THE RELATIONSHIP BETWEEN HEALTH LITERACY, PREVENTIVE HEALTH LITERACY, AND CIGARETTE SMOKING BEHAVIOR OF UNDERGRADUATES

By

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Cigarette smoking is among the most detrimental of risky health behaviors and is related to multiple poor health outcomes including development of cancer. It is a complex behavior that is initiated and maintained through multiple factors: individual factors (e.g., psychological factors, stress), environmental factors (e.g., peer smoking behavior, accessibility), structural factors (local, state, and national policy) and sociodemographic factors (economic status and race/ethnicity). One individual factor, health literacy, has not been studied in relation to smoking behavior. In addition, a component of health literacy, preventive health literacy, has been mostly neglected by researchers. This involves one's knowledge of preventive health behaviors, risk perception of disease development, the belief in one's ability to make use of that knowledge and risk information to make good health behavior decisions (i.e., self-efficacy), and the ability to make preventive health actions (i.e., utilize preventive health care services and participate in positive health behaviors). Thus, the purpose of the current study was three-fold: 1) develop a better understanding of levels of health literacy and preventive health literacy, 2) determine if smoking behavior was associated with health literacy and preventive health literacy, and 3) examine the relationship between health literacy and preventive health literacy, among a sample of undergraduate students. The results indicated that health literacy and preventive health literacy

as measured by health knowledge, risk perception, self-efficacy, and health action were high among the sample. However, only risk perception and health action significantly contributed to the prediction of smoking status. This finding suggests that smoking cessation programs may benefit from working to address engagement in positive health behaviors and improving risk perception, rather than health knowledge associated with smoking or self-efficacy to quit smoking. Furthermore, the results indicated that preventive health literacy did not offer a clear advantage over health literacy in the prediction of smoking status. These results were discussed and ideas for future clinical and research directions were provided.

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CHAPTER I: INTRODUCTION

Smoking is among the most detrimental of health behaviors. According to the Report of the Surgeon General, smoking negatively impacts nearly every organ in the body (U.S. Department of Health and Human Services, 2014). The Centers for Disease Control and Prevention (CDC) report that smoking is "the leading cause of preventable death" (CDC, 2015, line 7). It has been linked to many serious health conditions including, but not limited to, stroke, chronic obstructive pulmonary disease, coronary heart disease, and many forms of cancer (e.g., CDC, 2014). Moreover, it has specifically been identified as the number one modifiable behavioral risk factor in the development of cancer (McCance & Huether, 1998).

Cancer is a complex disease that is one of the leading causes of death around the world. According to the 2014 World Cancer Report, in the year 2012 cancer was responsible for 8.2 million deaths worldwide and unfortunately, the number of annual cases of cancer is expected to rise in the coming years (as cited in World Health Organization [WHO] Cancer Fact Sheet, 2014). The American Cancer Society reported that in the United States in 2017, there will be approximately 1,688,780 new cancer diagnoses and individual cancer deaths will approximate 600,920 (American Cancer Society, 2017).

The development of cancer has both a biological and environmental basis (McCance & Huether, 1998). Genetics play a role in our risk for cancer development and there are also certain agents in our environment that are carcinogenic. Carcinogens are agents that increase the likelihood of abnormal changes, or mutations, in cells that can lead to cancer development. It is not just our biology or our environment that causes us to develop cancer, but rather, the interaction between those two factors (McCance & Huether, 1998). For the purpose of this study, the focus is on cigarette smoking, a behavior with known carcinogenic effects.

Cigarette smoke contains carcinogens that are significantly related to the development of cancer (McCance & Huether, 1998). Chemicals in cigarette smoke have a prolonged effect on our health, causing many mutations in cells over time. In fact, there is a steep rise in the incidence of lung cancer after someone has been smoking for 10-20 years. Chemicals from cigarette smoke concentrated in the lungs are absorbed into the bloodstream and carried all over the body. While these chemical carcinogens have the ability to impact cell mutations of many different organs, they are most likely to cause cancer development in areas such as the lungs, bladder, pancreas, kidneys, larynx, oral cavity, and esophagus (McCance & Huether, 1998).

Because of the significant impact of cigarette smoke on the development of cancer and other serious health conditions, the CDC has identified tobacco use as one of the major amendable health risk behaviors, along with lack of physical activity, poor nutrition, and excessive alcohol consumption (CDC, 2009). The CDC sees this risk behavior as one that can have a significant impact on the health of Americans if changed (CDC, 2015). In fact, a United States federal government health initiative called, "Healthy People 2020" recognizes the importance of preventive health behaviors, namely eliminating the use of tobacco products, and aims to both reduce cigarette smoking (CDC, 2015) and reduce cancer cases and associated poor health outcomes (U.S. Department of Health and Human Services, 2014, para. 1). While it is well understood by the scientific community that smoking cigarettes causes cancer, among other serious conditions, and multiple prominent health organizations recognize the importance of not smoking as a preventive health behavior, there are still around 36.5 million Americans smoking cigarettes (CDC, 2016). If we are to work toward better understanding this behavior, and reducing its impact, we must identify the factors involved in the initiation and maintenance of cigarette smoking behavior.

Smoking is a complex behavior that is influenced by many factors. One may consider the influences of smoking behavior in a multi-level determinant model, as shown in Figure 1. This model implies there are factors across a variety of levels such as individual, environmental, structural, and sociodemographic factors, that may impact smoking status. To be aware of all of these factors is of vital importance when setting out to study smoking behavior. Researchers cannot simply isolate one factor without recognizing the complexity of the context in which smoking behavior occurs. For the purpose of this study, the focus is on an individual-level factor related to smoking behavior. Other factors known to be associated with smoking behavior are measured and included as predictors of smoking behavior, when necessary. Specifically, this study addresses the individual factor of *health literacy* (HL) and its relationship to smoking behavior. The rationale and related literature for studying HL in relation to smoking behavior is discussed in the next section.

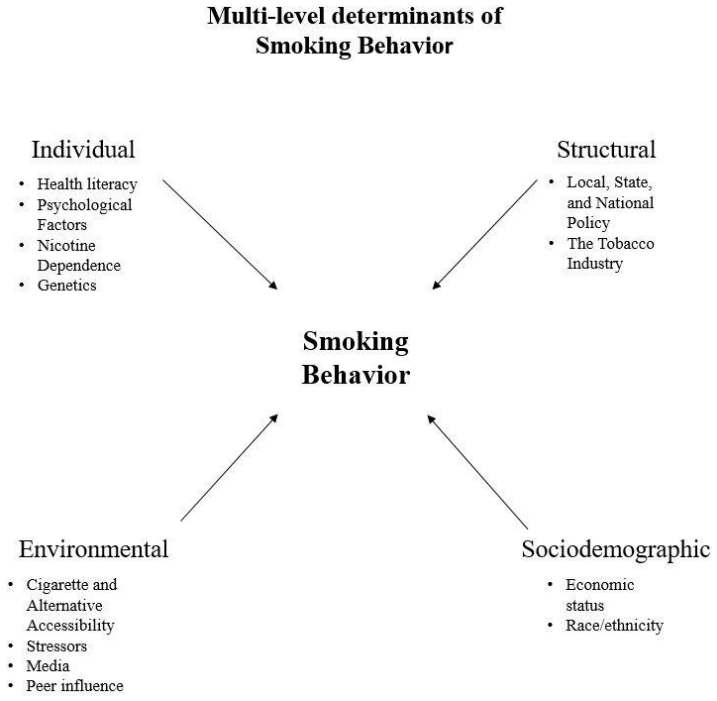

Figure 1. *Multi-level determinants contributing to the initiation and maintenance of smoking behavior.*

CHAPTER II: LITERATURE REVIEW

Health Literacy

The World Health Organization (WHO) defines HL as "…the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" (WHO, 1998, p. 10). This has been a long-standing way of conceptualizing HL. This definition expresses that HL is more than the ability to read and write that is often associated with traditional literacy. It also encompasses health knowledge, or the ability to obtain and understand health information, and the ability to use that information to be healthy. However, the definition is not comprehensive in that it does not define the specific factors that influence the utilization of health knowledge to make healthy actions. For example, someone could know that cigarette smoking is related to poor health outcomes but not see themselves as "at risk" for poor health outcomes, and therefore choose not to make behavioral changes. As another example, someone may be motivated to make changes but not believe in their ability to do so (i.e., they may have low self-efficacy). Up to this point, measures created to assess HL have not been comprehensive in their measurement of the multiple factors thought to comprise HL. An expanded multi-component approach to defining and assessing HL is proposed to encompass one's health knowledge and ability to make healthy actions, while recognizing that one's self-efficacy, or the belief in one's ability to make such actions, and one's personal health risk perceptions, play a key role in their behavior. This expanded approach to understanding HL is rooted in the Health Belief Model (HBM). The HBM is a theory of health behavior that suggests decisions regarding such behaviors are made in part due to beliefs about one's vulnerability to develop associated diseases and ability to make behavioral changes (e.g., Janz & Becker, 1984; Rosenstock, 1990).

In 2003, a National Assessment of Literacy aimed to determine general levels of HL among the United States population (e.g., Kutner, Greenberg, Jin, & Paulsen, 2006). This assessment included items measuring prose, document, and quantitative literacy across clinical, prevention, and health care navigation domains. Based on their conceptualization and measurement of HL, the assessment revealed that about 22% of Americans have "basic" levels of HL (i.e., "skills necessary to perform simple and everyday literacy activities"), and 14% have "below basic" HL (i.e., "no more than the most simple and concrete literacy skills"; Kutner, Greenberg, Jin, & Paulsen, 2006, p. 5). In addition, it has been shown that those with higher self-reported health also had higher levels of HL (Kutner et al., 2006). This connection between HL and health outcomes has been well-established and is one of the primary reasons the study of HL, and factors associated with it, is important. For example, low HL has been associated with less utilization of preventive health services, less knowledge of health conditions, more chronic health conditions, higher rates of hospitalization and healthcare cost, lower self-reported health status, and a sense of shame in those with deficits in health knowledge (e.g., Berkman, Sheridan, Donahue, Halpern & Crotty, 2011; U.S. Department of Health and Human Services, n.d.). While low HL has been connected to poor outcomes such as those mentioned above, relatively little is known about the connection between HL and one of the most detrimental health-related behaviors: cigarette smoking (Stewart et al., 2013, p. e5).

Exploring the relationship between smoking and HL represents a potential area of growth for the literature for several reasons. It would be beneficial to better understand the relationship between smoking and HL as one step toward determining how and why HL relates to health outcomes. For example, does smoking function as a factor in contributing to the relationship between HL and health outcomes? A second reason why studying HL in relation to smoking

behavior is important, is that it can help those interested in smoking cessation to develop interventions with improved knowledge about the association between HL and smoking behavior. Also, demographic patterns highlighting groups with low HL and higher levels of smoking behavior could also hone efforts to develop smoking cessation interventions to target specific groups. Finally, better understanding the relationship between HL and smoking could be beneficial as health care initiatives emphasize reducing the prevalence of smoking and the number of new cases of cancer; particularly those caused by behavioral risk factors such as smoking. If HL is highly related to smoking behavior, it may be a key point of intervention to reduce the number of new smokers, and thus, the number of new cancer cases.

While the literature on HL in general is quite extensive, this field of study has areas of potential growth. As previously mentioned, prior conceptualizations of HL often neglect the active component of the construct that translates knowledge and perceived risk in action. Thus, this expanded conceptualization of HL, comprised of health knowledge, health action, health risk perception, and self-efficacy, is more specific and comprehensive. Creation of new comprehensive HL measurement tools is another area of potential growth. In addition, gaps in the literature exist in relation to HL's connection to smoking in another area: prevention. *Preventive health literacy* (PHL) which is proposed to be an extension of HL, comprises knowledge about preventive health behaviors, personal risk perception of disease development, belief in one's ability to make use of that knowledge to make good health behavior decisions (i.e., self-efficacy), and the ability to take preventive health actions (i.e., utilize preventive health care services and participate in positive health behaviors). Developing studies around these areas of improvement in the field of HL is of vital importance. The remainder of Chapter II examines these areas of potential growth.

Health Literacy and Smoking

There are only a few studies in the literature that have assessed the relationship between HL and smoking (Stewart et al., 2013, p. e5). After a thorough search of the literature, there appear to be no studies that have specifically assessed the relationship between HL as measured by a valid and reliable HL tool, and smoking status (e.g., "regular" smoking vs. non-smoking). However, the relationship between components thought to comprise HL (i.e., health knowledge, risk perception, self-efficacy, and health action [i.e., positive health behaviors like attending doctors' visits, eating a balanced diet, and exercising]) and smoking do appear to have the focus of previous research. Health knowledge and risk perception have been associated with HL (e.g., Stewart et al., 2013), along with health action (e.g., von Wagner, Knight, Steptoe, & Wardle, 2007). The connection between HL and self-efficacy is less established. In some cases, self-efficacy to perform certain actions has been shown to be related to HL (e.g., Donovan-Kicken et al., 2012), and in other cases, though it was hypothesized to be associated, it was not (e.g., Stewart et al., 2013). This discrepancy related to the connection between self-efficacy and HL among these studies may be due to differences in how self-efficacy was measured and with what behavior self-efficacy was associated. For example, self-efficacy was measured by one question about confidence in ability to quit smoking in the study by Stewart et al. (2013) but measured by a set of items related to confidence in one's ability to understand the risks of medical procedures when reading informed consent documents in the study by Donovan-Kicken et al. (2012). Nonetheless, inclusion of self-efficacy in the review was thought to be important due to the limited, but discrepant, information regarding its connection to HL and evidence that it is related to successful smoking cessation (e.g., Lee, Catley, & Harris, 2014). Thus, HL is operationalized as including four components: health knowledge, risk perception, self-efficacy, and health

action. Together, these constructs are thought to comprise the necessary skill sets that enable someone to best engage in informed behaviors that contribute to good health. Research assessing the relationship between each of these constructs and smoking behavior will be addressed below in four sections.

In the first section are studies that have examined the relationship between health knowledge and smoking. The second section contains studies that have assessed the relationship between risk perception and smoking. The third section includes studies that have assessed the relationship between self-efficacy and smoking. Lastly, in the fourth section are studies that have assessed the relationship between smoking and other health actions.

Health knowledge and smoking. Research addressing the connection between the knowledge of health consequences resulting from smoking and smoking behavior has shown that smokers report less health knowledge than both non-smokers and former smokers (e.g., Klesges et al., 1988). Former smokers had the most knowledge about health consequences associated with smoking followed by nonsmokers, smokers who had a previous quit attempt, and finally, smokers without a previous quit attempt. The health knowledge of the consequences of smoking was higher in all groups (former smokers, non-smokers, and smokers with a previous quit attempt) compared to current smokers who had not attempted to quit (Klesges et al., 1988).

In another study among college students, non-smokers (compared to current smokers) have been found to have more accurate perceptions about the harm associated with smoking cigarettes; that is, non-smokers view smoking as more detrimental to health than current smokers (Seigers & Terry, 2011). In addition, compared to non-smokers, those who, in the literature, have been labeled “deniers” or “social smokers” (i.e., those who smoke infrequently and/or irregularly) were less likely to see smoking a few cigarettes per day as harmful to their health

(Seigers & Terry, 2011). Interestingly, the "deniers" group also saw smoking a few cigarettes per day as more harmful to health compared to those who are regular smokers (Seigers & Terry, 2011). Thus, previous research shows that college student non-smokers compared to smokers of any kind (regular or social) have a better understanding of the health risks associated with smoking (Seigers & Terry, 2011). However, further research is needed to determine if these findings are replicated. Next is a discussion of personal risk perception and smoking behavior.

Risk perception and smoking. The way in which personal risk perception differs in relation to smoking behavior has been examined in the literature. One study has shown that among college students, smokers are less likely than non-smokers to see occasional smoking (for example on the weekends or at parties) as risky to health (Murphy-Hoefer, Alder, & Higbee, 2004). Other studies have examined the relationship between personal risk perceptions and smoking cessation attempts. A longitudinal study by Jacobson, Catley, Lee, Harrar, & Harris (2014) examined how different components of risk perception impact smoking behaviors of college students. Among other factors, perceived vulnerability to poor outcomes was shown to be the best predictor of positive smoking behavior change in their intervention (Jacobson et al., 2014). This idea that one's personal risk perception plays a role in their ability to change behavior and stop smoking has also been supported in other populations by different researchers (e.g., Costello, Logel, Fong, Zanna, & McDonald, 2012).

Self-efficacy and smoking. Self-efficacy as related to smoking reduction/cessation, or the belief in one's ability to reduce or quit smoking, has not been studied extensively by researchers. Self-efficacy is a factor that has been shown to predict smoking cessation or attempts to stop smoking in college student samples (e.g., Lee et al., 2014) and to be associated

with such behavioral changes in older adult samples (e.g., Schnoll et al., 2011; Smit, Hoving, Schelleman-Offermans, West, & de Vries, 2014).

In the study noted above involving a college student sample, the researchers were interested in determining if self-efficacy, as measured by degree of temptation to smoke, and motivation, among other factors assessed at the onset of the study, predicted smoking behavior at later time points (Lee et al., 2014). This sample of college students consisted entirely of smokers. The sample completed baseline assessments on smoking behaviors, self-efficacy, motivation, and other factors. Then, they were randomized into different Motivational Interviewing treatment groups for a few brief sessions. At 6 months out from the baseline assessment, they were organized into groups based on their smoking behavior since baseline assessment. Those categories were "no quit attempt", "quit attempt but no maintenance", and "quit attempt with maintenance" (Lee et al., 2014, p. 1334). Self-efficacy was a significant predictor of both attempts to quit smoking and the maintenance of smoking cessation (Lee et al., 2014). Thus, this study supported the idea that self-efficacy related to temptation to smoke is an important factor to assess among college students as it may be related to their ability to stop smoking. However, this is only one study involving college student samples. Additional research is needed to determine if this can be replicated.

Health action and smoking. Smoking has been studied in relation to some forms of health action, or participating in positive health behaviors. One study conducted with a college student sample revealed differences in health behaviors among current smokers and former smokers (Berg, Schauer, Rodger, & Narula, 2012). Current smokers in their study were more likely to participate in excessive drinking and had poorer dietary behaviors (i.e., smokers limited fat intake less in their diet; Berg et al., 2012). In another study with a college student sample,

compared to their college-aged peers who did not smoke, students who participated in any form of smoking behavior, whether it was daily or not, were more likely to participate in other risky behaviors (Sutfin et al., 2012). These other risky health behaviors were related to alcohol and other drug use (Sutfin et al., 2012). Results from these studies indicate a connection between smoking behavior and other poor health behavior actions. The association between smoking and other forms of health action such as participation in self-care, attending regular doctor's visits, and seeking mental health counseling, is less understood.

While the relationship between HL (as defined by health knowledge, risk perception, self-efficacy, and health action) and smoking behavior is one area in the literature that has not been studied, another important component of HL, regarding the preventability of major diseases, has also been somewhat neglected by researchers (Moore, Smith, & Reilly, 2013). Furthermore, researchers have noted that "…few studies have examined the links between healthy behaviors, perceptions of the importance of lifestyle factors for cancer, and HL" (Adams et al., 2013, p. 207). Thus, aside from needing to better understand the connection between HL and smoking, understanding the relationship between preventive HL and smoking is another opportunity for growth in the literature.

Preventive Health Literacy

For the purposes of this study, PHL, an extension of HL, involves one's knowledge of the role behavior plays in the prevention of poor health outcomes, risk perception of disease development, the belief in one's ability to make use of that knowledge and risk information to make good health behavior decisions (i.e., self-efficacy), and the ability to take preventive health actions (i.e., utilize preventive health care services and participate in positive health behaviors). The health literate person understands the association between risk behaviors and disease

outcomes, understands their risk for outcomes based on their behavior, believes in their ability to make change based on that knowledge and risk, and engages in healthy actions. The preventive health literate person understands the association between prevention behaviors and disease outcomes, understands their personal risk based on engagement in preventive behaviors, believes in their ability to make changes to prevent future disease development, and engages in preventive health behaviors in order to prevent future disease outcomes. The fundamental difference between HL and PHL across all four proposed components is that in the case of PHL, the focus is on knowledge and engagement to prevent poor health outcomes, while HL does not include the focus on preventing poor health outcomes. A detailed description of the proposed construct of PHL is discussed below. However, first it is important to understand why the prevention component of this construct is so important.

Aside from a lack of research on the preventive component of HL (Moore et al., 2013), it is important to better understand this construct due to the current shift toward primary prevention in health care. Primary prevention, or identifying and subsequently altering a modifiable risk behavior such as smoking, is integral to reducing the development of diseases, including cancer (Redeker, Wardle, Wilder, Hiom, & Miles, 2009). An understanding of the importance of primary prevention has been reflected in recent changes in the United States health care system. For example, the Patient Protection and Affordable Care Act of 2010 broke significant ground in the nation's move toward prevention (e.g., Koh & Sebelius, 2010). The law is proposed to "…usher in a revitalized era for prevention at every level of society" (Koh & Sebelius, 2010, p. 1296) in different ways including providing better access to preventive services, fostering a sense of health in the workplace and among communities, and establishing prevention as a "national priority" (Koh & Sebelius, 2010, p. 1297). The law also promotes the development of health care

teams, such as primary care physicians, that emphasize prevention (Koh & Sebelius, 2010). If health care professionals are to encourage their patients to make healthy behavior changes, it would be beneficial to ensure that patients understand how significant a role their own behaviors play in the prevention of disease. At this turning point in the history of our country's health care system, it is vital that we work to understand the degree to which people appreciate how their own behaviors impact their health and the degree to which they use that health knowledge to make positive behavior change. Furthermore, do they understand that their health actions (i.e., participating in positive health behaviors and seeking preventive health services), in fact, play a role in preventing future disease development?

Research related to preventive health literacy. While the construct of PHL is novel, it can theoretically be seen as an extension of traditional HL. However, empirically it is not yet certain how HL and PHL relate. For example, are those who are health literate also preventive health literate? While questions like these remain to be answered, researchers have examined the relationship between some preventive health behaviors and HL.

Researchers have found that those who have low HL may not understand the importance of preventive health behaviors as related to cancer development (Adams et al., 2013). In a sample of Australians (N = 2824, 15 years or older), those with lower HL as measured by the Newest Vital Sign test (Weiss et. al., 2005), were more likely to underestimate the role of risky health behaviors (e.g., smoking, poor diet, alcohol use) in the development of cancer (Adams et al., 2013). This indicates that those with low HL may also be low in PHL. Similarly, in a study with a sample of British adults (N = 759, ages 18-90), higher HL as measured by an adapted version of the Test of Functional Health Literacy in Adults ([TOFHLA]; Parker, Baker, Williams, Nurss, 1995) was associated with positive health behaviors such as not smoking,

eating more healthy foods, and having higher self-reported health (von Wagner et al., 2007). Thus, one may ascertain that higher HL is connected to more positive health behaviors that are associated with the prevention of disease development.

In another study, researchers aimed to explain the relationship between HL and health outcomes (Ownby, Waldrop-Valverde, & Taha, 2012). Among their measured variables were "preventive health behaviors" (i.e., having a flu shot or having a dental or vision check-up in the last year [p.780]) and behaviors thought to maintain health (i.e., physical activity [an inverse proxy, hours spent watching tv, was used in place of physical activity]). In their sample of older adults (N = 9,103, > 40 years old), obtained from the 2003 U.S. National Assessment of Health Literacy, they found that while these health behaviors were associated with reported health status, when entered into their regression model, they did not alter the relationship between HL and self-reported health status. In this sample of older adults, a set of behaviors thought to prevent poor health outcomes or promote health did not help explain the relationship between HL and self-reported health status. However, there were limitations to this study that should be noted. The use of the inverse proxy for physical activity (hours spent watching TV) may not adequately reflect physical activity, as noted by the researchers (Ownby et al., 2012). Also, they included a limited number of health behaviors and preventive health behaviors. Future studies may want to assess additional, more common, health behaviors thought to be connected to health outcomes such as smoking and alcohol use. Finally, their sample included only older adults. Thus, their results may not generalize to younger populations.

Researchers have also examined the degree to which individuals are knowledgeable about the impact of preventive health behaviors and risk behaviors on health outcomes. One group of Australian researchers interested in public knowledge about the preventability of major

diseases determined that overall, people may not be knowledgeable about how individual behaviors may impact development of many chronic diseases including skin, lung, and cervical cancer (Moore et al., 2013). In this sample of Australian participants, it seemed that there may not have been great awareness of how significant individual behavior is in the prevention of disease development. In another study, a particular subset of individuals was least likely to acknowledge awareness of behavioral risk factors (such as smoking) for cancer development, specifically. These individuals were those ranging in age from 15-24 (Redeker et al., 2009). This suggests that adolescents and college-aged persons may have low PHL, when other studies suggest that the HL of people with more education (e.g., college students) compared to less educated groups (e.g., high school graduates or those who didn't complete high school) is higher (e.g., Kutner et al., 2006). Furthermore, in the study by Redeker et al. (2009), low SES was also associated with less preventive health knowledge. Thus, while the degree to which education level confounded the findings of the aforementioned study (Redeker et al., 2009) is somewhat unclear, assessing this age group may be important to determine their level of awareness/knowledge of the role health behaviors play in preventing disease development.

It has been observed that those with lower HL may not participate in preventive health behaviors and that those of college age may be particularly low in their awareness of the impact of preventive health behaviors (e.g., not smoking) on health outcomes. However, how does one's PHL relate to their smoking behavior? The next section highlights research that has been conducted with college students related to constructs encompassed within PHL (preventive health knowledge, risk perception, self-efficacy, and preventive health action) and smoking behavior.

Preventive Health Literacy in College Students

Previous research suggests that college-aged students have "adequate" levels of HL (e.g., Ickes & Cottrell, 2010). However, whether college students have adequate PHL remains to be understood. Furthermore, like the limited research on the connection between HL and smoking behavior, there seems to be limited research on the connection between components of PHL and smoking behavior. The research mentioned above showed that risk perception may be lower among college smokers compared to non-smokers (e.g., Murphy-Hoefer et al., 2004) and self-efficacy is a factor shown to be associated with successful smoking cessation attempts (Lee et al., 2014). In addition, as mentioned previously, individuals ranging in age from 15-24 may be the least likely to acknowledge awareness of behavioral risk factors (such as smoking) for cancer development (Redeker et al., 2009). Also, research has shown connections between smoking and participation in other health behaviors. College student smokers, when compared to non-smokers, have been shown to have poorer health behaviors such as binge drinking and less frequently limiting dietary fat intake (Berg et al., 2012), and participating in alcohol and other drug use (Sutfin et al., 2012). Thus, it seems that smoking behavior among college students is associated with poor health behaviors. However, many questions remain to be answered. For example, do college students regularly participate in other forms of health action such as preventive health care services and is this related to their health behaviors (like smoking)? Are college students aware of the impact their health behaviors play in the development or prevention of future health problems?

While it is apparent that the connection between HL and smoking behavior, and PHL and smoking behavior, should be further explored, longstanding issues exist in the field in relation to the measurement of HL. Therefore, in the section below, a brief review and critique of a few prominent measurement tools in HL will be provided. This section will also include a discussion

of the appropriateness of fit for the tools in measuring HL and PHL as they have been defined in this paper.

Measurement Issues and Critique of Measures of Health Literacy

There are many measures that have been developed to assess HL. However, as previously mentioned these measures have often not been comprehensive. The Institute of Medicine (US) Roundtable on HL reported, "There is currently no open-access (free/easily available) comprehensive measure of HL" (2009). This Roundtable on HL also provided details about what they believed a comprehensive measure of HL should include, such as measures of "oral understanding", "health knowledge", and "navigation skills", indicators to "guide quality improvement", and indicators of the degree to which information provided by the health care system is understandable and attainable (Institute of Medicine [US] Roundtable on HL, 2009). Other suggested characteristics of HL measures include specificity and sensitivity to changes in HL and the capability to be adapted into different formats (Institute of Medicine [US] Roundtable on HL, 2009). While this roundtable was documented in 2009, there does not appear to have been any movement on the development of a more comprehensive measure or updates since this roundtable on HL. The following section will be a review and critique of some of the prominently utilized measures of HL.

The Test of Functional Health Literacy in Adults (TOFHLA). The TOFHLA is one of the "gold standard" measures of HL (e.g., Haun, Valerio, McCormack, Sørensen, Paasche-Orlow, 2014). It contains a reading comprehension section with 50 items and a numeracy section containing 17 items that were developed from hospital materials. This measure has both high face and construct validity and takes about 20 minutes to complete (Parker et al., 1995).

The TOFLHA has been utilized with different populations including older adult populations (e.g., Mõttus et al., 2014) and college students (e.g., Ickes & Cottrell, 2010). Scores on the TOFLHA have also been connected to many different health outcomes. For example, in a study conducted with a large British sample (N = 719) of adults ages 18-90 utilizing a slightly modified version of the TOFHLA, higher HL was associated with not smoking, eating fruits and vegetables, and having higher self-reported health (von Wagner et al., 2007).

While the TOFHLA is a well-established, reliable, and valid measure of HL, it may not be a fully comprehensive measure (e.g., Baker, 2006). While it seems to capture information about one's knowledge of health information and ability to process that information, other components of HL are left out (Ickes & Cottrell, 2010). For example, it does not address the belief in one's ability to make use of the information/knowledge they have about health (i.e., self-efficacy). Also, because the TOFHLA was developed for assessment in those with low HL, it may not be difficult enough to capture unique differences in HL among college students, a presumably well-educated group (Ickes & Cottrell, 2010).

There is also a shortened version of the TOFHLA, the S-TOFHLA (Baker, Williams, Parker, Gazmararian, & Nurss, 1999). It contains 4 items related to numeracy, 2 items related to reading comprehension, and takes at most about 12 minutes to complete (Baker et al., 1999). It has also shown high internal consistency for the numeracy and reading comprehension items (Baker et al., 1999).

The S-TOFHLA has been utilized in adult populations (e.g., Baker et al., 1999) and college student populations (e.g., Williams, 2015 [a dissertation project]) and it has been found to be a better predictor of health outcomes than other measures of HL including the NVS ([Newest Vital Sign Test]; Osborn et. al, 2007; Weiss et. al., 2005). For example, low scores on

this measure have been associated with poor health outcomes including low physical fitness, high BMI, and having fewer natural teeth (Mõttus et al., 2014).

Thus, while the S-TOFHLA may not have been utilized in research as frequently as the TOFHLA, it may be beneficial to use for a variety of reasons. For example, it requires less time to complete and may predict health outcomes better than other measures of HL. However, the S-TOFHLA, like the TOFHLA, involves an interactive process between the researcher and participants (or professional and patient), and therefore, may be difficult to adapt to different formats such as an online study. These measures also seem to only address traditional literacy and numeracy in a health context. They do not assess other components of HL as they have been operationalized.

The Rapid Estimate of Adult Literacy in Medicine (REALM). The REALM is also one of the "gold standard" measures of HL (e.g., Haun et al., 2014). It is a 66 item measure of word recognition and pronunciation of medical terms that was originally designed to be utilized in settings such as primary care (e.g., Davis et al., 1993; Davis et al., 1991).

The REALM has been utilized with older adult populations (e.g., Mõttus et al., 2014) and low scores on the REALM have been associated with poor health including low physical fitness, high BMI, and fewer natural teeth (Mõttus et al., 2014). It has been shown in some studies to have ceiling effects with many people scoring high on this test (e.g., Mõttus et al., 2014). Also, although the REALM is often used as a measure of HL, some researchers argue that while it seems to be a valid and reliable measure of someone's ability to read and pronounce medical terms, that does not mean it is an appropriate measure of HL (Dumenci, Matsuyama, Kuhn, Perera, & Siminoff, 2013). Assessment of only one's ability to read and pronounce medical

terms does not address other factors identified in standard operational definitions of HL (Dumenci et al., 2013).

There is also a shortened version of the REALM called the REALM-R (e.g. Bass, Wilson, & Griffith, 2003). The REALM-R only contains 8 items and was developed as a method of screening patients for deficits in HL (Bass et al., 2003). Patients are asked to say the 8 items aloud and the whole process takes about 2 minutes, suggesting very little burden. The authors noted that this tool could be easily adapted to include area-specific words (Bass et al., 2003). For example, if someone was interested in studying cancer, words such as carcinogen or immunocompromised, could be used as terms related to that content area.

In an initial study to determine the REALM-R's reliability, the scale was found to have strong internal validity (Cronbach's $\alpha = 0.91$; Bass et al., 2003). It also was found to be highly correlated with the original REALM ($r =. 72$) (Bass et al., 2003). The REALM-R has been utilized in middle-aged adult populations (e.g., Press, Shapiro, Mayo, Meltzer, & Arora, 2013) and older adult populations (e.g., Levy, Janke, & Langa, 2015).

The strengths of the REALM-R include its brevity and use in a variety of populations. However, both the REALM-R and REALM require an interactive process between researcher and participant (or professional and patient) and therefore, they may be difficult to adapt to an online study. Also, as other researchers have noted, it may not adequately address the health knowledge component of HL as participants are only having to read medical terms; thus, it seems to only get at traditional literacy with health-related terms.

Comprehensive Health Activities Scale (CHAS). The Comprehensive Health Activities scale is a new measure of HL (Curtis et al., 2015). This 45 item assessment contains four different components: A health scenario followed by related questions, a prescription from a

medication bottle followed by questions about usage and dose, verbal information followed by related questions, and a video with health information followed by an assessment of both immediate and delayed recall (Curtis et al., 2015).

It was created for use among the "aging population" (Curtis et al., 2015, p. 158) in hopes to more accurately reflect encounters patients may be having during interactions with doctors. Specifically, the authors noted, "In addition to addressing reading and numeracy abilities using print documents and pill bottles as in the commonly used assessments, the addition of spoken communication and multimedia video allowed us to also measure comprehension and recall of verbal information without written support documents, as is often necessary in medical encounters" (Curtis et al., 2015, p. 158).

The CHAS was found to be significantly related to self-reported health status, physical health, depression, and anxiety (Curtis et al., 2015). Also, it was found to have high construct validity as related to a few of the prominently used measures of HL (i.e., TOFHLA, REALM, and NVS), and high reliability and predictive validity (Curtis et al., 2015).

One drawback of using this measure is that, because it is brand new, it appears to have only been utilized in an elderly population. Thus, it is not yet certain how it would function as a measure of HL in other populations. Another potential drawback of utilizing this measure may be the length of time that it takes to complete (approximately 60 minutes). In addition, while it seems to be more comprehensive than other measures, it only seems to address the health knowledge component of HL. However, the authors noted that it could be adapted to an online version (Curtis et al., 2015).

Newest Vital Sign Test (NVS). The NVS is a measure of HL that takes very little time to complete (~ 3 minutes) and is often conducted while taking a patient's vital signs (Weiss et. al.,

2005). The measure contains only 6 questions and asks patients to assess information on an ice cream container (i.e., a nutrition label). Participants look over the nutrition label and then answer the questions about the content of the label (Weiss et. al., 2005).

The NVS has been utilized in older adult populations (e.g., Mõttus et al., 2014), middle aged adults (Osborn et. al, 2007), with children (e.g., Driessnack, Chung, Perkhounkova, & Hein, 2014), and with college students (e.g., Williams, 2015; Mas, Jacobson, & Dong, 2014). It has been found to be highly correlated with other measures of HL such as the S-TOFHLA and REALM (Osborn et. al, 2007). In terms of the connection between the NVS and health outcomes, low scores on the NVS have been associated with poor health including low physical fitness, high BMI, and fewer natural teeth (Mõttus et al., 2014).

One positive characteristic of this measure is its high sensitivity to detecting low literacy and moderate specificity (Osborn et. al, 2007). Also, it does not seem to have the ceiling effects found in the TOFLHA (e.g., Ickes, & Cottrell, 2010). However, in one study, the S-TOFLHA was found to be a better predictor of health outcomes than the NVS (Osborn et. al, 2007). Although traditional administration of the NVS requires the administrator to read the items to the patient/participant, among groups thought to possess high HL such as college students, it may be adaptable to an online study in which participants read the items themselves. However, like other prominent measures of HL, it may not be a comprehensive assessment. The measure does seem to address health knowledge, albeit specific to the nutrition domain, but not the other proposed components of HL.

While there are certainly positives and negatives associated with each measure, overall, a widely accessible and comprehensive measure does not exist. Furthermore, a comprehensive measure that assesses health knowledge, health action, risk perception, and self-efficacy has not

been found. Thus, it was important to utilize multiple measures to gather a comprehensive assessment of HL as it has been operationalized.

Summary of review and critique of health literacy measures. While the aforementioned critique does not represent an exhaustive list of HL measurement tools, it does cover a few of the most commonly used tools. Each tool has specific strengths and weaknesses but one collective characteristic is that the tools are not comprehensive measures of HL, especially as the construct has been operationally defined for the purposes of this study. This critique highlighted some of the issues in measurement of HL and indicates a need for the development of comprehensive, open-access measures of HL.

While the measurement of HL is an area of growth for the literature, another important facet of studying HL in relation to smoking behavior is how to do so with recognition that HL is certainly not the only factor contributing to smoking behavior. As previously mentioned in Chapter I, many factors play a role in the development and maintenance of smoking behavior. The section below will highlight a few of the other known factors which are associated with smoking behavior. These factors are assessed and taken into account in the study.

Factors Contributing to Smoking Behavior

It is recognized that there are many factors that contribute to smoking behavior. It involves individual factors like HL, age and depressive symptomology, structural factors like state and national law, environmental factors like media and peer influence, and sociodemographic influences such as economic status and race/ethnicity. While researchers are not able to capture all factors contributing to a certain behavior, including those known to be highly associated with the behavior of interest is important when building the best model to predict the behavior. This section provides a brief summary of several key factors that contribute

to smoking behavior. Those factors include demographic characteristics, nicotine dependence, and psychological factors (i.e., depression, anxiety, and alcohol use).

Demographic characteristics. The Centers for Disease Control and Prevention (CDC) use data from a national survey to determine the prevalence of smoking behavior and associated demographic characteristics. From the 2013 National Health Interview Survey (NHIS), the CDC reports that current cigarette smoking is higher among men than women (20.5% vs. 15.3%), in young adults (ranging in age from 25-44), among those who are multi-racial and American Indians/Alaska Natives, among those with a GED (General Education Development) degree, among persons who identify as lesbian, gay, or bisexual, and among those living below the poverty line (Jamal et al., 2014). Thus, age, gender, race/ethnicity, education, poverty status, and sexual orientation are important demographics to assess in relation to smoking behavior.

Nicotine dependence. Addiction to nicotine in cigarettes is a significant contributing factor to smoking behavior (U.S. Department of Health and Human Services, 2014). Among college students, studies have shown that nicotine dependence is most highly associated with both "heavy" and frequent smoking but can also be found in groups that only smoke occasionally (Dierker et al., 2007). Thus, assessing nicotine dependence, through measures such as the Hooked on Nicotine Checklist ([HONC; DiFranza et. al, 2002) which is further discussed below, among college students with any amount of smoking behavior is important.

Comorbid/contributing psychological factors. In regards to psychological factors contributing to smoking behavior and comorbidities with smoking behavior, depression, anxiety, and alcohol use seem to play a key role. In general, adult smokers tend to have more depressive symptomology than do non-smokers (e.g., Berg, Wen, Cummings, Ahluwalia, & Druss, 2013) and this may also hold true for college student samples (Ridner, 2005). In terms of anxiety,

studies show that young adults who are more dependent upon nicotine have a higher prevalence of anxiety disorders (e.g., Breslau, Kilbey, & Andreski, 1991). Lastly, with regards to alcohol use, there is a high prevalence of comorbidity with college student smokers. A national survey conducted in 2001 among college students indicated that greater than 98% of smokers also drink (Weitzman, & Chen, 2005). Thus, depression, anxiety, and alcohol use may co-occur often among college student smoker samples.

Summary and Purpose

Based on the research presented above and a review of the literature, several gaps have emerged related to the study of HL. First, little research has assessed the relationship between HL and smoking, one of the most detrimental of health risk behaviors. Second, a significant component of HL, related to the knowledge and beliefs about the preventive nature of positive health behaviors has been mostly ignored by researchers. Third, relatively little research has been conducted assessing the HL of college students. Finally, little is known about the differences in HL (and PHL) across different "levels" of smoking behavior among college students. The purpose of this study was to begin working toward addressing some of those gaps. The aims and research questions (RQ) of the present study include the following:

Aim 1: Assess the HL of undergraduate students in relation to their smoking behavior.

RQ_1: *What is the level of HL among undergraduates as measured by health knowledge, risk perception, self-efficacy, and health action?*

RQ_2: *Is HL of undergraduate students associated with smoking behavior?*

Aim 2: Assess the PHL of undergraduate students in relation to their smoking behavior.

RQ_3: *What is the level of PHL among undergraduates as measured by health knowledge, risk perception, self-efficacy, and health action?*

RQ_4: *Is PHL of undergraduate students associated with smoking behavior?*

Aim 3: Assess the relationship between HL and PHL.

RQ_5: *How do undergraduate students' levels of HL relate to their levels of PHL*

CHAPTER III: METHOD

Prior to initiating any human subject activities the study was approved by the Institutional Review Board of East Carolina University (UMCIRB 15-001740).

Participants

Only undergraduate students greater than 18 years of age from ECU were permitted to participate in the study. Exclusion criteria included having graduate student status.

Measures

The survey consisted of several different measures to collect information about demographics, and to assess smoking behavior, HL, PHL, nicotine dependence, alcohol use, depression, and anxiety. Chronbach's alpha was calculated for each established measure to assess internal consistency.

Demographics. A demographics survey was created for use in this study in which participants were asked to report their age, sex, race/ethnicity, sexual orientation, current year in school (education), and total family/household income (as a measure of poverty status). These demographic variables were analyzed descriptively and then their relationship with smoking status was analyzed.

Smoking status. Participants were asked to select which category of cigarette smoking status best described their behavior. The category choices were "regular smoker", "social smoker", "former smoker", and "non-smoker".

Health literacy. HL was measured using a combination of measures/items to assess health knowledge, self-efficacy, risk perception, and health action. An established measure of HL, the Newest Vital Sign (NVS) test was also given (Weiss et. al., 2005). This established measure was used in exploratory analyses to compare HL of the sample based on this measure to

HL based on the new conceptualization and measurement developed for the study. Items developed to assess health knowledge and risk perception were selected and/or modified from previous research addressing smoking health knowledge and risk perception (i.e., Oncken, McKee, Krishnan-Sarin, O'Malley, & Mazure, 2005). The items used to assess self-efficacy and health action were developed for use in this study.

The Newest Vital Signs Test (NVS): Comparison measure. The NVS is a measure traditionally used to assess HL. It primarily assesses health knowledge by having participants/patients read information on an ice cream container (i.e., a nutrition label) and then answer the questions about the content of the label (Weiss et. al., 2005). It contains 6 questions, takes about 3 minutes to complete, and is traditionally administered via an interactive process between the participant and administrator. Administration of the NVS in this study deviated from normal as participants were administered the NVS through an online format and were presented with the questions in an open-ended format, rather than having the items read-aloud to them. This method of administration has not yet undergone a validation study (B. D. Weiss, personal communication, September 20th, 2015). However, it was proposed that despite the potential for added difficulty in administration this way, a college student sample, which is assumed to have adequate levels of traditional literacy, will not have significant trouble reading and answering the items, even without them being read aloud. The NVS will be used as a comparison measure in future analyses to determine if HL differs among the sample based on the method of measurement. Research has shown that low scores on the NVS have been associated with poor health outcomes (e.g., Mõttus et al., 2014) and it has been shown to have high sensitivity to detecting low literacy and moderate specificity (Osborn et. al, 2007). In addition, it has been

shown to have internal consistency (Chronbach's α = .76) and to have adequate criterion validity (r = 0.59, p <.001) (Weiss et. al., 2005).

Health knowledge. Health knowledge was measured via a set of modified items drawn from items developed by researchers studying smokers' health knowledge of the risks associated with smoking (i.e., Oncken et al., 2005). The authors identified health outcomes associated with smoking and asked participants to answer "true" or "false" to items asking whether a particular outcome could be caused or made worse by smoking (although exact wording of those items is not provided in the article). The following health outcomes, among others, were identified by the researchers as related to smoking and were used in their set of items: cancer, pulmonary disease, cardiovascular disease, oral disease, reproductive health problems, and premature death ([i.e., taking years off one's life]; Oncken et al., 2005, p. 780). In this study, participants were asked to answer "true" or "false" to questions about the impact of smoking on each of the broad categories of health outcomes listed above. A sample item was, "Smoking cigarettes can cause the development of cancer, or worsen this condition if it is preexisting." In addition, a few other items were developed from the Centers for Disease Control and Prevention's smoking and tobacco use statistics (CDC, 2017a). For example, one item read, "The total economic cost of smoking in the United States is _____ of dollars per year" and answer choices were "thousands," "millions," or "billions." Participants also answered questions about the impact of excessive alcohol use and poor diet on health outcomes related to those behaviors. For excessive alcohol use, related health outcomes will include cancer, liver disease, pancreas disease, cardiovascular disease (National Institute of Alcohol Abuse and Alcoholism [NIAAA], n.d.) and premature death. For poor diet, related health outcomes included cancer, diabetes, cardiovascular disease (WHO, 2015) and premature death. While data on these additional behaviors were

collected, they are not the focus of the study, and results from these data are not included in this document.

Risk perception. Risk perception was assessed via a set of items aiming to address participant's beliefs about their own personal risk of disease development. Participants were presented with the items and asked to rate their degree of agreement using a 6 point scale ("1" indicated "strongly disagree", "2" indicated "disagree", "3" indicated "neutral", "4" indicated "agree," "5" indicated "strongly agree," and "6" indicated "N/A, I do not participate in the described behavior". The items reflect categories of illnesses known to be related to smoking; the same diseases identified by Oncken et al. (2005) that were also used to assess health knowledge of smoking behavior, as mentioned above. Other health outcomes regarding excessive alcohol consumption and poor diet will also be reflected in the items, as described above. However, the question format and rating scale for the items associated for risk perception in this study deviated from the format used by Oncken et al. (2005). Oncken et al. (2005) used the following format: "Compared to a nonsmoker of your age and sex, how likely is it that you will develop the following conditions if you continue to smoke (p. 780)," rated on a 7-point Likert-type scale. The question format for this study is: "My personal cigarette smoking behavior puts me at risk for _____." and participants rated their agreement using the scale described above. Similar to the health knowledge items, only those items related to cigarette smoking will be reported in this document.

Self-efficacy. Self-efficacy was measured by a set of items developed to assess self-efficacy for behavior change. Participants were asked to rate their agreement to statements about their perceived ability to make behavior change. They responded to the items using a scale in which "1" indicated "strongly disagree", "2" indicated "disagree", "3" indicated "agree", "4"

indicated “strongly agree,” and “5” indicated “N/A I do not participate in the described behavior.” One example item is, “If I was recommended to do so, I could stop smoking cigarettes despite barriers or challenges that may make that change difficult.”

***Health action*.** Health action was assessed via a set of items developed for use in the study that address degree of participation in different positive health behaviors. Participants were presented with items and asked to rate their degree of agreement using a 4 point Likert-type scale (“1” indicated “strongly disagree”, “2” indicated “disagree”, “3” indicated “agree”, and “4” indicated “strongly agree”). An example item is, “I eat a balanced diet.”

Preventive health literacy. PHL was assessed via a set of questions developed for use in this study. The questions were developed as modifications of the HL questions described above to assess preventive health knowledge, risk perceptions associated with not participating in preventive health behaviors (or participating in risky health behaviors), self-efficacy to engage in preventive health behaviors, and actual engagement in preventive health behaviors.

***Preventive health knowledge*.** Preventive health knowledge was measured by a set of items that were also developed from information about the harmful effects of cigarettes from the CDC’s website (CDC, 2017a). These items focused more on prevention of outcomes. An example item is, “Cigarette smoking is the leading cause of preventable death in the United States.” Additional items that noted the preventive role of all positive health behaviors were designed in parallel to those in the health knowledge section (adapted from Oncken et al., 2005; NIAAA, n.d.; WHO, 2015). An example item is, “Preventive health behaviors (like eating healthy, exercising regularly, and attending regular physical or mental health doctor’s visits) can reduce the likelihood of developing cancer or improve the condition if it is preexisting.” As in

other sections, only statistics on items directly related to cigarette smoking are reported in the results.

Risk perceptions regarding preventive/risky behaviors. Risk perception regarding preventive/risky behaviors were assessed via a set of items mirroring the risk perception items described above with greater emphasis on the role of health behaviors in either the prevention or increased potential for manifestation of each illness. Participants were presented with the items and asked to rate their degree of agreement using a 6 point scale ("1" indicated "strongly disagree", "2" indicated "disagree", "3" indicated "neutral", "4" indicated "agree," "5" indicated "strongly agree," and "6" indicated "N/A, I do not participate in the described behavior". The items reflected the different illnesses described above as identified by Oncken et al. (2005) in relation to smoking behavior, and other outcomes described above that have been connected to excessive alcohol use and poor diet (NIAAA, n.d.,; WHO, 2015). An example item is, "Changing my cigarette smoking behavior would reduce my risk for developing cancer".

Self-efficacy to engage in preventive health behaviors. Self-efficacy was measured by a set of items developed aiming to address self-efficacy to participate in preventive health behaviors. They responded to the items using a scale in which "1" indicated "strongly disagree", "2" indicated "disagree", "3" indicated "agree", "4" indicated "strongly agree," and "5" indicated "N/A I do not participate in the described behavior." A sample item is, "If I was recommended to do so, I could reduce my risk of disease development and/or poor health outcomes by stopping cigarette smoking despite barriers or challenges that may make that cessation difficult."

Preventive health action. Preventive health action was assessed via a set of items developed for use in the study that aim to address participation in different preventive health

behaviors and self-care. The items mirror the health action items described above in the description of HL measurement, but have a shifted emphasis to prevention of poor health outcomes. Participants were presented with the items and asked to rate their degree of agreement using a 4 point Likert-type scale ("1" indicated "strongly disagree", "2" indicated "disagree", "3" indicated "agree", and "4" indicated "strongly agree"). An example item is, "To prevent future disease development and/or poor health outcomes, I do not smoke cigarettes."

Potential covariate variable measures.

Nicotine dependence. Nicotine dependence was assessed by the Hooked on Nicotine Checklist ([HONC]; DiFranza et. al, 2002), a 10-item measure of autonomy over cigarettes which has been shown to be a better predictor of smoking behavior among college student groups compared to more traditional measures such as the Fagerström Test for Nicotine Dependence ([FTND]; e.g., Heatherton, Kozlowski, Frecker, & Fagerström, 1991). The 10 items require "yes" or "no" responses and the more items answered "yes" reflect the degree of autonomy the individual has lost (DiFranza et. al, 2002). It has been shown to have high predictive validity in college student samples, even among non-daily smokers (Sledjeski et al., 2007). The HONC has been shown to have high internal consistency among college student samples (e.g., $\alpha = .89$) and high concurrent validity (e.g., Wellman, McMillen, & DiFranza, 2008).

Alcohol use. Alcohol use was assessed via a brief 3-item self-report measure called the AUDIT-C that was developed from the original 10-item Alcohol Use Disorders Identification Test ([AUDIT]; Bush, Kivlahan, McDonnel, Fihn, & Bradley, 1998). It contains items associated with frequency and quantity of alcohol consumption and has multiple choice responses associated with points. Two slight changes from standard format will include an added

specification of how many ounces of different types of alcohol reflect a standard drink and modifying an item to ask how many times one has more than 5 drinks on one occasion (original AUDIT-C asks about having more than 6 drinks on one occasion). This information was obtained from the National Institute of Alcohol Abuse and Alcoholism ([NIAAA], n.d.). A higher score a participant receives is typically associated with increased drinking affecting their safety (Bush et al., 1998). This measure has been utilized among college student samples and has been shown to have high internal consistency (Cronbach's $\alpha = .76$) and split-half reliability ([Spearman-Brown coefficient = .881]; Barry, Chaney, Stellefson, & Dodd, 2015).

Depression. Depressive symptomology was assessed via the Patient Health Questionnaire-9 ([PHQ-9]; e.g., Kroenke, Spitzer, & Williams, 2001; Kroenke & Spitzer, 2002). The PHQ-9 was developed as a brief screening tool, taking only about 5 minutes to complete, to assess depressive symptomology with higher scores reflecting increased occurrence of depressive symptoms (e.g., Blackwell & McDermott, 2014). It has high sensitivity and specificity to detecting depression (e.g., Kroenke et al., 2001). It has also been shown to have high internal consistency among primary care settings (Cronbach's $\alpha = 0.89$; Cronbach's $\alpha = 0.89$). While a study specifically addressing the reliability and validity of the measure for use among college students was not found in the literature, it is not suspected that there is a major difference in the reliability and validity of the measure in the college student sample vs. other community samples.

Anxiety. Anxiety symptomology were assessed via the Generalized Anxiety Disorder 7-item scale ([GAD-7]; Spitzer, Kroenke, Williams, & Löwe, 2006). On this seven item measure, higher scores reflect more severe anxious distress (Spitzer et al., 2006). The GAD-7 has been shown to have high internal consistency (Cronbach's $\alpha = .92$) and test-retest reliability (intraclass-

correlation = .83; Spitzer et al., 2006). While a study specifically addressing the validity and reliability of the measure for use among college students was not found in the literature, it is not suspected that there will be major differences in the validity and reliability of the measure in the college student sample versus other community samples.

Procedure

Data were collected via an online survey created through Qualtrics and it was expected that the survey would take 30 minutes or less to complete. Participants were recruited through the online SONA system used by the Department of Psychology to allow students in the Introductory Psychology course (PSYC 1000) to receive research participation credit. Students recruited through the SONA system had the opportunity to participate in this study, among other options, to receive course credit in their PSYC 1000 course. Upon completion, students received .5 points toward their 5 total required points for their PSYC 1000 class, commensurate with their effort and time spent completing the survey (i.e., the standard is to receive .5 credits per half hour spent completing the study).

Upon opening the link to the survey, participants were presented with an informed consent page. At the bottom of the informed consent page were two buttons: "Yes, I agree to participate" and "No, I do not agree to participate". Upon clicking the "Yes, I agree to participate" button, participants were directed to the survey questions. Upon clicking the "No, I do not agree to participate" button, participants were directed to the debriefing page. Participants were always presented with the demographics questions first, followed by smoking status questions, sections on HL, PHL, and other contributing factors (i.e., nicotine dependence, alcohol use, depression, and anxiety questions). The very last screen that all participants viewed was the debriefing page.

Statistical Analyses

Descriptive statistics were used to analyze the demographic data and answer research questions 1 and 3 related to determining the level of HL and PHL among undergraduates. For example, frequencies were used to understand responses to the risk perception, self-efficacy, and health action components of both HL and PHL. Health knowledge and preventive health knowledge items were scored as either a "0" or "1" depending on whether or not the answer was correct. Then, a composite health knowledge and preventive health knowledge score was derived by summing the individual items. Higher scores indicated a greater degree of health knowledge and preventive health knowledge. Additionally, the mean and standard deviation of each composite variable derived from the individual health knowledge, risk perception, and health actions were calculated. Self-efficacy was measured with only one item, therefore, the mean and standard deviation of that item was derived with exclusion of the "N/A" response choice. Chi-square or correlational analyses, depending on the variable, were utilized to determine if relationships existed between participants' composite anxiety, depression, nicotine dependence, and alcohol use scores and smoking status. Relationships between smoking status and demographic factors were also examined with this method. Factors significantly associated with smoking status were included as predictors in subsequent logistic regression models.

To answer research questions 2 and 4, first point-biserial correlations were conducted to examine the association between each HL or PHL component, along with demographic predictors identified, and smoking status. Then, logistic regressions were used to determine which predictors contributed to the prediction of smoking status.

Last, to answer research question 5, correlational analyses were used to examine the relationship between each parallel component of HL and PHL. Then, t-tests were utilized to

determine if mean scores on parallel composite variables were significantly different from one another. Of note, reliability analyses were also conducted on each established measure to assess the internal consistency of each set of items.

CHAPTER IV: RESULTS

Participants

Participants in this study consisted of undergraduate students (N = 491) from East Carolina University. Data were collected from 643 students, however, 152 students failed to meet the validity threshold of answering 80% or more of the validity indicator items correctly. Therefore, their data was excluded from analyses. The sample was approximately 55% female and 45% male. The age of participants ranged from 18 to 26 years (M = 18.96 years, SD = 1.09 years) and 77% were freshmen. With regard to ethnicity, approximately 93% of the sample identified as Non-Hispanic/Latino while 5% identified as Hispanic/Latino and 2% did not respond. With regard to race, approximately 14% identified as Black, 1% as Native American, 3% as Asian, 78% as White, 4% as "Other", and less than 1% did not respond. Approximately 96% of the sample identified as heterosexual or straight, <1% identified as gay or lesbian, 2% identified as bisexual, and <1% identified as "not sure" or "other". Around 20% of the sample estimated their family household income to be less than $20,000, around 61% indicated income between $21,000 and $99,000, and 27% indicated income greater than $100,000 per year (see Table 1 for more details).

Table 1

Demographic Characteristics

Characteristic	*N*	*%*
Gender		
Male	219	44.6
Female	271	55.2
Ethnicity		
Hispanic/Latino	24	4.9
Non-Hispanic/Latino	456	92.9
Race		
Black	68	13.8
Native American	5	1.0

Asian	13	2.6
White	382	77.6
Other	19	3.9
Sexual Orientation		
Heterosexual or Straight	473	96.3
Gay or Lesbian	1	.2
Bisexual	10	2.0
Not sure	3	.6
Other	3	.6
Year in school		
Freshman	376	76.7
Sophomore	78	15.9
Junior	27	5.5
Senior	9	1.8
Estimated Household Income ($)		
< 10,000	29	5.9
10,000-20,000	30	6.1
21,000-40,000	69	14.1
41,000-60,000	116	23.6
61,000-99,000	112	22.8
>100,000	132	26.9

Smoking Behavior and Related Demographics

Approximately 4% of the sample identified as "regular smoker (e.g., smoking on most days)," 11% as "non-daily smoker," 5% as "former smoker (e.g., used to smoke but do not currently smoke cigarettes at all)," 78% as "non-smoker," and 2% "other". The smoking status item responses were recoded into either "smoker" or "non-smoker" due to the limited number of responses in the original groups. Overall, approximately 14% of participants reported smoking behavior of some kind while 83% of participants reported not currently smoking. Next is a description of analyses conducted to assess the relationship between smoking status and various demographic variables.

Chi-square analyses were conducted to determine the relationship between smoking status and gender, smoking status and race, and smoking status and income category. A

significant relationship was found between gender and smoking status, $\chi 2$ (1, N = 477) = 11.81, p = .001, with a small-moderate effect size (Φ = .16, p = .001), indicating that males were more likely to be smokers than females. Due to this significant finding, gender was entered in subsequent logistic regression analyses as a predictor variable. Analyses revealed no difference between Blacks and Whites with regard to smoking status, X^2 (1, N = 437) = 2.05, p = .15 or between self-reported income category and smoking status, X^2 (5, N = 476) = 8.21, p = .15. An independent samples t-test was also used to determine whether or not smokers and non-smokers differed with regard to age. There was no significant difference between smokers (M = 19.03, SD = 0.97) and non-smokers (M = 18.95, SD = 1.12) with regard to age, t(442) = -.53, p = .59. There were too few participants who identified as Hispanic/Latino smokers to conduct a chi-square analysis assessing the relationship between smoking status and ethnicity. However, generally, as would be expected, there were more non-smokers than smokers in both the Hispanic/Latino and Non-Hispanic/Latino groups.

Smoking Status and Potential Covariates

Depressive symptoms, as measured by the PHQ-9, anxiety symptoms, as measured by the GAD-7, nicotine dependence, as measured by the HONC, and alcohol use, as measured by the Audit-C, were all screened among participants. First, reliability analyses were conducted for each of the measures used to screen the above mentioned factors to determine whether or not scores on the measure should be utilized in further analyses. Analyses revealed that each of the measures had acceptable reliability with Cronbach's alpha at .80 or higher for each measure (Audit-C: α = 80; PHQ-9: α = .89**;** GAD-7: α = .94**;** HONC: α = .85). Then, point-biserial correlations were used to determine whether or not significant associations existed between scores on the measures of the above-mentioned factors and smoking behavior.

A significant association was observed between smoking status and nicotine dependence scores, as would be expected, such that having higher nicotine dependence scores was associated with being a smoker, r_{pb} (475) = .49, $p < .001$. A significant association was also observed between smoking status and alcohol use scores such that having higher alcohol use scores was associated with being a smoker, r_{pb}(445) = .31, $p < .001$. There was not a significant association observed between smoking behavior and depressive symptoms, r_{pb}(465) = .06, $p = .18$, or anxiety symptoms, r_{pb}(474) = .057, $p = .21$. Due to the significant associations observed between smoking status and both nicotine dependence scores and alcohol use scores, the composite scores for both of those variables were entered as predictor variables in subsequent logistic regression analyses to attain the best overall classification and to allow for examination of the unique contribution of HL components, controlling for expected substance dependence covariate.

Health Literacy of Undergraduate Students (RQ_1)

To assess RQ_1, "What is the level of HL among undergraduates as measured by health knowledge, risk perception, self-efficacy, and health action," descriptive statistics, including frequencies and measures of central tendency, were utilized. Details regarding any recoding and/or transforming of data that occurred are described below in the sections corresponding to each component of HL: health knowledge, risk perception, self-efficacy, and health action.

Health knowledge. To examine smoking health knowledge, a set of 12 items were utilized. Participant responses to these items were recoded such that each correct answer received a score of "1" while each incorrect answer received a score of "0". Then, a composite health knowledge score was calculated by adding together scores on each of the individual items. Therefore, the maximum "score" a participant could receive on these set of items was a 12/12. On average, participants answered approximately 80% of those questions correctly (M = 9.51,

SD = 1.35). Although smoking health knowledge has not been measured in this way before, answering 80% of the items correctly on average is considered adequate if compared to the standards of the NVS. On the NVS, answering between 4 and 6 of the 6 items correctly, or roughly 70-100% of the items, is suggestive of adequate literacy (Weiss et al., 2005).

Risk perception. Smoking risk perception was assessed by a set of 6 items. Among the participants who rated their degree of risk perception, approximately 25% strongly disagreed that their smoking behavior put them at risk for the negative health outcomes. Furthermore, only 2-3% of participants strongly agreed that their smoking behavior put them at risk for various poor health outcomes, such as cancer and cardiovascular disease (see Table 2). Next, a composite risk perception score was calculated by averaging responses across the risk perception items. Cases who selected the "N/A" option were not used in the calculation of this composite score. Descriptive analyses indicated composite risk perception was generally low (*M* = 1.9, *SD* = 1.3), such that on average, participants disagreed that their smoking behavior put them at risk for poor health outcomes. Of note, for each of the negative health outcomes, the majority of participants (~57%) selected "N/A (I do not participate in the described behavior)".

Table 2
Frequencies of Risk Perception

Personal Risk Perception	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A (I do not participate in the described behavior)
Cancer	25.5%	5.1%	3.9%	6.1%	3.1%	56.4%
Pulmonary Disease	25.3%	5.3%	5.3%	4.9%	2.6%	56.6%
Cardiovascular Disease	25.5%	5.3%	4.1%	5.9%	2.6%	56.6%
Oral Disease	25.7%	5.5%	3.9%	5.3%	3.1%	56.6%
Reproductive Health	26.1%	5.5%	4.3%	4.9%	2.2%	57.0%
Premature Death	26.5%	5.9%	4.1%	4.1%	2.9%	56.6%

Self-efficacy. Smoking related self-efficacy was assessed by 1 item. Among those who rated their degree of self-efficacy, 10.8% selected "strongly agree," 7.3% selected "agree," and <4% selected "disagree" or "strongly disagree." This suggests that among smokers in the sample, the majority felt self-efficacious with regard to their ability to change their smoking behavior if asked to do so. Descriptive analyses of the self-efficacy variable revealed high smoking related self-efficacy (M = 3.26, SD =.91). Of note, the majority of participants (78.2%) selected "N/A (I do not participate in the described behavior)."

Health action. The final component of HL assessed was health action. This component was measured by asking participants to rate their degree of agreement with statements regarding their engagement in health behaviors. Of note, among the described health behaviors, participants strongly agreed most frequently to the item related to avoiding cigarettes. They strongly disagreed most frequently to the item related to seeking mental health treatment if needed (see Table 3). A composite health action value was calculated by averaging responses across the health action items. Descriptive analyses indicated composite health action was generally high (M = 2.9, SD = .45), such that on average, participants agreed that they participated in positive health behaviors.

Table 3
Frequencies of Health Action

Health Action	Strongly Disagree	Disagree	Agree	Strongly Agree
Eat balanced diet	2.9%	33.6%	54.4%	9.2%
Exercise regularly	5.1%	28.7%	46.6%	19.6%
Avoid cigarettes	3.5%	12.2%	32.8%	51.5%
Attend doctor's visits	3.7%	19.1%	51.9%	25.3%
Limit alcohol	2.6%	14.7%	51.3%	31.4%
Take care of body	.2%	12.4%	62.5%	2.4.%
Seek mental health treatment if needed	9.0%	24.2%	50.9%	15.5%

Health Literacy and Smoking Behavior (RQ_2)

The second goal of the study was to better understand the relationship between each component of HL and smoking behavior. First, point-biserial correlations were conducted to examine the relationship between composite scores on each individual component of HL, the other identified factors, and smoking status and to assess for multi-collinearity among these factors as predictors for further analyses. Then, binary logistic regression was used to predict smoking status (smoker vs. non-smoker) based on the proposed HL components (smoking health knowledge, health action, smoking risk perception, and smoking cessation self-efficacy) and other factors found to be associated with smoking status (nicotine dependence, alcohol use, and gender). In the logistic regression, all factors were entered simultaneously. Last, because there was case wise exclusion of participants who selected "N/A I do not participate in the described behavior" in both the risk perception or self-efficacy items, individual fisher's exact tests of independence were conducted to determine whether or not risk perception and self-efficacy were independent of smoking status. The frequencies and percentages of smokers versus non-smokers who selected the "N/A" option was also noted.

The point-biserial correlations revealed that each predictor was significantly associated with smoking status, except for smoking knowledge and self-efficacy, which both approached significance (p = .06 and p = .07, respectively). Table 4 provides the results for the point-biserial correlations. To further examine the combined ability of each HL component and other factors to predict smoking status, a binary logistic regression was conducted. The logistic regression model predicted smoking status (smoker vs. non-smoker) of participants based on multi-component conceptualization of HL (i.e., smoking health knowledge, health action, smoking risk perception, and smoking cessation self-efficacy) and the other factors found to be associated with smoking

status (nicotine dependence, alcohol use, and gender). Due to high observed correlations among some of the predictor variables above, linear regression was first used to examine the variance inflation factor (VIF) of these relationships as an assessment for problematic collinearity. No problematic collinearity was observed (VIF statistics < 1.5). The overall logistic regression model was statistically significant, χ^2 (7, N = 92) = 37.307, p = .000. The model explained 45% (Nagelkerke R^2) of the variance in smoking status and correctly classified 77% of cases. In the equation, health action and risk perception were the only predictors to significantly contribute to the predictions of smoking group membership. Those with more engagement in positive health behaviors were 7.1 times more likely to be non-smokers (*Wald* = 6.0, p = .01). Those with a greater degree of risk perception were 1.9 times more likely to be smokers (*Wald* = 7.2, p < .01). The effect of alcohol use was marginally significant, such that those with a higher degree of alcohol use were 1.2 times more likely to be smokers (*Wald* = 3.0, p = .08). The effect of gender, health knowledge, nicotine dependence, and self-efficacy in the model were not statistically significant.

Table 4
Point-biserial Correlations between Health Literacy, Smoking Status, and Covariates

Variables	1	2	3	4	5	6	7	8
1. Smoking Status	-							
2. Smoking Knowledge	.089	-						
3. Risk Perception	.572**	.111	-					
4. Self-efficacy	.184	.332**	.110	-				
5. Health Action	-.256**	.021	-.202**	.099	-			
6. Alcohol Use	.312**	.110*	.185**	.274**	-.202**	-		
7. Nicotine Dependence	.487**	-.015	.469**	-.211*	-.190**	.138**	-	
8. Gender	-.157**	-.041	-.165*	.052	.115*	-.155**	-.127**	-

***. Correlation is significant at the .01 level. * Correlations is significant at the .05 level.*

Last, because a large proportion of the sample answered "N/A" for the risk perception and self-efficacy items, exploratory fisher's exact analyses were conducted to examine patterns

of smoking status distribution across the 5 levels of agreement and these distributions were descriptively compared to smoking status distribution among participants who selected the N/A response for risk perception items. Fisher's exact tests were used rather than chi-square analyses due to there being too few cases in the expected count, which violated chi-square assumptions. The "N/A" category was not included in the analysis as it would significantly inflate the fisher's exact value as the distribution of smokers (e.g., 5%) versus non-smokers (e.g., 60%) who selected this response option was obviously skewed toward non-smokers. The frequencies and percentages of smokers versus smokers across all response categories are included in Tables 5 through 10. The analyses indicated that smokers were more likely to be in the "agree" and "strongly agree" categories across the risk perception items, indicating a higher degree of risk perception. Non-smokers were more likely to be in the "disagree" or "strongly disagree" categories, indicating a lower degree of risk perception. Across the risk perception items, between 55-65% of non-smokers and 4-5% of smokers indicated that this item was not applicable (N/A) to them, such that risk perception could not be assessed.

Table 5
Fisher's Exact Test for Cancer Risk Perception and Smoking Status

Cancer Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	106 (76.3%)	16 (23.9%)	61.818**	.549
Disagree	15 (10.8%)	8 (11.9%)		
Neutral	7 (5.0%)	11 (16.4%)		
Agree	7 (5.0%)	22 (32.8%)		
Strongly Agree	4 (2.9%)	10 (14.9%)		
N/A	*269 (58.6%)*	*3 (4.3%)*		

***Significant at the .01 level*

Table 6
Fisher's Exact Test for Pulmonary Risk Perception and Smoking Status

Pulmonary Risk Perception	Smoking Status

	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	106 (76.8%)	15 (22.4%)	65.819**	.565
Disagree	14 (10.1%)	10 (14.9%)		
Neutral	11 (8.0%)	14 (20.9%)		
Agree	4 (2.9%)	19 (28.4%)		
Strongly Agree	3 (2.2%)	9 (13.4%)		
N/A	*270 (66.2%)*	*3 (4.3%)*		

***Significant at the .01 level.*

Table 7

Fisher's Exact Test for Cardiovascular Risk Perception and Smoking Status

Cardiovascular Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	108 (78.3%)	14 (20.8%)	71.871**	.588
Disagree	12 (8.6%)	12 (17.9%)		
Neutral	10 (7.2%)	9 (13.4%)		
Agree	5 (3.6%)	23 (34.3%)		
Strongly Agree	3 (2.2%)	9 (13.4%)		
N/A	*270 (66.2%)*	*3 (4.3%)*		

***Significant at the .01 level.*

Table 8

Fisher's Exact Test for Oral Disease Risk Perception and Smoking Status

Oral Disease Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	106 (75.2%)	17 (25.4%)	62.407**	.555
Disagree	19 (13.5%)	9 (13.4%)		
Neutral	8 (5.7%)	10 (14.9%)		
Agree	5 (3.5%)	20 (29.9%)		
Strongly Agree	3 (2.1%)	11 (16.4%)		
N/A	*270 (65.7%)*	*3 (4.3%)*		

***Significant at the .01 level.*

Table 9

Fisher's Exact Test for Reproductive Health Risk Perception and Smoking Status

Reproductive Health Risk Perception	Smoking Status

	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	108 (78.8%)	17 (25.8%)	65.315**	.570
Disagree	13 (9.5%)	12 (18.2%)		
Neutral	11 (8.0%)	9 (13.6%)		
Agree	4 (2.9%)	19 (28.8%)		
Strongly Agree	1 (.01%)	9 (13.6%)		
N/A	*271 (66.4%)*	*4 (5.7%)*		

***Significant at the .01 level.*

Table 10

Fisher's Exact Test for Premature Death Risk Perception and Smoking Status

Premature Death Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	109 (79.0%)	18 (26.9%)	57.865**	.533
Disagree	13 (9.4%)	14 (20.9%)		
Neutral	9 (6.5%)	10 (14.9%)		
Agree	5 (3.6%)	14 (20.9%)		
Strongly Agree	2 (1.4%)	11 (16.4%)		
N/A	*270 (66.2%)*	*3 (4.3%)*		

***Significant at the .01 level.*

The same exploratory analytical approach described above was used to examine smoking status distribution across the 4 levels of agreement regarding self-efficacy to chance smoking behavior. Results revealed that smokers and non-smokers were approximately equally likely to feel self-efficacious to make this behavior change. Around 90% of non-smokers and 16% percent of smokers indicated that this item was not applicable (N/A) to them, such that their self-efficacy could not be assessed. The frequencies and percentages of smokers versus smokers across all self-efficacy response categories are included in Table 11.

Table 11

Fisher's Exact Test for Smoking Change Self-efficacy and Smoking Status

Smoking Change Self-efficacy	Smoking Status

	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	6	2	5.340	.234
Disagree	3	6		
Agree	16	18		
Strongly Agree	17	33		
N/A	*365 (89.7%)*	*11 (15.7%)*		

Preventive Health Literacy of Undergraduates (RQ_3)

Preventive health knowledge. Compared to smoking health knowledge, the preventive smoking health knowledge items focused on information that might be relevant to smoking prevention efforts, such as the health benefits of smoking cessation. Each of these items had a correct answer. Participant responses to these items were recoded such that each correct answer received a score of "1" while each incorrect answer received a score of "0". Then, a composite preventive knowledge score was calculated by adding together scores on each of the individual items. Therefore, the maximum "score" a participant could receive on these set of items was a 5/5. On average, participants answered approximately 80% of those questions correctly (M = 3.85, SD = .92).

Preventive risk perception. Preventive smoking risk perception was assessed by a set of 6 items. Among those who rated their degree of preventive risk perception, approximately 13% either agreed or strongly agreed that changing their smoking behavior would reduce their risk for various negative health outcomes (see Table 12). Next, a composite preventive risk perception score was calculated by averaging responses across the risk perception items. Those cases who selected the "N/A" option were excluded from the creation of this composite variable. Descriptive analyses revealed that composite risk perception was generally moderate (M = 3.6, SD = 1.3), such that on average, participants were between feeling neutral and agreeing that changing their cigarette smoking behavior would reduce their risk for poor health outcomes. Of

note, for each of the negative health outcomes, the majority of participants (~78%) selected "N/A (I do not participate in the described behavior)".

Table 12
Frequencies of Preventive Risk Perception

Personal Risk Perception	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A (I do not participate in the described behavior)
Cancer	3.1%	2.0%	3.7%	6.7%	6.3%	78.2%
Pulmonary Disease	2.9%	4.0%	4.3%	7.1%	5.7%	78.0%
Cardiovascular Disease	2.9%	2.0%	3.7%	6.7%	6.5%	77.8%
Oral Disease	2.6%	1.6%	3.9%	7.1%	6.5%	78.2%
Reproductive Health	2.6%	1.6%	4.7%	6.9%	6.1%	78.0%
Premature Death	2.4%	1.6%	5.3%	7.1%	5.9%	77.5%

Preventive self-efficacy. Smoking related preventive self-efficacy was assessed by 1 item. Among participants who rated their degree of preventive self-efficacy, 10.2% selected "strongly agree," 12.8% selected "agree," and <4% selected "disagree" or "strongly disagree." This suggests that among smokers in the sample, the majority felt self-efficacious with regard to their ability to reduce their risk for poor health outcomes through smoking cessation. Descriptive analyses for this variable revealed high smoking related preventive self-efficacy (M = 3.23, SD =.79). Of note, the majority of participants (73.9%) indicated that they did not participate in the described behavior (i.e., selected N/A).

Preventive health action. The final component of PHL that was assessed was health action. On the 7 items assessing this construct, the majority of participants either agreed or strongly agreed that they engage in the various health actions to prevent disease development or poor health outcomes (see Table 13). Next, a composite preventive health action variable was

also calculated by averaging responses across the health action items. Descriptive analyses indicated composite preventive health action was generally high (M = 3.09, SD = .52), such that on average participants agreed that they participated in positive health behaviors.

Table 13
Frequencies of Preventive Health Action

Health Action	Strongly	Disagree	Agree	Strongly
Eat balanced diet	1.0%	18.7%	59.1%	21.2%
Exercise regularly	1.0%	18.1%	50.7%	29.9%
Do not smoke	1.6%	8.8%	24.8%	64.6%
Attend doctor's visits	1.8%	15.5%	49.1%	33.2%
Limit alcohol	1.0%	14.1%	48.3%	36.7%
Take care of body	.2%	8.1%	58.5%	33.0%
Seek mental health treatment if needed	5.9%	26.1%	44.2%	23.4%

Preventive Health Literacy of Undergraduates and Smoking Behavior (RQ_4)

The second goal was to better understand the relationship between each component of PHL and smoking behavior. First, point-biserial correlations were conducted to examine the relationship between composite scores on each individual component of PHL, the other identified factors associated with smoking status, and smoking status and to assess for multi-collinearity among these factors as predictors for further analyses. Then, binary logistic regression was used to predict smoking status (smoker vs. non-smoker) based on the proposed PHL components (preventive smoking health knowledge, health action, smoking risk perception, and smoking cessation self-efficacy) and other factors found to be associated with smoking status (degree of alcohol use, nicotine dependence, and gender). All factors were entered into the regression analysis simultaneously. Last, because participants who selected "N/A I do not participate in the described behavior" in either the preventive risk perception or preventive self-efficacy items were excluded, fisher's exact tests of independence were conducted for individual

preventive risk perception and preventive self-efficacy items to examine whether or not they were independent of smoking status.

The point-biserial correlations revealed that all proposed predictor variables were significantly associated with smoking status except for preventive smoking knowledge and preventive self-efficacy, which approached significance. Table 14 provides the intercorrelations. To further examine the combined ability of each PHL component and other identified factors to predict smoking status, a binary logistic regression was conducted. The logistic regression model predicted smoking status (smoker vs. non-smoker) of participants based on each of the four proposed PHL constructs (preventive smoking knowledge, preventive health action, preventive smoking risk perception, and preventive smoking cessation self-efficacy) and other factors found to be associated with smoking status (nicotine dependence, alcohol use, and gender). Due to high observed correlations among some of the predictor variables above, linear regression was first used to examine the variance inflation factor (VIF) of these relationships as an assessment for problematic collinearity. No problematic collinearity was observed (VIF statistics < 1.5). The overall logistic regression model was statistically significant, $\chi^2(7, N = 85) = 33.79$, $p = .000$. The model explained 45% (Nagelkerke R^2) of the variance in smoking status and correctly classified 81% of cases. In the equation, preventive risk perception was the only predictor to significantly contribute to the predictions of smoking group membership. Those with a higher degree of risk perception were 2.0 times more likely to be smokers (*Wald* = 6.84, $p < .01$). The preventive health action and nicotine dependence predictors approached significance. The effect of engagement in other positive health behaviors was marginally significant, such that those with a higher reported engagement in these activities were 4.39 times more likely to be non-smokers (*Wald* = 3.56 , $p = .06$). The effect of nicotine dependence was also marginally significant, such

that those with a higher degree of nicotine dependence were 1.4 times more likely to be smokers (*Wald* = 3.52, *p* = .06). The effect of gender, health knowledge, alcohol use, and self-efficacy in the model were not statistically significant.

Table 14

Correlations between Preventive Health Literacy, Smoking Status, and Covariates

Variables	1	2	3	4	5	6	7	8
1. Smoking Status	-							
2. Smoking	-.041	-						
3. Risk Perception	.431**	.005	-					
4. Self-efficacy	.119	.127	.305**	-				
5. Health Action	-.228**	-.076	-.157	.124	-			
6. Alcohol Use	.312**	-.011	.109	.111	-.217**	-		
7. Nicotine Dep.	.487**	-.064	.259**	-.089	-.157**	.138**	-	
8. Gender	-.157**	-.088	-.050	-.002	.077	-.155**	.127**	-

***. Correlation is significant at the .01 level. * Correlations is significant at the .05 level.*

Similar to the previously described exploratory analyses, because a large proportion of the sample answered "N/A" for the preventive risk perception and preventive self-efficacy items, exploratory fisher's exact analyses were conducted to examine patterns of smoking status distribution across the 5 levels of agreement and these distributions were descriptively compared to smoking status distribution among participants who selected the N/A response for risk perception items. Fisher's exact tests were again used rather than chi-square analyses due to there being too few cases in the expected count, which violated chi-square assumptions. The "N/A" category was not included in the analysis as it would significantly inflate the fisher's exact value as the distribution of smokers (e.g., 5%) versus non-smokers (e.g., 90%) who selected this response option was obviously skewed toward non-smokers. The frequencies and percentages of smokers versus smokers across all response categories are included in Tables 15 through 20. The analyses indicated that smokers were more likely to be in the "agree" and "strongly agree" categories across the risk perception items, indicating a higher degree of risk perception. Non-smokers were more likely to be in the "disagree" or "strongly disagree"

categories, indicating a lower degree of risk perception. Across the risk perception items, between 80-90% of non-smokers and 10% of smokers indicated that this item was not applicable (N/A) to them, such that risk perception could not be assessed.

Table 15
Fisher's Exact Test for Preventive Cancer Risk Perception and Smoking Status

Preventive Cancer Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	12 (32.4%)	2 (3.2%)	24.442**	.499
Disagree	4 (10.8%)	5 (7.9%)		
Neutral	9 (24.3%)	7 (11.1%)		
Agree	6 (16.2%)	25 (39.7%)		
Strongly Agree	6 (16.2%)	24 (38.1%)		
N/A	*371 (91.0%)*	*7 (10.0%)*		

***Significant at the .01 level.*

Table 16
Fisher's Exact Test for Preventive Pulmonary Disease Risk Perception and Smoking Status

Preventive Pulmonary Disease Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	10 (26.3%)	3 (4.8%)	15.376**	.396
Disagree	4 (10.5%)	5 (7.9%)		
Neutral	10 (26.3%)	9 (14.3%)		
Agree	8 (21.1%)	25 (39.7%)		
Strongly Agree	6 (15.8%)	21 (33.3%)		
N/A	*370 (90.7%)*	*7 (10.0%)*		

***Significant at the .01 level.*

Table 17
Fisher's Exact Test for Preventive Cardiovascular Disease Risk Perception and Smoking

Preventive Cardiovascular Disease Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	11 (29.7%)	2 (3.1%)	21.816**	.472
Disagree	4 (10.8%)	5 (7.9%)		
Neutral	9 (24.3%)	7 (11.1%)		

Agree	6 (16.2%)	25 (39.7%)		
Strongly Agree	7 (18.9%)	24 (38.1%)		
N/A	*369 (90.9%)*	*7 (10.0%)*		

***Significant at the .01 level.*

Table 18

Fisher's Exact Test for Preventive Oral Disease Risk Perception and Smoking Status

Preventive Oral Disease Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	11 (29.7%)	1 (1.6%)	24.962**	.505
Disagree	2 (5.4%)	5 (7.9%)		
Neutral	10 (27.0%)	7 (11.1%)		
Agree	8 (21.6%)	25 (39.7%)		
Strongly Agree	6 (16.2%)	25 (39.7%)		
N/A	*371 (91.0%)*	*7 (10.0%)*		

***Significant at the .01 level.*

Table 19

Fisher's Exact Test for Preventive Reproductive Health Risk Perception and Smoking Status

Preventive Reproductive Health Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	10 (26.3%)	2 (3.2%)	14.689**	.388
Disagree	4 (10.5%)	3 (4.8%)		
Neutral	8 (21.1%)	13 (20.6%)		
Agree	8 (21.1%)	24 (38.1%)		
Strongly Agree	8 (21.1%)	21 (33.3%)		
N/A	*370 (90.7%)*	*7 (10.0%)*		

***Significant at the .01 level.*

Table 20

Fisher's Exact Test for Preventive Premature Death Risk Perception and Smoking Status

Preventive Premature Death Risk Perception	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	10 (24.4%)	1 (1.6%)	18.938**	.432
Disagree	2 (4.9%)	5 (8.1%)		
Neutral	13 (31.7%)	11 (17.7%)		

Agree	8 (19.5%)	25 (40.3%)
Strongly Agree	8 (19.5%)	20 (32.3%)
N/A	*365 (89.9%)*	*8 (11.4%)*

***Significant at the .01 level.*

The same exploratory analytical approach described above was used to examine smoking status distribution across the 4 levels of agreement regarding self-efficacy to chance smoking behavior. Results revealed that smokers were more likely to "agree" or "strongly agree" that they could make behavior change to prevent poor health outcomes, compared to non-smokers. Around 81% of non-smokers and 14% percent of smokers indicated that this item was not applicable (N/A) to them, such that their self-efficacy could not be assessed. The frequencies and percentages of smokers versus smokers across all self-efficacy response categories are included in Table 21.

Table 21
Fisher's Exact Test for Preventive Smoking Change Self-efficacy and Smoking Status

Preventive Smoking Change Self-efficacy	Smoking Status			
	Non-smoker (%)	Smoker (%)	*Fisher's Exact*	Φ
Strongly Disagree	7 (8.8%)	0 (0%)	8.571*	.261
Disagree	2 (2.5%)	5 (8.3%)		
Agree	30 (37.5%)	32 (53.3%)		
Strongly Agree	23 (28.8%)	23 (38.3%)		
N/A	*345 (81.2%)*	*10 (14.3%)*		

**Significant at the .05 level.*

Association between Health Literacy and Preventive Health Literacy (RQ_5)

The final research question aimed to understand the relationship between HL and PHL. First, correlational analyses were used to examine the relationship between each component. Table 22 provides the results of these analyses. Each parallel component of HL and PHL was significantly correlated at the .01 level of significance. Following these analyses, paired-sample t-tests were conducted to compare mean scores of associated composite variables of risk perception and health action, and self-efficacy. It was not appropriate to compare mean scores of

the knowledge components as there were different numbers of items used to measure health knowledge and preventive health knowledge. However, descriptively, the average health knowledge and preventive health knowledge scores of the sample were approximately equal, with participants answering around 80% of health knowledge and preventive health knowledge items correctly.

Table 22
Correlations between Health Literacy and Preventive Health Literacy Components

Variables	1	2	3	4	5	6	7	8
1. Health knowledge	-							
2. Risk Perception	.111	-						
3. Self-efficacy	.332**	.110	-					
4. Health action	.021	-.202**	.099	-				
5. Preventive health knowledge	.117**	-.020	.138	-.054	-			
6. Preventive risk perception	.152	**.625****	.332**	-.203*	.005	-		
7. Preventive self-efficacy	.087	.055	**.637****	.124	.127	.305**	-	
8. Preventive health action	.011	-.167*	.233*	**.673****	-.076	-.157	.124	-

The paired-sample t-tests revealed risk perception was significantly lower than preventive risk perception, $t(102) = -7.93$, $p < .01$, indicating that students endorsed less agreement that their smoking behavior puts them at risk for poor health outcomes and more agreement that changing their smoking behavior could reduce their risk for poor health outcomes. Students perceived less risk associated with their behavior but perceived that they could get out in front of poor health outcomes by changing that same behavior. Health action was significantly lower than preventive health action, $t(481) = -10.16$, $p < .01$, indicating that students endorsed less agreement that they engage in positive health behaviors and more agreement that they engage in positive health behaviors to reduce their risk for poor health outcomes. Students endorsed a higher degree of agreement about participating in positive behaviors when the question asked if

they were doing so to prevent poor health outcomes. Self-efficacy and preventive self-efficacy did not significantly differ, indicating that the students endorsed similar levels of agreement with their ability to change their smoking behavior if asked to do so and reduce their likelihood for poor health outcomes by changing smoking behavior if asked to do so.

CHAPTER V: DISCUSSION

This study sought to expand the conceptualization of HL beyond health knowledge, to introduce the construct of PHL, and to understand the relationship between both forms of HL and smoking behavior among a sample of undergraduate students. "Gold-standard" measures of HL used in previous research were not comprehensive in that they seemed to be assessing only health knowledge without capturing other factors thought to comprise HL (e.g., the NVS [Weiss et. al., 2005]). In this study, an expanded multi-component conceptualization of HL was proposed, including health knowledge, risk perception, self-efficacy, and health action, and measures were adapted to assess each component. In addition, this multi-component approach was applied in parallel fashion to the concept of PHL. Both forms of HL were compared and evaluated in models developed to understand their contribution to predicting smoking status.

Review of Findings

This section provides a review of pertinent findings from each study aim and discussion of their connection to previous literature. In addition, there is discussion regarding the support for the proposed multi-component conceptualization of HL and extension of PHL.

Health literacy and smoking behavior (Aim 1). The first aim of the study was to examine levels of health knowledge, risk perception, self-efficacy, and health action in the sample of undergraduates and to assess the relationship between these factors and smoking behavior. Descriptive statistics revealed that the sample had a high degree of health knowledge with the average of correct responses being 80%. A supplementary analysis of participant performance on the NVS in this sample revealed that most had adequate literacy per this measure's standard, with participants answering 75% of the items correct on average. This

finding is also consistent with other research in which college students have also performed well on the NVS (Mas et al., 2014; Williams, 2015).

Among respondents who rated their degree of risk perception, the majority of participants selected "strongly disagree" and "disagree" indicating that they did not see themselves as at risk for a variety of poor health outcomes. Less than 10% of participants selected "agree" or "strongly agree" regarding their personal smoking behavior putting them at risk for poor health outcomes, while approximately 20% of the sample either currently smoked cigarettes or were former smokers. Follow-up analyses revealed that current smokers were more likely to agree that their smoking behavior put them at risk for poor health outcome. This supports the idea that college student smokers understand and recognize the risk associated with their smoking behavior.

Among respondents who rated their degree of self-efficacy, most indicated feeling self-efficacious to make behavior change associated with cigarette smoking if it was recommended that they do so. Less than 4% indicated that they "disagree" or "strongly disagree," about their ability to change smoking behavior if recommended to do so. Smokers compared to non-smokers were equally likely to have self-efficacy regarding changing smoking behavior. The developmental stage of participants is notable regarding these findings. Participants' high degree of self-efficacy regardless of smoking status may not be based solely on personal experience but rather on naïve or developmentally consistent views; most of the sample were non-smokers and those who were smokers were likely to have experienced fewer quit attempts compared to an older sample with a longer smoking history.

Last, with regard to health action items, it was observed that between 55% and 85% of participants agreed that they engage in positive health behaviors such as eating a balanced diet,

exercising regularly, avoiding cigarettes, attending doctor's visits, limiting alcohol intake, taking care of their body, and seeking mental health treatment if needed. However, notably, approximately 35% disagreed that they eat a balanced diet, exercise, and would seek mental health treatment if needed. This is mostly consistent with previous literature. For example, while previous studies have shown that the majority of college students avoid smoking cigarettes, estimates of 25% of college males, and only 3% of college females, report drinking more than 14 alcoholic beverages per week (Reilly, Burke, Lofgren, & Morrell, 2006).

Next, it was revealed that only risk perception and health action significantly contributed to the prediction of smoking status. Those with higher risk perception and less engagement in positive health behaviors were more likely to be smokers. In a previous study, smokers who perceived themselves as being vulnerable to poor health outcomes were more likely to reduce their cigarette smoking (Jacobson et al., 2014). The fact that those with less engagement in positive health behaviors were more likely to be smokers is not surprising. Previous studies have shown that college students who smoke, when compared to their peers who do not smoke, have poorer health behaviors such as engaging in alcohol or other drug use and having a less healthy diet (Berg et al., 2012; Sutfin et al., 2012). Self-efficacy for changing smoking behavior and smoking health knowledge did not significantly contribute to the prediction of smoking status.

Regarding self-efficacy, it is somewhat surprising that this construct did not contribute to the prediction of smoking status; previous literature has shown self-efficacy to resist temptations to smoke predicts smoking cessation attempts and maintenance (Lee et al., 2014). Also, theoretical models such as the HBM, emphasize self-efficacy as a factor that is involved in making behavioral changes (e.g., Janz & Becker, 1984; Rosenstock, 1990). The fact that knowledge about smoking was not a significant contributor to the prediction of smoking status is

compelling and supports the proposed idea that knowledge is not the only factor researchers should be assessing and intervening upon with regard to HL. Knowledge in itself is valuable, but the extent to which it contributes to other factors that directly affect behaviors like smoking is an empirical question to be answered. Furthermore, increasing knowledge about the harmful effects of smoking may not be the most comprehensive approach to smoking prevention or cessation interventions. This is further discussed below in the clinical implications section.

Preventive health literacy and smoking behavior (Aim 2). The second aim of the study was to assess levels of preventive health knowledge, risk perception, self-efficacy, and health action and assess the relationship between these factors and smoking behavior. Regarding preventive smoking health knowledge, on average participants answered approximately 80% of the items correctly. This suggests that they have knowledge about such topics as the benefits of smoking cessation and that smoking is the leading cause of preventable death. This is somewhat incongruent with previous literature showing that an Australian sample did not have a high degree of knowledge that many diseases were preventable (Moore et al., 2013). However, similar to what was noted for health knowledge, previous literature has shown that college students perform well on measures of HL that capture health-related knowledge (Williams, 2015).

Among respondents who rated their degree of preventive risk perception, about 12% agreed or strongly agreed that changing their cigarette smoking behavior would reduce their risk for poor health outcomes. Further analyses revealed that more smokers, compared to non-smokers, agreed or strongly agreed to these items, suggesting that it was perceived among the smokers that changing their smoking behavior could reduce their personal risk for poor health outcomes. This is the first known assessment of perception of risk reduction related to changing cigarette smoking behavior among undergraduates. The findings support the idea that

undergraduate smokers understand and perceive that their health risks could be reduced by changing their cigarette smoking behavior.

Among respondents who rated their degree of preventive self-efficacy, the majority agreed that they could stop smoking to prevent poor health outcomes. As mentioned previously, the fact that this sample feels highly self-efficacious may be a reflection of their developmental stage. Compared to older samples, they may have less experience with either attempting smoking cessation or changing other unhealthy behaviors. Even if there were smokers in the sample who began smoking at an early age and have had unsuccessful quit attempts, they may still believe in their ability to quit at some point in the future if they were asked to do so because of health concerns. It is unlikely that such health concerns have yet arisen for them due to their youth and relatively less extensive smoking history than older samples. Therefore, they may believe when such a threat/motivator arises, they would be able to quit.

With regard to preventive health action items, 70-95% of participants agreed that they engage in positive health behaviors to prevent poor health outcomes. To our knowledge, there are no previous studies which have asked college students about their degree of engagement in health behaviors to prevent poor health outcomes. However, previous literature shows undergraduates report avoiding some risky health behaviors like smoking, but also engaging in some poor health behaviors like excessive alcohol use (Reilly et al., 2006).

In terms of predicting smoking status, only preventive risk perception was a significant contributor. Higher preventive risk perception was associated with a greater likelihood of being a smoker. It may be surprising that those who thought their risk for poor health outcomes would be reduced by changing their smoking behavior were more likely to be smokers. However, this

finding underscores the idea that individuals do not smoke out of ignorance but actually do understand the risk and also believe those risks may be lowered should they choose to do so.

The finding that preventive health action was a marginally significant contributor to predicting smoking status was also unsurprising. Like the role of health action in predicting smoking status, this finding is congruent with previous research showing that non-smokers are more likely to engage in healthy behaviors compared to smokers (e.g., Sutfin et al., 2012). This might be explained by the idea that a person who engages in healthy behaviors to prevent poor health outcomes is likely more cognizant of the role of risky health behaviors, and therefore would avoid those risky behaviors too.

The finding that preventive health knowledge was not a significant contributor in predicting smoking status supports the idea that increasing such knowledge may not be the best target to prevent smoking. Last, it is surprising that participants' self-efficacy for preventing poor health outcomes by changing their behavior did not contribute to prediction of smoking status. As noted previously, other studies show that self-efficacy has predicted smoking cessation attempts (Lee et al., 2014) and theoretical models such as the HBM, emphasize self-efficacy as a factor that is involved in making behavioral changes (e.g., Janz & Becker, 1984; Rosenstock, 1990).

Collectively, the PHL components, as measured in this study, did not result in a stronger model for predicting smoking status, as evidenced by the limited change in case classification by this model. This suggests that consideration is needed regarding the conceptualization and measurement of PHL and whether or not it adds value as a unique construct in predicting behavior. This is expanded upon in the limitations and future directions sections.

Relationship between health literacy and preventive health literacy (Aim 3). The final aim was to better understand the relationship between HL and PHL. Participants who endorsed higher levels of the HL components also endorsed high levels of parallel PHL components. The fact that relationships were observed between these factors is unsurprising given there is some conceptual overlap and that PHL is an extension of HL. However, significant differences were observed between some parallel components.

The average percent of correct answers for the health knowledge and preventive health knowledge items were equal. This suggests that knowledge about smoking outcomes and the behavior's role in increasing the risk for poor health outcomes was generally understood among the sample. However, these factors' average scores were not able to be compared head-to-head as there were not parallel items, nor the same number of items, for each construct. The low degree of observed association between the two factors may also be a result of method variance.

Risk perception was significantly lower than preventive risk perception. This suggests that students perceived less risk associated with their smoking behavior but perceived that they could get out in front of poor health outcomes by changing their smoking behavior. This finding may also be a reflection of the participants' developmental stage and self-efficacy. As previously descried, it was observed that participants' belief in their ability to make behavior change was high, so this may be tied up in their having a greater sense of ability to prevent poor health outcomes through behavior change. This lower perceived risk compared to perceived ability to make behavioral changes that would prevent poor outcomes may explained by theories about adolescent personal fables (e.g., Elkind, 1967). This theoretical viewpoints on adolescent development posits that adolescence is a time period when we see ourselves as unique and therefore that we may have unique, often lowered, vulnerability for poor outcomes. Perhaps

adolescents in the sample saw themselves as unique and likely to experience different outcomes (often better outcomes) than others relative to their sense of ability to prevent poor health outcomes. Also, perhaps this sense of uniqueness made them feel better able to make behavioral change to prevent poor outcomes, which may be difficult for others.

Health action was also significantly lower than preventive health action. When asked about the same health behaviors, they endorsed more participation when the question asked about engaging in the behaviors to prevent poor health outcomes. This observed difference may be due to socially-desirable responding. In other words, when asked about engagement in health behaviors within a prevention framework, participants may have endorsed more engagement in the same behavior they previously reported because they wanted to seem more health conscious or seem to have high awareness of the role health behaviors play in disease prevention.

Self-efficacy and preventive self-efficacy did not significantly differ. This is possibly due to the similarity in the measurement of these constructs. Upon reflection, the language of self-efficacy items across both the HL and PHL constructs was very similar and participants may have not considered the items to be different. Therefore, they may have responded in the same way to both items.

PHL was conceptualized as an extension of the HL. The results from this study indicated that the parallel components of these constructs are associated but that there were some differences between average scores on the components. Whether or not PHL is an extension of HL in an additive or chronological way is yet to be understood and needs further examination. Difficulties with comparing the parallel components and future directions for working to better understand these construct's relationship are described in subsequent sections.

Clinical Implications

The results provided information which can inform both smoking prevention and smoking cessation interventions for young adults. The findings indicated that neither having knowledge of the harmful effects of smoking nor feeling self-efficacious to change smoking behavior contributed to the prediction of smoking status. However, engagement in positive health behaviors and perceiving oneself to be at risk for poor smoking-related health outcomes did contribute to the prediction of smoking status. These findings call into question the use of educational strategies as the primary component of smoking prevention efforts and suggest effort spent in promoting positive health behaviors and developing understanding of one's cigarette-related health risks may prove more effective.

Most smoking prevention campaigns, including those geared toward adolescents and young adults, focus on educating the viewer about the harmful effects of smoking. An example of this is the Youth Tobacco Prevention program from the Centers for Disease Control and Prevention, which highlights educational materials designed for youth regarding cigarette smoking information and statistics (CDC, 2017b). Another campaign called "The Truth" also focuses on increasing knowledge about smoking (American Legacy Foundation, n.d.). However, this campaign also encourages young adults to "take action" to be the generation that ends tobacco use. For example, beyond information demonstrating the harmful effects of smoking, this campaign exposes young people to the disparity and social injustice related to cigarette smoking (American Legacy Foundation, n.d.). The additional piece about taking action to end smoking is compelling. In the current study, health action was a significant predictor of smoking status and those with more engagement in healthy action were more likely to be non-smokers. While the action part of this campaign relates to engaging in events and efforts to educate others,

it is still a step in the direction of getting young people to be more than passive recipients of knowledge.

Future prevention campaigns should bolster active engagement of young adults in both efforts to prevent their peers from smoking and in positive health behaviors while simultaneously considering how they might utilize adolescents' beliefs about being unique when constructing methods to combat smoking initiation and prevention (e.g., Alberts, Elkind, Ginsberg, 2007; Elkind, 1967). For example, for prevention campaigns, presenting information about taking preventive healthy action for one's own unique reasons would be beneficial. Prevention campaigns might also hold awareness events that encourage a specialized healthy action plan for adolescents and young adults. This could include engaging in active events which promote identification of unique ways individuals could work to become healthier based on their values and interests.

Evidence-based behavioral techniques already used to aid in smoking behavior change efforts for adolescents, such as motivational interviewing ([MI]; e.g., Colby, 2015; Heckman, Egleston, & Hofmann, 2010) might also incorporate this idea. A relatively recent review article examining the efficacy of MI for smoking cessation indicated that this approach yielded 45% better odds of smoking abstinence compared to control conditions (Heckman et al., 2010). To get ahead of smoking initiation, both MI techniques and elements of behavioral activation treatment (Lejuez, Hopko, Acierno, Daughters, Pagoto, 2011) might be incorporated into a prevention model in integrated primary care and school settings. Interventions in both settings might first use MI to elicit unique reasons to engage in healthy behavior and enhance motivation. Then, as readiness to make change increases, behavioral plans might be developed with each child or adolescent to incorporate value-driven healthy activities into their routine. For example, an

adolescent with a value for being competitive may engage in competitive sports as a method to participate in value-driven activity which also promotes exercise. Another adolescent with a social justice value may participate in events with The Truth campaign which aim to decrease excessive cigarette advertisement in low-income areas. They may also see the act of not smoking, or quitting smoking, as a form of resistance to such marketing tactics. Regardless of which activity is chosen, engaging in positive health behaviors of any kind might prevent smoking, as those who engaged in other positive health behaviors were more likely to be non-smokers in the current study.

In interventions for adolescents and young adults who already smoke, similar considerations could be taken. For example, in MI interventions, questions used to elicit change talk might place emphasis on identifying unique reasons for changing or not change their behavior. This might be particularly important for adolescents and young adults may view themselves as unique and view themselves as having separate consequences than others (Alberts, et al., 2007). Identifying their unique reasons for changing behavior or not change behavior based on their perceived consequences may best propel them toward readiness to change. Furthermore, as risk perception predicted smoking status in this study and enhanced perceived vulnerability among young adult smokers has predicted smoking cessation attempts previously (Jacobson et al., 2014), using MI to bring awareness to risk information may be valuable.

Limitations

There are notable limitations with this study. First, with regard to measurement, the "N/A, I do not participate in the described behavior" response choice in the risk perception and self-efficacy item sets led to the inability to draw conclusions about a significant portion of the sample. The composite variable created for risk perception and the self-efficacy variable

excluded those who selected the "N/A" option. This led to less participant data being included in subsequent analyses. Notably, it also leads the researchers to be unable to ascertain whether or not those who selected the "N/A" option would have similar or different responses than those who did not select "N/A". It would have been more beneficial to remove the "N/A" response choice to fully capture participants' personal risk perception and self-efficacy related to a particular behavior. This would force participants to consider how their degree of engagement in specific behaviors increases or decreases their risk for specific health outcomes. With this limitation, it cannot be known what conclusions might have been reached if all of the sample was included.

Also related to measurement, in some cases the parallel HL and PHL components were not distinct or were not designed to be most effectively compared head-to-head. For example, the health knowledge and preventive health knowledge items could be improved to better map on to the operational definitions. Health knowledge items should assess for understanding that there is a relationship between behaviors and outcomes while preventive health knowledge items should directly measure participants' understanding that engaging in specific health behaviors increases or decreases the likelihood of disease outcomes. In the current study, the health knowledge and preventive health knowledge measures did not contain equal numbers of parallel item, causing difficulty with ability to compare performance levels on the measures directly. Further development of the conceptualization and measurement of each of the parallel constructs is needed.

There was also limited external validity in this study. The sample was homogenous and primarily composed of white freshmen students around 18 years of age. Due to the homogeneity of the sample, it cannot be assumed that the findings can be generalized to all college students.

Furthermore, it also cannot be assumed that these findings would hold true for other populations, particularly older adults. Those who are older and who are more likely to be managing health comorbidities may have different insights with regard to health knowledge, risk perception, self-efficacy, and engagement in health behaviors. They might have had life experiences which have shown them the effects of poor health behaviors on health outcomes.

Future Directions

Future directions for this line of research include continued improvement in HL conceptualization and measurement, conducting additional studies with young adults after, and utilization of different samples in future studies. Continued refinement of specific components that comprise HL is needed. In this study, the WHO's definition of HL (WHO, 1998) was utilized as a starting point for developing a more comprehensive approach to assessing heath literacy by expanding it beyond knowledge to also include risk perception, self-efficacy, and health action. While the measures developed for this study also assumed that participants had the ability to read items, the writing portion of traditional literacy was not measured due to the online nature of the study. However, a health literate person would need the skill of writing to attain the knowledge to inform health behaviors. In addition, other skills might be measured in future iterations of HL measurement. For example, communication skills such as assertiveness might contribute to one's motivation and ability to attain knowledge about the health behavior-health outcome connection and seek support for making behavior change. Also, with regard to conceptualization and measurement, identification of specific factors that contribute to or explain connections between HL factors and health behaviors is indicated (i.e., consideration of mediators and moderators).

Following refinement of the conceptualization and measurement of HL and PHL, additional research is needed to draw conclusions about the similarities and differences between HL and PHL and their connection to behavior among young adults. Would findings be similar in another sample of undergraduates? Furthermore, future research in this area might target older adult samples. It would be interesting to see whether or not a larger difference would be observed between HL and PHL in a sample that is managing diseases that have resulted in part from engagement in unhealthy behaviors. In the long-term, studies examining intervention upon HL and resultant behavioral outcomes are needed. Future research might help answer questions such as, "How can clinicians motivate individual patients or how can global ad campaigns motivate society to consider the preventive role their behaviors can play in disease outcomes?" and "Is focusing on the prevention of poor outcomes advantageous for behavioral change outcomes?"

Conclusion

This study was the first attempt to expand the conceptualization and measurement of HL. It was also the first attempt to conceptualize and measure the preventive aspect of HL. Overall, the results of the study indicated that increasing risk perception related to poor health outcomes associated with smoking and fostering engagement in positive health behaviors, rather than increasing smoking knowledge or self-efficacy, may be most valuable with regard to smoking prevention and intervention efforts. Although the results from this study provided an initial understanding of HL and PHL among college students as related to smoking behavior, the study prompted many additional questions and left room for much growth in this line of research. Continued research to answer these questions is of great importance.

As previously noted, millions of Americans are still smoking today, and this detrimental behavior is “the leading cause of preventable death” (CDC, 2015, line 7). Understanding how individual level factors such as HL contribute to smoking behavior will aid in developing prevention and intervention strategies to reduce cigarette smoking. The significance of this continued pursuit is in its contribution to the prevention of cancer, and other smoking-related illnesses which would be drastically reduced with the elimination of cigarette smoking.

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APPENDIX A: INSITUIONAL REVIEW BOARD APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/irb**

Notification of Exempt Certification

From: Social/Behavioral IRB
To: Juliann Stalls
CC: Lisa Campbell
Date: 3/21/2016
Re: UMCIRB 15-001740
Smoking Behavior of Undergradautes

I am pleased to inform you that your research submission has been certified as exempt on 3/18/2016. This study is eligible for Exempt Certification under category #2.

It is your responsibility to ensure that this research is conducted in the manner reported in your application and/or protocol, as well as being consistent with the ethical principles of the Belmont Report and your profession.

This research study does not require any additional interaction with the UMCIRB unless there are proposed changes to this study. Any change, prior to implementing that change, must be submitted to the UMCIRB for review and approval. The UMCIRB will determine if the change impacts the eligibility of the research for exempt status. If more substantive review is required, you will be notified within five business days.

The UMCIRB office will hold your exemption application for a period of five years from the date of this letter. If you wish to continue this protocol beyond this period, you will need to submit an Exemption Certification request at least 30 days before the end of the five year period.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

APPENDIX B: INFORMED CONSENT

Informed Consent

You are being invited to participate in a research study titled "Smoking Behavior of Undergraduate Students" being conducted by Juliann Stalls, a graduate student at East Carolina University in the Psychology department. The goal is to anonymously survey 350 or more students. The survey will take approximately 30 minutes to complete. It is hoped that this information will assist us to better understand behaviors of undergraduate students. You do not need to be a smoker to participate in this research. Your participation in the research is voluntary. You may choose not to answer any or all questions, and you may stop at any time. There is no penalty for not taking part in this research study. Upon completion, you will be awarded .50 credits toward your total research participation credit. By checking each of the statements below, you are indicating that you wish to continue with the research. All of those boxes must be selected to participate. If you do not wish to participate, you may close this window and not begin the survey. Please email Juliann Stalls at stallsj10@students.ecu.edu for any research related questions or the Office of Research Integrity & Compliance (ORIC) at 252-744-2914 for questions about your rights as a research participant. If you would like, please stop and print this page for you records prior to beginning.

- o I have read all of the information above.
- o I have had an opportunity to ask questions about this research that I did not understand and have received satisfactory answers via email or phone call.
- o I know that I can stop taking part in this study at any time.
- o I am 18 years or older.
- o By consenting, I am not giving up any of my rights.