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Examining the Relationship between Health Literacy and Preventive Care Use

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Abstract

We examined the role of health literacy on preventive care among college students and assessed individual health literacy skills from a theory-based multidimensional perspective using both subjective and objective measures. Methods: Participants (n=561) completed our online survey with valid responses. Data collection was conducted from April to June 2020. We assessed participants' health literacy using different measures, including Health Insurance Literacy Measure (HILM), eHealth Literacy Scale (eHEALS), All Aspect of Health Literacy Scale (AAHLS), and the Newest Vital Sign (NVS). The first three were subjective measures. The last one was an objective test. Preventive care included annual flu vaccinations, annual routine physical examinations, blood pressure checks, blood tests for cholesterol level, and annual dental checks. We performed logistic and linear regressions to examine the relationships among individual's preventive care use, health literacy, and other factors including age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status. Age, education, gender, race/ethnicity, health insurance coverage (medical health insurance and dental insurance), and self-rated health status predicted 15.42% of the variance (model R^2) in the number of preventive care services received. Higher HILM, eHEALS, and AAHLS scores were significantly associated with a greater number of preventive care services received. The HILM increased the model R^2 by 2.42%. The eHEALS increased the model R^2 by 1.20%. The AAHLS increased the model R^2 by 1.73%. We identified health insurance status, health literacy, self-related health status, age, gender, and race/ethnicity as important predictors of preventive care use.

Keywords

health literacy, flu vaccination, routine physical examination, blood pressure check, cholesterol level check, dental check

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Abstract

We examined the role of health literacy on preventive care among college students and assessed individual health literacy skills from a theory-based multidimensional perspective using both subjective and objective measures. Participants (n = 561) completed our online survey with valid responses. Data collection was conducted from April to June 2020. We assessed participants' health literacy using different measures, including Health Insurance Literacy Measure (HILM), eHealth Literacy Scale (eHEALS), All Aspect of Health Literacy Scale (AAHLS), and the Newest Vital Sign (NVS). The first three were subjective measures. The last one was an objective test. Preventive care included annual flu vaccinations, annual routine physical examinations, blood pressure checks, blood tests for cholesterol level, and annual dental checks. We performed logistic and linear regressions to examine the relationships among individual's preventive care use, health literacy, and other factors including age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status. Age, education, gender, race/ethnicity, health insurance coverage (medical health insurance and dental insurance), and self-rated health status predicted 15.42% of the variance (model R^2) in the number of preventive care services received. Higher HILM, eHEALS, and AAHLS scores were significantly associated with a greater number of preventive care services received. The HILM increased the model R^2 by 2.42%. The eHEALS increased the model R^2 by 1.20%. The AAHLS increased the model R^2 by 1.73%. We identified health insurance status, health literacy, self-related health status, age, gender, and race/ethnicity as important predictors of preventive care use.

Keywords: health literacy, flu vaccination, routine physical examination, blood pressure check, cholesterol level check, dental check

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Introduction

One of the goals of Healthy People 2030 is to increase preventive care for people of all ages. Preventive health care refers to the health care people receive before they feel sick in order to stay healthy. Preventive care is defined as "the care you receive to prevent illnesses or diseases. It also includes counseling to prevent health problems" (Independence Blue Cross, 2018). Some common preventive health care services include immunizations (e.g., flu vaccinations, COVID-19 vaccines), annual physical examinations, preventive dental care, cancer screenings (e.g., colorectal cancer screenings starting at age 45, Pap tests for women aged 21-65), and behavioral therapy (e.g., weight management, smoking cessation, and mental health screenings).

Preventive health care has many benefits for both personal and public health (Kreps, 2023). Getting preventive care reduces the risk for diseases, disabilities, and death, as well as saves health care costs for patients and societies. Preventive care can catch

potential health problems before becoming real problems. For example, if a healthcare provider notices a person's blood pressure is increasing during a regular physical examination, the health care provider can guide that person to begin engaging in activities to lower the blood pressure (e.g., healthy diet, physical activity) before it becomes more severe. Therefore, preventive care can increase people's lifespan and life quality because it can detect health problems early so these problems can be addressed at a manageable stage. According to the Centers for Disease Control and Prevention (CDC), each year in the United States (U.S.) over 100,000 lives could be saved if people received the recommended clinical preventive care (Fox & Shaw, 2014). Moreover, preventive care reduces the cost of treatment. For example, a patient might end up in an emergency department costing thousands of dollars due to poor management of his/her/their diabetes condition; however, if receiving regular checkups, the patient can exert better control over the health problem to help avoid emergency department visits.

Having health insurance is a strong predictor for individual decision-making related to preventive care use; however, even among people with health insurance, less than 50% received recommended preventive care (Fox & Shaw, 2014). This finding indicates that there are additional factors that also influence preventive care use. These potential factors include health literacy, health status, and socio-demographic characteristics such as age, gender, education, and race/ethnicity. In the pursuit of understanding the intricate landscape of preventive care utilization, it is imperative to acknowledge and delve into the intersectionality among health literacy, health status, age, and other significant socio-demographic factors, particularly those associated with limited access to preventive care, such as lack of health insurance coverage and racial/ethnic disparities. This intersectionality takes on heightened relevance given the specific research questions at the heart of this study.

Health literacy is a key factor associated with preventive care use. According to Healthy People 2030, the most updated definition of personal health literacy is "the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others" (Santana et al., 2021; U.S. Department of Health & Human Services, 2020). Limited health literacy is associated with lack of awareness of the availability of preventive care services and understanding of the importance of using the services (Andrus & Roth, 2002), thereby contributing to a lower rate of preventive care use (Cho et al., 2008; MacLeod et al., 2017). Among elderly Medicare patients (age $\geq$ 65 years) in the U.S., lower health literacy was associated with lower preventive care use, such as prostate cancer screening (if male), mammography and Pap smear test (if female), flu vaccination, pneumococcal vaccination, and routine examinations associated with common chronic conditions (Cho et al., 2008; MacLeod et al., 2017; Scott et al., 2002). A study documented that elderly population in Taiwan (age $\geq$ 60 years) with higher health literacy tend to have a higher rates of using preventive care services, such as blood pressure examinations, blood sugar tests, general blood tests (including urine acid, cholesterol, and liver and renal function), flu and pneumonia vaccinations, and general health check-ups (Chen et al., 2013). Studies report different findings. For example, one study of a nationally representative sample of adults in the U.S. found that lower health literacy was associated with a decreased likelihood of using many preventive care services (e.g., flu vaccinations, dental checkups, vision checkups, mammograms,

colon cancer screenings, and prostate cancer screenings) among people aged 65 and older, but not among those who are 40 to 64 years old or younger than 40 (White et al., 2008). Another study reported that health literacy was significantly associated with health checkups and cancer screenings but not dental checkups in a general Japanese population sample aged between 20 and 79 years of age (Goto et al., 2019).

The inconsistent findings from these studies might be due to health literacy measurement error. The instruments used to measure participants' health literacy varied from study to study. This is a common methodological issue we identified in the literature. Health literacy is a multidimensional concept (Frisch et al., 2012; Kreps et al., 2020). There are more than 51 instruments available for measuring individuals' health literacy (Haun et al., 2014). Some health literacy instruments such as the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA) have been criticized for only aligning superficially to a definition of health literacy (Nguyen et al., 2017; Thomason & Mayo, 2015). Moreover, one study points out that self-reported, perception-based health literacy and objective, performance-based health literacy should be treated as separate concepts (Schulz et al., 2021). The second possible explanation for the inconsistent findings from previous studies is that many studies used samples of elderly populations or participants with various age ranges. Few studies have examined the individual factors associated with preventive care use, particularly among young adults. However, it is critical to investigate preventive care use among young adults because such behavior lowers their odds of accruing preventable disease later in life (Lee et al., 2018). In addition, college students are in a vital stage to establish healthy behavior and initiative preventive care routine. Therefore, to reduce gaps in the literature, we (1) assessed an individual's health literacy skills from a theory-based multidimensional perspective using both subjective and objective measures, and (2) examined the relationship between health literacy and preventive care use in a college student sample by controlling other important factors including age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status.

Research Questions

- Is the use of preventive health care services (i.e., annual flu vaccinations, annual routine physical examinations, blood pressure checks, blood tests for cholesterol level, and annual dental checks) associated with age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status?
- Does health literacy play a role in predicting the use of preventive health care services, when adjusting for age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status?

Methods

Research Design

This current study builds upon a cross-sectional online survey project designed to investigate college students' health literacy, information-seeking behaviors, and preventive care use. The research was conducted at a land-grant university situated in a rural county in north-central Oklahoma. The campus accommodates around 25,000 enrolled students, with a majority being undergraduate students (81%), attending full-time (77%), and identifying as non-Hispanic white (67%). Recruitment and data collection using Qualtrics were conducted between

April and June 2020. The participation criteria included being (1) a student enrolled at Oklahoma State University, (2) 18 years or older, (3) proficient in English, and (4) physically located in the U.S. Study recruitment invitations were sent out to randomly selected university system student-email addresses by the Oklahoma State University Institute for Research and Information Management using a simple random sampling strategy. Students who received the recruitment email were also encouraged to invite their friends who met the eligibility criteria to consider participating in this study. The first 120 participants received a $5 Amazon electronic gift card as incentives. A final sample size of 561 was included in data analysis because these participants completed the survey with valid responses (i.e., passing both of the survey validation items). The two survey validation items asked participants to select "somewhat agree" for one and "somewhat disagree" for the other, from a five-point Likert scale. Failing to correctly answer these validation items indicates a lack of attention when filling out our survey. Detailed procedures were reported elsewhere (Chen, Ariati, et al., 2022; Chen, Li, et al., 2022).

Measures

Dependent Variables

We adopted measures from the Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire (CDC, 2023) and the National College Health Assessment (NCHA) Survey (American College Health Association, 2021) to measure participants' preventive care use, including annual flu vaccinations, annual routine physical examinations, blood pressure checks in the last two years, blood tests for cholesterol level in the last two years, and annual dental checks, as these are common preventive services (U.S. Department of Health and Human Services, 2022). All of these are dichotomous variables (*Yes* or *No*). We also created a variable representing the number of different types of preventive health care services our participants received (Becker et al., 1989). If they received all five preventive care services (i.e., annual flu vaccination, annul physical exam, blood pressure checks, blood tests for cholesterol, and dental checks), they scored 5 on this variable. If they received none of the preventive care services, they scored 0. This is the dependent variable on a continuous ratio-level scale from 0 to 5.

Independent Variables

We assessed participants' health literacy using different measures, including the Health Insurance Literacy Measure (HILM), eHealth Literacy Scale (eHEALS), All Aspect of Health Literacy Scale (AAHLS), and the Newest Vital Sign (NVS). The HILM (21 items) assessed participants' ability to select and use their health insurance (Paez et al., 2014). The eHEALS (8 items) assessed participants' perceived skills at using information technology for health (Norman & Skinner, 2006). The AAHLS (13 items) was developed based on Nutbeam's health literacy conceptual model (Nutbeam, 2000), assessing participants' functional health literacy, communicative health literacy, and critical health literacy (Chinn & McCarthy, 2013). The NVS asked participants to interpret a mock-up ice-cream nutrition label and answer six open-ended questions (Weiss et al., 2005). Both the HILM, eHEALS, and AAHLS were subjective measures using self-reported survey questionnaires. The NVS was an objective test. All of these tests measured continuous variables. The HILM is a valid and reliable measure to assess health insurance literacy for a nationally representative sample of U.S. adults as well as among samples of college students,

racial/ethnic minorities in the U.S., and adults in other counties (Bardy, 2023; Ghaddar et al., 2012; Holst et al., 2022; James et al., 2020; Paez et al., 2014; Upadhyay et al., 2022). The eHEALS has sufficient reliability and validity to evaluate eHealth literacy among college students and young adults in multiple countries (Le et al., 2023; Nguyen et al., 2016; Norman & Skinner, 2006; Tsukahara et al., 2020). The AAHLS yields reliable and valid data for different populations including college students in the U.S., adults in the U.K., and U.S. immigrants and refugees (Barsell et al., 2018, 2020; Chen et al., 2018; Chinn & McCarthy, 2013; Kim et al., 2023). The NVS has been validated and demonstrate satisfactory reliability with various populations across the word including college students in the U.S. (Avci et al., 2019; Chen, Li, et al., 2022; Soto Mas et al., 2014; Weiss, 2018; Weiss et al., 2005).

Socio-demographic characteristics included medical health insurance coverage and dental insurance coverage (have insurance vs. no insurance), education (undergraduate or graduate), gender (male or female), age, race/ethnicity (white, Hispanic/Latino, black or African American, American Indian or Alaska Native, Asian, or other), and self-reported health status (poor, fair, good, very good, or excellent).

Data Analysis

We applied four steps in our data analysis. First, we performed a set of logistic regression models with one type of preventive care use in each model as the dependent variable, and demographics variables (i.e., age, education, gender, race/ethnicity), health insurance coverage (medical insurance or dental insurance), and self-rated health status as the independent variables. For the health insurance coverage, we used medical health insurance coverage for annual flu vaccinations, annul physical exams, blood pressure checks, and blood tests for cholesterol, and dental insurance for annual dental checks. Second, to examine the unique contribution of health literacy in predicting preventive care use, we added the health literacy measures one at a time into the first step models to evaluate to what extent the model R^2 increased. Third, due to the potential correlations among distinct types of preventive care use, we created a continuous variable representing the number of preventive care services individuals received and then performed a linear regression model with the number of preventive care uses as the dependent variable. The independent variables included demographics variables (age, education, gender, and race/ethnicity), health insurance coverage (putting both medical insurance and dental insurance in the model), and self-rated health status. In the last step, we added the health literacy measures one at a time into the third step models to evaluate to what extent the model R^2 increased.

Results

Sample Description

Table 1 shows information about participants' demographic characteristics. Participants' ages ranged from 18 to 65 (M = 24.99, SD = 7.47). Most participants were female (64%, n = 358), white (67%, n = 377), undergraduate (64%, n = 360), and between 18 and 25 years old (66%, n = 368). Only about 5% (n = 28) of the participants were aged above 40. About 11% (n = 62) of the participants did not have any type of medical health insurance and 29% (n = 162) did not have dental health insurance. More than half of the participants (55%, n = 310) rated their health status as very good or excellent; about 11% (n = 60) of the participants rated their health status as poor or fair. The possible

score range of self-rated health status was from 1 to 5 (M = 3.58, SD = 0.88).

Preventive Care Use

More than half of the participants received annual flu vaccinations (54%, n = 302) and annual physical exams (57%, n = 320). The majority of the participants (91%, n = 512) received blood pressure checks within the past two years. About 48% (n = 268) of participants received blood tests for cholesterol level within the past two years. Most (72%, n = 404) received annual dental checks. About 3% (n = 19) of the participants did not use any of the preventive care and 21% (n = 116) of the participants used all five preventive care services. The possible score range of the number of preventive care

Table 1
Participants' demographic characteristics (N = 561)

Demographics	n	%
Age		
18-25	368	65.60
26-39	164	29.23
40-65	28	5.00
Sex		
Male	203	36.19
Female	358	63.81
Race/Ethnicity		
White	377	67.20
Hispanic/Latino	45	8.02
Black or African American	37	6.60
American Indian or Alaska Native	34	6.06
Asian	52	9.27
Other	16	2.85
Education		
Undergraduate	360	64.17
Graduate	197	35.12
Missing	4	0.71
Medical Health Insurance		
Yes	499	88.95
No	62	11.05
Dental Health Insurance		
Yes	399	71.12
No	162	28.88
Self-rated Health Status		
Poor	4	0.71
Fair	56	9.98
Good	191	34.05
Very good	229	40.82
Excellent	81	14.44

Table 2
Effects of insurance coverage and other socio-demographic characteristics on the odds of using different types of preventive care

	Odds Ratio				
Predictors	Flu vaccinations	Physical examinations	Blood pressure checks	Blood tests for cholesterol	Dental checks
Health insurance^	3.51**	1.74	1.68	2.02*	6.25**
Gender (ref: male)	1.15	1.61*	2.79*	1.44	1.90*
Age	1.01	1.02	1.06	1.06**	0.99
Race/ethnicity (ref: white)					
Hispanic/Latino	2.11*	0.90	1.10	2.13*	2.05
Black or African American	0.84	1.56	0.43	1.63	0.85
American Indian or Alaska Native	0.77	0.67	0.40	1.44	1.15
Asian	0.61	0.57	0.23*	0.66	1.40
Other	1.42	0.84	1.00	2.01	1.49
Education (ref: undergraduate)	1.70*	0.95	0.99	1.05	0.85
Self-rated health status (ref: poor)					
Fair	2.56	0.88	0.40	3.71	3.21
Good	3.26	1.03	0.27*	3.01	7.39
Very good	3.23	1.90	0.55	3.83	10.72
Excellent	2.89	2.03	1.00	4.70	17.75*
Model Pseudo R^2	4.64%	4.45%	10.26%	5.43%	18.03%

Note.
^ dental insurance for dental checks, medical insurance for the other types of care
*$p < .05$, **$p < .001$

services received was from 0 to 5 (M = 3.22, SD = 1.37).

Health Literacy

The possible score range of HILM was from 21 to 105 (M = 64.80, SD = 18.35). The possible score range of eHEALS was from 8 to 40 (M = 32.04, SD = 6.01). The possible score range of AAHLS was from 10 to 33 (M = 26.49, SD = 3.62). The possible score range of NVS was from 0 to 6 (M = 5.22, SD = 1.14). The Cronbach's α values were 0.95 for HILM, 0.90 for eHEALS, 0.70 for AAHLS, and 0.60 for NVS.

Research Question 1

Is the use of preventive health care services (i.e., annual flu vaccinations, annual routine physical examinations, blood pressure checks, blood tests for cholesterol

Table 3

Effects of insurance coverage and other socio-demographic characteristics on the number of preventive care services received

Predictors	*b*	*SE*	*95% CI*	*p*
Medical health insurance	0.42	0.20	[0.03, 0.82]	.036*
Dental health insurance	0.78	0.14	[0.50, 1.06]	< .001**
Gender (ref: male)	0.38	0.11	[0.16, 0.61]	.001*
Age	0.02	0.01	[0.00, 0.04]	.014*
Race/ethnicity (ref: white)				
Hispanic/Latino	0.51	0.20	[0.11, 0.91]	.012*
Black or African American	0.09	0.23	[-0.36, 0.54]	.684
American Indian or Alaska Native	-0.15	0.23	[-0.60, 0.30]	.514
Asian	-0.34	0.19	[-0.71, 0.04]	.078
Other	0.37	0.32	[-0.27, 1.01]	.256
Education (ref: undergraduate)	0.18	0.13	[-0.07, 0.44]	.115
Self-rated health status	0.22	0.06	[0.10, 0.34]	< .001**
Model Adjusted R^2 = 15.42%				

Note.

SE = standard error; *CI* = confidence interval; **p* < 0.05, ***p* < 0.001.

level, and annual dental checks) associated with age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status? Analysis included separate logistic regression models – looking at one preventive care use at a time, with results presented in Table 2, and looking at all the types of preventive care use together, with results presented in Table 3.

As Table 2 shows, age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status together predicted 4.64% of the variance in receiving annual flu vaccinations, 4.45% of the variance in receiving annual physical exams, 10.26% of the variance in receiving blood pressure checks, 5.43% of the variance in receiving blood tests for cholesterol level, and 18.03% of the variance in receiving annual dental checks (in this instance, the dental health insurance coverage replaced the medical health insurance coverage).

Older people had higher odds of receiving blood tests for cholesterol level than younger people (*OR* = 1.06, *p* < .001). Graduate students were almost two times more likely to receive annual flu vaccinations compared to undergraduate students (*OR* = 1.70, *p* = .013). Compared to males, females had higher odds of receiving annual physical exams (*OR* = 1.61, *p* = .011), blood pressure checks (*OR* = 2.79, *p* = .011), and annual dental checks (*OR* = 1.90, *p* = .004). Compared to Whites, Asians were much less likely to receive blood pressure checks (*OR* = 0.23, *p* = .001). Hispanic/Latinos were two times more likely to receive annual flu vaccinations (*OR* = 2.12, *p* = .036) and blood tests for cholesterol level (*OR* = 2.13, *p* = .027) compared to Whites. Compared to people without medical health insurance,

those having medical health insurance were three times more likely to receive annual flu vaccinations (*OR* = 3.51, *p* < .001) and two times more likely to receive blood tests for cholesterol level (*OR* = 2.02, *p* = .022). Compared to people without dental insurance, those having dental insurance were six times more likely to receive annual dental checks (*OR* = 6.25, *p* < .001). Compared to people who self-rated their health status as poor, those who self-rated their health status as good were less likely to receive blood pressure checks (*OR* = 0.27, *p* = .042). Those who self-rated their health status as excellent were 17 times more likely to receive annual dental checks than people who self-rated their health status as poor (*OR* = 17.75, *p* = .029).

Looking at Table 3, age, education, gender, race/ethnicity, health insurance coverage (medical health insurance and dental insurance), and self-rated health status (treated as a continuous variable) predicted 15.42% of the variance in the number of preventive care services received. Older people were more likely to receive more types of preventive care services than younger people (*b* = 0.02, *p* = .014). Education was not associated with the number of preventive care services received. Females were more likely to receive multiple types of preventive care services than males (*b* = 0.38, *p* = .001). Hispanic/Latinos were more likely to receive more types of preventive care services than Whites (*b* = 0.51, *p* = .012). Those having medical insurance (*b* = 0.42, *p* = .036) and dental insurance (*b* = 0.78, *p* < .001) were more likely to receive multiple types of preventive care services. Those with better self-rated health status were more likely to receive more types of preventive care services than those with lower self-rated health status (*b* = 0.22, *p* < .001).

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Research Question 2

Does health literacy play a role in predicting the use of preventive health care services, when adjusting for age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status? Analysis included separate logistic regression models – looking at one preventive care use at a time (Table 4) and looking at all the types of preventive care use together (Table 5).

Table 4 shows, after adding different types of health literacy measures into the logistic regression models one at a time, we identified that a higher HILM (health insurance literacy) score was significantly associated with higher odds of receiving annual physical examinations (*OR* = 1.02, *p* < .001), blood pressure checks (*OR* = 1.03, *p* = .003), and

Table 4
Logistic regression models of different preventive care use

Preventive Care Use	Health Literacy Measure	Pseudo R^2 without health literacy variable	Pseudo R^2 with the health literacy variable	*OR*	*p*
Flu vaccinations	HILM	4.64%	4.64%	1.00	.833
	eHEALS		5.12%	1.03	.056
	AAHLS		5.37%	1.06	.019*
	NVS score		5.18%	1.18	.042*
Physical examinations	HILM	4.45%	6.32%	1.02	< .001**
	eHEALS		5.02%	1.03	.038*
	AAHLS		5.30%	1.07	.012*
	NVS score		4.45%	0.99	.900
Blood pressure checks	HILM	10.26%	13.22%	1.03	.003*
	eHEALS		12.16%	1.07	.012*
	AAHLS		12.12%	1.12	.013*
	NVS score		12.83%	1.43	.003*
Blood tests for cholesterol	HILM	5.43%	9.06%	1.03	< .001**
	eHEALS		6.35%	1.04	.009*
	AAHLS		6.77%	1.09	.002*
	NVS score		5.44%	0.99	.874
Dental checks	HILM	18.03%	18.22%	1.01	.265
	eHEALS		18.05%	1.01	.744
	AAHLS		18.03%	1.00	.892
	NVS score		18.16%	1.10	.348

Note.
Adjusted for age, Education, gender, race/ethnicity, health insurance coverage (medical insurance or dental insurance), and self-rated health status; *OR* = odds ratio
*$p < .05$, **$p < .001$
HILM: Health Insurance Literacy Measure;
eHEALS: eHealth Literacy Scale
AAHLS: All Aspect of Health Literacy Scale
NVS: Newest Vital Sign

blood tests for cholesterol level (*OR* = 1.03, $p < .001$). The HILM score increased the models' R^2 by 2% to 3%. A higher eHEALS (eHealth literacy) score was significantly associated with higher odds of receiving annual physical examinations (*OR* = 1.03, $p = .038$), blood pressure checks (*OR* = 1.07, $p = .012$), and blood tests for cholesterol level (*OR* = 1.04, $p = .009$). The eHEALS score increased the models' R^2 about 0.5% to 1%. A higher AAHLS (All Aspects of Health Literacy Measure) score was significantly associated with higher odds of receiving annual flu vaccinations (*OR* = 1.06, $p = .019$), annual physical examinations (*OR* = 1.07, $p = .012$), blood pressure check (*OR* = 1.12, $p = .013$), and blood tests for cholesterol level (*OR* = 1.09, $p = .002$). The AAHLS score

Table 5
Linear regression models of the number of preventive care services received

Health Literacy Measure	Adjusted R^2 without health literacy variable	Adjusted R^2 with the health literacy variable	*b*	*p*
HILM	15.42%	17.84%	0.01	< .001**
eHEALS		16.62%	0.03	.003*
AAHLS		17.15%	0.05	< .001**
NVS score		15.68%	0.08	.105

Note.
Adjusted for age, Education, gender, race/ethnicity, medical health insurance coverage, dental insurance coverage, and self-rated health status; *$p < .05$, **$p < .001$.
HILM: Health Insurance Literacy Measure;
eHEALS: eHealth Literacy Scale
AAHLS: All Aspect of Health Literacy Scale
NVS: Newest Vital Sign

increased the models' R^2 about 0.5% to 1%. A higher NVS (ice-cream label test score) score was significantly associated with higher odds of receiving annual flu vaccinations (*OR* = 1.18, $p = .042$) and blood pressure checks (*OR* = 1.43, $p = .003$). The NVS score increased the models' R^2 about 0.5% to 2%.

Table 5 shows that after adding different types of health literacy measures into the linear regression model one at a time, we identified that higher HILM ($b = 0.01$, $p < .001$), eHEALS ($b = 0.03$, $p = .003$), and AAHLS ($b = 0.05$, $p < .001$) scores were significantly associated with a greater number of preventive care services received. The HILM score increased the model R^2 by 2.42%. The eHEALS score increased the model R^2 by 1.2%. The AAHLS score increased the model R^2 by 1.73%. However, we found that the NVS (ice-cream label test score) was not a significant predictor of the number of preventive care services received and it only increased the model R^2 by 0.26%.

Discussion

We examined the relationships among individuals' demographic characteristics, health insurance status, self-reported health status, health literacy, and preventive care use. Most of our findings were consistent with previous research. First, we found that whether or not having health insurance was a significant predictor of receiving preventive care. Generally, people with health insurance were more likely to receive more types of preventive care than people without insurance. Specifically, those with health insurance were more likely to receive annual flu vaccinations, blood tests for cholesterol level; those with dental insurance were more likely to receive annual dental checks. These findings were consistent with previous studies reporting that compared to people without health insurance, those with health insurance had higher rates of receiving recommended preventive care services including flu vaccinations, blood pressure tests, and cholesterol level tests (Borsky et al., 2018; Fox & Shaw, 2014; Keisler-Starkey & Bunch, 2020; Vaidya et al., 2011). Health

insurance coverage is a critical predictor of using preventive care because most health insurance plans cover eligible preventive services at 100%; however, those with no health insurance have to pay for the preventive care services on their own.

Second, we found that graduate students were almost twice as likely to receive annual flu vaccinations compared to undergraduate students. This finding was consistent with previous studies reporting people with higher education attainment have higher rates of using preventive care such as physical exams, dental checks, flu vaccinations, and blood test for cholesterol level (Fletcher & Frisvold, 2009; Lee et al., 2018). Greater education may influence preventive care use partly through occupational characteristics (prestige) and access to care (Fletcher & Frisvold, 2009). It also may be due to graduate students usually being older than undergraduate students.

Third, for age difference, we found that older people tended to receive more types of preventive care services than younger people, especially blood tests for cholesterol check. Vaidya et al. (2011) also found that older population had higher odds of using preventive care for blood pressure and cholesterol. However, there are two different hypotheses about age and preventive care use in the literature: (1) as age increased, preventive care use also increase because older people face a higher incidence of preventable diseases (Kenkel, 1994); (2) older people might have less incentive to invest in health because they have a shorter length of remaining life (Peng & Lin, 2018). Most of our participants were between 18 and 25 years old. Our findings were consistent with the first hypothesis due to our college student sample.

Fourth, we found that females tended to receive more types of preventive care services than males, especially annual physical exams, blood pressure checks, and dental checks. These findings were consistent with previous research conducted in the U.S. reporting men had significantly lower odds of having blood pressure checks, cholesterol checks, dental checks, and flu vaccinations compared to women (Vaidya et al., 2011, 2012). The lower preventive care utilization among males might be due to their common belief that they are less likely to visit a doctor compared to females (Vaidya et al., 2012).

Finally, we found that Asians were less likely to receive blood pressure checks compared to Whites. This finding was consistent with a prior study that used a nationally representative sample of the U.S. population, reporting that Asians had lower odds of receiving blood pressure checkups compared to Whites (Vaidya et al., 2011). This might be due to two reasons: (1) American Asians have low utilization of health care services, which also leads to their low use of preventive care; (2) Asian Americans have higher use of complementary and alternative medicines (e.g., herbal medicines) compared to Whites, which decreases their use of preventive care (Mackenzie et al., 2003; Vaidya et al., 2011).

Some of our findings were inconsistent compared to previous research. For example, we found that Hispanics/Latinos were more likely to receive annual flu vaccinations and blood tests for cholesterol check compared to Whites; this finding was different from previous studies where reporting Hispanics/Latinos were less likely to receive preventive care services including annual flu vaccinations (Bustamante et al., 2010; Henning-Smith et al., 2019). This inconsistent finding might be due to different study samples. Bustamante et al.'s study (2010) used a nationally representative sample of non-institutionalized U.S. residents. Henning-Smith et al. (2019) examined the racial/ethnic differences in preventive care among U.S. rural residents. We used a convenience sample of college

students from a land-grant university in U.S. southwest region. The characteristics of the Hispanic/Latino college students enrolled in this university might be different from a national representative sample.

We also found that those who self-rated their health status as poor were almost four times more likely to receive blood pressure checks compared to people who self-rated their health status as good. This finding aligned with prior research that if people have higher perceived risk and more worry about having a disease, they are less likely to avoid health information (Chen, Ariati, et al., 2022), and thus, are more willing to receive preventive health checks. Previous studies reported that people with chronic conditions were most likely to receive flu vaccinations (Böhmer et al., 2012; Schmitz & Wübker, 2011). Interestingly, the association between self-rated health status and receiving annual flu vaccinations was non-significant in our study. However, we found that people with better self-rated health status tended to receive more types of preventive care services than those with poorer self-rated health status, especially annual dental checks. This might be due to the association between better health outcomes and higher socio-economic status. Those with better self-rated health tend to be able to afford high-quality health care including preventive care through higher socio-economic status (McMaughan et al., 2020).

Limitations

This study has several limitations. First, the cross-sectional survey design of this study limits our ability to infer causal relationships. Second, our convenience sampling method that recruited participants from a single university tempered our ability to generalize our findings to a larger population. Third, we were unable to calculate the response rate of this online survey because the total population of potential respondents who could get access to the survey was not available.

Conclusions

Our study contributes to the literature by examining the relationships among individual's preventive care use, age, education, gender, race/ethnicity, health insurance coverage, and self-rated health status; moreover, this study shows that health literacy plays an important role among these relationships influencing preventive care use. We also supported previous findings identifying health insurance status, health literacy, self-related health status, age, gender, and race/ethnicity as important predictors of preventive care use. Acknowledging the complex interplay of factors affecting preventive care utilization is crucial. Our exploration into preventive care and its determinants is not conducted in isolation; rather, it recognizes the complex interplay between health literacy, health status, and other significant socio-demographic factors. These multifaceted dimensions interact in nuanced ways that profoundly influence individuals' access to and utilization of preventive healthcare services. By acknowledging and addressing these intersectional dynamics, we can foster a more comprehensive understanding of the challenges and opportunities in the realm of preventive healthcare, ultimately contributing to the development of targeted interventions that can help bridge existing gaps in care access and delivery.

Implications Health Behavior Theory and Research

We assessed the complex health literacy concept in this study by conducting multiple measures to capture individual's self-reported, perception-based health literacy

and objective, performance-based health literacy. Generally speaking, we observed consistent patterns across several types of health literacy measures that people with higher health literacy tended to have a higher rate of preventive care use. This is consistent with previous research (Chen et al., 2013; Cho et al., 2008; MacLeod et al., 2017; Scott et al., 2002). The studies conducted by Cho et al. (2008) and Scott et al. (2022) measured health literacy using the Short Test of Functional Health Literacy in Adults (S-TOFHLA) (Baker et al., 1999). MacLeod et al. (2017) used a single-item question to measure health literacy: "How confident are you filling out medical forms by yourself?" Chen et al. (2013) measured health literacy by education, cognitive function, and disease knowledge. These health literacy measures have been criticized for only measuring a limited aspect of health literacy (Haun et al., 2014). It is critically important to assess multiple health literacy competencies because health literacy is a multi-construct concept (Chinn & McCarthy, 2013). Our study took a step further by examining distinct types of theory-based health literacy measures (both self-reported and performance-based) and identifying their unique power of predicting each different type of preventive care use, as well as the overall number of preventive care services received.

White et al. (2008) measured health literacy using the 2003 National Assessment of Adult Literacy (NAAL) and found that lower health literacy was associated with a decreased likelihood of using preventive care among people aged 65 and older, but not among people below 65. Among our college student sample, we found that all of our self-reported health literacy measures were associated with the number of preventive care services received; however, our performance-based health literacy measure was not associated with the number of preventive care services received. This could be considered consistent with White et al.'s findings where no correlation between using preventive care and health literacy among people below 65 because the NAAL they used to measure health literacy was also a performance-based test.

Goto et al. (2019) found that health literacy was significantly associated with health checkups and cancer screening, but not dental checkups. They measured health literacy using a self-reported scale that was similar to our AAHLS measure. Our findings were consistent with Goto et al.'s results that higher AAHLS was associated with the overall number of preventive care services received; higher AAHLS was associated with all the preventive care use measures except annual dental checks. Measuring more specific dental health literacy using Rapid Estimate of Adult Literacy in Dentistry might generate different results (Goto et al., 2019).

Besides AAHLS, our findings also indicated that HILM (health insurance literacy) was an important predictor for individuals' number of preventive care services received. Similarly, previous research found that having a higher HILM score was associated with a lower likelihood of both delayed or foregone preventive care (Tipirneni et al., 2018). A systematic literature review also confirmed that health insurance literacy was an important factor that can enable effective utilization of preventive health care (Yagi et al., 2022).

Implications for Health Behavior Practice

The findings of this study provide a guide for future preventive care interventions by identifying the crucial factors influencing such health behaviors. They especially suggest the importance of recognizing the influences of health literacy on participation in important preventive care, both when conducting future research and when

introducing preventive care promotion interventions. They encourage adoption of strategic health promotion intervention strategies that are segmented to address the unique health information needs of people with health literacy challenges (when utilizing health education programs, health promotion campaigns, health communication materials and technologies, as well as in developing responsive health policies) to promote widespread public participation in preventive care services that can enhance health outcomes (Kreps, 2023; Kreps et al., 2020).

Discussion Questions

How can health behavior researchers integrate health literacy into preventive health care promotion efforts?

Why is health literacy level such an influential factor in public participation in preventive care services?

Ethical Approval

The larger study was approved by Oklahoma State University Institutional Review Board.

Conflict of Interests

The authors have no conflicts of interest to declare.

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