Health Literacy and Medication Adherence in Adolescents

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Objective To assess the relationship between health literacy levels and medication adherence in adolescents.

Study design A convenience sample of adolescents ages 12-21 years was recruited April-September 2011 at an urban adolescent health center. Health literacy and medication adherence was measured via the Rapid Estimate of Adult Literacy in Medicine-TEEN (REALM-TEEN) and Adherence to Refills and Medications Scale. The interrelated effects of age, sex, chronic illness, learning disability, health rating, and health literacy on adherence to medication were explored via the use of regression trees.

Results Of 138 adolescents surveyed, 112 (81%) were included in the analysis because they reported ever taking a medication and completed all survey questions. Median participant age was 16.1 years, 94% were African American, and 64% were female. Median REALM-TEEN score was 57 (6th-7th grade; range 0-66). Median ARMS score was 21 (poor; range 0-56). A positive correlation was found between worse adherence (greater ARMS scores) and self-report of a learning disability (P = .041), and between ARMS scores and having a chronic illness (P = .003). The ARMS and REALM-TEEN scores were not correlated (P = .069). Regression tree analysis indicated that adolescents with both a chronic illness and a learning disability had worse ARMS scores (median score 24), compared with adolescents having only a chronic illness (median score 22), independent of health literacy scores.

Conclusion Almost one-quarter of adolescents reported having a learning disability and had worse medication adherence independent of health literacy levels. This finding suggests other cognitive factors, beyond reading, may play a role in medication adherence. *(J Pediatr 2015;166:378-82)*.

Health literacy is defined as having the ability to read, understand, and navigate within a health care system.[1] Studies of adults have shown an association between low health literacy and worse health outcomes, decreased use of preventive services, and poor self-reported health status.[2-8] The 2003 National Assessment of Adult Literacy indicated that 40% of US adults ages 16 years and older had literacy levels at basic or below basic levels, defined as having no more than the most simple and concrete literacy skills to perform simple, everyday activities, and having limited functional capacity to understand, assess, and navigate the health care system.[9] Low health literacy levels have been implicated as a contributing factor in poor adherence to medication regimens by adults, another factor affecting health outcomes.[10,11]

Few studies of health literacy have focused on adolescents. A study of adolescents with HIV explored the relationship between literacy level and adherence to medication regimen using the Test of Functional Health Literacy in Adults[13] and the Diabetic Self-Care Practice Instrument,[14] adapted for adolescents with HIV, to assess current HIV medications and the number of missed doses during the last 3 days.[12] An association between the adolescent's health literacy level and medication adherence was not found, but greater health literacy levels were positively associated with amount of medical care received.[12]

The aim of the current study was to explore the relationship between health literacy level and adherence to medications in a convenience sample of adolescent patients attending the Adolescent Health Center (AHC), a primary care site for adolescents at Children's National Health System, a nonprofit children's hospital in Washington, DC. We hypothesized that adolescents with lower health literacy levels would have worse medication adherence and that adolescents with a chronic illness would have worse adherence to medication compared with their healthy peers, independent of health literacy.

Methods

Adolescents age 12-21 years who spoke fluent English and were outpatients at the AHC were recruited for the study. A recruiter approached patients in the waiting area and described the study to the adolescent and his or her guardian. Guardian consent was required for adolescents younger than 18 years of age. Interviews and

AHC	Adolescent Health Center
ARMS	Adherence to Refills and Medications Scale
REALM-TEEN	Rapid Estimate of Adult Literacy in Medicine-TEEN

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testing took place in a separate, private room. All participants received a $10 stipend for completion of the study. The Children's National Institutional Review Board approved this study protocol.

Health literacy level was determined using the Rapid Estimate of Adult Literacy in Medicine-TEEN (REALM-TEEN),[15] a health literacy tool validated in 10- to 19-year-old subjects recruited from schools and pediatric clinics. The REALM-TEEN consists of 66 medical terms arranged in 3 columns, with 22 words in each column. The words are organized in order of difficulty, with the words least difficult to pronounce at the top. Participants were asked to read the words out loud in order. If they were unable to read the word, pronounced it incorrectly, or skipped the word, they did not receive credit for that word. Correct word pronunciation was determined by Webster's Third New International Dictionary of the English Language.[16] Correctly pronounced words were added to come up with a total or raw score, 0-66. This score was then converted to 4 grade range categories, ≤3rd grade, 4th-6th grade, 7th-8th grade, and ≥9th grade. The grade range was then used to determine whether the adolescent's health literacy was at, below, or above the self-reported grade level.[15]

The Adherence to Refills and Medications Scale (ARMS),[17] a scale validated in low-literacy adults with chronic disease, was used to determine adolescents' adherence to medication. The ARMS consists of 14 open-ended questions, based on a 4-point Likert scale. Responses of "none," "some," "most," or "all" of the time were given values from 1 to 4, respectively. A lower score indicates better medication adherence, with a total score of 21 or greater indicating worse medication adherence. The internal consistency of the full-item (14 questions) ARMS scale was high across all literacy levels (Cronbach alpha = 0.8), including those with marginal or adequate literacy skills, as measured by the REALM.[18] Kripalani et al[17] established the reading difficulty of ARMS at below the eighth grade level. Participants were instructed to answer all questions. If they did not understand a question, they were instructed to leave the answer blank.

The study questionnaire consisted of 14 questions on demographics, including the participant's age in years, sex, self-reported race and ethnicity, language spoken at home, current educational level, highest grade completed, whether they had ever repeated a grade level or had a learning disability, their parent's or guardian's educational level, their self-perceived health status, any history of chronic illness, and if they had ever taken a medication. Study questions were developed and piloted by the study team, and the self-reported health rating question was obtained from "Early Adolescents Perceptions of Health and Health Literacy."[19] Participants were given a recorded version of the study questions and a paper version of the study questions. They were asked to listen to the tape while following along on the paper version. Participants recorded their answers to study questions on the paper version of the questionnaire. Scoring of the REALM-TEEN and ARMS was performed by the recruiter immediately after completion of the questionnaire. All scores were kept confidential, unless a participant requested their score. The investigator would then discuss the participant's score with them privately and explain what it meant.

STATA 10 (Stata Corp, College Station, Texas), SPSS 19 (SPSS Inc, Chicago, Illinois), and Salford system CART (Salford Systems, San Diego, California) were used for data analysis. The association of variables with health literacy and adherence to medication was examined using Mann-Whitney *U* tests because of skewed data. The interrelated effects of age, sex, chronic illness, learning disability, health rating, and health literacy on adherence to medication were explored by the use of regression trees or recursive partitioning. This is an alternative nonparametric approach to linear regression in which, as in linear regression, a function is optimized.[20] This optimization is used to subdivide, or partition, the data into 2 groups recursively. The objective function used was the least sum of the absolute deviation from the median. Bootstrapping of 10% random sample left out was used to select the best tree.[20]

Results

Of 148 adolescents approached for participation in the study, 138 were enrolled in the study and 112 completed all survey questions and answered yes to ever taking a medication. Responses from these 112 teens were analyzed (**Table I**). Median was used instead of mean because of small sample size. Participant median age was 16.1 years (range, 12-21), 94% were African American, and 64% (n = 72) were female. The median enrolled school grade level was 11th grade (range 7th grade-college/technical school). Fifteen percent (n = 17) reported not currently being in school. Forty-three percent (n = 47) of participants reported being very healthy, 41% (n = 45) reported being "sort of" healthy, and 16% (n = 18) reported being unhealthy. Thirty-six percent (n = 40) of participants reported having a chronic illness. Twenty percent (n = 22) of participants reported having a learning disability. The median REALM-TEEN score was 57 (range, 0-66) corresponding to 6th-7th-grade literacy level. Median ARMS score for study subjects was 21 (range, 14-56), indicating poor medication adherence (**Table I**). The ARMS and REALM-TEEN scores were not correlated ($P = .041$).

Univariate analyses comparing health literacy levels and medication adherence, respectively, with sex, chronic illness, learning disability, or self-health rating are shown in **Table II**. Univariate analysis indicated that having a chronic illness and having a learning disability were associated with poor medication adherence ($P = .003$ and $P = .041$, respectively). No statistically significant association was found between REALM-TEEN scores and having a chronic illness ($P = .081$).

Sex did not have a statistically significant relationship to medication adherence ($P = .83$). Self-health rating had no correlation with medication adherence ($P = .14$). The internal consistency of the ARMS in the adolescent population