, Intermediate and Proficient, the majority of adults (53%) were found to have "Intermediate" health literacy (Kutner, Greenburg, Jin, & Paulsen, 2006). However, data from the NAAL revealed that 36% of

adults had Basic or Below Basic health literacy, and thus had below average competence in interpreting and acting upon health information (Kutner et al., 2006).

Health literacy levels are lower among those with less education, but improve with each additional level of education attained (Kutner et al., 2006). Furthermore, health literacy levels are markedly low among more vulnerable populations, including the poor and the elderly. Specifically, 27% of adults who are covered by Medicare and 30% of adults covered by Medicaid have Below Basic health literacy (Kutner et al., 2006). An additional 30% of people covered by Medicare as well as 30% of people covered by Medicaid have Basic health literacy, for a total of 57% of people on Medicare and 60% of people on Medicaid having health literacy levels below the national average (Kutner et al., 2006). These findings indicate that adults above 65 and adults living below the poverty line are significantly more likely to have low health literacy than younger or more affluent adults.

Disparities in health literacy are also a concern among certain ethnic groups. In the 2003 NAAL, 41% of Hispanics surveyed had Below Basic health literacy while 25% had Basic, and 24% of African Americans had Below Basic health literacy while 34% had Basic. In contrast, 9% of whites and 13% of Asian/Pacific Islander participants had Below Basic health literacy (Kutner et al., 2006). These differences are important because race/ethnicity is known to be related to disparities in health, and racial/ethnic disparities in health literacy levels could play into or exacerbate these health disparities (Williams & Sternthal, 2010).

Patient outcomes. The skill-centered definitions for health literacy provided by the U.S. Department of Health and Human Service and the Agency for Healthcare Research and Quality imply that health literacy is necessary to navigate the health care system in order to receive optimal care and maintain health. There is also evidence that health literacy may play a role in some health disparities. As the American Medical Association (1999) pointed out, the health care industry is becoming more and more market driven, which requires patients to use information wisely to be responsible consumers. Shi & Singh (2016) note that in order for patients to effectively decide how to spend their money on healthcare, they need either the knowledge or the ability access resources to understand what healthcare services are best for their needs. This means patients without the ability to understand healthcare resources are at an economic disadvantage when navigating the healthcare market. Parker, Ratzan, & Lurie (2003) stated that such disparities will widen as the health care system continues to become more market-driven. People living below the poverty line already have overall worse health due to environmental conditions and the psychosocial stressors associated with living in an impoverished environment (Cohen, Janicki-Deverts, Chen, & Matthews, 2010). Low health literacy may compound these issues because it leads to an inability to fully understand and utilize health care options.

Health literacy has also been linked to physical and mental health outcomes independent of socioeconomic status, race, and other factors that traditionally are known to be related to decreased health (Williams & Sternthal, 2010). Wolf, Gazmararian, and Baker, (2007) found that older adults with lower health literacy demonstrated worse

physical function and mental health status, even when controlling for chronic conditions, negative health behaviors, socioeconomic factors and demographic factors. In their extensive literature review, DeWalt et al. (2004) noted that low health literacy was associated with less use of preventative healthcare, increased risk of hospitalization, increased risk of depression in women and the elderly, later presentation with prostate cancer, worse diabetes self-management and outcomes, and overall lower reported health status. Lower health literacy has also been associated with poor medication adherence and self-management, more emergency department visits, and poorer outcomes for asthma patients (Mancuso & Rincon, 2006).

Health care system as a whole. Low health literacy not only affects patient outcomes, but also the health care system as a whole. The American Medical Association in its 1999 report on health literacy indicated that low health literacy is likely a major source of avoidable costs for both patients and insurance providers. Data from two high-quality studies support this assertion, although there is some disagreement in the literature (Weiss & Palmer, 2004; Howard, Gazmararian, & Parker, 2005; American Medical Association, 1999). What is clear, however, is that lower health literacy means poorer understanding of a doctor's instructions, which has been shown to lead to decreased patient compliance—a potential cause of medical mistakes (Hussey & Gililand, 1989). The American Medical Association (1999) recognizes case law evidence that healthcare professionals and hospitals can be considered liable for adverse outcomes caused by a patient's lack of understanding of health information.

The widespread effects of low health literacy necessitate that physicians take responsibility in addressing this issue, for the sake of their patients as well as their

profession. Accordingly, in 2000 the U.S. Department of Health and Human Services

(USDHHS) made improving health literacy one of the goals for the Healthy People 2010

initiative. In 2003, the Institute of Medicine (now known as the National Academy of

Medicine) declared health literacy a priority area for national action (K. Adams &

Corrigan, 2003).

Relationship Between Health Literacy and Health-Risk Behaviors

The proposals by the USDHHS and the National Academy of Medicine have led

to an increase in research pertaining to health literacy, its relationship to health outcomes,

and possible interventions to help improve it. Nonetheless, there is still disagreement as

to the specific relationship of health literacy and health-risk behaviors. In particular,

there is no consensus regarding the relationship of health literacy levels with smoking

behavior and alcohol consumption.

Health literacy and smoking behaviors. According to the Center for Disease

Control and Prevention (CDC) (2016), smoking cigarettes is the primary cause of

preventable disease and death in the United States. Understanding which populations are

likely to smoke is important because this information could allow physician and public

health workers to tailor interventions to those populations. As of 2015, 15.1% of

American adults smoked regularly (CDC's Office on Smoking and Health, 2016). The

percentages of smokers were much higher for those with less education – 24% of adults

who did not graduate high school smoked, as well as 34.1% of adults with a GED and

19.8% of those with a high school diploma (CDC's Office on Smoking and Health,

2016). Smoking rates were also higher for those living in poverty: 26.1% for adults

living below the poverty level vs. 14% of adults at or above the poverty level (CDC's Office on Smoking and Health, 2016). Because health literacy is also lower among those with less education and those living in poverty, there may be a correlation between health literacy and smoking.

However, findings from several studies have been mixed. Researchers conducting a study at two obstetrics and gynecology clinics in Louisiana found that pregnant white women who were older, had more education, and demonstrated higher literacy smoked more than African American pregnant women (Arnold et al., 2001). These results seem to suggest that higher general literacy is correlated with increased smoking behavior. It was also reported in a study of young Swiss men that those with higher literacy were more likely to smoke (Dermota et al., 2013). Wolf et al. (2007) found that individuals with lower literacy were more likely to have never smoked, although the correlation was no longer significant when adjusted for demographic and socioeconomic covariates.

Conversely, data from studies of parents in child clinics and colorectal cancer survivors support the notion that lower health literacy is related to higher smoking rates (Frederickson et al., 1995; Husson, Mols, Fransen, van de Poll-Franse, & Ezendam, 2015). Also, researchers examining health literacy and smoking in African Americans revealed that those with lower health literacy were 68% more like to be current smokers than those with higher health literacy (Hoover et al., 2015). These results could suggest that health literacy may be associated with difference in smoking status *within* races, but that health literacy may not be a mediating factor in the differences of smoking behaviors *between* races. Similarly, in a study of patients with low socioeconomic status seeking

treatment to quit smoking, patients with lower health literacy relapsed more often than those with higher health literacy (Stewart et al., 2014). Again, such results could indicate that health literacy predicts variation in smoking behavior within a socioeconomic demographic.

Finally, data from studies in non-American populations demonstrate a correlation between smoking behavior and health literacy. Researchers conducting a study of elderly Chinese noted that health literacy was inversely correlated with probability of engaging in risky behaviors, which they defined as smoking, regular alcohol consumption, and lack of exercise (Liu, Liu, Li, & Chen, 2015). In a study of preteens in Australia, the researchers found that adolescents with lower general literacy were more likely to smoke (Hawthorne, 1997). Further research is necessary to clarify the relationship between health literacy and smoking.

Health literacy and alcohol use. Alcohol consumption is prevalent in American culture. Published results from the 2015 National Survey on Drug Use and Health indicate that 86.4% of adults over 18 have consumed alcohol at some point in their lifetime, and 56.0% have consumed alcohol in the past month (Center for Behavioral Health Statistics and Quality, 2016). While moderate amounts of alcohol are not considered harmful, heavy consumption can lead to alcohol poisoning, cirrhosis, liver disease, birth defects, and death, in addition to countless emotional and interpersonal problems (Meyer & Quenzer, 2013). Alcohol consumption is also a risk factor in cancers of esophagus, pharynx, larynx, liver, mouth, and breast (National Cancer Institute, 2017). Even so, 26.9% of adults over 18 reported binge consumption of alcohol in 2015, and

7.0% reported heavy consumption (binge consumption five or more times in the last 30 days) (Center for Behavioral Health Statistics and Quality, 2016).

Like smoking, identifying populations that are at risk for alcohol abuse could help tailor interventions. However, despite the prevalence of alcohol abuse, there are relatively few studies examining the relationship between health literacy and alcohol use, and the results from existing studies are varied. For example, Liu et al. (2015) found alcohol use to be similar to other health risk behaviors, in that those with higher health literacy are less likely to engage in alcohol use. In addition, Hawthorne (1997) found that lower general literacy was a predictor of teenage alcohol use for boys, but not for girls.

Conversely, the results from several studies indicate that participants with higher health literacy were more likely to consume alcohol (R. J. Adams et al., 2013). Dermota et al. (2013), in their study of young men in Switzerland, found that those with higher health literacy drank more alcohol. Similarly, Chisolm, Manganello, Kelleher, & Marshal (2014) reported that American adolescents with higher health literacy were more likely to report alcohol use. Husson et al. (2015) conducted a study of colorectal cancer survivors and found overall that low health literacy was associated with increased health-risk behaviors, including smoking, but that survivors with lower health literacy were more likely to indicate not using alcohol. This is another topic that merits further investigation and clarification.

Health literacy and health anxiety

The changing definition of health anxiety. Another health behavior that is of concern is health anxiety and its relationship to health literacy. Health anxiety is defined

as "anxiety that arises when bodily sensations or changes are believed to be indicative of a serious disease, or…excessive worry about having or getting a serious illness" (Bobevski, Clarke, & Meadows, 2016, p. 13). According to a 2001 study, the prevalence of health anxiety in the general population is 6.2% (Looper & Kirmayer). However, other researchers found the prevalence of health anxiety specifically in medical clinics to be nearly 20% (Claude, Hadjistavropoulos, & Friesen, 2014).

Interestingly, health anxiety has not been found to be related to socioeconomic status or to be more common in one gender (Rask et al., 2016; Looper & Kirmayer, 2001). Health anxiety can be a symptom of many different psychological disorders, including obsessive compulsive disorder, panic disorder, generalized anxiety disorder, and major depressive disorder (Abramowitz, Olatunji, & Deacon, 2007). When health anxiety occurs on its own rather than as a symptom of a psychological disorder, the severity can range from non-pathological to a serious psychiatric disorder that used to be referred to as hypochondriasis (Hadjistavropoulos et al., 2012).

Many researchers conducting early studies about health anxiety examined specifically hypochondriasis, which has been defined as "obsessive rumination with intrusive thoughts, ideas, or fears of harboring an illness that cannot be stopped or can be stopped only with great difficulty" and often includes misinterpretation of bodily functions and sensations, fascination with medical information, fear of contamination, and/or fear of medication (Fink et al., 2004, p. 1683). Looper and Kirmayer (2001) found the prevalence rate of hypochondriasis to be around 1.7% in a sample of Canadian adults. However, with the advent of the DSM-5 in 2016, hypochondriasis was declared obsolete,

and it has now been divided into somatic symptom disorder (SSD) and illness anxiety disorder (IAD) (Hedman, Axelsson, Andersson, Lekander, & Ljótsson, 2016).

In the DSM-5, somatic symptom disorder is defined as involving "one or more somatic symptoms that are distressing or result in significant disruption of daily life…[and] excessive thoughts, feelings, or behaviors related to the somatic symptoms or associated health concerns" (American Psychiatric Association, 2013, para. 9). Similarly, illness anxiety disorder entails "a preoccupation with having or acquiring a serious, undiagnosed medical illness... [but] somatic symptoms are not present or, if present, are only mild in intensity" (American Psychiatric Association, 2013, para. 26). It is estimated that 75% of previous diagnoses of hypochondriasis would now be classified as SSD, and 25% would now be classified as IAD (Hedman et al., 2016). Both of these disorders involve health anxiety as a feature.

The effects of health anxiety. Health anxiety and associated psychiatric disorders are associated with significant physical and psychological morbidity. People with health anxiety have lower self-reported mental and physical health, including anxiety and depression (Bobevski et al., 2016; Hall, Rodin, Vallis, & Perkins, 2009; Fink, Ørnbøl, & Christensen, 2010; Looper & Kirmayer, 2001; Simon, Gureje, & Fullerton, 2001; Robbins & Kirmayer, 1996).

Because patients with health anxiety often seek medical reassurance to attempt to alleviate their anxiety, health anxiety has costly impacts on the health care system as well. Fergus, Bardeen, Gratz, Fulton, and Tull (2015) found that health anxiety was correlated with significantly increased emergency department use in substance abusers, and cited a New England Healthcare Institute study in which researchers claimed that

health anxiety costs the health care system $38 billion annually in emergency department overuse costs. Fink et al. (2010) agreed that severe health anxiety had a long-term impact on health care costs, stating that such patients used 41-78% more health services than patients without health anxiety. Additionally, Bobevski et al. (2016) determined that health anxiety made patients significantly more likely to visit their primary care doctors and medical specialists. They noted that patients with somatic symptom disorder especially present a unique problem for doctors, who are not well-equipped to deal with medical issues in which there is no physical symptom of disease.

Patients with health anxiety also cause difficulties for doctors because they are less likely to comply fully with their treatment regimen. For example, Claude, Hadjistavropoulos, and Friesen (2014) stated that health anxiety was related to lower compliance with dietary and exercise regimens for diabetes patients. Also, as previously mentioned, some health anxiety patients are afraid of prescription medication, which may make them less likely to maintain their prescriptions.

Potential relationships between health anxiety and health literacy. Few studies have been conducted examining the relationship between health literacy and health anxiety. Researchers in Japan examined the relationship between health literacy and risk perception and health-risk anxiety, and another group of American researchers related health literacy to perception of cancer risk in female breast cancer survivors (Ishikawa, Kato, & Kiuchi, 2016; Brewer et al., 2009).

Despite the lack of research, understanding the connection between health literacy and health anxiety could be important in clinical practice because it could help physicians identify which patients may be at risk for health anxiety and how best to educate such

patients on managing their physical illnesses and/or unexplained symptoms. Understanding this relationship would also help clinicians treating health anxiety to tailor their interventions toward the health literacy levels of the most commonly-affected populations. Furthermore, medical information is becoming easily accessible online, and it will be important for physicians to understand the role that comprehension of such information plays in health anxiety in order to decide how best to deal with anxious and self-diagnosing patients.

There are several ways in which health anxiety and health literacy could be related. One possible connection could be that health literacy impacts the cognitive processes underlying anxiety. Hadjistavropoulos et al. (2012) described the cognitive behavioral model of health anxiety as suggesting that the emotional distress in health anxiety comes from a misattribution of normal bodily symptoms and harmless health information as catastrophic signals of disease. Individuals with low health literacy may be more likely to make such misattributions, especially if they research health information online and misinterpret that information. Fergus and Dolan (2014) found that searching for health information online leads to an increase in anxiety for 38% of individuals who do so.

Hadjistavropoulos et al. (2012) also demonstrated that health anxiety was related to higher scores on four scales: perceptions of Difficulty Coping with Illness, Medical Services Inadequacy, Likelihood of Illness, and Awfulness of Illness. People with low health literacy may feel more intimidated by the idea of coping with an illness because the health care system itself seems overwhelmingly complicated and because they do not understand the doctor's instructions for how to manage the disease. They may also have

misconceptions about the likeliness of disease and overestimate their chances of contracting or developing a serious illness. For example, Brewer et al. (2009) noted that women with lower health literacy overestimated their own risk of having cancer recurrence as compared to women with higher literacy. Lower health literacy is also associated with worse attitudes about and lower satisfaction with treatment, which could also lead to increased perception of Medical Services Inadequacy, a feature of health anxiety (Paasche-Orlow & Wolf, 2007).

Furthermore, lack of health literacy has been shown to cause feelings of helplessness and shame when dealing with the health care system (Paasche-Orlow & Wolf, 2007). Such feelings are related to an external locus of control in a health care setting, or the feeling that one does not have control over one's own health decisions, treatment, or outcomes. Skidmore, Dyson, Kupper, & Calabrese (2014) state that lower internal health locus of control (HLOC) and high external HLOC predicts increased anxiety. Thus, HLOC could be a mediating pathway connecting low health literacy to health anxiety.

In contrast, it could be that higher health literacy is a factor that leads to health anxiety. A well-known cultural example of this relationship is that medical students have unusually high health literacy compared to the general population, but often experience anxiety and hyperawareness about health (Collier, 2008). The results of the Japanese study of health literacy and health-risk anxiety also suggest a relationship between higher health literacy and greater reaction to health risk. Ishikawa et al. (2016) found that while there was no difference in perception of health risk or anxiety about health according to health literacy, those with higher health literacy were more likely to react to health risks

with protective behaviors. These results at the very least suggest that higher health literacy leads individuals to think more about health risks, thus leading to action to mitigate risk.

In contrast, health anxiety could be the cause of increased health literacy. One reason for such an association is that people with health anxiety tend to use health services more often (Bobevski et al., 2016). More experience with the health care system could lead to an increase in health literacy for such patients. Furthermore, patients with health anxiety are much more likely to use the Internet to research health information (Eastin & Guinsler, 2006). Reading about health information online could also lead to higher health literacy as a result of increased exposure to medical information. Because both health literacy and health anxiety affect utilization of the health care system, understanding their interaction could be useful in addressing inappropriate uses of the healthcare system.

Purpose and Hypotheses

This purpose of this study was to examine the relationship between health literacy and health-risk behaviors, including smoking, alcohol use, and health anxiety in patients at a local federally funded clinic in a mid-size city in the Southwestern United States. To date, the results of similar studies have been mixed, and few have been conducted in a multiracial population of low socioeconomic status (Hoover et al., 2015). Additionally, there are few studies designed to examine health literacy and its relationship to health anxiety. Information about the relationship between health literacy and health behaviors could allow physicians to use health literacy as a tool to assess risk of smoking, alcohol use, and health anxiety, and also consider literacy level when assessing risky health

behaviors. Furthermore, the aim of this pilot study to examine the relationship between health literacy and health anxiety could act as a starting point for researchers to examine the association in more detail, including the impact it may have on future health education, health anxiety treatment, and the phenomenon of online medical information.

Research Questions

In this study, we sought to address the following research questions:

1. What is the relationship between health literacy and smoking status in a racially diverse population of adults of low socioeconomic status, and how is this relationship affected by race/ethnicity, sex, and age?

2. What is the relationship between health literacy and alcohol use in a racially diverse population of adults of low socioeconomic status, and how is this relationship affected by race/ethnicity, sex, and age?

3. What is the relationship between health literacy and health anxiety in a racially diverse population of adults of low socioeconomic status, and how is this relationship affected by race/ethnicity, sex, and age?

Hypotheses

We hypothesize that, when controlling for race, lower health literacy will be associated with increased smoking behavior. We also hypothesize that alcohol and health literacy will not be correlated in this study population, but that alcohol use depends on cultural factors more than on educational factors such as health literacy. Finally, we hypothesize that individuals with lower health literacy will demonstrate higher levels of health anxiety as measured in this study.

CHAPTER TWO

Methods

Participants

Participants were selected from a convenience sample of patients presenting for care at the main site of a federally qualified health center called the Family Health Center (FHC) in Waco, Texas between February and August 2016. Patients were only enrolled in the study if they were over 40 years old and if they spoke English, because the survey used was written in English.

Procedure

Health Literacy Data Collection

The research plan for collecting the health literacy and demographic data was approved by the University Institutional Review Board. Volunteer research assistants were trained in use of the Newest Vital Sign and how to conduct patient interviews using an assigned script. The assistants approached patients that met the inclusion criteria while the patients were in the exam room waiting for the doctor. The research assistants described the study purpose to the patients as measuring health literacy and other health behaviors. The patients were freely able to choose to participate or not participate in the study, and those that chose to participate signed an IRB-approved consent form detailing the interview, use of medical records, and confidentiality procedures. After informed consent was obtained, the research assistants conducted the interviews in an exam room, which took about 20 minutes. The research assistants read

the questions directly from the questionnaire to the patients and marked the patients'

answers on the survey form. Patients' names were entered into a raffle for a gift card for

participating in the study.

Demographic Information, Smoking and Alcohol Behavior Data Collection

Demographic information (age, race/ethnicity, and sex) and smoking and alcohol

use were extracted from the patients' EPIC medical records by the same trained research

assistants. Consent for the use of medical records was given on the same written consent

form used in the patient surveys for the collection of health literacy data. Age was

recorded as a continuous variable in years, race/ethnicity was a categorical variable

recorded as Non-Hispanic (NH) White, NH Black, Hispanic, and Other, and sex was

recorded as a categorical variable (male or female). Alcohol was treated as a categorical

variable (yes or no), as was smoking (Current or Not Current).

Health Anxiety Data Collection

Health anxiety data was collected in a previous study and used with the

permission of the authors (Fergus, Kelley, & Griggs, 2016).

Measures

Newest Vital Sign

The Newest Vital Sign is a rapid measure of health literacy designed by Pfizer

Inc. that consists of six questions designed to assess a patient's understanding of an ice

cream nutrition label (Appendix A). The questions are intended to evaluate prose

literacy, numeracy, and document literacy (Pfizer Inc., 2011). The questionnaire is

designed to be administered by nurses in healthcare settings, such as while the nurse is taking other vital signs, and thus is said to only take three minutes. Pfizer Inc. specifies that a score of 0-1 correct out of six "suggests a high likelihood (50% or more) of limited literacy," while a score of 2-3 "indicates the possibility of limited literacy," and a score of 4-6 "almost always indicates adequate literacy" (2011, p. 3). Pfizer Inc. recommends not assisting the patients in answering the questions but does advocate adjusting communication of the questions in order to ensure that the patients understand what is being asked. The Newest Vital Sign was validated against a widely-used and validated measure of health literacy, the TOFHLA (Test of Functional Health Literacy in Adults) (Weiss et al., 2005).

In analyses, health literacy was treated in two different ways. First, it was treated as a categorical variable with the categories being the scoring stratification recommended by Pfizer: high likelihood of limited health literacy, possibility of limited health literacy, and adequate health literacy. Next, the categories of "high likelihood of limited health literacy" and "possibility of limited health literacy" were collapsed to become one category referred to as "inadequate health literacy." This meant that health literacy was treated as a dichotomous variable in which patients either had inadequate or adequate health literacy.

Measures of Smoking Behaviors and Alcohol Consumption

Smoking behaviors and alcohol consumption were self-reported by patients to their physicians during a normal clinic visit. These answers were recorded in the patients' medical records and were obtained for use in this study through accessing the patients' EPIC medical files.

Whiteley Index

Patient health anxiety was assessed using a 6-question shortened version of the Whiteley Index in which patients rated their agreement with a statement on a scale from 1-5 (Appendix B). Scores can range from 6-30, with higher scores indicating greater health anxiety. The Whiteley Index was originally published in 1967 in the British Journal of Psychiatry as a 14-question dichotomous questionnaire to assess hypochondriasis (Pilowsky, 1967). It was designed to assess three factors that were related to hypochondriasis: bodily preoccupation, disease phobia, and a paranoid conviction of presence of disease. Pilowsky found that the index demonstrated good test-retest reliability, however subsequent testing found the yes/no structure to be unstable (Welch, Carleton, & Asmundson, 2009). As a result, Asmundson et. al (2008) recommended a six-question version of the index designed to assess two factors: Somatic Symptoms/Bodily Preoccupation, and Disease Worry/Phobia.

The six-item version, referred to as WI-6, was found to be more stable than the longer version, and it retained internal reliability (Asmundson, Carleton, Bovell, & Taylor, 2008). Furthermore, Welch et. al. (2009) recommended Likert rating scale from 1-5 rather than a true/false structure. This form was also found to be more stable (Cronbach's α= 0.87), was found to correlate well with the original Whiteley Index (Comparative fit index = 0.99) (Welch et al., 2009). In analyses, WI-6 scores were treated as a continuous variable, with higher scores indicating more health anxiety.

Data Analyses

First, univariate statistics were used to describe all variables of interest. Means (with standard deviations) for continuous variables and proportions for categorical

variables were generated for the total sample population. Next, we evaluated the distribution of race/ethnicity by health behaviors (smoking and alcohol). Multivariate logistic regression was used to generate odds ratios and corresponding 95% confidence intervals to evaluate the association of age, race/ethnicity, and health literacy with each health behavior. Finally, we stratified by race/ethnicity to evaluate the relationship of age and health literacy with each health behavior among three separate groups: non-Hispanic Whites, non-Hispanic Blacks, and Hispanics. Microsoft Excel and SAS v9.4 (SAS Institute, Inc., Cary, North Carolina) were used for data management and analysis. Statistical tests were 2-sided, with level of significance defined *a priori* at the α=0.05 level.

CHAPTER THREE

Results

Sample Characteristics

Sample Demographics

The sample consisted of 335 patients presenting to the FHC Family Medicine clinic. Four-hundred and six patients met the inclusion criteria and were enrolled in the study, but only 335 completed the full survey and were included in the final analysis. The participants were mostly female (75.2%). One-hundred thirty-nine (41.49%) self-identified as Black, 106 (31.64%) as Non-Hispanic White, 63 (18.81%) as Hispanic, and 27 (8.06%) as "Other." In multivariate analyses, the participants who identified as "other" were not included because their specific ethnicities could not be identified.

Health Literacy

Table 1 is a summary of the relationships between health literacy and sample demographic information of age, sex, and race/ethnicity. Slightly more than half of the participants (57.61%) scored a 0 or a 1 on the Newest Vital Sign (NVS), indicating a high likelihood of limited health literacy (HL), while 96 (28.66%) scored a 2 or 3, classified as a possibility of having limited HL. Only 46 (13.73%) scored a 4 or higher, indicating adequate HL. In multivariate analyses, health literacy scores were treated as a dichotomous variable, inadequate HL (NVS$\leq$3) and adequate HL (NVS$\geq$4).

Health literacy and ethnicity, sex, and age. Among the 106 NH Whites, 46

(43.40%) had a high likelihood of limited HL, 31 (29.25%) had a possibility of limited

HL, and 29 (27.36%) had adequate HL. Among Blacks, 91 out of 139 (65.46%) had a

high likelihood of limited HL, 40 (28.78%) had a possibility of limited HL, and eight

(5.76%) had adequate HL. For the Hispanic portion of the sample, 38 out of 63

participants (60.32%) had a high likelihood of limited HL, 17 (26.98%) had a possibility

of limited HL, and eight (12.70%) had adequate literacy. Finally, for individuals who

self-identified as other races/ethnicities besides Hispanic, NH White, and Black, 18 out of

27 (66.67%) had a high likelihood of limited HL, eight (29.63%) had a possibility of

limited HL, and one (3.73%) had adequate HL.

Bivariate analyses were conducted to determine the association between health

literacy and race/ethnicity, which was found to be significant (X^2(df=6) = 28.56, p <

.0001). Hispanics were 2.59 times more likely than Non-Hispanic Whites (NH Whites)

to have inadequate health literacy (NVS<3) (p = .03), while Blacks were 6.17 times more

likely (p < .001), and other races/ethnicities were 9.79 times more likely (p = .03).

The data revealed that 61.45% of males had high likelihood of limited HL,

compared to 56.35% of females, and 15.66% of males and 13.10% of females had

adequate HL. When bivariate analyses were conducted to determine the relationship

between health literacy and sex, health literacy was not found to differ significantly

between males and females (X^2(df=2) = 1.86, p = .394). Because health literacy and sex

were not found to be associated, sex was not included in further multivariate analyses.

Finally, a bivariate analysis was conducted to examine the relationship between health

literacy and age. Older participants were found to be slightly but significantly more likely (OR = 1.06, p =0.002) to have inadequate health literacy (NVS≤3).

Smoking

Table 2 is a summary of the relationship between smoking and the sample demographics. Of the 335 participants, 164 (48.96%) either reported being a non-smoker or had not been asked about their smoking habits. Eighty-one (24.18%) self-identified as former smokers, while 90 (26.87%) reported that they were current smokers. These rates are consistent with the CDC's 2015 report on smoking in individuals of low socioeconomic status (CDC's Office on Smoking and Health, 2016). In further analyses, smoking habits were treated as a dichotomous variable: current smokers (n = 90, 26.87%) and everyone else (n = 245, 73.15%).

Among the Hispanic participants (n = 63), ten (15.87%) were current smokers, and among the 106 NH Whites, 39 (36.79%) were current smokers. Out of the 139 Black participants, 34 (24.46%) were current smokers. In bivariate analyses, smoking behaviors were significantly associated with race/ethnicity in this sample. NH Whites were significantly more likely to be current smokers than participants of other races/ethnicities: 3.13 times as likely as Hispanics (p = 0.005) and 1.79 times as likely as Blacks (p = 0.038). Smoking was not found to be significantly related to age in this sample (p = 0.154).

Alcohol Use

Table 3 is a summary of the relationship between alcohol use and the demographic information of the sample. Out of the 335 participants, 45 had not been

asked about their alcohol use. Of the 290 who were asked, 70.69% reported not consuming alcohol. Bivariate analyses revealed that sex was highly predictive of alcohol use, with males being 3.08 times as likely to consume alcohol as females (p<0.001). Of the 51 Hispanic participants who had been asked about their alcohol use, 12 (23.53%) indicated that they consume alcohol. In NH Whites, 34 out of 96 (35.42%) reported consuming alcohol, and 35 out of 120 Blacks (29.17%) did as well. Race/ ethnicity and age were not significantly associated with alcohol in this sample.

Health Anxiety

Only 26 participants met the inclusion criteria for and were enrolled in both the health literacy study and the study in which 6-item Whiteley Index (W1-6) was used to assess health anxiety. Of those 26, only 18 completed both the NVS and the WI-6. Scores on the WI-6 ranged from 7 to 27, with a mean of 16.46 (SD = 5.97).

Research Questions

Health Literacy and Smoking Behaviors

In the bivariate analyses, the relationship between health literacy and smoking was not statistically significant (OR = 1.88, p = 0.123). However, the association became significant when adjusting for race/ethnicity and age. In the multivariate analyses, participants with inadequate HL were 3.07 times more like to be current smokers than participants with adequate health literacy (p = 0.012).

Because both race and HL were statistically significantly predictive of smoking, each race was analyzed individually with age included as a covariate (Table 4). When each ethnicity was analyzed individually, lower HL was associated with increased

smoking behaviors in both NH Whites and in Blacks. However, in Hispanic participants, lower HL was associated with decreased smoking behavior, though the relationship was not statistically significant.

Health Literacy and Alcohol Use

The data did not demonstrate a statistically significant relationship between health literacy and alcohol use, even when controlling for race/ethnicity and age (OR = 1.02, p = 0.961). Table 5 is a summary of the odds ratios describing the likelihood of alcohol use when each race/ethnicity was analyzed separately with age as a covariate. Though none of the relationships were statistically significant, trends in the data were as such: in NH Black participants, lower HL was associated with decreased likelihood of consuming alcohol, while in Hispanics and NH Whites, lower HL was associated with increased likelihood of consuming alcohol.

Health Literacy and Health Anxiety

Of the 18 participants who completed both the NVS and the WI-6, nine (50%) scored a 0 or 1 on the NVS, meaning they had a high likelihood of limited HL. The average WI-6 score for these nine participants was 17.67. Five participants (27.78%) scored a 2 or 3, indicating that they had a possibility of limited HL, and these participants scored an average of 16.60 on the WI-6. Finally, four participants (22.22%) had adequate health literacy, as indicated by a score of 4, 5, or 6. These participants had a mean WI-6 score of 13.75. The data suggest that health anxiety may decrease as health literacy increases, but the sample size is too small to draw any definitive conclusions.

Table 1. Unadjusted (bivariate) odds ratios describing likelihood of having inadequate health literacy, (NVS$\leq$3), n=335.

	OR	95% CI	p
Age	1.06	1.02, 1.09	0.002
Sex			
Male	0.81	0.41, 1.63	0.56
Female	Ref		
Race/Ethnicity			
Hispanic	2.59	1.10, 6.09	0.03
NH White	Ref		
NH Black	6.17	2.68, 14.17	<0.001

Table 2. Unadjusted (bivariate) and adjusted (multivariate) odds ratios describing the likelihood of being a current smoker.

	Bivariate			Multivariate		
	OR	95% CI	p	OR	95% CI	p
Age	0.98	0.96, 1.01	0.154	0.97	0.94, 1.00	0.036
Race/Ethnicity						
Hispanic	0.32	0.15, 0.71	0.005	0.24	0.11, 0.55	<0.001
NH White	Ref			Ref		
NH Black	0.56	0.32, 0.97	0.038	0.43	0.24, 0.77	0.005
Health Literacy						
Inadequate	1.88	0.84, 4.21	0.123	3.07	1.27, 7.38	0.012
Adequate	Ref			Ref		

Table 3. Unadjusted (bivariate) and adjusted (multivariate) odds ratios describing the likelihood of using alcohol.

	Bivariate			Multivariate		
	OR	95% CI	p	OR	95% CI	p
Age	0.98	0.96, 1.01	0.145	0.98	0.96, 1.01	0.147
Race/Ethnicity						
Hispanic	0.56	0.26, 1.21	0.142	0.52	0.24, 1.16	0.109
NH White	Ref			Ref		
NH Black	0.75	0.42, 1.33	0.328	0.75	0.41, 1.36	0.345
Health Literacy						
Inadequate	0.81	0.38, 1.70	0.572	1.02	0.46, 2.27	0.961
Adequate	Ref			Ref		

Table 4. Adjusted (multivariate) odds ratios describing likelihood of smoking stratified by race/ethnicity adjusted for age.

	OR	95% CI	p
Hispanic			
Inadequate HL	0.52	0.09, 3.10	0.470
Adequate HL	Ref		
NH White			
Inadequate HL	1.00	0.94, 1.08	0.944
Adequate HL	Ref		
NH Black			
Inadequate HL	0.96	0.91, 1.00	0.074
Adequate HL	Ref		

Table 5. Adjusted (multivariate) odds ratios describing likelihood of using alcohol stratified by race/ethnicity adjusted for age.

	OR	95% CI	p
Hispanic			
Inadequate HL	1.04	0.09, 11.50	0.973
Adequate HL	Ref		
NH White			
Inadequate HL	1.48	0.52, 4.17	0.460
Adequate HL	Ref		
NH Black			
Inadequate HL	0.29	0.06, 1.43	0.128
Adequate HL	Ref		

CHAPTER FOUR

Discussion

Health Literacy in Waco

Low health literacy (HL) is a prevalent problem in the Waco area that needs further examination. In the current study, 86.72% of participants had inadequate HL, which was defined as scoring a 3 or lower on the Newest Vital Sign (NVS) assessment tool, while only 13.73% had adequate HL, with a NVS score of 4 or more. Previous research has demonstrated the association of lower health literacy with older age and lower socioeconomic status (Kutner et al., 2006). There may be other factors that affect health literacy rates in the Waco population, such as education or culture, but further research is needed to elucidate these factors.

Health Literacy and Health Behaviors

As predicted, inadequate health literacy was significantly associated with increased likelihood of being a current smoker when controlling for race/ethnicity and age. There were no statistically significant differences when the data were stratified by race/ethnicity. These results support the idea that patients with low health literacy may be more likely to engage in smoking behavior. Further research is necessary to elucidate mechanisms involved in this potential relationship.

Also as predicted, inadequate HL was not significantly associated with alcohol use in this sample. However, alcohol was significantly associated with sex, with men being 3.082 times as likely to report alcohol use than women ($p < 0.0001$). The sample was 75.2% female, which may have skewed the relationship between the two variables.

Further studies with gender-balanced populations are needed to clarify the relationship between alcohol use and health literacy. There were no statistically significant differences when the data were stratified by race/ethnicity. The results of this study support the notion that low health literacy is not associated with alcohol consumption, unlike smoking behavior. Further research could examine the reason why alcohol consumption was not associated with low health literacy in this sample, as well as other factors that may influence alcohol use instead.

There was not enough data to draw conclusions about the relationship between health literacy and health anxiety. Further studies are necessary to examine this relationship with a larger sample.

Limitations

One limitation of this study was that the sample recruited consisted only of people over the age of 40. This meant that we did not obtain any measure of how health literacy impacts health behaviors in younger populations. Because older people are more likely to have low HL, our data may have been skewed by this age range (Kutner et al., 2006). Another limitation was the high proportion of females in the sample, which may have skewed the results involving alcohol consumption. Because of the skewed distribution of age and sex in the sample, we controlled for age and sex in all multivariate analyses. In the future, researchers could correct for this issue by oversampling for males and younger populations.

Furthermore, the study was limited by the fact that all participants spoke English. Hispanic patients that spoke only Spanish were excluded, despite making up a sizable portion of the Family Health Center patient population, because the survey was only

written in English. The exclusion of Spanish-speaking patients led to an underrepresentation of Hispanic participants: the general population of Waco is 29.2% Hispanic, while our sample was 18.81% Hispanic (U. S. Census Bureau, 2010). Future researchers could correct this problem by obtaining a validated Spanish translation of the Newest Vital Sign.

Another limitation is that the data was collected from patients who were already presenting to a medical clinic with a health issue. This meant that in order to be involved in the study, patients needed to have sufficient health literacy to know the Family Health Center existed and to make an appointment there. By not surveying patients who did not use the health clinic, we may have missed some of the people with the lowest health literacy, individuals that have no interaction with the health system and may not even know that the Family Health Center is a resource that is available to them. These patients would be a particularly vulnerable population because they would also have the least influence to stop smoking and alcohol consumption, and perhaps the most health anxiety. In further studies, the potential bias in the sample could be corrected for by surveying the wider community in a different setting than a medical clinic.

A limitation related to examining health anxiety was that not enough patients completed both the Whiteley Index of health anxiety and the health literacy assessment to draw conclusions about the relationship between health literacy and health anxiety. This study could serve as a pilot study to motivate future research into this relationship. Because health anxiety is a particularly difficult problem to catch in a medical setting but can still cost the healthcare system a significant amount of money, the relationship

between health literacy and health anxiety could help identify potential patients that should be screened for health anxiety (Fergus et al., 2015).

The sample in this study was a convenience sample, which limits the generalizability of the result. Research assistants were only present in the clinic during certain hours on certain days of the week, and only in one site of the large Family Health Center complex. This means that the patients who were present during those hours are not necessarily representative of the population that the Family Health Center serves.

Finally, this study is limited by the fact that all data was obtained by self-report. While self-reports are commonly used in health assessment studies, there is an inherent risk of over- or under-estimation of behaviors on the part of the patient due to social-desirability bias (Plous, 1993). It is also possible that people with lower health literacy may have been more likely to under-report their substance use because they had less of an understanding about why this information is important in a medical setting. Furthermore, because smoking and drinking behaviors were recorded at a previous appointment by the patient's physician, the questions asked were not standardized, making the results less reliable. Despite the inherent biases involved, self-report questionnaires are a widely-accepted method of assessing health behaviors, including in the Center for Disease Control and Prevention's nationwide Behavioral Risk Factor Surveillance System, the largest health survey in the world (CDC, 2014).

Conclusion

Results from the current study emphasize the lack of adequate health literacy in Waco, as well as the relationship between low health literacy and poor health behaviors. In this multiracial, low-income sample, inadequate health literacy predicted smoking

behaviors and may predict increased health anxiety but did not have a statistically significant relationship with alcohol use.

The relationship between health literacy and smoking behaviors highlights the importance of adequate health literacy education. Though further research is necessary to elucidate why people with low health literacy are more likely to smoke, it is possible that increasing health literacy may prevent people from smoking. Furthermore, the association between low health literacy and increased smoking behavior means that healthcare providers should be aware that patients who smoke may have low health literacy. This awareness can lead them to adjust their communication strategies when treating such patients, which can increase patient compliance and improve medical outcomes. This does not mean that increasing a patient's health literacy can cause him or her to quit smoking, but rather that providers should know to be aware that their patients who smoke may be more likely to have low health literacy because these two factors are associated, at least in this sample.

It may also be feasible for providers to screen patients for low health literacy. The Newest Vital Sign is a quick and easy tool to administer that can help providers better understand their patients' communication needs, potentially transforming their delivery of care for the better. Perhaps the results of this study could raise awareness of the important relationship between health literacy and physical health, as well as the importance of providers understanding the health literacy levels of their patients.

Health literacy significantly impacts health, but it is also something that can be changed and improved with education and resources. While the results of this study indicate that some of the patients at the Family Health Center have low health literacy,

they also indicate an opportunity for public health intervention and changes in provider behaviors – initiatives that have the potential to greatly improve the health of the Waco community.

APPENDICES

Newest Vital Sign

Figure A1: Newest Vital Sign Nutrition Label for Pint of Ice Cream

Nutrition Facts

Serving Size	½ cup
Servings per container	4

Amount per serving

Calories	250	Fat Cal	120

	%DV
Total Fat 13g	20%
Sat Fat 9g	40%
Cholesterol 28mg	12%
Sodium 55mg	2%
Total Carbohydrate 30g	12%
Dietary Fiber 2g	
Sugars 23g	
Protein 4g	8%

*Percentage Daily Values (DV) are based on a
2,000 calorie diet. Your daily values may
be higher or lower depending on your
calorie needs.
Ingredients: Cream, Skim Milk, Liquid
Sugar, Water, Egg Yolks, Brown Sugar,
Milkfat, Peanut Oil, Sugar, Butter, Salt,
Carrageenan, Vanilla Extract.

Figure A2: Score Sheet for Newest Vital Sign

The Newest Vital Sign™
A Health Literacy Assessment Tool

Score Sheet for the Newest Vital Sign
Questions and Answers

READ TO SUBJECT:
This information is on the back of a container of a pint of ice cream.

	ANSWER CORRECT?	
	yes	no

1. If you eat the entire container, how many calories will you eat?
   Answer: 1,000 is the only correct answer

2. If you are allowed to eat 60 grams of carbohydrates as a snack, how much ice cream could you have?
   Answer: Any of the following is correct: 1 cup (or any amount up to 1 cup), half the container. Note: If patient answers "two servings," ask "How much ice cream would that be if you were to measure it into a bowl?"

3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?
   Answer: 33 is the only correct answer

4. If you usually eat 2,500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?
   Answer: 10% is the only correct answer

READ TO SUBJECT:
Pretend that you are allergic to the following substances: penicillin, peanuts, latex gloves, and bee stings.

5. Is it safe for you to eat this ice cream?
   Answer: No

6. (Ask only if the patient responds "no" to question 5): Why not?
   Answer: Because it has peanut oil.

Number of correct answers:

Interpretation
Score of 0-1 suggests high likelihood (50% or more) of limited literacy.
Score of 2-3 indicates the possibility of limited literacy.
Score of 4-6 almost always indicates adequate literacy.

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February 2011

Whiteley Index 6-Item Version

1. Do you often worry about the possibility that you have got a serious illness?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

2. Do you worry a lot about your health?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

3.   Do you often have the symptoms of a very serious illness?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

4. Do you find that you are bothered by many different symptoms?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

5. Do you think there is something seriously wrong with your body?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

6. Are you afraid of illness?

    1 . . . . 2 . . . . 3 . . . . 4 5
Not at all   A great deal

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