

Manuscript Title

The Validity and Reliability of the Health Literacy Measure for Adolescents

Running Title: Health Literacy Scale for Adolescents

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Abstract

Aims: This research has been planned methodologically to determine the validity and reliability of the Turkish language form adaptation of the “Health Literacy Measure for Adolescents”.

Methods: The study was carried out between February-June 2018 with 440 students aged 15-19 who attended two different high schools in the same province. The Introductory Information Form and the Health Literacy Measure for Adolescents were used as data collection tools. The linguistic equivalency of the measure was examined carefully. Factor analysis was made for the measure’s structural validity and the Kaiser-Meyer-Olkin coefficient=0.90 and Bartlett’s Test of Sphericity=8.401, $p=0.000$ were determined for suitability of the factor analysis for the data.

Results: The analysis of the validity of the known groups showed that adolescents’ age and high school year was sensitive to the total scale score and to the sub-dimension scores for “self-sufficient”, “read”, “use” and “perceive”. The Cronbach’s Alpha value of the scale was 0.93. The total variance in the factor analysis explains 55.40% and the factor loads vary between 0.30-0.93. The test and retest reliability coefficient were 0.91. The item total correlations of the scale vary between 0.10-0.60.

Conclusions: It was determined that the measure is a valid and reliable measuring tool.

Key words: adolescent, health literacy, validity, reliability, high school

1. Introduction

Solutions have been developed for many health problems from the past to the present-day and it has acquired importance for individuals to be able to reach and understand health information and to have the skills to implement this knowledge for being able to continue healthy lives. According to the research realized in this field, the concept of Health Literacy (HL) was formed [1,2]. The World Health Organization (WHO) defines HL as “*the skill of the individual to reach, understand and use health information for protecting and continuing health*” [3]. HL provides for individuals to reach accurate information and for the development of quality conditions in health services [4]. It is stated that a low HL level could be the cause of an inadequacy in the first stage health applications and of an increase in chronic diseases [5,6]. Providing adolescents with accurate and reliable health information is of vital importance [7,8], because continuing healthy behaviors throughout life can only be realized with an adequate level of HL [9]. Very few studies have been made on the HL of adolescents [10-12]. In a study made, it was estimated that the HL skills of at least one in three adolescents was insufficient [13]. In studies made on adolescents, it was stated that males had a lower HL level than females [14,15] and that as the age and year attending school increases, the level of HL increases [16-19].

1.1. Literature review

When the studies made on HL are examined, it is observed that different measuring tools have been developed, which are still used in many countries. Of these, The Rapid Estimate of Adult Literacy in Medicine (REALM) and The Test of Functional Health Literacy in Adults (TOFHLA) are widespread and the best known in the world and in Turkey [20]. Furthermore, the HELMA [1], Health Literacy Assessment Scale for Adolescents (HAS-A) [21] and The e-Health Literacy Scale (HEALS) have been developed for determining the HL levels in adolescents [22,23].

When the literature is examined, it is observed that the health information of adolescents is generally obtained from sources at school [24-26]. Consequently, nurses working in schools should cooperate with the Ministry of Health on adding HL to the school curricula. Furthermore, the number of Turkish scales is almost nonexistent in the evaluation of adolescents' HL. It should be provided to develop health by developing scales for the culture of our society for determining adolescents' HL and for raising the level of HL [27]. Therefore, it is planned to make a validity and reliability study of the HELMA, which was developed for determining adolescents' HL.

2. METHODS

2.1. Design

The research has been planned methodologically to determine the validity and reliability of the Turkish language form adaptation of the “Health Literacy Measure for Adolescents” (HELMA).

2.2. Sample and setting

The research setting was composed of adolescents (N=1495) between the ages of 15-19, who attended the Konak Ibn-i Sina Vocational and Technical Anatolian High School and the Betontaş Anatolian High School and who voluntarily agreed to participate in the study between February-June 2018. It is expected that the sampling size is not less than 5-10-fold the number of items for making factor analysis in the scale studies [28,29]. It was planned to make the study with 440 persons (n=440). The stratified random sampling method was used for constituting the sampling and 220 persons each from both high schools were determined for a total of 440 students. The students were selected with the simple random sampling method from the 9th, 10th, 11th and 12th grades. An evaluation was made with 50 persons for test-retest reliability and these individuals were not included in the study sampling.

2.3. Instruments

The research data were collected through the Introductory Information Form and the HELMA.

2.3.1. Introductory Information Form:

It was prepared by the researcher scanning the literature and is composed of seven questions, unique to HL, such as age, gender, level of education, level of education of parents, profession of parents, health status and sources where health information is obtained [1, 14, 18-19, 22, 25-26, 30-31].

2.3.2. HELMA

It was developed by Ghanbari et al.(2016) and is composed of 44 items [1]. The measure has a total of eight sub-dimensions: self-sufficient, access, read, understand, evaluate, use, communicate and understand numbers. Every item is given points with a five-point Likert-type scale with (1) never, (2) rarely, (3) sometimes, (4) frequently, and (5) always [32]. The Cronbach’s Alpha values obtained for the eight sub-dimensions of the measure by Ghanbari et al. (2016) varies between 0.61-0.89 [1].

2.4. Data analysis

The “Statistical Package for the Social Sciences (SPSS) 23.0” and the “Analysis of Moment Structures (AMOS) 21.0” statistical package programs were used by the researcher for data analysis. Numbers and percentages were used for evaluation of data for variables with a number and average±standard deviation and minimum-maximum values were used for variables with a

measurement. The measure was implemented on the individuals by using the face-to-face interview method. The data collection for everyone lasted for an average of 20-25 minutes.

2.4.1. Validity analysis

The process employed to adapt the HELMA for the Turkish context and to conduct the validity study involved three stages:

- Language validity
- Content validity
- Construct validity
- Validity of Known Groups

The translation and back-translation method were used for the language validity of the HELMA. While making the translation to Turkish, the measure was translated from English to Turkish by two independent translators, who knew English at the level of native language. The measure, which was back translated to English, was once again compared by the researchers with the original English measure and assumed its final form after making the required corrections. The measure prepared was presented for the opinion of the researcher who formed the original measure and approval was obtained.

The measure, which provided language validity, was presented for the opinion of 15 experts for the contents/scope validity. It was requested from the experts that they make an evaluation of the suitability of items by giving points of (1) unsuitable, (2) somewhat suitable, (3) rather suitable, and (4) very suitable. The Scope Validity Index (SVI) was used to evaluate the contents and scope validity of the measure (SVI: 1.00). After the expert opinions, the content validity of the measure was made by calculating Kendall's Coefficient of Concordance (Kendall's $W=0.011$).

It was implemented after the expert suggestions and making the final form of the measure. Fifteen adolescents, who were not within the scope of the study, and who were attending the same high schools, were included in the pilot test. While collecting data, since the 42nd, 43rd and 44th items of the measure contained numerical data, sample questions were solved by the researcher with the aim of making them easier to understand by the adolescents. Subsequently, it was requested that the adolescents respond to the 42nd, 43rd and 44th items of the measure. To determine the construct validity of the Adolescent Health Literacy Scale, both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted. To assess whether the scale was adequate for factor analysis, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity were performed.

The Multivariate Analysis of Variance (MANOVA) was implemented to measure the significant difference among groups when making the validity of the known groups. Tukey's Honest Significant Difference (HSD) statistics were examined for the differences of the groups within each factor. The effect size was calculated with the Partial Eta-squared values.

2.4.2. Reliability analysis

The process employed to adapt the HELMA for the Turkish context and to conduct the reliability study involved three stages:

- Internal consistency analysis
- Parallel form reliability
- Test–retest method

The item total correlation for the measure's reliability was made with the Cronbach's Alpha reliability coefficient, the Independent-Samples T-Test and the Test-Retest analysis. Cronbach's alpha reliability coefficients were calculated for the internal consistency analysis. Test–retest analysis was performed between the two measurements for time invariance. The test was implemented again two weeks after the first implementation for the Test-Retest reliability analysis of the 50 persons who participated in the study from within the same setting. These individuals were not included in the study sampling. Parallel form reliability was conducted to assess the stability of the scale. This measurement was examined with a Pearson's correlation coefficient. The level of importance in the validity and reliability analyses was 0.005.

2.5. Ethical considerations

Written permission was obtained from Ghanberi et al. (1) via the Internet for making the Turkish validity and reliability of the measure. Written permissions were obtained from the Izmir Provincial Directorate of National Education for the Konak Ibn-i Sina Vocational and Technical Anatolian High School and the Betontaş Anatolian High School and from the Uşak University, School of Medicine, Ethics Committee for Non-interventional Clinical Research. Verbal approval was obtained from individuals participating in the study by giving them information about the study and by informing that the information about them would remain anonymous.

3. Results

3.1. Sample characteristics

Of the participants in the study, 22% were 15 years-old and 1.6% were 19 years-old, 20.2% were in ninth grade and, 29.1% were in twelfth grade. Of the research group, 67.3% were females and 32.7% were males. Of the mothers, the educational status of 7% was illiterate and 4.5% were higher education or university graduates. Examination of the professions of the

parents showed that 1.6% of the mothers and 1.8% of the fathers were health workers. Of the students, 4.3% defined their health status as weak and 20% as excellent. To the question on the most reliable sources of information related to health, 91.8% said health workers and 7.3% said friends (**Table 1**).

3.2. Validity Analysis

The measure statements were translated to Turkish for the language and scope validity and were evaluated for adaptability to the Turkish culture by 15 university teachers who knew English well and who were experts in the fields of internal diseases nursing, public health nursing, surgical diseases nursing, pediatrics nursing and obstetrics and gynecology nursing. At the conclusion of the expert evaluations, the SVI=1, the Chi-square=64.911, $p<0.05$, the Kaiser-Meyer-Olkin (KMO)=0.900 and $X^2=5847.922$. A different structure was constituted from the eight-factor and 44 item original measure after the Explanatory Factor Analysis (EFA). According to the EFA, the measure's eigenvalue was above one and was formed from a six-factored structure and 55.40% of the total variance of these factors were explained, whereas, the sub-dimensions for self-sufficient (8 factors), access (8 factors), read (8 factors), understand (5 factors), evaluate (5 factors), use (4 factors), perceive (3 factors) and understand numbers (3 factors) were determined (**Table 2**).

The factor load values for the 44 items of the HELMA varied between 0.30-0.93 and in the confirmatory factor analysis, the adaptation indicators of the model were in the form of $\chi^2/df=2.259$, RMSEA=0.05, CFI=0.86, NFI=0.77, NNFI=0.85, SRMR=0.06, GFI=0.83, AGFI=0.81 and $p<0.001$. in the analysis of the validity of known groups, being in high school, being younger in age and being male were characteristics that formed the sub-categories in which points were expected to be lower and that age of the adolescents, high school year and the gender affected at a low level the measure dimensions ($p<0.01$) (**Table 3**).

3.3. Reliability Analysis

The item measure total correlation values were between 0.10-0.60 in the item analysis made for the reliability study of the HELMA (**Table 4**), the correlation values obtained from each item were between 0.63-0.87 and the correlation coefficient between the total points was 0.91 (**Table 5**). The 23rd item was the best measure characteristic to be measured and the 42nd item was the item that measured the least and since the p value (<0.001) calculated for the item-total measure point correlation of all the items was statistically significant, items were not removed from the measure. The Cronbach's Alpha value of the measure was 0.93 and the sub-dimension Cronbach's Alpha values were between 0.76-0.84 (**Table 6**). Timewise all the factors and item points in the test and re-test measurements of the HELMA did not show a change ($p>0.050$).

4. Discussion

The research has been planned methodologically with the aim of evaluating the validity and reliability of the language adaptation of the Turkish form of the HELMA, which was developed by Ghanbari et al. [1]. At the conclusion of the analyses made, it was determined that the HELMA is a valid and reliable measuring tool.

4.1. Validity

Validity is a concept related to the degree of being able to measure accurately the variable of a scale wanted to be measured [34]. The criteria, which determine the validity of a measurement tool, are collected under three headings, “contents/scope validity, criterion-dependent validity and structural validity [33,34]. There are three types of methods in language adaptation studies, “*one-way translation*”, “*group translation*” and “*back-translation*”. The validity and reliability of measures used by making one-way translations is low [35]. It is necessary for translations that will be adapted to be made with great care in conformance with the culture of the language by an expert team whose language skills are adequate and who are formed from different professions [33]. The translation and back-translation method were used for the measure’s language validity in the study based on the information in this literature. The opinions of 15 experts were utilized in the study made for the Turkish version of the HELMA. In accordance with the responses received from the experts, the KMO and SVI values of each item were calculated to be 1.00. The SVI value should be at least 0.80 [36-38]. The measure was evaluated as applicable for the Turkish society [37,39].

Explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) were utilized for testing the measure’s structure validity with the aim of determining which concepts and characteristics the HELMA measured and to what extent they were measured accurately [37,40]. The KMO was used to determine the sufficiency of the sampling size in the EFA and the “Bartlett’s Test” was used to determine if there was a relationship between the variables [28]. It is unacceptable for the KMO value to be below 0.5 [37, 40-42]. Bartlett’s Test of Sphericity should be $\text{sig} < 0.05$. If it is below 0.5, then the hypothesis is rejected [43]. It was observed in the study that the KMO value was 0.894 and the Bartlett’s Test was $X^2=5847.922$, $p < 0.001$ and these values are excellent [37,42]. Principal components analysis was used for determining the factor pattern. “Varimax” was selected from the perpendicular rotating methods as a rotation and care was taken for the eigenvalue of the factors to be larger than one [37,40]. According to the literature, it is enough for the explained variance to be between 40-60% [38]. At the conclusion of the analysis made, eight factors were obtained, which explained 55.4% of

the total variance that exceeded the eigenvalue of one. It is necessary for this factor load value to not be lower than 0.30 for being able to set forth that the factor of the items found was measured well [44]. The factor load values for the 44 items in the study vary between 0.30 and 0.93. After the EFA, the CFA was made with the aim of testing the accuracy of the factors formed [38,45].

According to the literature, the CFA analysis showed adaptation to the original model and it was determined that the adaptation indices were within acceptable values. According to some literature, in the measure's validity test, the "known groups" validity method was used, which is also shown as criterion validity. The known groups validity shows the measure's external validity [46]. The relationship between demographic characteristics of the research group, such as age, high school year and gender and the average points of the factors were examined. The MANOVA was proposed for observing if there was a significant difference for multivariate factors, such as age and high school year and the Analysis of Variance (ANOVA) for examining the relationship between the slight variable of gender with the factor points and to obtain the partial eta-squared values as the effect sizes [37,46]. It was stated that it is necessary to study Tukey's statistics for examining among which groups there is a difference for the factors found with a significant difference ($p < 0.005$). "*When evaluating effect sizes, 0.01 is evaluated as low, 0.06 as medium and 0.14 as high*" [47]. The analysis results showed that the measure dimensions affected the age, high school year and gender of the adolescents at a low level. It was set forth that being in a lower high school year, being younger and being male were characteristics that formed the sub-categories expected to have lower points.

4.2. Reliability

Item analysis is a method that sets forth the measure's internal consistency. Some researchers state that a non-negative correlation coefficient lower than 0.20 is acceptable in large samplings where there are 400 or more participants [38]. In the study made, it was found that the item measure total correlations were between 0.10-0.60 and since the sample scope was enough, no item was removed from the measure [48]. The Cronbach's Alpha values evaluate for determining that every item is measured with the same way of behaving within the factor to which it belongs. "*It is interpreted in the manner that for the coefficient to be $0.80 < \alpha < 1.00$ is a very high degree of reliability*" [37,49]. The Cronbach's Alpha coefficient of the measure was calculated to be 0.93. The Cronbach's Alpha value shows that the items were consistent within each other and that the measure's internal consistency was good. Invariance over time is known more as the retest technique. In this method, the measure is implemented to the sampling group two times and the correlation between points obtained from the two

implementations are calculated. An average two-week period was considered appropriate between the two implementations [49]. In determining that it is a measure with invariance over time, the correlation obtained is in a positive direction, shows a high level of relationship and these points should be a minimum of 0.70 [38,44]. The measure was re-implemented to the 50 persons who participated in the research two weeks after the first implementation for the HELMA's Test-Retest reliability analysis. While the Test-Re-test reliability coefficient obtained for every item was found to be between 0.63-0.87, the Test-Re-test reliability coefficient among the total points was found to be $r=0.91$ and the invariance of the measure over time was at a strong level in a positive direction [50,51].

5. Limitations

The limitations of this study are that it was carried out on students attending two high schools in Western Turkey. Further studies could include a greater distribution of students from various provinces in Turkey.

6. Conclusions

At the conclusion of the analyses made, it can be stated that the Turkish form of the HELMA, which is composed of eight sub-dimensions, can be used in a valid and reliable manner with the aim of evaluating the HL status of adolescents. The nurses and other health personnel at all the health institutions can utilize the HELMA in the evaluations of the HL status of individuals when making health diagnostics of adolescents. It is thought that repeating the measure would be beneficial by reinvestigating the psychometrical characteristics on different sampling groups.

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8. Conflict of Interest

The authors declare no conflict of interest.

9. Funding Statement

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Table 1. Introductory Characteristics of the Participants (n=440)

Introductory Characteristics	n	%
Age		
15 years	97	22
16 years	113	25.7
17 years	145	33
18 years	78	17.7
19 years	7	1.6
Gender		
Female	296	67.3
Male	144	32.7
Educational Status		
9th grade	89	20.2
10th grade	106	24.1
11th grade	117	26.6
12th grade	128	29.1
Mother's Educational Status		
Illiterate	31	7
Primary school graduate	163	37
Middle school graduate	93	21.3
High school graduate	133	30.2
Higher education/ university graduate	20	4.5
Father's Educational Status		
Illiterate	9	2
Primary school graduate	106	24.1
Middle school graduate	150	34.1
High school graduate	116	26.4
Higher education/ university graduate	59	13.4
Mother's Profession		
Health worker	7	1.6

Other	433	98.4
Father's Profession		
Health worker	8	1.8
Other	432	98.2
Health Status		
Very weak	4	0.9
Weak	19	4.3
Average	127	28.9
Good	202	45.9
Excellent	88	20
Reliable Information Sources		
Health worker		
Yes	404	91.8
No	36	8.2
Radio-TV		
Yes	92	20.9
No	348	79.1
Written Press		
Yes	204	46.4
No	236	53.6
Internet		
Yes	220	50
No	220	50
Family members		
Yes	166	37.7
No	374	62.3
Friend		
Yes	32	7.3
No	408	92.7
Book/Brochure		
Yes	200	45.5
No	240	54.5
TOTAL	440	100

Table 2. Factor Loads (n=440)

Item	Factors							
	Self-sufficient	Access	Read	Under-stand	Evaluate	Use	Perceive	Under-stand Numbers
Item 1					0.352			
Item 2	0.517							
Item 3	0.625							
Item 4	0.407							
Item 5	0.651							
Item 6	0.69							
Item 7	0.651							
Item 8	0.701							
Item 9	0.437							
Item 10				0.7				
Item 11				0.78				
Item 12				0.797				
Item 13				0.773				
Item 14				0.472				
Item 15							0.69	
Item 16							0.802	
Item 17							0.711	
Item 18			0.545					
Item 19			0.528					
Item 20			0.531					
Item 21			0.514					
Item 22			0.576					
Item 23			0.546					
Item 24			0.457					
Item 25						0.699		
Item 26						0.675		

Item 27						0.582		
Item 28						0.486		
Item 29			0.469					
Item 30					0.791			
Item 31					0.846			
Item 32					0.728			
Item 33					0.622			
Item 34		0.5						
Item 35		0.609						
Item 36		0.435						
Item 37		0.617						
Item 38		0.72						
Item 39		0.645						
Item 40		0.614						
Item 41		0.309						
Item 42								0.697
Item 43								0.928
Item 44								0.913

Table 3. The Relationship Among the Demographic Characteristics of Participants in Study (age, high school year and gender) and the Sub-measure Points (n=440)

Demographic Characteristics		Self-sufficient	Access	Read	Under-stand	Evaluate	Use	Perceive	Under-stand Numbers	Total
Age	p value	0.014	0.095	0.001	0.614	0.095	0.011	0.003	0.866	0.003
	Effect Size	0.028	0.018	0.045	0.006	0.018	0.03	0.037	0.003	0.036
High School Year	p value	0.001	0.217	0	0.138	0.179	0.003	0	0.144	0
	Effect Size	0.036	0.01	0.054	0.013	0.011	0.032	0.043	0.012	0.043
Gender	p value	0.770	0.014	0.420	0.163	0.191	0.968	0.436	0.900	0.338
	Effect Size	0.000	0.015	0.002	0.004	0.003	0.000	0.000	0.000	0.002

Table 4. Results of the Analysis of Item-Total Correlations and the Alpha Coefficient of the Health Literacy Measure in Adolescents (n=440)

Item	Scale mean if item deleted	Scale variance if item deleted	Item total correlation	Cronbach's alpha if item deleted
Item 1	168.318	462.236	0.420	0.926
Item 2	168.039	464.415	0.467	0.926
Item 3	167.973	463.585	0.476	0.926
Item 4	168.139	463.596	0.390	0.926
Item 5	168.134	457.939	0.525	0.925
Item 6	168.066	460.9	0.483	0.925
Item 7	167.884	465.059	0.413	0.926
Item 8	168	462.105	0.477	0.926
Item 9	168.175	465.07	0.368	0.926
Item 10	168.305	455.912	0.467	0.926
Item 11	168.143	455.28	0.546	0.925
Item 12	168.055	456.038	0.556	0.925
Item 13	168.173	454.098	0.558	0.925
Item 14	168.089	461.311	0.486	0.925
Item 15	168.355	461.318	0.491	0.925
Item 16	168.477	464.245	0.441	0.926
Item 17	168.477	458.728	0.528	0.925
Item 18	168.266	457.991	0.506	0.925
Item 19	168.014	464.515	0.431	0.926
Item 20	168.105	458.978	0.511	0.925
Item 21	168.032	456.974	0.579	0.925
Item 22	167.736	464.126	0.454	0.926
Item 23	167.852	460.805	0.585	0.925
Item 24	167.809	463.093	0.526	0.925
Item 25	168.084	457.353	0.555	0.925

Item 26	168.259	458.539	0.477	0.925
Item 27	168.2	457.978	0.570	0.925
Item 28	167.991	460.916	0.509	0.925
Item 29	167.941	460.826	0.549	0.925
Item 30	169.073	461.234	0.326	0.928
Item 31	169.091	459.796	0.370	0.927
Item 32	168.548	460.686	0.463	0.926
Item 33	168.466	464.026	0.335	0.927
Item 34	168.396	455.625	0.534	0.925
Item 35	168.164	459.176	0.462	0.926
Item 36	168.089	458.500	0.487	0.925
Item 37	167.957	461.996	0.483	0.925
Item 38	168.214	458.865	0.465	0.926
Item 39	168.168	460.086	0.479	0.925
Item 40	168.161	454.245	0.573	0.925
Item 41	168.423	463.497	0.343	0.927
Item 42	169.436	480.064	0.086	0.928
Item 43	169.45	478.708	0.154	0.928
Item 44	169.486	478.733	0.144	0.928

Table 5. Correlation Analysis Results of Test-Retest Scores of The Health Literacy Measure in Adolescents and Its Subdimensions (n=440)

Item	r	p
Item 1	0.829	0.000*
Item 2	0.91	0.000*
Item 3	0.916	0.000*
Item 4	0.839	0.000*
Item 5	0.821	0.000*
Item 6	0.765	0.000*
Item 7	0.733	0.000*
Item 8	0.861	0.000*
Total Measure	0.913	0.000*

* p<0.001

Table. 6. The Health Literacy Measure in Adolescents and the Sub-dimensions of the Cronbach's Alpha Coefficients (n=440)

Measure and Sub-dimensions	Number of Items	Cronbach's Alpha Coefficients
Self-sufficient	8	0.803
Access	8	0.801
Read	8	0.825
Understand	5	0.844
Evaluate	5	0.775
Use	4	0.757
Perceive	3	0.8
Understand Numbers	3	0.818
Total Measure	44	0.927