Discover Social Science and Health

Research

Health literacy levels and self-rated health in the state of Delaware: a cross-sectional study

Raymond A. Tutu[1] · Edmund Essah Ameyaw[2] · John Kwagyan[3] · Doris Ottie-Boakye[4]

Received: 9 September 2024 / Accepted: 3 December 2024
Published online: 14 January 2025

Abstract
Background Better health literacy has been found to be associated with better health outcomes across varied populations. This study aimed to (1) examine the health literacy levels of individuals with respect to the extent to which they acquire, understand, appraise, and apply health information, and (2) to assess the relationship between health literacy and self-reported health in the state of Delaware.
Methods The sampling frame consisted of 60 purposively selected faith-based organizations across the state of Delaware who predominantly serve minorities. Accounting for clustering design, a sample size was determined based on a Mixed Methods test. In total, 1095 participants responded to a survey questionnaire which included a validated short version of the European Health Literacy Questionnaire (HLS-EU-Q16). The data was analyzed using descriptive statistics, reliability techniques, chi-square test of independence, and ordinal logistic regression.
Results The study found that about a quarter of the participants had inadequate level of health literacy and about another quarter had problematic level of health literacy. These results are reflected across the health domains—health care, disease prevention, and health promotion. Health literacy was predictor of self-rated health. The odds of better self-rated health are 0.360 times lower for people with inadequate health literacy levels compared to those with sufficient health literacy.
Conclusion Health literacy profoundly shapes health outcomes. The high proportion of people expressing difficulty concerning accessing, comprehending, appraising, and using health information in the health care, disease prevention, and health promotion domains in state of Delaware would require a concerted effort.

Keywords Health literacy · Health outcomes · Delaware · Self-reported health · Faith-based organizations

1 Introduction

1.1 Background

This study assesses health literacy levels and its impact on self-reported health in the state of Delaware. Health literacy—"the personal characteristics and social resources needed for individuals and communities to access,

✉ Raymond A. Tutu, rtutu@deusu.edu; Edmund Essah Ameyaw, edmundessah.ameyaw@howard.edu; John Kwagyan, jkwagyan@howard.edu; Doris Ottie-Boakye, doboakye@gmail.com | [1]Global Societies Program, Delaware State University, Dover, DE 19901, USA. [2]Pharmaceutical Sciences in the College of Pharmacy, Center for Applied Data Science, Howard University, Washington, DC 20059, USA. [3]Graduate School, MPH Program, Howard University, Washington, DC 20060, USA. [4]College of Health Sciences, University of Ghana, Legon, Accra, Ghana.

understand, appraise and use information and services to make decisions about health" [1] – is a critical social determinant of health. Individuals require skills and competencies in accessing, comprehending, analyzing, and applying health information in diverse health domains like health promotion, healthcare settings, and preventive health [2]. Health literacy is a function of personal characteristics such as the language spoken, one's capacity to communicate clearly, and one's ability to listen attentively. Other characteristics include one's age, socioeconomic status, past lived experiences, cultural upbringing, and mental health. Each of these personal factors influences how we gain, appreciate, and respond to health information. While individual skills are essential aspects of health literacy, systemic characteristics are equally important [3]. In the United States, health professionals, health educators, health systems, the media, as well as private sector organizations are the primary institutional sources of health information and, therefore, are supposed to ensure that health information is comprehensible and actionable [4].

Health literacy is a predictor of health outcomes [4]. High health literacy levels have significant association with positive health outcomes and the disparities in health literacy mirror the disparities in health outcomes [5]. Poor health literacy has been found to be associated with patients' medication errors, lack of understanding about prescribed medication, poor understanding of nutrition labels, and increase in preventable hospital visits [6–9]. Additionally, studies have found that inadequate health literacy was associated with poor chronic disease management, poor self-rated health, and mortality [10, 11].

Unfortunately, over the past three decades, health literacy levels have remained low across the United States [12, 13]. Data from the National Adult Literacy survey showed that over 50% of adults in the United States had low functional health literacy [14]. In an assessment of literacy domains such as listening, speaking, writing, reading, and numeracy, it was found that about 21% of American adults scored in the lowest of the 5 skill levels, which has dire implications for health literacy. More so, the low health literacy levels are associated with social disparities in the country [5, 13]. In examining the social, demographic, and economic determinants of health literacy, several studies have found that educational attainment, age, race, income, marital status, social capital, and employment status are associated with health literacy levels [15–18, 39–43]. In the United States, there is higher prevalence of low health literacy among racial minorities, people with low socio-economic status, men, as well as the elderly [15, 16, 19, 20]. Racial minorities have consistently had lower health literacy compared to Whites. Studies have found that the higher one's educational attainment, the higher the individual's health literacy. The finding of a positive association between education and health literacy has been explained as the result of the social resources and status acquired through the gaining of knowledge, competencies, and habits with implications for health [2, 21]. However, other studies have found that educational attainment does not fully embody access to resources; and skills acquired may be limited if not socially valuable [22]. Income is also positively related with health literacy. The inverse relationship between age and health literacy is attributable to the general decline in the mental and physical capabilities of the elderly [16, 23]. Within the last decade, Rikard and colleagues examined the relative effects of social resources on health literacy levels. Social resources are "normative social means that provide economic protection and benefits. Measures of social resources may include language spoken, marital status, and methods of seeking out health information" ([5], p.2). They found that speaking English and being married or living together as a couple are associated with higher health literacy levels. Social interactions are promoted by marriage and that enhances economic support towards affordability of healthcare services [24].

1.2 Delaware's disease profile and historical health literacy levels

The health profile of Delaware underscores the need to prioritize health literacy. According to the Delaware Department of Health and Social Services, chronic diseases (e.g., heart conditions and stroke, cancer, diabetes) are responsible for three of the top five causes of death in the state [25]; and cardiovascular diseases as well as cancers accounted for almost 40% of all deaths in the state [25]. The Centers for Disease Control and Prevention [26] reported that, in 2022, 14% of adults in Delaware reported that they have been diagnosed with diabetes compared with 11.6% of the total U.S. population being diagnosed with diabetes. In the same year, another 14% of Delawareans reported that they have been diagnosed with pre-diabetes compared with 10.8% of adults in the U.S. population. In the preceding year, CDC [27] reported that 38% of Delaware's adult population stated having high cholesterol and 36% indicated having high blood pressure. More so, Delaware's health profile continues to show social disparities. For example, infant mortality rate among Blacks remains three times higher than that of Whites [28]. This health profile is gloomy and, to add insults to injury, a historical data show that health literacy in Delaware is quite limited [29].The historical

data used are from the 2003 National Assessment of Adult Literacy (NAAL)—which focused on assessing the ability to read, understand, and apply information, the 2010 US Census and the 2011 American Community Surveys. Through a predictive model, health literacy estimates were provided for census tracts across the United States by the University of North Carolina at Chapel Hill [29]. The estimates, range from 0 to 500 with a higher score representing higher health literacy.

The results showed that 11% of the adult population in Delaware lacked basic prose literacy skills compared to California which had the highest percentage of residents lacking prose literacy skills (23%) [38]. Further, 33% of Delawareans reported that they find health information challenging to understand, 60% reported that they find it more difficult to understand test results. Additionally, functional health literacy is limited in Delaware with 61% reporting needing assistance in reading healthcare materials [29]. In a cross-sectional study that examined the influence of health literacy on medication adherence among Black Medicaid beneficiaries with hypertension in Delaware, it was found that research respondents living in an area with basic health literacy level reported poorer medication adherence compared with those living in an area with an intermediate health literacy level; that is, limited health literacy was associated with low medication adherence [30].

Cognizant of that fact chronic conditions are high risk factors for cardiovascular diseases with dire consequences for the populations' quality of life, the Lt. Governor established a program with the goal "…to recognize organizations or individuals who are going above and beyond to advance health and well-being in one of four areas of focus: emotional well-being, healthy living, chronic disease management and prevention, and maternal and child health" ([28] p.3). The challenge seeks policy implementation, systems, and environmental change strategies that go beyond periodic health education programming that are usually short-term [28].

Given the importance of health literacy, apart from the studies referenced above, to our knowledge, there is paucity of research that examined four key competencies of health literacy—accessing, understanding, appraising, and applying health information in the state across the three health domains—healthcare, disease prevention, and health promotion. Therefore, in partnership with religious institutions in Delaware, as a first step in an expected long-term relationship to improving health literacy among congregants, this study assessed health literacy levels of Delawareans in faith-based institutions. Two specific objectives of the study are (1) to examine the health literacy levels of individuals about the extent to which they acquire, understand, appraise, and apply health information, and (2) to assess the relationship between health literacy and self-reported health.

2 Methods

2.1 Context

The research team formed a partnership with the umbrella organizations of faith-based groups in Delaware. Specifically, the partnership included, but not limited to, the Interdenominational Ministers Action Council (IMAC), the Interdenominational Ministerial Alliance (IMA), the United Methodist Congregations, and other independent (e.g., Presbyterian Church, The Apostolic Church) and non-denominational churches (including predominantly migrant-serving churches) across the three counties in Delaware. These churches serve predominantly people of color. One of the most significant social networks that migrants participate in are religious groups and organizations [31]. Stroope [32] found that religious institutions provide greater access to social services, resources, and information; and they also serve as a haven for social cohesion, interconnectedness, identity and belonging, and access to various forms of social capital [33, 34]. This underscores the assertion that religious organizations play a vital role in the lives of people and hence a partnership with churches to assess current health literacy levels and to inform future steps to engage health literacy enhancement.

2.2 Study design: sampling and sample size

The sampling frame consist of 60 purposively chosen faith-based organizations with which the research team is familiar with leadership and members. These organizations are across all the three counties in the State.

Accounting for the clustering design based on the primary outcome variable, the a priori sample size was estimated based on Mixed Methods Test [35], calculated two-sided, at a 5 percent level of significance ($\alpha = 0.05$) to achieve at least

90% power to detect significance effect of substantial magnitude. We estimated that a sample size of 720 subjects, from 60 clusters with an average of 12 subjects per cluster would achieve sufficient power to detect a difference between the group mean of at least 5.00 in a primary endpoint, collective efficacy. We note that the present manuscript does not evaluate collective efficacy, without any ambiguity. The difference in group mean is assumed here as a general comparison of any two levels of a potential covariate. Sample size calculation assumed a standard deviation of the difference in mean of 2.50, and an intra-cluster correlation coefficient is 0.050. Sample size was estimated using the software, Power and Sample Size, PASS version 19.

Organizational membership varies substantially from as little as 30 to as large as over 1000 based total estimated membership data obtained from the organizations' leaders. Therefore, we adopted sampling fraction of 2.5–5.0% depending on the membership size to sample from each organization to mitigate oversampling or under sampling from any. A total of 1095 respondents from the 60 religious organizations in Delaware were enrolled and studied.

2.3 Participant recruitment

Respondents were recruited from the participating churches. The leadership of the churches announced the study to the congregation at church service. As part of the announcement, congregants were informed about the eligibility criteria (i.e., being a resident of Delaware, a member of the church, and above 18 years of age) along with the importance of the study. The leaders read the information on the informed consent or paraphrased it. Congregants who were interested and met the eligibility criteria enrolled to complete the survey after each service for the duration of the study. Informed consent was obtained from all individual participants included in the study. As an incentive, participants stood the chance of winning a $25 gift card. The survey was shared with participants using QR code, a weblink, paper-based, a tablet/iPad as appropriate.

2.4 Instrument

A survey questionnaire was used for the study. The instrument was divided into three parts. The first section of the survey consisted of the validated short version of the European Health Literacy Questionnaire (HLS-EU-Q16), which was developed to measure health literacy in general populations [35, 36]. It consists of 16-item questionnaire, which measure four health literacy competencies namely access to health information, comprehension of health information, appraisal of health information, and application of health information to one's life. These competencies are assessed on three health domains—healthcare, disease prevention, and health promotion. The competencies are measured on a 4-point Likert scale (1 = very difficult, 2 = difficult, 3 = easy, and 4 = very easy).

The second part of the survey questionnaire elicited information on the demographic characteristics of the respondents, as well as their self-rated health. These included age, sex, educational attainment, marital status, and ethnicity. The self-reported health variable was measured on an ordinal scale from poor (1) to excellent (5). The third part of the questionnaire collected information about their congregational affiliation. Specifically, questions pertained to membership to ensure that we capture and distinguish between membership and visitors. Research participants consented to the study and the questionnaire was subsequently administered by research assistants.

2.5 Analyses

The study used descriptive statistics to show percentage distribution of the socio-demographic variables, and the statement items measuring health literacy competencies by health domain. Reliability analysis (Cronbach alpha) was used to assess the internal consistency of the 16 statement items measuring health literacy levels. To be able to achieve the three levels of health literacy (inadequate health literacy (scores 0–8); problematic health literacy (scores 9–12); and sufficient health literacy (scores 13–16) recommended by the authors of the HLS-EU Questionnaire, the responses were dichotomized. "Very difficult" and "difficult" responses were recoded and given a value of zero (0) whereas "easy" and "very easy" responses were given a value of one (1). A summation of the scores were subsequently undertaken.

Chi-Square tests of independence were used to compare and examine the bivariate association between demographic variables, and respondents' health literacy levels, and self-reported health. Subsequently, ordinal logit regression models were fitted to assess the predictors of self-reported health and the relative effects of health literacy on self-rated health.

Predictor variables that showed statistical significance with the outcome variable (self-rated health) at the bivariate stage were included in the model. Statistical Package for Social Science (SPSS) version 29 was used to conduct the analyses with statistical significance levels examined at the conventional level (alpha = 0.05).

2.6 Ethical approval and informed consent

The study was approved by the Delaware State University Institutional Review Board. Also, the Ethics Review Committee of the Ghana Health Service approved this study. Additionally, the survey questionnaire used in the study was approved by both Delaware State University Institutional Review Board and the Ethics Review Committee of the Ghana Health Service in accordance with the guidelines and regulations of Delaware State University Institutional Review Board and the Ethics Review Committee of the Ghana Health Service. Informed consent was obtained from all individual participants included in the study.

3 Results

3.1 Descriptive statistics: survey respondents' characteristics

About a fifth of the respondents were aged between 18 and 34 years and almost half of all respondents were aged between 35 and 64 years (Table 1). Thirty percent of respondents reported to be aged 65 years and over. About two-thirds of the respondents were female. More than half were currently married or in consensual union (co-habiting) while about 24% reported to be single. Over 80% identified as Black/African American and about 11% identified as White. About 43% had attained college degree and 23% reported to have had a master's or higher degree. A little over half of the respondents (i.e., 52%) had inadequate or problematic health literacy skills. Regarding self-rated health, 15% reported their health as poor/fair while 11% indicated their health as excellent.

3.2 Reliability analysis and descriptive statistics—percentage distribution of health literacy

Reliability analysis was conducted for the 16 statement items measuring health literacy. The Cronbach's alpha value generated was 0.938. This value indicates a very high accuracy and reliability of the instrument in measuring health literacy.

In the health care domain, up to about 45% reported to finding it "very difficult" or "difficult" to dealing with one of the seven statement items (Table 2). About 29% reported having difficulty in finding information on treatments of illnesses that concern them and where to get professional help when ill, 22% reported difficulties in understanding what their doctor says, 16% reported difficulties with understanding doctor's and pharmacist's instructions on how to take a prescribed medication, 45% reported difficulties in judging when there is a need to get a second opinion from another doctor.

In the disease prevention domain, 44% reported difficulties in finding information on how to manage mental health problems like stress and depression. About 21% reported having difficulties with understanding health warnings about behavior such as smoking, low physical activity and drinking too much while 18% reported having difficulties with understanding why they need health screening. Those who reported having difficulties with judging if the information on health risks in the media is reliable was 53%.

About 42% of respondents indicated a level of difficulty in the items measuring health literacy in the health promotion domain. Respondents who reported difficulties with finding out about information on activities that are good for their mental well-being was 34% while another 34% reported difficulties with understanding advice on health from family members or friends. Regarding understanding information in the media on how to get healthier, 42% reported difficulties while 36% reported difficulties in judging which everyday behavior is related to their health.

3.3 Bivariate analyses: background characteristics, health literacy, and self-rated health

Association between the background characteristics of respondents and health literacy was examined. Age and ethnicity were significantly associated with health literacy (Table 3). The 18–24 age group had the highest percentage of respondents being sufficiently health literate (59%) while the 45–54 age group had the lowest percentage of

Table 1 Demographic and health characteristics of study respondents

Variables	Categories	N	%
Age (years)	18–24	90	8.7
	25–34	128	12.4
	35–44	141	13.6
	45–54	161	15.5
	55–64	205	19.8
	65 +	311	30.0
	Total	1036	100.0
Sex	Female	675	66.5
	Male	340	33.5
	Total	1015	100.0
Marital status	Single	251	24.4
	Married/Living together	582	56.6
	Divorced/Separated	108	10.5
	Widowed	88	8.6
	Total	1029	100.0
Ethnicity	Black/African American	766	81.3
	White	99	10.5
	Hispanic	62	6.6
	Other	15	1.6
	Total	942	100.0
Education	Up to high school	316	34.0
	College (Undergraduate)	397	42.7
	Masters and Higher	216	23.3
	Total	929	100.0
Health literacy	Inadequate	262	26.7
	Problematic	248	25.3
	Sufficient	471	48.0
	Total	981	100
Self-reported health	Poor/Fair	149	14.6
	Good	439	43.0
	Very good	322	31.5
	Excellent	112	11.0
	Total	1022	100

respondents being sufficiently health literate (40%). Fifty percent of the female respondents were in the sufficient health literacy category compared with 46% of males in the same category. Forty percent of respondents identifying as Hispanic had the highest percentage of respondents being inadequately health literate compared to 22% and 20% of Blacks/African American and Whites respectively.

Regarding educational attainment, those with a master's or higher education had the highest percentage of respondents being sufficiently health literate (57%). The chi-square analyses that examined the association between the background characteristics, health literacy, and self-reported health showed that the variables that were significantly associated with self-reported health status were respondent's age, marital status, educational attainment, and health literacy (Table 3).

3.4 Ordinal logistic regression for predicting self-rated health

Ordinal logistic regression models were fitted to examine the impact of health literacy on self-rated health in (i) unadjusted model and (ii) adjusted model that controls for background factors including age, marital status, and education (Table 4). The background factors controlled for in the adjusted model were those that were significantly associated

Table 2 Percentage distribution of health literacy items

Health literacy items	N	Very difficult	Difficult	Easy	Very easy
Health care					
How easy would you say it is to find information on treatments of illnesses that concern you?	1086	4.1	24.8	50.0	21.1
How easy would you say it is to find out where to get professional help when you are ill?	1085	3.9	25.1	49.9	21.2
How easy would you say it is to understand what your doctor says to you?	1084	3.4	18.8	55.6	22.1
How easy would you say it is to understand your doctor's or pharmacist's instruction on how to take a prescribed medicine?	1086	3.3	12.3	56.1	28.3
How easy would you say it is to judge when you may need to get a second opinion from another doctor?	1079	5.7	39.6	42.8	11.9
How easy would you say it is to use information the doctor gives you to make decisions about your illness?	1082	3.8	25.3	55	15.9
How easy would you say it is to follow instructions from your doctor or pharmacist?	1070	2.3	13.6	60.1	23.9
Disease prevention					
How easy would you say it is to find information on how to manage mental health problems (problems of the mind) like stress or depression?	1057	8	35.8	43.8	12.4
How easy would you say it is to understand health warnings about behavior such as smoking, low physical activity and drinking too much?	1057	4.5	16.6	49.3	29.6
How easy would you say it is to understand why you need health screenings?	1061	3.1	15.3	52.9	28.7
How easy would you say it is to judge if the information on health risks in the media is reliable?	1064	8.9	44	38.9	8.2
How easy would you say it is to decide how you can protect yourself from illness based on information in the media?	1061	8.6	39	42.2	10.2
Health promotion					
How easy would you say it is to find out about activities that are good for your mental well-being?	1056	5.3	28.9	50.8	15
How easy would you say it is to understand advice on health from family members or friends?	1066	3.8	29.7	51.9	14.6
How easy would you say it is to understand information in the media on how to get healthier?	1063	5.7	36	45.8	12.4
How easy would you say it is to judge which everyday behavior is related to your health?	1055	4.7	31.1	52.4	11.8

Table 3 Distribution of health literacy levels and self-rated health on the background characteristics

	Inadequate		Health literacy				P-value			Self-reported health						P-value
			Problem-atic		Sufficient			Poor/Fair		Good		Very good		Excellent		
Variables	%	N	%	N	%	N		%	N	%	N	%	N	%	N	
Age																
18–24	14.5	12	26.5	22	59.0	49	0.02	12.5	11	35.2	31	35.2	31	17.0	15	0.024
25–34	31.3	35	21.4	24	47.3	53		16.5	20	42.1	51	28.1	34	13.2	16	
35–44	31.7	40	24.6	31	43.7	55		10.7	14	36.6	48	36.6	48	16.0	21	
45–54	34.7	51	25.2	37	40.1	59		13.9	22	46.2	73	31.6	50	8.2	13	
55–64	28.3	54	25.7	49	46.1	88		16.9	34	44.3	89	29.9	60	9.0	18	
65 +	20.8	60	26.0	75	53.1	153		14.2	43	45.9	139	31.4	95	8.6	26	
Sex																
Female	25.0	153	25.0	153	50.0	306	0.513	15.2	99	42.8	279	31.7	207	10.3	67	0.546
Male	27.4	87	26.5	84	46.1	146		12.8	42	43.2	142	31.3	103	12.8	42	
Marital status																
Single	21.6	48	25.7	57	52.7	117	0.591	14.2	34	36.3	87	34.6	83	15.0	36	0.005
Married/living together	28.4	153	24.7	133	46.9	253		14.6	83	43.1	245	31.0	176	11.3	64	
Divorced/Separated	24.8	25	27.7	28	47.5	48		13.5	14	47.1	49	33.7	35	5.8	6	
Widowed	29.5	23	24.4	19	46.2	36		16.9	14	50.6	42	27.7	23	4.8	4	
Ethnicity																
Black/African American	22.4	163	25.3	184	52.3	380	0.003	14.5	109	42.7	320	32.5	244	10.3	77	0.55
White	20.0	19	37.9	36	42.1	40		10.4	10	44.8	43	31.3	30	13.5	13	
Hispanic	40.4	23	15.8	9	43.9	25		16.1	10	46.8	29	21.0	13	16.1	10	
Other	8.3	1	41.7	5	50.0	6		14.3	2	35.7	5	28.6	4	21.4	3	
Education																
Up to high school	23.8	71	27.2	81	49.0	144	0.31	19.2	59	44.3	136	28.3	87	8.1	25	0.012
College	25.1	95	25.9	98	49.1	186		12.4	48	44.8	173	30.8	119	11.9	46	
Masters and higher	18.4	38	24.8	51	56.8	117		10.8	23	38.7	82	35.8	76	14.6	31	
Health literacy																
Inadequate								23.7	59	46.2	115	22.5	56	7.6	19	< 0.001
Problematic								15.6	37	46.4	110	29.5	70	8.4	20	
Sufficient								8.6	39	39.0	177	37.9	172	14.5	66	

with self-rated health at the bivariate stage of analyses. Model diagnostics show that both models indicated that the assumptions undergirding ordinal logistic regression were met. The model fitting information (MFI) and goodness-of-fit (GoF) statistics for both models demonstrate that the models adequately described the data (Model 1: MFI—chi square 47.907, p-value < 0.001 and GoF—Pearson chi square 2.275, p-value 0.685; Model 2: MFI—chi square 69.066, p-value < 0.001 and GoF—Pearson chi square 426.374, p-value 0.193). Additional model diagnostics using test of parallel lines indicated that the odds of falling into a higher self-rated health level are the same across categories and the odds predictors falling into the categories of self-reported health are the same across the response categories (Model 1: p-values—0.695; Model 2: p-values—0.915).

The logit models show that the predictors of self-rated health are health literacy and educational attainment. In both models, health literacy had negative ordered log-odds estimates. The coefficients for all the categories of health literacy were negative: (Model 1 inadequate health literacy (– 0.995) and problematic health literacy (– 0.594); Model 2: inadequate health literacy (– 1.023) and problematic health literacy (– 0.583). That is, respondents with inadequate and problematic health literacy have an increased probability of having lower self-reported health compared to those with sufficient health literacy (Table 4). Educational attainment had the following categories: up to high school, college (undergraduate), and master's and higher (reference category). The ordered log-odds regression coefficients for educational attainment are as follows: up to high school (– 0.598, with p-value: 0.001), and college (0.268, with p-value: 0.103). That is, respondents with up to high school and college (undergraduate) education have an increased

Table 4 Ordinal Logistic Regression model of the impact of Health Literacy on Self-Reported Health

		Model 1		P-Values	Model 2		P-Values
		Estimates	Std Errors		Estimates	Std Errors	
Variables	Categories						
Health literacy	Inadequate	− 0.995	0.150	< 0.001	− 1.023	0.165	< 0.001
	Problematic	− 0.594	0.149	< 0.001	− 0.583	0.154	< 0.001
	Sufficient (Ref.)						
Age	18–24				0.271	0.294	0.355
	25–34				− 0.061	0.246	0.805
	35–44				0.415	0.224	0.065
	45–54				− 0.104	0.201	0.605
	55–64				− 0.14	0.183	0.445
	65 + (Ref.)						
Marital status	Single				0.132	0.299	0.659
	Married/Living together				0.039	0.249	0.874
	Divorced/Separated				0.004	0.300	0.989
	Widowed (Ref.)						
Education	Up to high school				− 0.598	0.173	< 0.001
	College (Undergraduate)				− 0.268	0.165	0.103
	Masters and Higher (Ref.)						

likelihood of having a lower rating on self-reported health compared to respondents with master's or higher education, although there is not significant difference between those with college degree and master and higher category.

4 Discussion and conclusion

The main objectives of this study have been to examine the health literacy levels of individuals about the extent to which they acquire, understand, appraise, and apply health information to their everyday life, as well as to assess the relative effects of health literacy on self-reported health. The study drew on a standardized and validated short version of the European Health Literacy Questionnaire (HLS-EU-Q16), which administered among predominantly minority-serving religious organizations in the state of Delaware. The analysis showed that about a quarter of the respondents had inadequate level of health literacy and about another quarter had problematic level of health literacy. These results are reflected across the health domains—health care, disease prevention, and health promotion. This finding aggravates the unencouraging health profile of the state of Delaware [25].

In the health care domain, up to 45% reported having difficult in one of the seven items. While the level of difficulties among the study participants are quite high, similar studies in Europe (e.g., Switzerland and Romania) have revealed high "difficulty" responses in accessing health information. In a study in Switzerland among adult aged 58 years and above, about 35% of participants reported having difficulty to deal with one of the items measuring health literacy in the health care domain [39], and in Romania, among sampled population in the North-West region, 21.6% of the respondents found it very difficult to protect themselves from illness based on the health information received from the media [40]. In the disease prevention domain in this study, about a fifth reported having difficulties comprehending health warning about lifestyle issues such as smoking, poor exercising habits, and drinking compared to only 2.7% reporting similar difficulties in the Switzerland study [39]. In the health promotion domain, 4 out of 10 reported having some form of difficulty. Similarly, van der Heide [42] found that among Dutch adults, that in the health promotion domain, accessing health information is deemed as more difficult. About 3 out of 10 in this study reported difficulties regarding finding out information on activities that are good for their mental well-being and understanding advice on health from family members or friends. The mental health finding of this study seems to mirror the low global mental health literacy. In a similar study, Meier et al. [39] reported that almost 25% of respondents indicated difficulty in accessing information on how to manage mental health problems such as stress or depression. Comparable low mental health literacy has been reported in studies in Romania [40] and Catalonia [41]. Garcia-Cordina et al. [41] found that almost 17% of the study participants in Catalonia

indicated some level of difficulty in finding information on how to manage mental health problems. Almost a fourth of respondents reported difficulties in judging which everyday behavior is related to their health. Such high proportion of people expressing difficulties exemplifies the inadequate and problematic health literacy levels and suggests that the limited health literacy levels in the state of Delaware is far from being abated [29].

Health literacy was found to be statistically significantly associated with age. This study found age to seemingly have a partial inverse relationship with health literacy. The 18–24 aged group had the highest health literacy and the health literacy scores decreased with age until age 55. Health literacy scores increased for the age group 55–64 and 65 year and over although their scores were lower than that of the 18–24 years group. The youngest age group scoring higher than the oldest age group can be explained using the factual general decline in the mental and physical proficiencies of the elderly [16, 23]. For example, research suggests that age is related to hearing and cognitive deficiencies. Consequently, it is more difficult for older people to comprehend or judge more intricate parts associated with health [40], especially since some health tasks require information processing, which older people may find more difficult to complete [42].

This study found health literacy as a significant predictor of self-rated health, which exemplifies the conventional wisdom that health literacy is a predictor of health outcomes [4]. It was found that respondents with inadequate and problematic health literacy levels have an increased chance of reporting their health lower than those with sufficient health literacy. The odds of better self-rated health are 0.360 times lower for people with inadequate health literacy levels compared to those with sufficient health literacy. Also, the odds of those with problematic health literacy levels having a higher self-reported health status is lower in comparison to those with sufficient health literacy levels by 0.558. Therefore, better health literacy is associated with better self-reported health. This study's findings are similar to the findings of other studies that show that better health literacy levels are positively associated with better health outcomes and variations in health literacy reflect disparities in health outcomes [5, 11]; this suggests that the poor self-rated health may be due to the influence of poor health literacy's impact on lack of comprehension on prescribed medication, medication errors, inadequate understanding of better lifestyle choices, poor chronic disease management, and as well as difficulties in judging which everyday behavior is related to health [6–10, 43].

Clearly, health literacy heavily influences health outcomes. The high proportion of people expressing varying forms of difficulty regarding accessing, understanding, critically analyzing, and using health information in the health care, disease prevention, and health promotion domains in state of Delaware would require a concerted effort; and this academy-religious organizations partnership is the beginning. The need to systematically increase health literacy will result in better individual disease prevention strategies, competencies required to navigate the health care system, and proficiencies to decipher health promotion messages.

5 Strengths and limitations

The enthusiasm from the research partners (church leaders), which reflected in the high response and participation by congregants and, therefore, the overall success of the project are major strengths of the paper. However, this study has a number of limitations. First of all, the study design does not enable the determination of causal effects between the main predictor variable (health literacy) and the outcome variable (self-rated health). Secondly, although the short version of European Health Literacy Questionnaire (HLS-EU-Q16), which was used in this study, is validated and easy to use, it is a subjective measure. Therefore, given that respondents were subjectively rating their competencies, reporting bias could have occurred with people over-rating or under-rating their skills and difficulties.

Thirdly, another limitation of the study is related to the sampling bias. The sample was restricted to respondents who identified as members of the participating churches. This means that people who may be regular attendees but may not identify as members would have been left out, thereby reducing the study's ability to fully estimate the extent of health literacy levels in the churches. While the study may assert that the results are generalizable to the population of the participating churches, it is limited in its ability to generalize the findings to the entire state of Delaware.

Finally, the ordinal scale has one limitation. The difference between ratings may seem to be equal but they are not in reality [37]. As with all ordinal measures, the real distances between the categories of the outcome variable (self-rated health—poor (1) to excellent (5)) is unknown though it is true that one can distinguish the least rank from the highest.

Author contribution R.T. conceptualized the paper. All the four authors (R.T., E.A., J.K., and D.O.B.) reviewed literature, developed and finalized the instrument for data collection. RT was involved in data collection, and all the four authors (R.T., E.A., J.K., and D.O.B.) were involved in writing of the paper. All authors revised and approved the final version.

Funding National Science Foundation, 2100825.

Data availability The data that supports the findings of this study are available from the corresponding author upon reasonable request. The data is archived and will be provided when requested.

Declarations

Competing interests The authors declare no competing interests.

References

1. World Health Organization. Health literacy toolkit for low-and middle-income countries: a series of information sheets to empower communities and strengthen health systems. Geneva: World Health Organization; 2015.
2. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, Brand H. Health literacy and public health: a systematic review and integration of definitions and models. BMC Pub Health. 2012;12(1):80.
3. Nielsen-Bohlman L, Panzer AM, Kindig DA, editors. Health literacy: a prescription to end confusion. Washington, DC: National Academies Press; 2004.
4. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2010). National Action Plan to Improve Health Literacy. Washington, DC: Author.
5. Rikard RV, Thompson MS, McKinney J, Beauchamp A. Examining health literacy disparities in the United States: a third look at the National Assessment of Adult Literacy (NAAL). BMC Pub Health. 2016;16:1–11.
6. Davis TC, Wolf MS, Bass PF III, Middlebrooks M, Kennen E, Baker DW, et al. Low literacy impairs comprehension of prescription drug warning labels. J Gen Intern Med. 2006;21(8):847–51.
7. Davis TC, Wolf MS, Bass PF III, Thompson JA, Tilson HH, Neuberger M, et al. Literacy and misunderstanding prescription drug labels. Ann Intern Med. 2006;145(12):887–94.
8. Rothman RL, Housam R, Weiss H, Davis D, Gregory R, Gebretsadik T, et al. Patient understanding of food labels: the role of literacy and numeracy. Am J Prev Med. 2006;31(5):391–8.
9. Wolf MS, Davis TS, Tilson HH, Bass PF, Parker RM. Misunderstanding of prescription drug warning labels among patients with low literacy. Am J Health Syst Pharm. 2006;63:1048–55.
10. Berkman ND, DeWalt DA, Pignone MP, Sheridan SL, Lohr KN, Lux L, et al. Literacy and health outcomes (AHRQ Publication No. 04–E007–2). Rockville: Agency for Healthcare Research and Quality; 2004.
11. Gupta S, Tutu RA, Boateng J, Busingye JD, Elavarthi S. Self-reported functional, communicative, and critical health literacy on foodborne diseases in Accra, Ghana. Trop Med Health. 2018;46:1–10.
12. Paasche-Orlow MK, Parker RM, Gazmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. J Gen Intern Med. 2005;20(2):175–84.
13. Fleary SA, Ettienne R. Social disparities in health literacy in the United States. HLRP Health Lit Res Pract. 2019;3(1):e47–52.
14. Kirsch I, Jungeblut A, Jenkins L, Kolstad A. Adult literacy in America: a first look at the findings of the national adult literacy survey. Washington, DC: National Center for Education Statistics, U.S. Department of Education; 1993.
15. Ayotte BJ, Allaire JC, Bosworth H. The associations of patient demographic characteristics and health information recall: the mediating role of health literacy. Aging Neuropsychol Cogn. 2009;16(4):419–32.
16. Sudore RL, Yaffe K, Satter Field S, Harris TB, Mehta KM, Simonsick EM, Newman AB, Rosano C, Rooks R, Rubin SM, et al. Limited literacy and mortality in the elderly the health, aging, and body composition study. J Gen Intern Med. 2006;21(8):806–12.
17. Dupre ME, Goerge LK. Exceptions to the rule: exceptional health among the disadvantaged. Res Aging. 2011;33(2):115–44.
18. Tutu RA, Gupta S, Busingye JD. Examining health literacy on cholera in an endemic community in Accra, Ghana: a cross-sectional study. Trop Med Health. 2019;47:1–10.
19. Baker DW, Gazmararian JA, Williams MV, Scott T, Parker RM, Green D, Ren J, Peel J. Functional health literacy and the risk of hospital admission among medicare managed care enrollees. Am J Public Health. 2002;92(8):1278–83.
20. Gazmararian JA, Baker DW, Williams MV, Parker RM, Scott TL, Green DC, Fehrenbach SN, Ren J, Koplan JP. Health Literacy among medicare enrollees in a managed care organization. JAMA. 1999;281(6):545–51.

21. Mirowsky J, Ross CE. Education, social status, and health. Aldine de Gruyter; 2003.
22. Muntaner C, Borrell C, Vanroelen C, Chung H, Benach J, Kim IH, Ng E. Employment relations, social class and health: a review and analysis of conceptual and measurement alternatives. Soc Sci Med. 2010;71(12):2130–40.
23. Howard DH, Sentell T, Gazmararian JA. Impact of health literacy on socioeconomic and racial differences in health in an elderly population. J Gen Intern Med. 2006;21(8):857–61.
24. Williams K, Umberson D. Marital status, marital transitions, and health: a gendered life course perspective. J Health Soc Behav. 2004;45(1):81–98.
25. Delaware Health Statistics Center. Delaware Vital Statistics Annual Report, 2021. Delaware Department of Health and Social Services, Division of Public Health
26. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data. 2022. https://www.cdc.gov/brfss/brfssprevalence/. Accessed 7 Jul 2024.
27. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data. 2021. https://www.cdc.gov/brfss/brfssprevalence/. Accessed 7 Jul 2024.
28. Arthur H, Butscher L, Moore L, Warren K. Lieutenant governor's challenge: motivating and Honoring Delawareans to improve their health and well-being. Del J Pub Health. 2024;10(1):116.
29. Health Literacy Council of Delaware. Why is Health Literacy Important. 2024. https://healthliteracyde.org/#:~:text=Meet%20the%20Health%20Literacy%20Council%20of%20Delaware&text=Its%20goal%20is%20to%20achieve,and%20understandable%20to%20all%20Delawareans. Accessed 14 Jan 2024.
30. Butzner M, Oyekanmi C, McDuffie MJ, Nescott E, McCullers A, Woldeamanuel E, Cuffee Y. Impact of health literacy on medication adherence among Black Medicaid beneficiaries with hypertension in Delaware: a cross-sectional study. Popul Health Manag. 2023;26(2):93–9.
31. Collyer M. When do social networks fail to explain migration? Accounting for the movement of Algerian asylum-seekers to the UK. J Ethn Migr Stud. 2005;31(4):699–718.
32. Stroope S. Social networks and religion: the role of congregational social embeddedness in religious belief and practice. Sociol Relig. 2012;73(3):273–98.
33. Tseng V, Seidman E. A systems framework for understanding social settings. Am J Community Psychol. 2007;39:217–28.
34. Mammana-Lupo V, Todd NR, Houston JD. The role of sense of community and conflict in predicting congregational belonging. J Community Psychol. 2014;42(1):99–118.
35. Ahn C, Heo M, Zhang S. Sample size calculations for clustered and longitudinal outcomes in clinical research. Boca Raton: CRC Press; 2014.
36. Pelikan J, Röthlin F, Ganahl K, Peer S. Measuring comprehensive health literacy in general populations – the HLS-EU instruments. In Proceedings of the Second International Conference of Health Literacy and Health Promotion Taipei, Taiwan. Ludwig Boltzmann Institute Health Promotion Research, Vienna, Austria. 2014.
37. Coolidge F. Statistics: a gentle introduction. 2nd ed. Thousand Oaks: Sage; 2006.
38. National Center for Education Statistics. 2024. https://nces.ed.gov/naal/estimates/StateEstimates.aspx. Accessed 13 Nov 2024.
39. Meier C, Vilpert S, Borrat-Besson C, Jox RJ, Maurer J. Health literacy among older adults in Switzerland: cross-sectional evidence from a nationally representative population-based observational study. Swiss Med Wkly. 2022;152(1314):w30158–w30158.
40. Coman MA, Forray AI, Van den Broucke S, Chereches RM. Measuring health literacy in Romania: validation of the HLS-EU-Q16 survey questionnaire. Int J Pub Health. 2022;67:1604272.
41. Garcia-Codina O, Juvinyà-Canal D, Amil-Bujan P, Bertran-Noguer C, González-Mestre MA, Masachs-Fatjo E, Saltó-Cerezuela E. Determinants of health literacy in the general population: results of the Catalan health survey. BMC Pub Health. 2019;19:1–12.
42. van der Heide I, Rademakers J, Schipper M, Droomers M, Sørensen K, Uiters E. Health literacy of Dutch adults: a cross sectional survey. BMC Pub Health. 2013;13:1–11.
43. Niedorys B, Chrzan-Rodak A, Ślusarska B. Health Literacy–a review of research using the European Health Literacy Questionnaire (HLS-EU-Q16) in 2010–2018. Pielegniarstwo XXI wieku/Nursing 21st Century. 2020;19(1):29–41.