Title: Assessing Health Literacy Among High School Students in New Jersey

Abstract:
The term 'health literacy' describes an individual's ability to learn and comprehend basic health information and use it to make informed health decisions. Previous research has highlighted the benefits of health literacy, especially as it relates to adolescent health. Given the lack of standardized health literacy assessments for adolescents, this study aimed to create an assessment tool to study trends in health literacy among high school students. The assessment was designed to study 8th-grade-level proficiency to ensure that all respondents would have some familiarity with the concepts. The health literacy questions specifically focused on five core health topics: Pregnancy & Parenting, Emotional & Mental Health, Sexual Health & Decision-Making, Nutrition & Healthy Living, and Substance Abuse. This assessment tool was created through an electronic survey platform and disseminated to high school students in New Jersey. Among the individual-level demographics studied within the sample population, differences in gender identity, English-language proficiency levels, and years of high school health education were found to impact health literacy scores. Additionally, scores differed between the different core health topics addressed in the survey. The results of this research, specifically the assessment tool, can be used to identify factors that influence health literacy in high school students to inform allocation of health education resources to the communities that need them most.

Introduction:
Health literacy describes an individual's ability to learn and comprehend basic health information, and use this knowledge to make informed health decisions. The benefits of health literacy can range from being able to find service care providers, completing necessary medical forms, knowing one's medical rights, and understanding the benefits of a healthy lifestyle and preventative resources. Accessibility of accurate health information is key to improving health outcomes; there is a clear relationship between increased awareness and taking appropriate healthcare action (Seo et al., 2016). Research shows that health literacy is strongly correlated with health status and patient-centered care (Benjamin, 2010). Additionally, trends indicate that poor health outcomes that result from a lack of health literacy are also associated with higher healthcare costs (The Importance of Health Literacy, n.d.) — by taking appropriate measures towards an individual's health, a patient is less likely to incur significant expenses from arising conditions and corresponding treatment.

Research has demonstrated that there are several factors that contribute to health literacy disparities, both on the individual level (race, gender, language barriers, etc) and on the community level (socioeconomic status, educational attainment, etc). Underserved and under-resourced communities may lack the resources and access to proper healthcare. Language gaps between patients and healthcare resources have been shown to create issues with miscommunication and misinformation (Calderón & Beltrán, 2004). Cultural barriers between different races and ethnicities have also been shown to directly affect health literacy levels (Benjamin, 2010). This study aims to assess whether similar factors also affect high school students' levels of health literacy.

Starting from primary school, it is critical that children are introduced to healthy living topics, as health education from a young age leads to better health decision-making abilities in the long run (The Importance of Health Literacy, n.d.). Health literacy is an especially important component of adolescent health as they are starting to take responsibility for their own health decision-making. As New Jersey students progress to high school, enrollment in a health education program is mandatory (New Jersey State Profile, n.d.). However, despite an existing standard curriculum for New Jersey health education, health literacy is not uniformly assessed throughout New Jersey schools. While standardized tests exist for subjects like mathematics and reading/comprehension, there is no standard way to assess health literacy to ensure statewide competency in this essential subject.

The purpose of this study is to use a new health literacy survey tool to assess the current levels of health literacy among high school students (grades 9 to 12) in the state of New Jersey. Our goal is to evaluate trends in health literacy levels of New Jersey high school students and determine whether health literacy varied based on individual demographics. Based on the previously discussed patterns in health outcome disparities, we hypothesized that similar demographic factors would also impact health literacy. Another point of interest was studying the relationship between students' health literacy and school-level variables, like socioeconomic status, academic achievement, etc. We hypothesized that students from New Jersey schools in areas of higher socioeconomic status and higher academic achievement would demonstrate higher health literacy scores compared to their peers enrolled in high schools in under-resourced communities.

Methods:

Our research team searched extensively to find a standard health literacy assessment tool that would be cost-effective and provide meaningful results, but would also be engaging for participants. We found that, despite health science being such an important topic, research suggests that there are no compelling tools to uniformly assess health literacy in adolescents. Therefore, we decided to create our own health literacy assessment tool in the form of an electronic survey.

We first created a health literacy question set to comprise the main portion of the survey. We used the New Jersey Department of Education's Comprehensive Health and Physical Education Standards as the basis of the topics addressed in this assessment. As our target population was high school students, we aligned our questions with the learning standards for the 8th-grade level, under the assumption that every student should have this knowledge before they enter high school. We narrowed down our questions to the following five core health topics, with four questions per topic:

1. Pregnancy & Parenting
2. Emotional & Mental Health
3. Sexual Health & Decision-Making
4. Nutrition & Healthy Living
5. Substance Abuse

For this study, we aimed to study the following individual-level demographics: race/ethnicity, gender identity, English language proficiency, years of high school health education, and grade level. This information was collected through a series of questions in the demographic section of the survey. In order to obtain information about school-level variables, we also requested respondents to enter the name of their high school and the city where it is located. From this information, we planned to collect the following school-level information from publicly-available school performance reports from the New Jersey Department of Education School Directory: private or public/charter, percent economically disadvantaged students, percent English learners, and percent of students that score above college readiness benchmarks.

Qualtrics survey software was used to create the health literacy assessment. On the first screen of the survey, participants were provided with information that included the elements of consent, and indicated their consent/assent by clicking “I agree”. Logic loops were utilized to automatically end the survey if a respondent did not consent to the study. Consenting participants then proceeded to complete the demographic questions before beginning the health literacy questions. In efforts to make the assessment more engaging, we used a variety of question formats (notably scenario-based questions) and digital graphics. All questions in the survey were optional, and all information collected from participants remained anonymous; no identifiers (including IP addresses) were collected.

Upon the creation of the survey, we submitted the research proposal, along with the survey questions, for approval by the Rutgers Institutional Review Board (IRB). This was required due to the involvement of human subjects who were also minors and therefore a protected group. The team leaders also had to undergo Collaborative Institutional Training Initiative (CITI) training for Human Subjects Research Protections prior to conducting the study.

Once all approvals were met, the survey was disseminated by the research team to New Jersey high school students through convenience sampling. Some methods of recruitment included social media, flyers, word of mouth, and outreach through the Governor’s STEM Scholars channels. All recruitment materials were also required to be approved by the IRB prior to dissemination.

Results:

The survey collected a total of 187 responses within the response-collection period of about three weeks. Of these responses, three respondents clicked “I Do Not Agree” and were immediately removed from the data pool. Two people did not click either “I Agree” or “I Do Not Agree,” so their responses had to be removed from the pool as well, as they did not officially consent to the study. Finally, among the 182 remaining respondents, 25 clicked “I Agree” but did not answer any of the remaining questions in the survey. This resulted in a final data pool of 157 responses that were used for further analysis.

Table 1 and Figure 1 depict the demographic breakdown of the 157 respondents. The racial/ethnic category with which most respondents identified was White/Caucasian (47%), followed by Asian or Pacific Islander (29.9%). Almost 11% of respondents identified as belonging to more than one racial/ethnic category. Hispanic or Latino and Black or African American students comprised 6.4% and 4.5% of respondents, respectively. About 2% of respondents identified as Native Hawaiian, Native American or Alaskan Native. For gender identity, the majority (59%) of respondents were female, while 35% were male. The rest of the respondents (about 4%) identified as transgender, pangender/gender fluid, or non-binary/non-conforming. Out of the survey respondents, about 38% were English Language Learners (ELL), while the remaining 62% were not. Over 13% of respondents received five or more years of high school health education, about 10% received four years, and about 22% received three years. Seven percent of respondents received one year of high school health education, and less than 1.3% reported receiving no health education in high school. Finally, the majority (about 67%) of respondents were 11th graders, while 12th graders made up the next largest group of about 19%. Tenth graders made up 9.6% of the sample population, while only 4.5% of respondents were 9th graders.

Table 1. **Demographics of Survey Respondents.**

Variable	***N***	***%***
Race/Ethnicity		
Asian or Pacific Islander	47	29.9
Biracial or Multiracial	17	10.8
Black or African American	7	4.5
Hispanic or Latino	10	6.4
White/Caucasian	72	45.9
Other (includes Native Hawaiian, Native American or Alaskan Native)	3	1.9
No response	1	0.6
Gender Identity		
Female	92	58.6
Male	55	35
Other (includes transgender, pangender/ gender fluid, non-binary/non-conforming	6	3.8
No response	4	2.5
English Language Learner (ELL)		
ELL	60	38.2
Not ELL	97	61.8
High School Health Education		
None	2	1.3
One year	11	7
Two years	34	21.7
Three years	73	46.5
Four years	16	10.2
Five or more years	21	13.4
Grade		
9th	7	4.5
10th	15	9.6
11th	105	66.9
12th	30	19.1

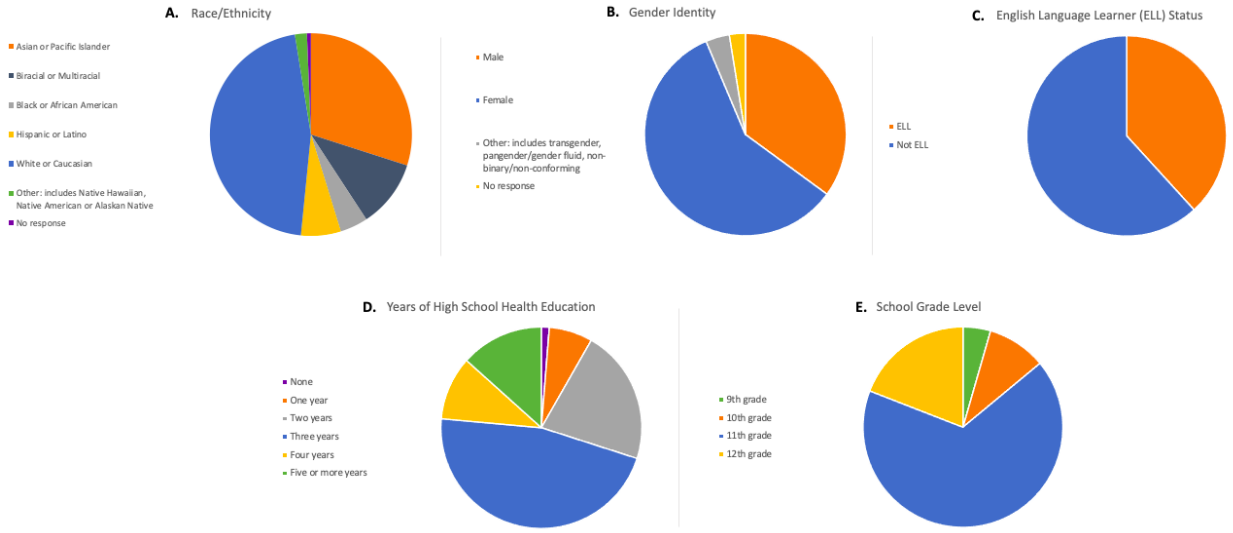


Figure 1. **Demographics of Survey Respondents.** Breakdown of demographic variables based on A) race/ethnicity, B) gender identity, C) English Language Learner (ELL) status, D) years of high school health education, and E) school grade level.

A set of scoring criteria was created to score responses to the health literacy questions. For multiple-choice questions with one possible correct answer, correct answers scored a 1 and incorrect answers scored a 0. For “select all that apply” questions, which had more than one correct response, if respondents selected all of the correct answers, they scored a 1; selection of any wrong answer automatically scored a 0, and selection of only some but not all correct answers resulted in partial credit (i.e., If a respondent selected 1 correct response out of 4 possible correct responses, they earned a .25, or 25%, on that question. However, if a respondent selected 1 wrong answer, even if they selected 3 correct responses, they received a 0 score). The ‘automatic zero’ criterion was based on the reasoning that even if the respondent does not know all the correct healthy choices, they should at least be able to identify unhealthy choices in order to demonstrate any level of proficiency in that topic.

These scores were added and converted to percentages; the resulting score distribution is depicted in Figure 2 below. The overall mean score was about 70% (±18.2%), while the median score was 75%. Three-fourths of respondents scored at least 61.3%, while the top one-fourth of the sample population scored 82.3% or above.

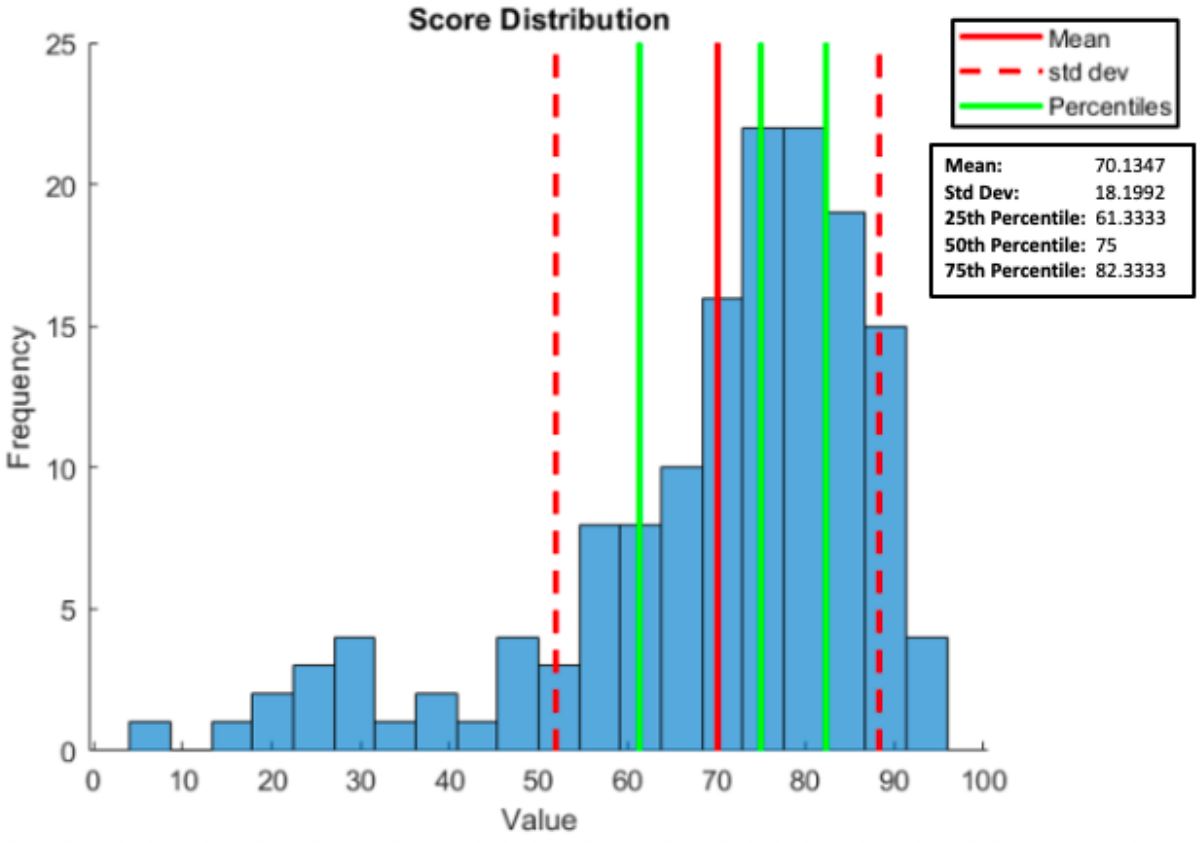
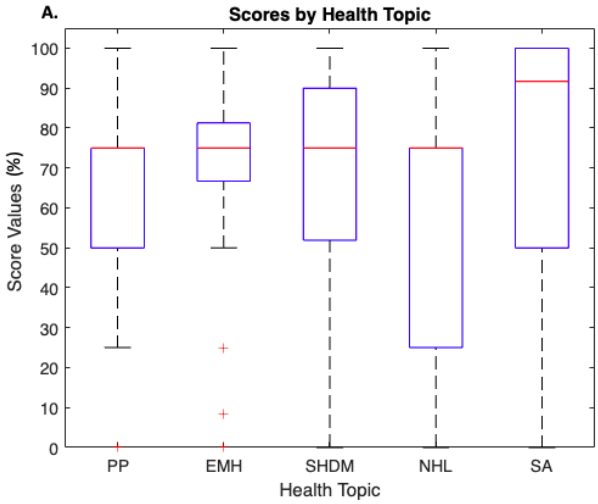


Figure 2. **Distribution of Health Literacy Assessment Scores.**

Analyses were conducted by overall score as well as by the five core health topics. As seen in Figure 2, the score distribution was non-normal, so non-parametric tests were used to determine the statistical significance of differences between groups. Mann Whitney U test was used for categories with two categorical variables (gender and ELL status), and the Kruskal-Wallis test was used for the remaining categories with more than two categorical variables. R and MATLAB programming languages, as well as Microsoft Excel, were used to conduct all statistical analyses.

A.



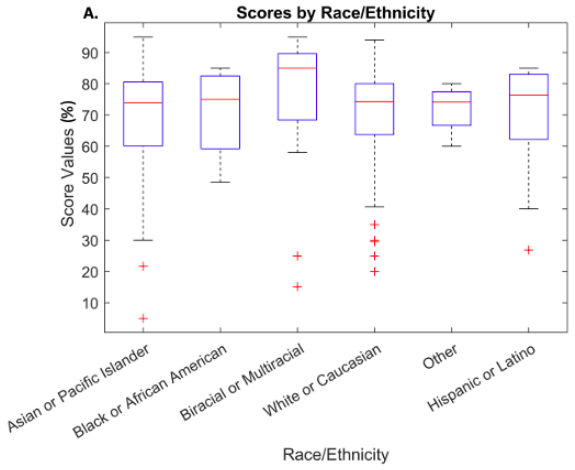
B.

	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
PP	61.62 ± 27.81	[0, 100]	[50, 75, 75]
EMH	69.21 ± 27.73	[0, 100]	[66.67, 75, 81.25]
SHDM	65.81 ± 31.11	[0, 100]	[51.88, 75, 90]
NHL	56.85 ± 31.98	[0, 100]	[25, 75, 75]
SA	72.30 ± 35.91	[0, 100]	[50, 91.67, 100]
Kruskal-Wallis test: p-value < 0.05			

Figure 3. **Health Literacy Assessment Scores by Health Topic.** A) Boxplot of score distribution for each core health topic studied in this assessment (PP = Pregnancy & Parenting, EMH = Emotional & Mental Health, SHDM = Sexual Health & Decision-Making, NHL = Nutrition & Healthy Living, SA = Substance Abuse). B) Corresponding statistical values; Kruskal-Wallis test resulted in p-value < 0.05.

As seen in Figure 3, there was a significant difference in median scores between the five core health topics. Specifically, respondents scored higher on the Substance Abuse (SA) topic (median = 91.67%) than the rest of the topics, all of which respondents scored at a median of 75%.

A.



B.

	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
Asian or Pacific Islander	69.20 ± 18.34	[5, 95]	[60.08, 74, 80.63]
Black or African American	70.88 ± 27.73	[48.5, 85]	[59.25, 75, 82.5]
Biracial or Multiracial	74.73 ± 24.52	[15.17, 95]	[68.38, 85, 89.58]
White or Caucasian	69.77 ± 17.14	[20, 94]	[63.75, 74.33, 80]
Hispanic or Latino	68.61 ± 20.84	[26.83, 85]	[62.25, 76.33, 83]
Other	72.08 ± 8.54	[60, 80]	[66.67, 74.17, 77.5]
Kruskal-Wallis test: p-value = 0.3543			

C.

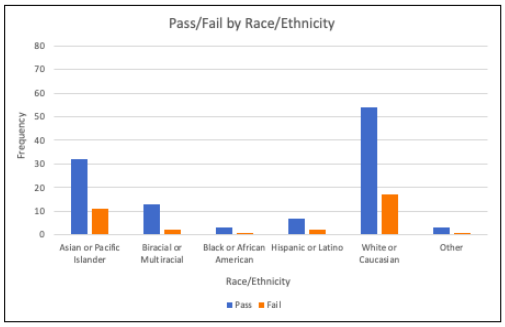


Figure 4. **Health Literacy Assessment Scores by Race/Ethnicity.** A) Boxplot of score distribution for different races/ethnicities of respondents. B) Corresponding statistical values; Kruskal-Wallis test resulted in p-value = 0.3543*. C) Pass/Fail distribution for different races/ethnicities of respondents (<60% = Fail, ≥60% = Pass).**'Other' category was excluded from Kruskal-Wallis test due to the low number of responses.*

There was no significant difference between median scores of the different races/ethnicities. In the box plot (Figure 4a), the median scores appeared to be around the same (around 75% ± 1%), with biracial being somewhat higher than the rest, with these respondents scoring at a median of 85%. However, Figure 4c shows that Asian or Pacific Islander and White or Caucasian groups had a higher Pass/Fail ratio compared to the remaining races/ethnicities (Figure 4c).

A.

B.

	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
Female	71.11 ± 18.22	[5, 95]	[67.33, 75, 84.17]
Male	69.42 ± 16.24	[26.83, 95]	[60, 73.5, 80]
Other	63.31 ± 31.59	[15.17, 90]	[33.25,80, 88.75]
Mann Whitney U test: p-value < 0.05			

C.

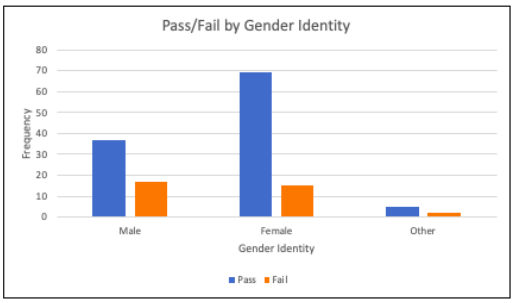
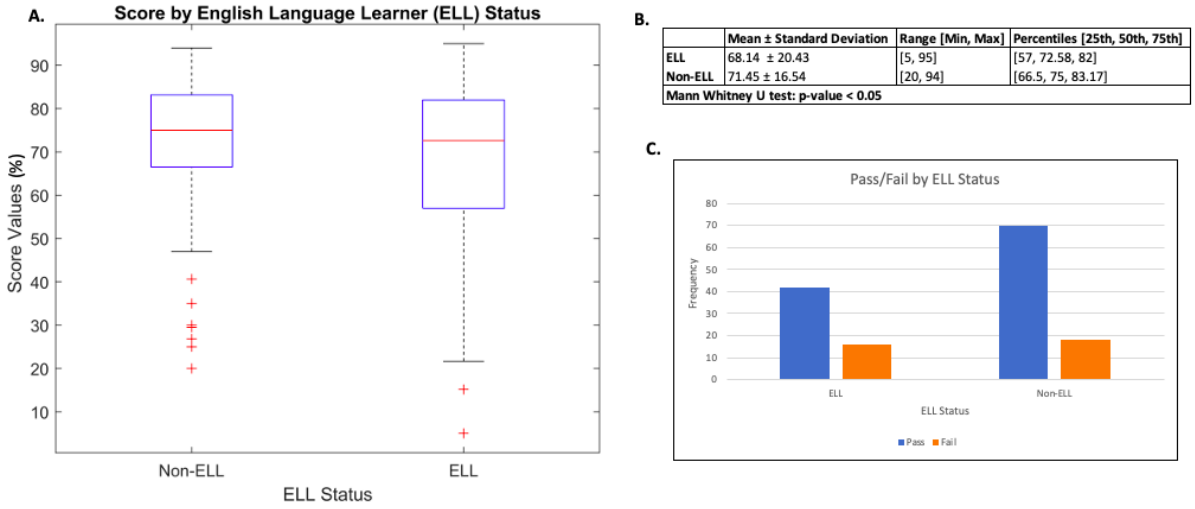


Figure 5. **Health Literacy Assessment Scores by Gender Identity.** A) Boxplot of score distribution for different gender identities of respondents. B) Corresponding statistical values;

Mann Whitney U test resulted in p-value < 0.05*. C) Pass/Fail distribution for different gender identities of respondents (<60% = Fail, ≥60% = Pass).*'Other' category was excluded from Kruskal-Wallis test due to the low number of responses.*

Gender identity (Figure 5) showed significant differences in median scores among the compared groups (male versus female). Females (median = 75%) scored higher than males (median = 73.5%) and also had a significantly greater Pass/Fail ratio (Figure 5c).

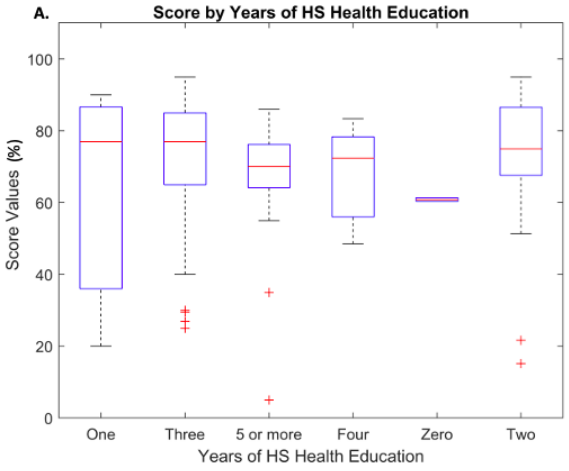


	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
ELL	68.14 ± 20.43	[5, 95]	[57, 72.58, 82]
Non-ELL	71.45 ± 16.54	[20, 94]	[66.5, 75, 83.17]
Mann Whitney U test: p-value < 0.05			

Figure 6. **Health Literacy Assessment Scores by English Language Learner (ELL) Status.** A) Boxplot of score distribution for ELL statuses of respondents. B) Corresponding statistical values; Mann Whitney U test resulted in p-value < 0.05. C) Pass/Fail distribution for ELL statuses of respondents (<60% = Fail, ≥60% = Pass).

ELL status (Figure 6) showed similar trends in results. There were significant differences in median scores among the compared groups (ELL median of 72% versus non-ELL median of 75%). Non-ELL respondents also had a greater Pass/Fail ratio than their ELL peers (Figure 6c).

A.



B.

	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
Zero years	60.83 ± 0.71	[60.33, 61.33]	[60.33, 60.83, 61.33]
One year	63.67 ± 28.81	[20, 90]	[36, 77, 86.67]
Two years	72.69 ± 18.39	[15.17, 95]	[67.58, 75, 86.58]
Three years	71.28 ± 18.12	[25, 95]	[65, 77, 85]
Four years	69.06 ± 11.86	[48.5, 83.33]	[56, 72.42, 78.33]
Five or more years	66.61 ± 18.55	[5, 86]	[64.17, 70, 76.17]
Kruskal-Wallis test: p-value < 0.05			

C.

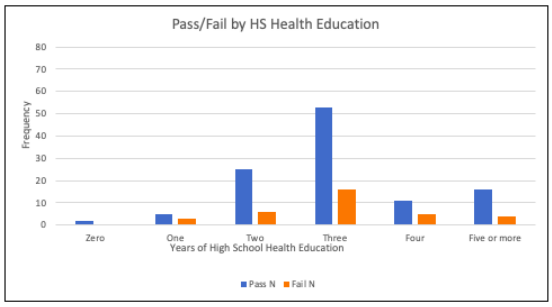
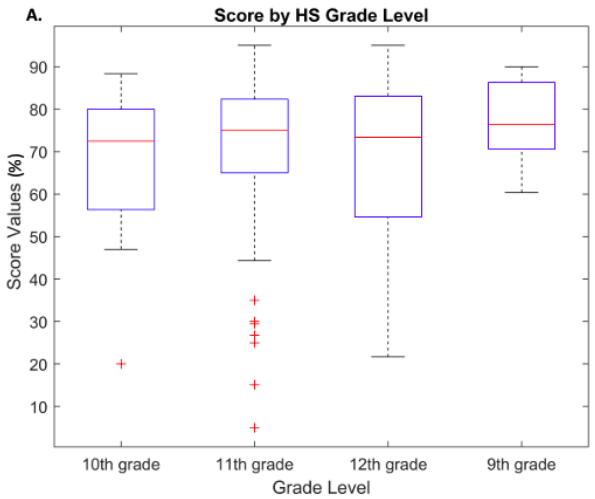


Figure 7. **Health Literacy Assessment Scores by Years of High School Health Education.** A) Boxplot of score distribution for different years of high school health education of respondents. B) Corresponding statistical values; Kruskal-Wallis test resulted in p-value < 0.05. C) Pass/Fail distribution for different years of high school health education of respondents (<60% = Fail, ≥60% = Pass).

Significant differences were observed in median scores between the different years of high school health education (Figure 7). The highest median scores (77%) were from respondents who had either one or three years of high school health education, closely followed by those with two years of high school health education (median = 75%). Surprisingly, respondents with four or five years of health education scored lower, with median scores of 72.4% and 70%, respectively. Those with three years of high school health education had the highest Pass/Fail ratio (Figure 7c); these students would traditionally be 11th graders, who made up the majority of the sample population.

A.



B.

	Mean ± Standard Deviation	Range [Min, Max]	Percentiles [25th, 50th, 75th]
9th grade	77.13 ± 11.40	[60.33, 90]	[70.58, 76.33, 86.25]
10th grade	66.91 ± 19.05	[20, 88.33]	[56.33, 72.5, 80]
11th grade	70.58 ± 18.14	[5, 95]	[65, 75, 82.33]
12th grade	68.86 ± 19.30	[21.67, 95]	[54.58, 73.33, 83.08]
Kruskal-Wallis test: p-value = 0.3384			

C.

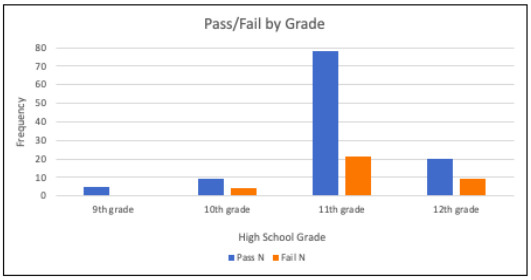


Figure 8. **Health Literacy Assessment Scores by High School Grade Level.** A) Boxplot of score distribution for different grade levels of respondents. B) Corresponding statistical values; Kruskal-Wallis test resulted in p-value = 0.3384. C) Pass/Fail distribution for different grade levels of respondents (<60% = Fail, ≥60% = Pass).

No significant differences in health literacy scores were found among the different grade levels (Figure 8). While 9th grades had the highest median scores of 76.3%, 11th grades showed the greatest Pass/Fail ratio among the respondents (Figure 8c).

Discussion:

Regarding the differences between the five core health topics, it appears that the high school students in this study have more knowledge on substance abuse topics than other health topics. As per New Jersey state law, all district boards of education are required to establish a thorough program in schools focusing on the prevention, intervention, evaluation, and treatment for alcohol, tobacco and other substance abuse habits (Alcohol, Tobacco & Other Drug Abuse, n.d.). Due to this specific subject being a primary focus in health education, students may have been more informed in this area; further research is needed to determine if the same difference exists in a larger sample and if so, why.

As discussed previously, no significant difference in health literacy levels was found among the different racial/ethnic groups. This result may be due to the fact that the majority of the sample consisted of these two race/ethnicity groups, which may have skewed the result.

As for gender identity, there were a handful of extremely low scores from some female respondents, so it was surprising that females had higher median scores than males. However, females made up a large percentage of the respondents, which made this population more resilient to extremes. Thus, the majority of females still scored higher than males despite low outlier scores. Despite the stereotypical biases that males perform better on math and science assessments, research shows that girls generally perform better across all subjects due to cultural and social differences in upbringing (American Psychological Association, 2014). This might explain the higher health literacy rates of female respondents of this study compared to the males.

The results regarding ELL status were expected. ELL students scoring lower than their non-ELL peers may be due to language barriers in health education classes. Language barriers have been proven to be detrimental to health education, and a lack of interpreters in the health communication industry makes it difficult for non-native English speakers to learn and retain important health information (Shamsi et. al, 2020). However, this score difference in our study may also be due to language gaps in comprehending the survey itself. To avoid this potential confounder, steps should be taken to make this assessment tool more accessible to non-native English speakers (for example, making it available in different languages).

The trends observed based on years of health education were unexpected. Rather than scoring higher due to their greater number of years receiving health education, respondents who received four or more years of health education scored lower than those with one to three years of health education. This may be because by their fourth year of health education class, students may be less engaged with the material. This lack of engagement is a commonly reported phenomenon across high school seniors — particularly as students of this age are experiencing transitional stages in their career, academic-related burnout, or other similar stressors (Jones et. al, 2021). This reflects the importance of making such assessment tools interesting. Therefore, continuation of this research should entail efforts to make this assessment tool even more engaging. This may include strategies like incorporating videos into the questions, adding more digital graphics, etc. In fact, we had considered adding animation videos to the questions but were unable to do so due to time restraints.

Finally, the disproportionate number of 11th graders in the sample may explain why there were no significant differences in scores between grade levels, as the other grades did not have enough respondents compared to the 11th grade. Additionally, all of the questions in the health literacy assessment were created based on 8th-grade health education standards, which may also explain why there were no significant differences in scores between different grade levels, since all high school students should be familiar with this content.

Due to the limited timeframe of this study, there were significant constraints in terms of sample size and sampling method. Due to the use of convenience sampling by the research team in order to recruit enough suitable subjects, many of the results were skewed by disproportionate numbers of responses from certain demographic groups (e.g., White/Caucasian, 11th grade, female). Additionally, because of the use of convenience sampling, the majority of respondents were students from a handful of schools with similar socioeconomic status and academic achievement, which were the main school-level variables that were intended to be studied. Thus, in this study, school-level variables were not further analyzed. Finally, when conducting non-parametric tests for each demographic group, the “other” categories for gender identity and race/ethnicity had to be excluded from this analysis due to the low number of responses in these categories, which would have skewed the results if included in the statistical tests.

Conclusion:

Due to the limitations discussed above, no broad conclusions about our target population of New Jersey high school students could be inferred from this study. However, it can be concluded that within the sample population, there are significant differences in health literacy scores between individual-level demographic groups, with the exception of race and grade level. Additionally, despite not being able to form any generalizations about New Jersey’s high school students overall, this study served as a pilot study for our new health literacy assessment tool.

The next steps for this project would involve addressing the aforementioned limitations to broaden the scope of this research. With more time and resources, it would be possible to collaborate with community partners throughout New Jersey to obtain a larger and more diverse

sample population. This will allow our results to be more representative of the New Jersey high school student population. Additionally, expanding the scope of this study to cover a variety of New Jersey communities would enable us to study trends in school-level variables and whether or not these affect health literacy scores. Finally, ongoing revision of the assessment tool will be necessary based on study outcomes. From this study, for example, we have learned that some revisions might be required to make the assessment more accessible and engaging.

We hope that our new health literacy assessment tool can be used by others studying health literacy in adolescents. Quantitative data points obtained using this assessment tool can help support factual outcomes and can be objectively measured, as opposed to qualitative assessments, which lend to a broader and more subjective interpretation of the results. Additionally, if this research were to be extended even further, this form of health literacy assessment can provide a window to look into how other measurable variables like physical environment, food security, and support systems affect health literacy rates. More specifically, research regarding school-level variables can prompt further evaluation into community dynamics within the school environment, such as how students interact with educational resources, differences in accessibility, academic culture, and more. This information can be used by school authorities to appropriately allocate resources for health education to the communities that need them most.

Acknowledgements:

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