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Peter Yang Date

The Association Between Health Literacy and Healthcare Utilization – Results from the 2015 Georgia Behavioral Risk Factor Surveillance Systems

By

Peter Yang

Master of Public Health

Department of Epidemiology

_____

Julie Gazmararian, PhD, MPH

Committee Chair

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By

Peter Yang

B.A.

Emory University - College of Arts and Sciences

2012

Thesis Committee Chair: Julie Gazmararian, PhD, MPH

An abstract of

A thesis submitted to the Faculty of the
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Abstract

The Association Between Health Literacy and Healthcare Utilization – Results from the 2015 Georgia Behavioral Risk Factor Surveillance Systems

By Peter Yang

Background: Only recently has the capacity to study health literacy on a population scale been developed, providing further insight into the dynamics of populations with lower socioeconomic status. Individuals with lower health literacy have been found to have a number of adverse outcomes, especially due to difficulties in utilizing healthcare. In the 2015 Georgia Behavioral Risk Factor Surveillance System (BRFSS), a health literacy module was implemented for the first time in that state. This presented two novel opportunities for study: gauge the distribution of health literacy rates in Georgia and assess their association with efficient healthcare utilization rates varying across chronic disease and health insurance status.

Methods: 4,574 randomly selected Georgia adults, weighted to improve representation of the state population, were contacted via phone survey. Logistic regressions on survey results were conducted using a dichotomized health literacy index score for their association with healthcare utilization behaviors that included having a personal doctor, having had a recent checkup, and consistent doctors' visits. Variables controlled for included socioeconomic demographics, chronic disease status, and health insurance coverage.

Results: The 2015 Georgia BRFSS sample was a representation of the demographics of the state of Georgia after weighting. Descriptive analyses identified health literacy disparities in individuals of lower age, lower educational attainment, lower annual household income, no employment status, disease comorbidity status, and uninsured status. An outcome of health literacy with the outcome variables found significant associations only when not controlling for potential confounders, implying only an overall association of health literacy with healthcare utilizations.

Conclusions: This analysis is the first use of a health literacy instrument that can adequately assess lower health literacy on a state level in Georgia. While the analysis of healthcare utilization found null results, the results combined with descriptive analyses identify potential populations to target for future interventions and study. The current surveillance data and future studies have the potential to inform policy on optimizing the healthcare system by identifying high risk populations to ensure enhanced access for individuals that are less capable of navigating through its complexities.

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Literature review

As healthcare systems across the world have advanced, so has the complexity of those systems. While this has occurred in the face of compounding healthcare needs, intricacies of this system often outpace the capacity of the patients to effectively utilize it. Of all the countries within the Organization for Economic Co-Operation and Development, the United States stands out for its complicated approach to healthcare whereby individuals are forced to navigate a system they know little about, with often prohibitive costs and poor outcomes [1] [2]. It is in this context that the concept of "health literacy" is intertwined with individual health outcomes, for research is increasingly suggesting that health literacy is essential in efficiently utilizing the healthcare system for positive health prognoses [3]. While the volume of research pertaining to health literacy as a predictor of outcomes has increased over the past few decades, there are still gaps in its study that merit exploration [4]. Through this review of literature, these gaps will be addressed through several specific topics around health literacy. These topics will include a workable definition of health literacy to inform measurement, factors that are associated with health literacy, possible covariates of health literacy, and relevant healthcare utilization outcomes.

Understanding Health Literacy: Definitions, Frameworks, and Measurement

Within the literature, there are many perspectives on health literacy. Due to this diversity, there are different directions that can be taken in interpretation and conceptualization. Therefore, it is important to use the literature to define health literacy, identify a framework relevant to literature gaps that are being addressed, and subsequently use this conceptualization to inform measurement of health literacy and its outcomes.

The most commonly used definition from the landmark work *Health Literacy: A Prescription to End Confusion* states "The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate

health decisions" [2] [5]. A systematic review for a definition from Sørensen, Van den Broucke [4] frames the concept through four primary understandings that have emerged from the debate over the broader concept of literacy: Literacy as an autonomous set of skills, Literacy as applied, practiced, and situated, Literacy as a learning process, and Literacy as text. Sørensen, Van den Broucke [4] argue that these four ideas can be applied to health literacy as well. By merging these perspectives, they generated a single, comprehensive definition to be used as a functional, working definition:

> "Health literacy is linked to literacy and entails people's knowledge, motivation and competences to access, understand, appraise, and apply health information to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course."

Of the definitions reviewed, Sørensen, Van den Broucke [4]'s covers the greatest breadth, which is important for its adaptability in addressing multiple avenues within the study of health literacy. This definition sets the precedent for further conceptualization through an analytical framework. In an example of an early health literacy framework, Baker [6] suggests integrating individual capacity for both print and oral literacy (Figure 1).

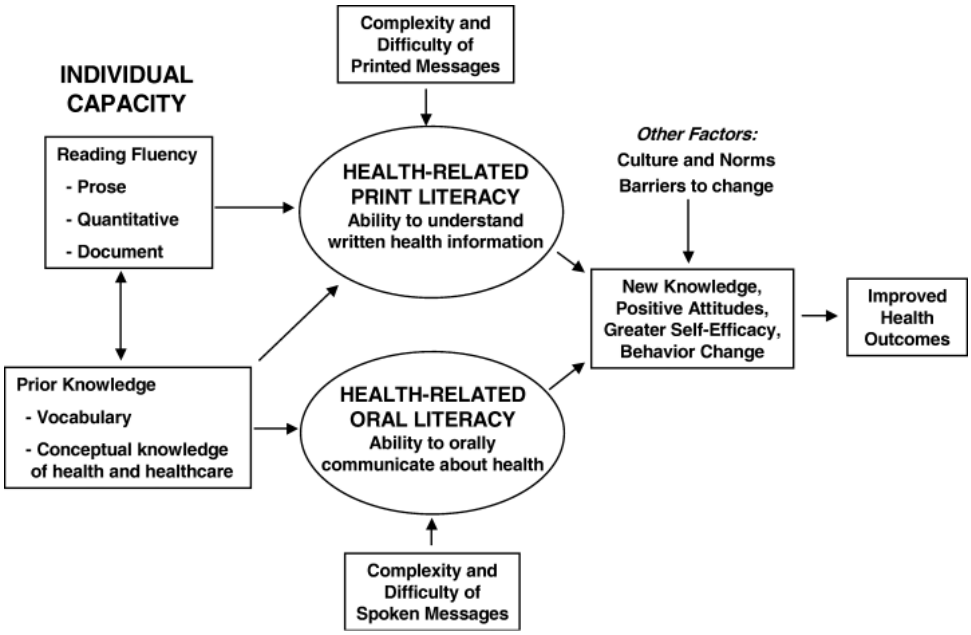

Figure 1. Health Literacy framework detailing print and oral literacy [6]

While this framework is comprehensive in accounting for patients' abilities to navigate healthcare, it is missing information on health literacy specifically related to healthcare provider outcomes, especially as suggested in future directions for health literacy research by Rudd [7]. Complementing this initial framework by Baker, Paasche-Orlow and Wolf [8] advanced upon these concepts with a comprehensive understanding of the part of the patient as an actor in a complex environment that includes both the healthcare system and external components (Figure 2).

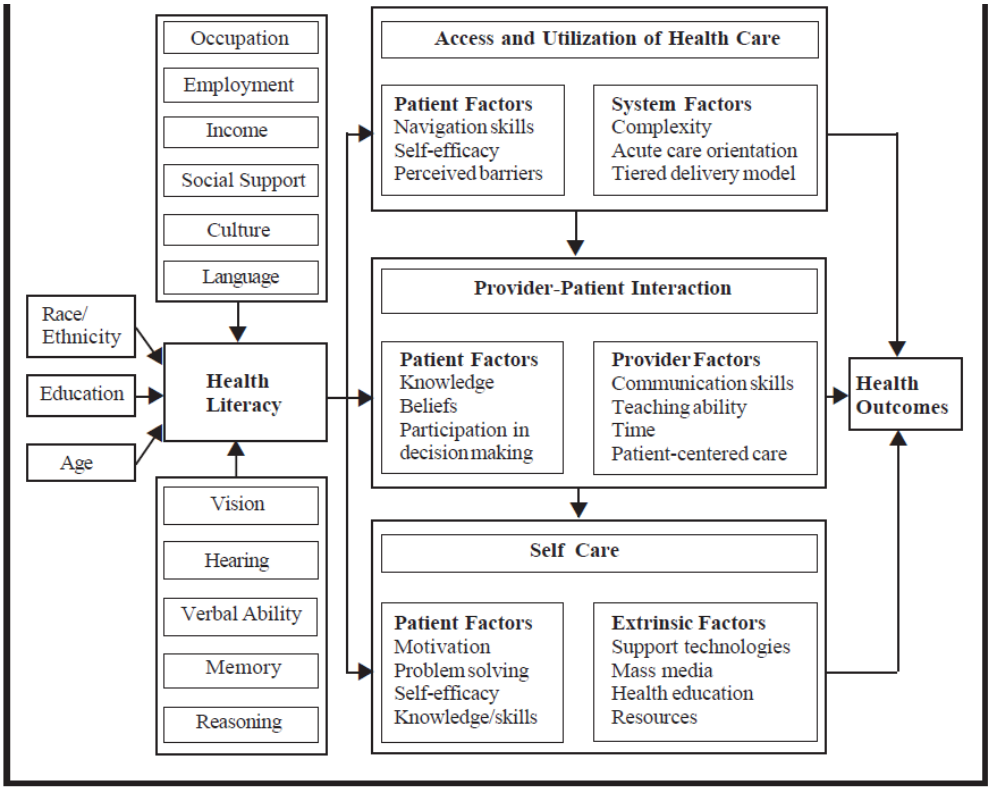

Figure 2. Health Literacy framework outlining causal pathways to health outcomes [8]

While Baker's framework falls within what could be considered "navigation", Paasche-Orlow and Wolf further reduce health literacy into three components: "Access and Utilization of Health Care", "Provider-Patient Interaction," and "Self-Care." This expansion of the framework conceptualizes the different ways in which health literacy issues may manifest in individuals and in the healthcare setting, especially on the part of the provider as mentioned by Rudd. This framework also includes factors known to be associated with health literacy, such as socioeconomic status and current health conditions/needs. While each framework contributes something unique, a combination of these sources serves to comprehensively cover the understanding of health literacy to further inform research.

While health literacy's conceptualization has advanced, so has the development of tools for its measurement. The various definitions and frameworks developed thus far have led to a

firmer understanding of a consistently important healthcare variable, leading to an improved ability to measure and study it. This understanding is further enhanced by the presence of various health literacy survey instruments.

One of the most commonly used instruments is the Test of Functional Health Literacy in Adults (TOFHLA), consisting of an extensive 50-item reading comprehension and 17-item numerical ability test [9]. Due to the length and limitations in providing the survey, a shortened version known as the S-TOFHLA was also developed [10]. In addition to the TOFHLAs, other available tests include the Wide Range Achievement Test – Revised (WRAT-R) and the Rapid Estimate of Adult Literacy in Medicine (REALM). While each test has unique strengths and limitations, the TOFHLA is consistently referred to as the gold standard [11]. Ultimately, however, one of the greatest drawbacks of these methods is that health literacy tests are often made difficult in populations that are already of lower literacy from lower educational attainment. Patient and researchers alike are inhibited since tests must be conducted in person and can be lengthy depending on the test.

However, research has proven that it may not take an entire questionnaire to predict lower proficiency in health literacy, as compared to tests like the TOFHLA. Chew, Griffin [12] demonstrated such an ability in a large healthcare institution using three questions assessing a patient's ability to read healthcare materials on their own, confidence in a patient's ability to fill out medical forms, and a patient's understanding of their own condition.

The brevity of these three questions relative to tests like the TOFHLA allow for new administration methods beyond an in-person survey, such as telephone surveys. 2015 was the first year that these questions were included in the Behavioral Risk Factor Surveillance Systems (BRFSS), a large-scale telephone survey administered at the state level. With this capacity to expand the scope of health literacy research, there is a novel capacity to study health literacy on a far greater scale.

Factors Associated with Health Literacy

There are several known predictors of health literacy. The Paasche-Orlow and Wolf [8] framework (Figure 2) specifically outlines three categories of these predictors: demographic, socioeconomic, and physical, presenting integral components of sociocontextual determinants of health [13]. Of these categories of determinants, the literature suggests some are stronger predictors than others, especially education in the form of educational attainment due to its direct link to health literacy [14] [15]. Education levels in particular are known to lead to large-scale social changes that include increases in health literacy levels [16].

While individual variables like education can be tested for association with health literacy, further study suggests that multivariable analyses fitting several socioeconomic predictors in models lead to better assessments of health literacy [14]. In a comprehensive multivariable analysis, it was found that not only educational attainment, but also race/minority status, age, and income level were significant predictors of health literacy levels [14]. Subsequently, these four predictors of health literacy should be controlled for in studies using health literacy as an exposure.

Health Conditions Associated with Health Literacy

In addition to socioeconomic predictors of health, it is known that the presence of other diseases requiring management and self-care leads to increased navigation of the system [17], and subsequently, a greater demand of health literacy. Diseases that are chronic, expensive to treat, and overall resource-intensive for the patient and provider are especially telling of this effect.

Those diseases that required healthcare skills, like appropriate self-medication and label/health message interpretation, were more likely to be associated with health literacy [3]. Diabetes is a leading example of this, especially due to the array of new medical terms and concepts for the patient [17-19]. Successful treatment of diabetes is contingent on the patient's

ability to understand and self-monitor their conditions, especially Hemoglobin A_{1C} outcomes [20]. More specifically, lower health literacy in diabetics was found to predict a reduced ability to identify hypoglycemia, possibly due to physician difficulty in accounting for patient recall and concept understanding [19] [21].

Cardiovascular diseases (including hypertension, high blood pressure, high cholesterol, and heart failure) have also been known to be strongly associated with health literacy [17-19]. While lower health literacy with cardiovascular conditions is often associated with higher mortality [22], especially in elderly populations [18], there are methods by which cardiovascular diseases impact health literacy. The Paasche-Orlow framework (Figure 2) shows two primary pathways: self-care and understanding the health condition. In an application of self-care regarding medication intake, Fang, Machtinger [23] found that despite patients properly taking Warfarin as an anticoagulant, there were deficits in knowledge of the medication, side effects, and issues of anticoagulation. The second pathway further exacerbates the self-care issue due to issues of communication between the provider and patient. In an application of this, Hill-Briggs and Smith [24] found that materials were consistently difficult for patients to understand, presenting further challenges for navigation.

While diabetes and cardiovascular conditions are the biggest two, there are many other diseases that were also found to be associated with health literacy. Often cited alongside these conditions are respiratory illnesses, particularly asthma and Chronic Obstructive Pulmonary Disease (COPD) [18] [17]. In addition, separate studies have also found strong associations between lower health literacy and rheumatoid arthritis [25] and chronic kidney disease [26].

Beyond the more bodily rooted chronic conditions, mental illnesses are also linked with health literacy, albeit in different pathways. Most salient is the role of stigma and the public's general mental health knowledge. It is possible that efforts to promote health literacy specifically pertaining to mental health are lacking, but it has been suggested in the literature that mental

health literacy is specifically inhibited by patients' ability to recognize disorders, knowledge of risk factors/causes, knowledge of appropriate self- and professional care, and attitudes encouraging care and help [27].

Health Literacy and Healthcare Utilization

Studies on healthcare utilization have spanned several decades, leading to multiple interpretations of its definition. Andersen and Aday [28] developed what is now the most widely used healthcare utilization framework, conceptualizing it around physician visits. In understanding these outcomes based on physician visits, the reader can better interpret usages of the term healthcare utilization [29]. This framework suggests that using variables relevant to physician utilization is key to understanding healthcare utilization as an outcome.

While the physician utilization framework is used most frequently, other studies have broadened the interpretation, including a Berkman, Sheridan [3] systematic review on health literacy. While this review was not for the purpose of defining healthcare utilization, it used a functional definition that involved other utilization outcomes such as emergency care/hospitalizations, preventive services, and interpreting labels/health messages. This systematic review served to address other non-Andersen and Aday-based healthcare utilization outcomes, still leaving a gap in understanding physician utilization as the outcome.

Since the systematic review lacked the Andersen and Aday physician visit-based conceptualization, additional literature using physician utilization behaviors as outcomes were identified. One of the first was an early cross-sectional study by Baker, Parker [30] which assessed low health literacy's association with doctor's visits or a regular source of care, though there were no significant results. Baker, Parker [31] followed up to this with a later study that identified a stronger likelihood of hospital admission for those with lower levels of health literacy. A more recent article by Schumacher, Hall [32] provided a broader review on primary

care behaviors that were typically inversely associated with preventable hospital admissions and emergency care preferences, especially doctor's office visits and access to a personal physician. Though not directly evaluating primary care services, a separate study of individuals in a consumer driven health plan conducted by Hardie, Kyanko [33], found a significant association between higher proficiency in health literacy and fewer inpatient admissions, emergency department visits, and an increased capacity to learn about medical conditions. While these studies have all evaluated interactions with the overall hospital systems, identification of physician utilization outcomes mentioned by the Andersen and Aday [28] framework are limited, especially on a wider scale that is not confined by the healthcare institution frequented by the patient.

Addressing the gaps of Sørensen, Van den Broucke [4], other studies have investigated physician-based outcomes. In a study of Medicare managed care enrollees, Scott, Gazmararian [34] found lower rates of preventive screenings and immunizations after accounting for physician visits as a significant covariate. Another study on Medicare patients by Cho, Lee [35] found positive correlations of higher health literacy with other common healthcare behaviors with reductions in hospitalizations and Emergency Room visits, which is suggested to be inversely associated with primary care visits, as suggested by Hardie, Kyanko [33].

While the literature on healthcare utilization outcomes is ever expanding, several gaps are present. First, all previous studies have been confined to healthcare institutions and hospitals, rather than wider areas. Second, the studies largely overlook physician-centered outcomes while providing a relatively non-comprehensive control of all known variables associated with health literacy. To that end, this study aims to investigate the association between health literacy and physician-based healthcare utilizations while controlling for socioeconomic demographics, chronic disease presence, and health insurance coverage using data from the 2015 Georgia Behavioral Risk Factor Surveillance Systems.

METHODS

Study Design

This study is a cross-sectional design using results from the 2015 Georgia Behavioral Risk Factor Surveillance Systems (BRFSS), a telephone-based survey administered annually by the state since 1984 and developed by the Centers for Disease Control and Prevention (CDC). Data is collected on behavioral risk factors and preventive health services that are known for their associations with some of the greatest risk factors for disease and mortality in the United States [36]. All states administer a form of the BRFSS and use similar methods and analyses to maintain consistency and comparability between states. Using methods and training provided by the CDC, state personnel conduct surveys use list-assisted, random-digit dialing to select a representative sample from all 18 Georgia Health Districts [37].

Data Collection

Selected participants were non-institutionalized Georgia adults at least 18 years old. Since the BRFSS is a telephone-based survey, data from households with telephone users is collected, while excluding those without. Since 2011, data from cellular phone users has also been included [38]. State personnel used disproportionate stratified sample (DSS) methods for households with landlines and cellular phones, to randomly draw telephone numbers from various strata that are generated based by household regional density. Using this method, a geographically representative and random sample is obtained for the state of Georgia. Some states sample disproportionately from specific in-state areas to account for deficiencies based on lower population densities. [39] [36]

DATA SOURCE

The BRFSS questionnaire has three components: the core component, optional CDC modules, and state-added questions. These components comprise various demographic and health behavioral questions asked by all states in the core, along with additional, more situationally relevant questions in the optional modules. While the CDC modules may comprise more emerging conditions, the state-added questions are typically developed by participating states and added to their own questionnaires to address more specific health issues in their respective regions [40].

DATA MEASURES

Exposure Variable

The exposure variable, health literacy, consisted of three questions in the 2015 BRFSS optional module: “How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy,” “How often do you have problems learning about your health condition because of difficulty in understanding written information,” and “How confident are you in filling out medical forms by yourself? For example, insurance forms, questionnaires, and doctor’s office forms.” All three questions had seven levels of responses counting refusals and “Don’t know”. Responses for the first two questions included “Always”, “Often,” “Sometimes,” “Occasionally,” and “Never” while the last question’s responses included “Not at all,” “A little,” “Somewhat,” “Quite a bit,” and “Extremely."

The responses for these three questions were merged to generate a single composite index of health literacy dichotomizing the results between those with lower and higher literacy. Due to potential variability between these three questions, internal consistency was first verified through the calculation of Cronbach’s Alpha, an estimate of reliability that increases with the number of inter-correlations within the test items. Once internal consistency was verified, the index was

generated based on a positive response to all three questions. If the individual respondent indicated any level of difficulty in their response to the question (i.e. any response other than "Never" or "Extremely"), they were categorized as being of lower proficiency in health literacy, while the others were categorized as being of higher proficiency in health literacy.

Outcome Variables

Three healthcare utilization variables were used as the outcome. This included whether an individual had a personal doctor, whether an individual had a checkup with a doctor in the past year, and whether patients were consistently seeing a doctor. The first two questions were directly drawn from the BRFSS for fitting within the healthcare utilization framework from Andersen and Aday [28]. The third variable was constructed to reflect whether patients were consistently seeing a doctor, by using the individuals' personal doctor status combined with another BRFSS variable documenting the number of times that that individual had visited a doctor in the past year. This latter variable is not to be confused with the second variable taken from the BRFSS.

Covariates

Chronic disease and health coverage status were also assessed for their potential involvement in the health literacy and healthcare utilization relationship. The chronic diseases included were those identified in the literature as having a strong association with health literacy and included diabetes, stroke, hypertension, high blood pressure, high cholesterol, heart failure, asthma, COPD/emphysema/bronchitis, arthritis/gout/lupus/other autoimmune disorders, chronic kidney disease, and depressive disorder. Chronic disease status was recoded into a composite variable where individuals were categorized by having 0, 1, or 2+ chronic diseases, with 2+ for comorbidities.

Health insurance status was determined by the BRFSS question: "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, government

plans such as Medicare, or Indian Health Service?" Excluding refusals and responses of "Don't know/Not sure", the variable had a dichotomous Yes/No response. A follow-up question presented an additional option for individuals to declare no health insurance, which was combined with the first question to comprehensively identify the uninsured.

A number of demographic variables were also identified for inclusion based on a review of the literature. This included gender (Male and Female), age in years (18-24, 25-34, 35-44, 45-54, 55-64, 65+), race/Ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic), education level (Less than high school, high school graduate/GED, some college, college graduate), annual household income (Less than $35,000, $35,000 - $74,999, Greater than $75,000), and employment status (Employed or unemployed).

Dataset management and analyses were conducted in Statistical Analysis Systems (SAS version 9.4). The dataset was adjusted to remove non-responses and combine survey response categories that had too few responses for proper analysis (i.e. "Other" races were removed due to low counts). In preparation for the analysis, several composite variables were created for use as the predictor and stratification variables. After cleaning and ensuring valid data points for health literacy values, a total of 3,655 individuals remained.

Weighting

Iterative proportional fitting, also known as raking, methodologies were used to weight the data to account for the varying selection probabilities of individuals across the state and the uneven noncoverage/nonresponse. The weighting methodology consists of two steps: design weight and the raking itself. In the design weight portion, the design weight is calculated using the formula

Design Weight = (1/NUMPHON2) * NUMADULT * STRWT

where NUMPHON2 is the count of telephone numbers that are residential numbers in a household; NUMADULT is the number of adults in that household; and STRWT is stratum weight accounting for selection probability differences among the area code strata, calculated by determining the inverse of each stratum's sampling fraction. STRWT is calculated through the formula

STRWT = NRECSTR / NRECSEL

where NRECSEL is the number of records selected out of the number of available records NRECSTR within each geographic strata, represented by the variable GEOSTR, and density strata, represented by the variable _DENSTR. GEOSTR can represent the full state of Georgia, or a smaller geographic subset (i.e. counties or health districts). _DENSTR represents the phone number density of a block listed or unlisted phone numbers. Each STRWT is calculated from individual GEOSTR * _DENSTR combinations.

In the raking step, the design weight is raked to anywhere between 8 and 16 margins. By default, the 8 margins that are always present are age group by sex, race/ethnicity, education status, marital status, tenure, sex by race/ethnicity, age group by race/ethnicity, and phone ownership. If the BRFSS includes geographic regions, margins for region, region by age group, region by sex, and region by race/ethnicity are added. Finally, if one or more of the counties has 500+ respondents, margins for county, county by age group, county by sex, and county by race/ethnicity are added. Based on these margins, a final weight, designated by a variable combining land-line and cell-phone data, is assigned to the individual respondents [41]. All subsequent analyses were performed while stratifying on a sample design stratification variable (combined values for state, geographic strata, and density strata) and weighting with the land-line and cell-phone final weight variable. Through the weighting methodologies, the total 3,655 individuals in the dataset represented 5,566,082 individuals in the state of Georgia.

ANALYSIS

Initial descriptive statistics were obtained in SAS using PROC Surveyfreq to obtain the prevalence of health literacy, demographics, other covariates, and healthcare outcomes in Georgia. Bivariate analyses of health literacy with the demographics, covariates, and healthcare outcomes were performed to understand the distribution of health literacy in Georgia broken down into the individual levels of these variables (e.g. health literacy distribution for each of individuals with 0, 1, or 2+ chronic diseases).

Next, logistic regressions using PROC Surveylogistic were performed to obtain odds ratios of those with lower overall health literacy within the different demographic categories. Crude odds ratios were obtained for age group (referent group 35 - 44), Race/Ethnicity (referent group Non-Hispanic White), Education level (referent group College graduate), Annual household income (referent group $75,000 or greater), and Employment status (referent group Employed).

To assess health literacy's relationship with the outcome variables, multi-variable logistic regression analyses were performed using PROC Surveylogistic, stratifying on the sample design stratification variable and weighting using the density strata. Unadjusted odds ratios were first obtained from models with just health literacy and each of the three outcome variables. These unadjusted odds ratios were then compared to adjusted odds ratios created by accounting for the demographic variables age, race, education level, annual household income, and employment status. Chronic disease and health insurance status were also controlled for in the model as potential confounders.

RESULTS

Demographics and General Trends

In the 2015 Georgia BRFSS, 4,678 individuals responded to varying levels of survey completion, although 3,655 individuals were used after removing non-responses to health literacy prompts. The distribution of respondents favored certain demographics, which using unweighted numbers, constituted female (61.8%), over 65 years (39.2%), white (68.5%), college graduates (36.1%), lower income (43.0% under $35,000), unemployed (55.8%) and insured (90.7%). After weighting to represent the full Georgia population, the proportions changed for female (53.6%), older (19.9% over 65), white (57.6%), college graduates (24.1%), lower income (43.5% under $35,000), unemployed (55.8%) and insured (90.8%) individuals. 21.7% had one chronic disease (24.3% weighted) while 58.5% had at least two (47.9% weighted).

Table 1 - General Descriptive Statistics for Health Literacy, Covariates, and Outcome Variables, 2015 Georgia BRFSS (n=3,655)

	Unweighted Frequency	Unweighted Total Percentage	Weighted Frequency	Weighted Total Percentage
Health Literacy				
Lower Health Literacy	1,917	52.5%	3,155,374	56.7%
Higher Health Literacy	1,738	47.6%	2,410,708	43.3%
Gender				
Male	1,398	38.3%	2,580,500	46.4%
Female	2,257	61.8%	2,985,581	53.6%
Age Group (Years)				
18 - 24	138	3.8%	648,912	11.8%
25 – 34	272	7.5%	867,014	15.7%
35 - 44	371	10.3%	912,579	16.5%
45 - 54	581	16.1%	1,048,798	19.0%
55 - 64	839	23.2%	942,245	17.1%
65 and older	1,417	39.2%	1,095,704	19.9%
Race/Ethnicity				
Non-Hispanic White	2,462	68.5%	3,165,011	57.6%
Non-Hispanic Black	867	24.1%	1,628,163	29.6%
Hispanic/Latino	120	3.3%	422,156	7.7%
Other, Non-Hispanic	146	4.1%	284,078	5.2%

Table 1 continued – General Descriptive Statistics for Health Literacy, Covariates, and Outcome Variables, 2015 Georgia BRFSS (n=3,655)

	Unweighted Frequency	Unweighted Total Percentage	Weighted Frequency	Weighted Total Percentage
Education Level				
Less than High School	405	11.1%	935,396	16.8%
High School Graduate/GED	969	26.6%	1,601,460	28.8%
Some College	952	26.1%	1,679,156	30.2%
College Graduate	1,316	36.1%	1,335,519	24.1%
Annual Household Income				
Less than $35,000	1294	43.0%	2,018,071	43.5%
$35,000 - $74,999	850	28.2%	1,370,508	29.5%
$75,000 and greater	866	28.8%	1,255,249	27.0%
Employment Status				
Employed	1,603	44.2%	3,079,343	55.8%
Unemployed	2,027	55.8%	2,436,416	44.2%
Number of Chronic Diseases				
None	614	19.8%	1,192,640	27.9%
One	674	21.7%	1,038,674	24.3%
Two or More	1,815	58.5%	2,049,012	47.9%
Health Insurance Status				
Has Health Insurance	3,307	90.7%	4,628,611	83.4%
No Health Insurance	336	9.3%	914,411	16.6%
Personal Doctor Status				
Has Personal Doctor	3,093	84.8%	4,111,379	74.0%
No Personal Doctor	553	15.2%	1,445,774	26.0%
Checkup in Last Year				
Had Checkup in Last Year	2,894	80.1%	3,973,634	72.2%
No Checkup in Last Year	718	19.9%	1,532,903	27.8%
Consistent Doctor's Visits				
Consistently Visiting	2,848	97.3%	3,780,437	95.7%
Not Consistently Visiting	78	2.7%	171,854	4.3%

Health Literacy Module Questions

In the 2015 Georgia BRFSS, the health literacy question distribution varied by the respective issue. Since the health literacy index was based on a negative response to at least one of these questions, the total sample size was 1,917. Using the weighted frequencies, 25.3% of

respondents reported having difficulty understanding their own health condition, 31% of respondents reported that they required help in reading healthcare and medical materials, and 39.8% of respondents reported lacking confidence in filling out medical forms on their own.

Table 2 - Health Literacy Questions and Distribution, 2015 Georgia BRFSS (n=3,655)

	Unweighted Frequency	Weighted Frequency	Weighted Percent	95% CI for Proportion
Health Literacy Questions				
Requires Help Reading Materials	961	1,736,858	31.0%	(28.8%, 33.2%)
Unconfident Filling Medical Forms	1,289	1,829,207	39.8%	(37.4%, 42.2%)
Difficulty Understanding Condition	819	1,227,214	25.3%	(23.2%, 27.5%)

Chronic Disease Distribution

In the 2015 Georgia BRFSS, some chronic diseases held a higher representation in the total population than others. Of the diseases that were identified as associated with lower health literacy in the literature, high blood pressure, high cholesterol, arthritis/auto-immune disorders, depressive disorder, and diabetes held the highest percentages of the weighted total population, in decreasing order of prevalence.

Table 3 - Chronic Disease Prevalence of Weighted Georgia Population, 2015 Georgia BRFSS (n=3,655)

	Unweighted Frequency	Weighted Frequency	Proportion of Weighted Total	95% CI for Proportion
Chronic Disease Conditions				
High Blood Pressure	2,213	27,970,744	63.8%	(34.4%, 38.0%)
High Cholesterol	1,792	2,195,580	36.3%	(34.3%, 38.2%)
Angina/Coronary Heart Disease	307	319,951	4.2%	(3.6%, 4.8%)
Heart Attack/Heart Failure	294	350,630	4.5%	(3.8%, 5.3%)
Stroke	245	295,244	3.8%	(3.2%, 4.5%)
Asthma	446	708,933	9.2%	(8.1%, 10.4%)
COPD/Emphysema/Bronchitis	449	32,288	6.9%	(6.1%, 7.8%)
Arthritis/Other Autoimmune	1,660	1,890,169	24.6%	(23.1%, 26.0%)
Chronic Kidney Disease	190	24,421	3.0%	(2.4%, 3.6%)
Depressive Disorder	923	1,407,969	18.3%	(16.8%, 19.8%)
Diabetes	754	869,486	11.3%	(10.2%, 12.3%)

Health Literacy Prevalences

Most of the demographic characteristics were associated with health literacy skills. The demographics that not had overall lower health literacy were non-university graduates, incomes <$75,000, unemployed, at least two chronic diseases, and uninsured. Of note in the health literacy trends is that every individual that reported being uninsured (n=336) was also found to be of lower health literacy.

Table 4 - Weighted Distribution of Health Literacy by Demographic, Chronic Disease Status, and Health Insurance Status, 2015 Georgia BRFSS (n=3,655)

	Number with Lower Health Literacy	Prevalence of Lower Health Literacy	Number with Higher Health Literacy	Prevalence of Higher Health Literacy
Gender				
Male	1,519,237	58.9%	1,061,263	41.1%
Female	1,636,137	54.8%	1,349,444	45.2%
Age Group (Years)				
18 - 24	420,808	64.8%	228,104	35.2%
25 – 34	524,863	60.5%	342,150	39.5%
35 - 44	457,925	50.2%	454,654	49.8%
45 - 54	579,043	55.2%	469,755	44.8%
55 - 64	512,499	54.4%	429,746	45.6%
65 and older	641,283	58.5%	454,422	41.5%
Race/Ethnicity				
Non-Hispanic White	1,646,231	52.0%	1,518,780	48.0%
Non-Hispanic Black	941,509	57.8%	686,654	42.2%
Hispanic/Latino	336,026	79.6%	86,129	20.4%
Other, non-Hispanic	191,854	67.5%	92,224	32.5%
Education Level				
Less than High School	792,838	84.8%	142,558	15.2%
High School Graduate/GED	1,061,812	66.3%	539,648	33.7%
Some College	844,255	50.3%	834,902	49.7%
College Graduate	449,317	33.6%	886,202	66.4%
Annual Household Income				
Less than $35,000	1,461,469	72.4%	556,602	27.6%
$35,000 - $74,999	684,853	50.0%	685,655	50.0%
$75,000 and greater	401,715	32.0%	853,535	68.0%

Table 4 continued - Weighted Distribution of Health Literacy by Demographic, Chronic Disease Status, and Health Insurance Status, 2015 Georgia BRFSS (n=3,655)

	Number with Lower Health Literacy	Prevalence of Lower Health Literacy	Number with Higher Health Literacy	Prevalence of Higher Health Literacy
Employment Status				
Employed	1,492,994	48.4%	1,586,348	51.5%
Unemployed	1,626,603	66.8%	809,813	33.2%
Number of Chronic Diseases				
None	526,875	44.2%	665,765	55.8%
One	485,140	46.7%	553,534	53.3%
Two or More	1,204,543	58.8%	844,469	41.2%
Health Insurance Status				
Has Health Insurance	2,215,033	47.9%	2,409,475	52.1%
No Health Insurance	917,282	99.9%	1,233	0.1%
Personal Doctor Status				
Has Personal Doctor	2,145,674	52.2%	1,965,705	47.8%
No Personal Doctor	1,003,873	69.4%	441,900	30.6%
Checkup in Last Year				
Had Checkup in Last Year	213,231	53.6%	1,843,403	46.4%
No Checkup in Last Year	990,113	64.6%	542,789	35.4%
Consistent Doctor's Visits				
Consistently Visiting	1,959,095	51.8%	1,821,343	48.2%
Not Consistently Visiting	73,291	42.6%	98,563	57.4%

Health Literacy Associations by Demographics, Number of Chronic Diseases, and Insurance

In the subcomponents of each demographic, certain groups had clear disadvantages over others. In unadjusted odds ratios calculated through logistic regressions, individuals that were likelier to be of lower health literacy were aged 18-34 or >65, not White, not a college graduate, lower than $75,000 in annual income, unemployed, with at least two chronic diseases, and without insurance. Once these odds ratios were adjusted to account for the other variables, statistical significance remained for individuals that were 18-24, other non-Hispanic ethnicities, high school/GED or less, lower than $75,000 in income, unemployed, with 2 or more chronic diseases, and uninsured demonstrated statistically significant trends in lower health literacy, compared to their respective referent groups.

Table 5 - Logistic Regression Analysis Between Low Health Literacy and Demographics, Chronic Disease Status and Health Insurance Status, 2015 Georgia BRFSS (n=3,655)

	Unadjusted Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio[1]	95% Confidence Interval[1]
Gender				
Male	1.18	(0.98, 1.42)	1.19	(0.92, 1.53)
Female	Ref	Ref	Ref	Ref
Age Group (Years)				
18 - 24	**1.83***	**(1.16, 2.88)**	**2.29***	**(1.01, 5.20)**
25 – 34	**1.52***	**(1.04, 2.23)**	1.22	(0.66, 2.26)
35 - 44	Ref	Ref	Ref	Ref
45 - 54	1.22	(0.89, 1.68)	1.62	(0.99, 2.64)
55 - 64	1.18	(0.88, 1.60)	1.16	(0.73, 1.83)
65 and older	**1.40***	**(1.06, 1.86)**	1.24	(0.77, 1.97)
Race/Ethnicity				
Non-Hispanic White	Ref	Ref	Ref	Ref
Non-Hispanic Black	**1.27***	**(1.02, 1.57)**	1.21	(0.90, 1.62)
Hispanic/Latino	**3.60***	**(2.10, 6.16)**	1.17	(0.48, 2.87)
Other, Non-Hispanic	**1.92***	**(1.24, 2.30)**	**2.00***	**(1.08, 3.70)**
Education Level				
Less than High School	**10.97***	**(7.01, 17.15)**	**5.00***	**(2.75, 9.10)**
High School Graduate/GED	**3.89***	**(3.08, 4.90)**	**1.97***	**(1.43, 2.73)**
Some College	**1.99***	**(1.59, 2.50)**	1.14	(0.84, 1.55)
College Graduate	Ref	Ref	Ref	Ref
Annual Household Income				
Less than $35,000	**5.58***	**(4.30, 7.26)**	**1.83***	**(1.29, 2.60)**
$35,000 - $74,999	**2.12***	**(1.61, 2.80)**	**1.53***	**(1.11, 2.11)**
$75,000 and greater	Ref	Ref	Ref	Ref
Employment Status				
Employed	Ref	Ref	Ref	Ref
Unemployed	**2.13***	**(1.78, 2.56)**	**1.85***	**(1.38, 2.47)**
Number of Chronic Diseases				
None	Ref	Ref	Ref	Ref
One	1.10	(0.82, 1.50)	1.34	(0.89, 2.02)
Two or More	**1.80***	**(1.41, 2.31)**	**1.85***	**(1.29, 2.67)**
Health Insurance Status				
Has Health Insurance	Ref	Ref	Ref	Ref
No Health Insurance	*	*	*	*

* and bold denotes significance at $\alpha = 0.05$

[1]Adjusted for age, race/ethnicity, education, annual household income, employment status, chronic disease status, and health insurance status

Healthcare Outcome Trends

Individuals that were female, aged 45 and up, with lower than $75,000 in income, with one or more chronic diseases, and with no insurance were likeliest to have a personal doctor. In checkup status, individuals that were female, aged 55 or older, non-Hispanic Black, of less than high school educational attainment, had two or more chronic diseases, and had no health insurance were likeliest to have had a checkup in the past year. Finally, for consistently seeing a doctor, individuals that were female, aged 65 and older, Hispanic/Latino, of lower than high school educational attainment, with one chronic disease, and uninsured were most likely to be consistently seeing a doctor.

Table 6 - Logistic Regression Analysis Between Healthcare Utilization Outcomes and Demographics, Chronic Disease Status, and Health Insurance Status, Adjusted[1] Odds Ratios and 95% Confidence Intervals, 2015 Georgia BRFSS (n=3,655)

	Has a Personal Doctor	Checkup in the last year	Consistently Seeing Doctor
Gender			
Male	**0.59 (0.44, 0.80)***	**0.71 (0.54, 0.92)***	**0.13 (0.06, 0.28)***
Female	Ref	Ref	Ref
Age Group (Years)			
18 - 24	0.58 (0.30, 1.15)	1.25 (0.62, 2.50)	1.20 (0.24, 5.93)
25 – 34	0.64 (0.40, 1.01)	0.89 (0.57, 1.38)	0.59 (0.16, 2.22)
35 - 44	Ref	Ref	Ref
45 - 54	**1.77 (1.14, 2.75)***	1.18 (0.80, 1.74)	1.43 (0.42, 4.91)
55 - 64	**2.65 (1.67, 4.21)***	**1.52 (1.02, 2.28)***	2.23 (0.61, 8.10)
65 and older	**4.89 (2.81, 8.51)***	**2.76 (1.74, 4.37)***	**15.45 (3.32, 71.95)***
Race/Ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	0.78 (0.56, 1.11)	**1.58 (1.13, 2.19)***	0.98 (0.39, 2.49)
Hispanic/Latino	0.80 (0.42, 1.51)	1.37 (0.75, 2.53)	**52.4 (5.80, 474.11)***
Other, Non-Hispanic	1.31 (0.68, 2.54)	1.05 (0.59, 1.88)	*
Education Level			
Less than High School	0.64 (0.34, 1.25)	**2.12 (1.20, 3.76)***	**6.16 (1.04, 36.43)***
High School Graduate/GED	0.74 (0.49, 1.12)	1.15 (0.80, 1.65)	0.63 (0.21, 1.86)
Some University	0.86 (0.59, 1.25)	1.07 (0.77, 1.49)	0.84 (0.34, 2.08)
University Graduate	Ref	Ref	Ref

Table 6 continued - Logistic Regression Analysis Between Healthcare Utilization Outcomes and Demographics, Chronic Disease Status, and Health Insurance Status, Adjusted[1] Odds Ratios and 95% Confidence Intervals, 2015 Georgia BRFSS (n=3,655)

	Has a Personal Doctor	Checkup in the last year	Consistently Seeing Doctor
Annual Household Income			
Less than $35,000	**0.53 (0.33, 0.84)***	0.71 (0.48, 1.04)	0.30 (0.08, 1.12)
$35,000 - $74,999	**0.57 (0.38, 0.87)***	0.93 (0.66, 1.31)	0.34 (0.10, 1.10)
$75,000 and greater	Ref	Ref	Ref
Employment Status			
Employed	Ref	Ref	Ref
Unemployed	1.10 (0.77, 1.58)	1.09 (0.79, 1.50)	1.39 (0.57, 3.36)
Number of Chronic Diseases			
None	Ref	Ref	Ref
One	**1.58 (1.07, 2.33)***	1.30 (0.92, 1.84)	**3.18 (1.27, 7.95)***
Two or More	**1.95 (1.31, 2.91)***	**1.55 (1.08, 2.24)***	3.22 (0.81, 12.73)
Health Insurance Status			
Has Health Insurance	Ref	Ref	Ref
No Health Insurance	**0.49 (0.32, 0.74)***	**0.36 (0.25, 0.54)***	*

* and bold denotes significance at $\alpha = 0.05$

[1]Adjusted for age, race/ethnicity, education, annual household income, employment status, chronic disease status, and health insurance status

Associations Between Health Literacy and Healthcare Utilization

Using unadjusted logistic regressions, individuals who did not have a personal doctor and had not had a checkup in the last year showed statistically significant trends in having lower health literacy, at odds ratios of 2.08 (95% CI 1.62, 2.67) and 1.58 (95% CI, 1.26, 1.97) respectively. However, after adjusting for age, race/ethnicity, educational attainment, income, employment status, number of chronic diseases, and health insurance status, none of the trends were statistically significant at the 95% level.

Table 7 - Associations Between Health Literacy and Outcome Variables for Individuals, Unadjusted and Controlling for Demographics, Chronic Disease Status, and Health Insurance Coverage, 2015 Georgia BRFSS (n=3,655)

	Unadjusted Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio[1]	95% Confidence Interval[1]
Personal Doctor Status				
Has Personal Doctor	Ref	Ref	Ref	Ref
No Personal Doctor	**2.08***	**(1.62, 2.67)***	1.32	(0.89, 1.94)
Checkup in Last Year				
Had Checkup in Last Year	Ref	Ref	Ref	Ref
No Checkup in Last Year	**1.58***	**(1.26, 1.97)***	0.87	(0.62, 1.22)
Doctor's Visit Consistency				
Consistently Visiting	Ref	Ref	Ref	Ref
Not Consistently Visiting	0.69	(0.38, 1.27)	0.88	(0.36, 2.15)

* and bold denotes significance at $\alpha = 0.05$

[1]Adjusted for age, race/ethnicity, education, annual household income, employment status, chronic disease status, and health insurance status

DISCUSSION

Results from the 2015 Georgia BRFSS presented two primary sets of health literacy findings: descriptive data that outlined health literacy's distribution in the state of Georgia for the first time and the opportunity to identify associations for health literacy and other variables.

The trends observed in the descriptive statistics are relatively consistent with the literature. Operating under the Chew, Griffin [12] assumption that the three questions in the health literacy module were sufficient for predicting inadequate health literacy, the 2015 Georgia BRFSS data serves to affirm and quantify trends identified in the literature. Drawing back to the Paasche-Orlow and Wolf [8] framework, and the findings of Martin, Ruder [14] and Nutbeam [15], educational attainment, race/ethnicity, age, and income level were associated with health literacy. The results of this analysis have affirmed the directionality of this association and have also quantified them for the state of Georgia by subpopulations of these demographics. While it was mentioned in the literature, the strength of the association for education level was particularly noteworthy as the data identified the groups most at risk by their odds ratios (5.00 for less than high school and 1.97 for high school/GED). Nutbeam [15] and Joplin, van der Zwan [25] in particular highlighted the risks of lower education on overall health literacy due to the development of necessary skills like being able to read healthcare forms and understand new medical concepts.

Two demographics not initially identified in the literature that were also found to be significant are employment status and health insurance status. While being unemployed is very likely to be a predictor of lower health literacy due to its presence on the causal pathways [8], health insurance status was not extensively evaluated in the literature. The few studies on health insurance status relative to health literacy detail its prevalence among individuals with Medicare, rather than overall insured status [34, 42]. In addition, no comparison has been made for the Medicare individuals with uninsured populations. The findings from this analysis, that 338 out of

339 uninsured individuals are of lower health literacy, are unprecedented in both the direction and the strength of the association. Some of the literature evaluating emergency care vs primary care utilizations, however, do hint at the likelihood of emergency care use amongst lower health literacy populations due to the lack of health insurance [32, 33].

The last trend observed in the descriptive data, chronic disease status, was also of mixed consistency with currently available research. The diseases most associated with lower health literacy in the literature, namely high blood pressure, high cholesterol, arthritis/auto-immune disorders, depressive disorder, and diabetes, were confirmed by the results of the 2015 Georgia BRFSS. However, the link between disease comorbidities and lower health literacy was relatively novel. There has been some exploration of individuals with multiple diseases and lower health literacy, but not comorbidity itself [17-20]. It is possible, however, that rather than being causal of one another, they are simply underlying symptoms of lower overall socioeconomic status due to their strong associations with lower socioeconomic status overall [43] [8].

While this statistical association itself is not conclusive, the null results of the analysis imply, at best, a marginal link between health literacy and healthcare utilization outcomes related to primary care. This analysis was performed to address a gap in the literature, especially due to identification, in some studies, of decreased emergency care and inpatient admission [31, 33], which have been inversely associated with primary care use in other studies [44]. However, it seems that lower health literacy does not seem to increase the overall likelihood of not having a personal doctor, not having had a checkup in the past year, and not consistently seeing a doctor in the state of Georgia.

While the analysis does not identify an association between lower health literacy and healthcare utilization outcomes from primary care use, it is possible that the differences from lower health literacy are present within the primary care setting, rather than in determining whether the primary care outcome will happen in the first place. Several studies have identified

differences in outcomes within the primary care setting for lower health literacy individuals [21, 45], especially in a decreased ability to understand their health situation and a decreased used of preventive services like immunizations and preventive screenings.

In addition to these results, it is also possible that while individuals of lower health literacy are not proficient at the more specific aspects of health promotion for preventive care, there are wide variations amongst the individual demographics. White, Chen [45] identified strong differences between various demographics, especially age groups, in their use of health literacy-associated behaviors. Ultimately, more in-depth study of specific healthcare utilizations, especially subdivided by demographic groups and geographic area may be necessary for further understanding of this subject.

While the data in the Georgia BRFSS is cross-sectional in nature and represents the year 2015, it is worth making a final note that there may be significant differences from BRFSS surveys before the Patient Protection and Affordable Care Act (ACA)'s implementation in 2013. As a policy, the ACA's purpose was the increase in healthcare access in the United States through several means, including healthcare infrastructural and financial incentives [46].

The strong discrepancy in health literacy outcomes between the insured and uninsured in the 2015 BRFSS dataset very possibly reflects the reach of the ACA. A nationwide review of the BRFSS from 2011-2014 demonstrates significant increases in access to health [47]. Due to the significant number of complex socioeconomic factors that were likely affected by the law, further research would need to be performed to assess the effects on health literacy.

There are at least three strengths of this study. The first, and most important, is that this is the use of the first dedicated state-level assessment of health literacy. Prior to this study, other assessments of health literacy were confined to healthcare institutions, like hospital systems in which surveys like the TOFHLA could be administered. Nesting a sensitive health literacy module within a comprehensive surveillance system like the BRFSS has the potential to enhance the understanding of state and federal health agencies of relative areas of health and socioeconomic disparity in their respective populations. Few, if any, other studies have been able to successfully evaluate health literacy over a wide geographic area with appropriate geographic and demographic representation. Second, as a complement to state-based module's increased reach, the large sample size is a significant advantage over previous research. Previously, the only study that was comparable in size was Chew, Griffin [12], though that sample was still largely confined to a single healthcare institution. Third, this study took advantage of a wide variety of already available surveillance-based questions from the BRFSS for analysis. This aided in the development of outcome questions and measurements, in addition to increasing the number of potentially confounding variables that could be controlled for.

There are at least three limitations of this study. First, as with most surveys, individual respondents are subject to recall bias, leading to potentially skewed results for individuals' health. In particular, questions relying upon an individual to remember a last event, such as the time of last checkup, often leads to an incorrect estimate. This recall bias could also be affected by respondent confidence in regards to less optimistic health outcomes, potentially leading to a weaker representation of their personal health literacy abilities, or even their own personal health. Second, the BRFSS is subject to selection bias. To begin with, the survey population does not account for adults who are institutionalized, do not reside in their own households (such as those in assisted-living communities), and who do not have a telephone of any sort. In addition, Georgia has a large proportion of rural areas that are likely represented by a much smaller number

of interviews administered. To compensate for this, the few points of data obtained from these sparsely populated areas are weighted higher, which increases the chance for estimation errors from results that are not truly representative of the actual population [39, 48].

In an extension of selection bias, a third issue was presented by the data itself. To balance the dataset, the number of individuals dropped from 4,678 to 3,655 based on whether they had responded to any of the health literacy module questions. These 923 dropped individuals represent 19.7% of the total dataset, meaning that roughly a fifth of the entire dataset was excluded. The loss of health literacy data from these individuals may have undermined the strength of the statistical associations due to disproportionate representation of some demographic and geographically located groups.

FUTURE DIRECTIONS

The BRFSS is a public health surveillance system used by state and federal health agencies dating back to 1984. This type of surveillance has been crucial for state and federal governments to understand present issues in health disparities and ongoing health trends to address [49]. As more surveillance data is obtained with future BRFSS health literacy module use, the potential for expanding the research into examining longitudinal trends will allow for the monitoring and study of trends that may be affected by a wide variety of greater social forces, such as shifts in educational and healthcare policies. In addition, this is a study on health literacy's association with healthcare utilization at a state level. Due to the null outcome associations, there is a potential opportunity to further explore into the various primary care behaviors that constitute the healthcare utilization framework created by Andersen and Aday [28]. In particular, preventive health behaviors deserve attention due to their potential to significantly reduce future adverse health outcomes and lower healthcare costs.

Additionally, while this analysis was used to identify overall trends, deeper investigation could be justified for demographic specific differences in health literacy's association with many of these outcomes. In particular, identifying disparities in population differences, like race and age, and identifying causal pathways between these variables and outcomes within healthcare settings, like emergency room versus primary care use has significant potential for development as these could better inform governmental and community based organizations' efforts to enact effective policies and interventions [32]. In addition, previously overlooked trends, like disease comorbidity, could lead to increased interest as another part of the causal pathways to evaluate. Ultimately, the results of the 2015 Georgia BRFSS's health literacy module will open possibilities to explore future research in improved policy and broader sociocontextual disparities through targeted and informed study.

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