RESEARCH ARTICLE

Sibel Peksoy Kaya[1]
Pervin Demir[2]
Sena Kaplan[1]
Sevil Sahin[1]

[1]Ankara Yıldırım Beyazıt University Faculty of Health Sciences, Nursing Department, Ankara, Türkiye
[2]Ankara Yıldırım Beyazıt University Faculty of Medicine, Department of Biostatistics and Medical Informatics, Ankara, Türkiye

***Corresponding Author:***
*Sibel Peksoy Kaya*
*mail: sibelpeksoy@gmail.com*
*sibelpeksoykaya@aybu.edu.tr*

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konuralptipdergi@duzce.edu.tr
konuralptipdergisi@gmail.com
www.konuralptipdergi.duzce.edu.tr

# The Turkish Validity and Reliability of the Coronavirus-Related Health Literacy Scale on Health Science Students

## ABSTRACT

**Objective:** Health literacy is one's ability to access, comprehend, appraise, and apply health-related information. Health literacy has become an important topic since the COVID-19 pandemic. This methodological study aimed to adapt the Coronavirus-Related Health Literacy Scale (HLS-COVID-Q22) to Turkish.

**Methods:** The sample consisted of 539 students of the faculty of health sciences of a university in Turkey. The study was conducted between December 2020 and May 2021. The content validity ratio was calculated for content validity. The construct and concurrent validity, internal consistency reliability, test-retest reliability, and ceiling and floor effects were also determined. A confirmatory factor analysis was performed for construct validity.

**Results:** The fit indices indicated an adequate fit ($\chi^2$/df: 4.97<5, Comparative Fit Index: 0.996). The composite reliability (>0.70) and Cronbach's alpha values (>0.90) were above acceptable limits. Most students had "adequate health literacy" (71.8%). A quarter of the students had "problematic health literacy" (24.5%). The remaining students had "inadequate health literacy" (3.7%). Students with lower levels of health literacy were more likely to have confusion about coronavirus-related information (p<0.001).

**Conclusions:** The results of the study show that the Health Literacy Scale Related to COVID-19 - Turkish Version (HLS-COVID-TR), consisting of 22 items, has sufficient reliability, internal and external construct validity. It has been determined that it is a valid and reliable scale for measuring health science students' COVID-19 related health literacy levels. Nearly three quarters of the students have sufficient health literacy level.

**Keywords:** COVID-19 Pandemic, Health Literacy, Validity, Reliability, University Student.

# Sağlık Bilimleri Öğrencilerinde COVID-19 ile İlişkili Sağlık Okuryazarlığı Ölçeğinin Türkçe Geçerlik ve Güvenirlik Çalışması

## ÖZET

**Amaç:** Sağlık okuryazarlığı bireylerin sağlık bilgilerine erişme, anlama, değerlendirme ve uygulama yeteneğidir. Özellikle COVID-19 pandemisinde sağlık okuryazarlığı giderek önem kazanmaya başlamıştır. Bu metodolojik çalışmanın amacı sağlık alanında üniversite öğrencilerinde "COVID-19 ile İlişkili Sağlık Okuryazarlığı Ölçeği"nin (SOY-COVID-Q22) Türkçe'ye uyarlamasının gerçekleştirilmesidir.

**Gereç ve Yöntem:** Bu metodolojik çalışma Türkiye'de bir üniversitede eğitim gören 539 Sağlık Bilimleri Fakültesi öğrencisi ile yapılmıştır. Çalışma Aralık 2020 – Mayıs 2021 tarihleri arasında yürütülmüştür. Kapsam geçerliliğini değerlendirmek için kapsam geçerlilik oranı hesaplanmıştır. Yapı ve eşzamanlı geçerlilik, iç tutarlılık güvenilirliği, test-tekrar test güvenilirliği ve tavan ve taban etkileri de belirlenmiştir. Yapı geçerliliği için doğrulayıcı faktör analizi yapılmıştır.

**Bulgular:** Uyum indeksleri yeterli uyumu göstermiştir ($\chi^2$/df: 4.97<5, Karşılaştırmalı uyum indeksi: 0.996). Bileşik güvenilirlik (>0.70) ve Cronbach alfa değerleri (>0.90) kabul edilebilir sınırların üzerinde bulunmuştur. Öğrencilerin çoğunun "yeterli sağlık okuryazarlığı"na (%71,8), katılımcıların dörtte birinin "sorunlu sağlık okuryazarlığı"na (%24,5) sahip olduğu belirlenmiştir. Diğer öğrenciler "yetersiz sağlık okuryazarlığı"na (%3,7) sahiptir. Sağlık okuryazarlığı düzeyi düşük olan öğrencilerin COVID-19 enfeksiyonu ile ilgili bilgiler konusunda kafa karışıklığı yaşama olasılığı daha yüksektir (p<0.001).

**Sonuç:** Çalışma sonuçları, 22 maddeden oluşan COVID-19 ile İlişkili Sağlık Okuryazarlığı Ölçeği - Türkçe Versiyonunun (SOY-COVID-TR) yeterli güvenilirliğe, iç ve dış yapı geçerliliğine sahip olduğunu göstermektedir. Sağlık bilimleri öğrencilerinin COVID-19 ile ilgili sağlık okuryazarlık düzeylerini ölçmek için geçerli ve güvenilir bir ölçek olduğu belirlenmiştir. Öğrencilerin yaklaşık dörtte üçünün yeterli sağlık okuryazarlık düzeyine sahiptir.

**Anahtar Kelimeler:** COVID-19 pandemisi, Sağlık okuryazarlığı, Geçerlik, Güvenirlik, Üniversite öğrencileri.

## INTRODUCTION

The novel coronavirus disease (SARS-COV-2) has taken hold of the whole world since its onset. Therefore, the World Health Organization (WHO) classified the COVID-19 disease as a "public health emergency" (1). The coronavirus continues to mutate, resulting in the emergence of new variants with high transmissibility. Even the vaccinated must take precautions because we do not know how protective the current vaccines are against variant strains of the virus (2). Therefore, preventive interventions against COVID-19 are important.

Globally, responses to the COVID-19 pandemic should be swift, regular, systematic, and coordinated (3). Policymakers and health authorities emphasize that everybody should be doing their part to help prevent the spread of the virus. Moreover, various platforms constantly feed updates and recommendations regarding the pandemic (4).

Health literacy (HL) is defined as one's ability to access the right sources of information, make sense of it, and put it into practice (4). WHO defines HL as "cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" (5). People with high HL can manage their health and participate actively in their healthcare (6). It is critical to understand public health recommendations, access information about the pandemic, and take protective measures against the virus (4). However, it is not always easy to access reliable sources of information (3). Therefore, individual and social HL is a must for preventing and managing the pandemic (7). People with high HL can tell reliable information from unreliable information regarding the pandemic. They can also access the right sources of information to make the right health decisions (4). There is a large body of research on HL in different groups (older adults, those with chronic diseases, those who tested positive for COVID-19, college students, etc.) (7-9). Health literacy is related to healthcare institutions, healthcare services, healthcare providers, and society. Therefore, we should determine the HL of both healthcare receivers and providers (10). Healthcare providers start developing HL skills in college. Chesser et al. (11) in 2020 found that almost half the college students had high HL levels, whereas the majority had basic levels of COVID-19 knowledge. Nyugen et al. (8) reported a negative correlation between high HL and fear of COVID-19 among medical students. Health and medical students need comprehensive knowledge to strengthen their patients' autonomy, participation, and self-management abilities (12). No systematic data suggests that undergraduate education helps health students develop HL skills. However, undergraduate students are also at risk during the pandemic (8).

Health literacy is assessed using the Health Literacy Survey European Questionnaire (HLS-EU-Q) (13–17) or other measurement tools (11,18,19) Those instruments measure general HL. On the other hand, the Coronavirus-Related Health Literacy Scale (HLS-COVID-Q22) is a more sensitive instrument that measures coronavirus-related HL. The scale was developed for a German population and adapted to Taiwanese and Indonesian populations (20,21).

This study aimed to adapt the HLS-COVID-22 to Turkish. The sample consisted of health sciences students because they will work as healthcare professionals after graduation.

## MATERIAL AND METHODS

**Ethic Approval and Recruitment:** The study was approved by the Ethics Committee of the University (Date:08.10.2020, No:34) and the Faculty of Health Sciences of the University (Date:22.10.2020, No: 27139605-299-E.34413). The study was also registered to the "COVID-19 Scientific Research Platform" of the Turkish Ministry of Health (Date: 30.09.2020). Authorization was obtained from the developer of the HLS-COVID-Q22. Each research stage was carried out according to the ethical principles outlined by the World Medical Association's Declaration of Helsinki. The data collection tools were prepared on Google Forms. All students were informed about the research purpose and procedure. Those who volunteered for the study clicked the "I agree to participate in the study" tab and then filled out the data collection forms.

**Participants:** This methodological study was conducted between December 2020 and May 2021. The sample consisted of 539 students from the faculty of health sciences of a public university in Ankara, Turkey. The faculty consists of the departments of nutrition and dietetics (n= 170), nursing (n= 149), social work (n= 48), sports sciences (n= 41), speech and language therapy (n=30), audiology (n= 29), child development (n= 28), health management (n= 24), and physiotherapy and rehabilitation (n= 20). The faculty has 2401 students, 688 of whom agreed to participate in the validity stage of the present study. One hundred and forty-nine students were excluded from the analysis because they responded "I do not know" to at least one item. The sample was large enough (n=539) to detect significant differences (22). The intraclass correlation coefficient (ICC) was calculated on 143 students. According to the ICC (>0.90), the minimum number of students was 68 (90% power and 0.05 alpha) (23). The test-retest reliability was assessed on 143 students (Figure 1).

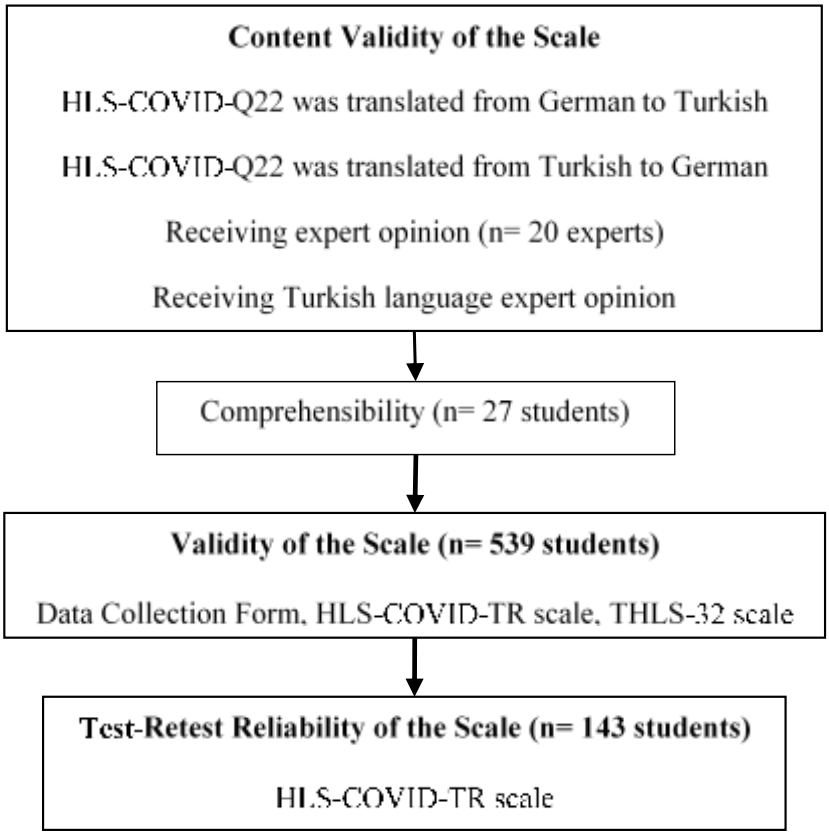


**Figure 1.** Flow chart.

**Data Collection:** The data was gathered using the "descriptive questionnaire", Coronavirus-Related Health Literacy Scale (HLS-COVID-Q22) and Turkish Health Literacy Scale (THLS-32).

**Descriptive Questionnaire:** The descriptive questionnaire was based on a literature (8,11,24,25) review conducted by the researchers. The questionnaire consisted of items on sociodemographic and COVID-19-related characteristics.

**Coronavirus-Related Health Literacy Scale (HLS-COVID-Q22):** HLS-COVID-Q22 was developed by Okan et al. (25) for a German adult population. The scale consists of 22 items and four subscales: access (six items), understand (six items), appraise (five items), and apply (five items). The items are rated on a four-point Likert-type scale ("1= very difficult" to "4 = very easy"). A mean score of ≤2.5 indicates "inadequate HL." A mean score of >2.5–<3 indicates "problematic HL." A mean score of ≥3 indicates "sufficient HL." The questionnaire has a Cronbach's alpha of 0.94 (25).

**Turkish Health Literacy Scale (THLS-32):** THLS-32 was adapted to Turkish by Okyay and Abacıgil (26). It was used to check the external validity of the HLS-COVID-TR. It has a conceptual model developed by the HLS-EU consortium. It consists of 32 items rated on a five-point Likert-type scale. It has two subscales [(i) healthcare and (ii) disease prevention and health promotion] and four information processing stages [(i) access, (ii) understand, (iii) appraise, and (iv) apply]. The THLS-32 score is converted using the equation of [(mean of original response format [1-4] - 1)*(50/3)]. The total score ranges from 0 (lowest HL) to 50 (highest HL). The total score is assessed on four levels ("0-25 = inadequate HL," "26-33 = problematic/limited HL," "34-42 = adequate HL," "43-50 = excellent HL"). The THLS-32 has a Cronbach's alpha of 0.92 (26).

**Procedure**

**Content validity:** Four linguists were involved in the translation of the HLS-COVID-Q22 into Turkish. In the first stage, two independent Turkish translators who speak and write both Turkish and German very well translated the scale into Turkish. In the second stage, two independent translators translated the Turkish version back into German (back-translation). Afterward, a Turkish language expert reviewed the German and Turkish versions of the items, which were then revised based on his feedback. Twenty experts assessed each item's intelligibility/clarity and relevance using a three-point rating scale (1 = relevant, 2 = relevant but needs minor alteration, 3 = not relevant).

**Pilot Test:** A pilot study was conducted with 27 students to check the items of the HLS-COVID-TR for intelligibility/clarity and relevance. No modifications were made to the items based on

the results. The students in the pilot study were not included in the main study.

**Validity:** The data were collected online to determine the internal and external validity of the HLS-COVID-TR.

**Reliability:** One hundred and forty-three students filled out the HLS-COVID-TR again to determine the test-retest reliability of the scale. HLS-COVID-TR was administered to students as a test-retest two weeks later to determine its consistency across time.

**Data Analysis:** The Shapiro-Wilk test and normality plots were used for normality testing. Frequency (percentage), mean±standard deviation, or median (quartile 1-quartile 3) values were used to summarize the variables. Content validity, internal construct validity, reliability, discriminant validity, convergent validity, and reproducibility were assessed to determine the psychometric properties of the HLS-COVID-TR.

The Content Validity Ratio (CVR) was calculated for each item. The Content Validity Index (CVI) was calculated for the total scale. Twenty experts determined the Critical CVR (CRVc) value. It was 0.50 at the significance level of 0.05 (27). An item had content validity if CVR was higher than CVRc.

A confirmatory factor analysis (CFA) based on the polychoric correlation matrix was conducted to determine the construct validity of the HLS-COVID-TR. Common goodness-of-fit indices [chi-square, root mean square error of approximation (RMSEA), standardized root means square residuals (SRMR), comparative fit index (CFI), Tucker-Lewis index (TLI), and goodness of fit index (GFI)] were used to check the overall fit of the models (28). The Average Variances Extracted (AVE) indicates that items can better reflect the characteristics of each research variable in the model (29). The factors had convergent validity if the AVE was ≥ 0.50. Composite Reliability (CR) tests based on factor loadings were performed to determine model fitness, whose cutoff should be ≥0.7 (29). Cronbach's alpha values were reported. A Cronbach's alpha of >0.90 indicates excellent internal consistency, >0.80 good internal consistency, and >0.70 acceptable internal consistency (30).

The Spearman rho correlation coefficient between the subscales was compared with the squared root of the AVE value for discriminant validity.

The Spearman rho correlation between the HLS-COVID-TR overall (subscale) score and the HL overall (subscale) score was calculated to check for convergent validity. The following classification was used: <0.30 negligible, <0.50 low, <0.70 moderate, <0.90 high, and ≥0.90 very high correlation (31).

The reproducibility (test-retest reliability) of the HLS-COVID-TR was determined using the intraclass correlation coefficient (ICC, two-way mixed model, absolute agreement). An ICC value of > 0.90 indicates excellent reliability (32). The Bland Altman graph was created from the quantile estimations based on order statistics. The 95% CIs for percentiles were calculated based on quantiles of the binomial distribution.

The Mann-Whitney U and Kruskal-Wallis tests were used to compare the distribution of the HLS-COVID-TR overall scores between the categories of the students' other demographic characteristics at a significance level of 0.05. The Dunn's Bonferoni adjustment results were reported for pair-wise comparisons. The categorical data analysis was applied by using the Pearson Chi_square test.

The statistical significance level was set at two-sided $p<0.05$. The data were analyzed using the Statistical Package for Social Sciences (SPSS for Windows, v 21.0, IBM Corp, Armonk, NY, USA) and the following R language (33) packages: the "psych" (34), "lavaan" (35), "semPlot" (36), "ggplot2" (37), "reshape2" (38), "ggh4x" (39), "DescTools" (40), and "ggpubr" (41).

## RESULTS

### The Psychometric Properties of the HLS-COVID-TR

**Content Validity:** Twenty experts evaluated the items. Four items (1, 2, 4, and 17) had a content validity ratio (CVR) of zero (0). The other items had a CVR of greater than zero (min=0.10, max=0.90). The total scale had a CVI of 0.51. Thirteen items had a CVR > critical CVR. The experts re-evaluated the items after modifications. The total scale had a CVI of 0.98. All items had a CVR of greater than 0.90

**Internal Construct Validity and Reliability:** A confirmatory factor analysis was performed to determine the goodness of fit values of the four-factor and second-order models. Figure 2 shows the standardized factor loadings and the goodness of fit indices of the two models. Each model had an $\chi^2$/df of smaller than 5. The other fit indices also satisfied good fitting model criteria (CFI, TLI, GFI >0.95 and RMSEA, RMSR<1.0). There was a significant difference between the two models. The second-order model was acceptable enough to evaluate the coronavirus-related HL construct. Table 1 shows the standardized factor loadings with 95% CI values and the description of the items. The factor loadings between the items and latent factors were higher than 0.75 for all latent factors ($p<0.05$). The overall fit of the second-order model was deemed to be acceptable based on the model fit indices (Figure 2).

**Table 1.** The description and factor loadings of the HLS-COVID-TR items.

| Item and factor | Description | Std Factor Loading* (lower – upper) |
|---|---|---|
| **Factor 1** | **Access** | 0.891 (0.865 - 0.918) |
| Item 1 | Obtaining online information about the coronavirus | 0.895 (0.867 - 0.922) |
| Item 2 | Obtaining online information regarding the protective behaviors that can help prevent the coronavirus | 0.877 (0.845 - 0.909) |
| Item 3 | Obtaining information from newspapers, magazines, or TV about protective behaviors that help prevent the coronavirus | 0.751 (0.707 - 0.795) |
| Item 4 | Learning about how to determine whether I have been infected with the coronavirus | 0.766 (0.725 - 0.808) |
| Item 5 | Finding information on where to access professional help in the event of a coronavirus infection | 0.856 (0.823 - 0.888) |
| Item 6 | Obtaining information on how much at risk I am for contracting the coronavirus | 0.841 (0.804 - 0.877) |
| **Factor 2** | **Understand** | 0.923 (0.907 - 0.94) |
| Item 7 | Understanding my doctor's, pharmacist, or nurse's instructions regarding preventive measures against the coronavirus infection | 0.889 (0.866 - 0.912) |
| Item 8 | Understanding the authorities' instructions regarding protective measures against the coronavirus infection | 0.889 (0.863 - 0.914) |
| Item 9 | Understanding family members' or friends' advice regarding preventive measures against the coronavirus infection | 0.881 (0.859 - 0.903) |
| Item 10 | Understanding media information on how to protect myself from the coronavirus infection | 0.927 (0.909 - 0.944) |
| Item 11 | Understanding online information about the risks of coronavirus | 0.933 (0.918 - 0.948) |
| Item 12 | Understanding information in the newspaper, magazine, or television about the risks of coronavirus | 0.878 (0.851 - 0.905) |
| **Factor 3** | **Appraise** | 0.922 (0.905 - 0.939) |
| Item 13 | Assessing the reliability of media information about the coronavirus and the pandemic | 0.771 (0.733 - 0.809) |
| Item 14 | Deciding what behaviors pose a higher risk for contracting the coronavirus | 0.901 (0.881 - 0.922) |
| Item 15 | Deciding what protective measures to take to prevent coronavirus infection | 0.935 (0.917 - 0.952) |
| Item 16 | Assessing how at risk I am for coronavirus infection | 0.870 (0.843 - 0.898) |
| Item 17 | Evaluating whether or not I have been infected with the coronavirus | 0.795 (0.757 - 0.832) |
| **Factor 4** | **Apply** | 0.962 (0.949 - 0.975) |
| Item 18 | Deciding on how to protect myself from coronavirus infection based on information in the media | 0.871 (0.845 - 0.897) |
| Item 19 | Following my doctor's or pharmacist's instructions on how to deal with coronavirus infection | 0.914 (0.896 - 0.933) |
| Item 20 | Using the information my doctor has given me to decide how to deal with coronavirus infection | 0.916 (0.899 - 0.933) |
| Item 21 | Using the information in the media to decide how to deal with coronavirus infection | 0.864 (0.839 - 0.889) |
| Item 22 | Acting in a way to avoid infecting others with the coronavirus | 0.774 (0.737 - 0.811) |

*Std: Standardized (lower – upper): the lower and upper limits of 95% Confidence Interval. *p<0.001 for all factor loadings.*
*Measured using a 4-point scale where 1 :very difficult, 2: difficult, 3:easy, 4:very easy.*

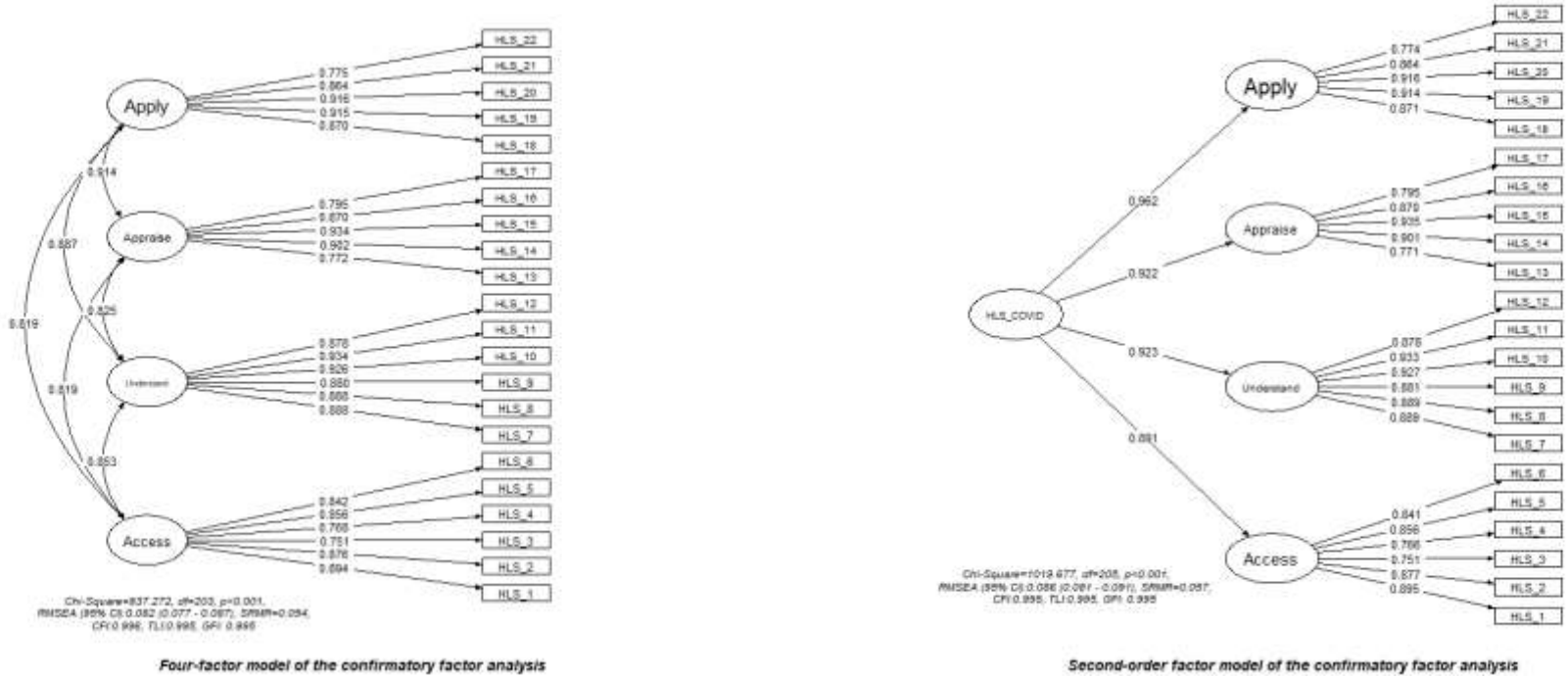


**Figure 2.** Confirmatory factor analysis results of the four-factor model and second-order factor model. *(df: degree of freedom ($\chi^2$/df: 4.62 for four-factor model and 4.97 for second-order model), RMSEA: Root Mean Square Error of Approximation, CI: Confidence Interval, SRMR: Standardized Root Mean Square Residuals, CFI: Comparative Fit Index, TLI: Tucker-Lewis Index, GFI: Goodness of fit Index)*

Table 2 summarizes the scale reliability measurements and the descriptive statistics of the scores. The composite reliability and AVE values were above the suggested threshold (CR and AVE should be higher than 0.70 and 0.50, respectively). Each subscale had a Cronbach's alpha of greater than 0.90, indicating excellent internal consistency.

**Table 2.** Reliability test results and descriptive statistics for second-order model confirmatory factor analysis of HLS-COVID-TR.

| Factors (items) | CR | AVE | CA (lower - upper) | Median (Q1 – Q3) | Median* (Q1 – Q3) |
|---|---|---|---|---|---|
| **Access** | 0.931 | 0.693 | 0.914 (0.780 – 0.986) | 3.3 (3.0 – 3.8) | 38.9 (33.3 – 47.2) |
| **Understand** | 0.962 | 0.810 | 0.957 (0.890 – 0.993) | 3.3 (3.0 – 4.0) | 38.9 (33.3 – 50.0) |
| **Appraise** | 0.932 | 0.734 | 0.926 (0.794 – 0.991) | 3.0 (2.6 – 3.6) | 33.3 (26.7 – 43.3) |
| **Apply** | 0.939 | 0.756 | 0.932 (0.812 – 0.992) | 3.2 (3.0 – 4.0) | 36.7 (33.3 – 50.0) |
| **HLS-COVID-TR** | 0.959 | 0.855 | 0.976 (0.959 – 0.988) | 3.2 (3.0 – 3.8) | 37.1 (32.6 – 46.2) |

*CR: Composite Reliability (>0.70), AVE: Average Variance Extracted (>0.50), CA: Cronbach alpha from Polychoric correlation matrix (>0.90 - excellent), lower-upper: limits of the 95% Confidence Interval, Median (Q1 – Q3): the median value of scale score (quartile 1 – quartile 3), *obtained from transformed scores with the formula [(mean-1)*(50/3)]).*

**Discriminant Validity:** The square root of the AVE value for each latent construct was higher than the correlation between the related latent construct and other latent constructs (see Table 3).

**Table 3.** Discriminant validity matrix*

| Subscores | Access | Understand | Appraise | Apply |
|---|---|---|---|---|
| **Access** | 0.832 | | | |
| **Understand** | 0.757 | 0.900 | | |
| **Appraise** | 0.706 | 0.693 | 0.857 | |
| **Apply** | 0.718 | 0.763 | 0.793 | 0.869 |

**The diagonal values were the* $\sqrt{AVE}$ *for each latent construct. The other values given in columns were the Spearman correlation coefficient between latent constructs.*

External Construct Validity (Convergent Validity). The correlation coefficient between the same subscales was greater than 0.50 (moderate) (see Figure 3). The correlation between the "HL" overall score and the "coronavirus-related HL" overall score was high (rho=0.750).

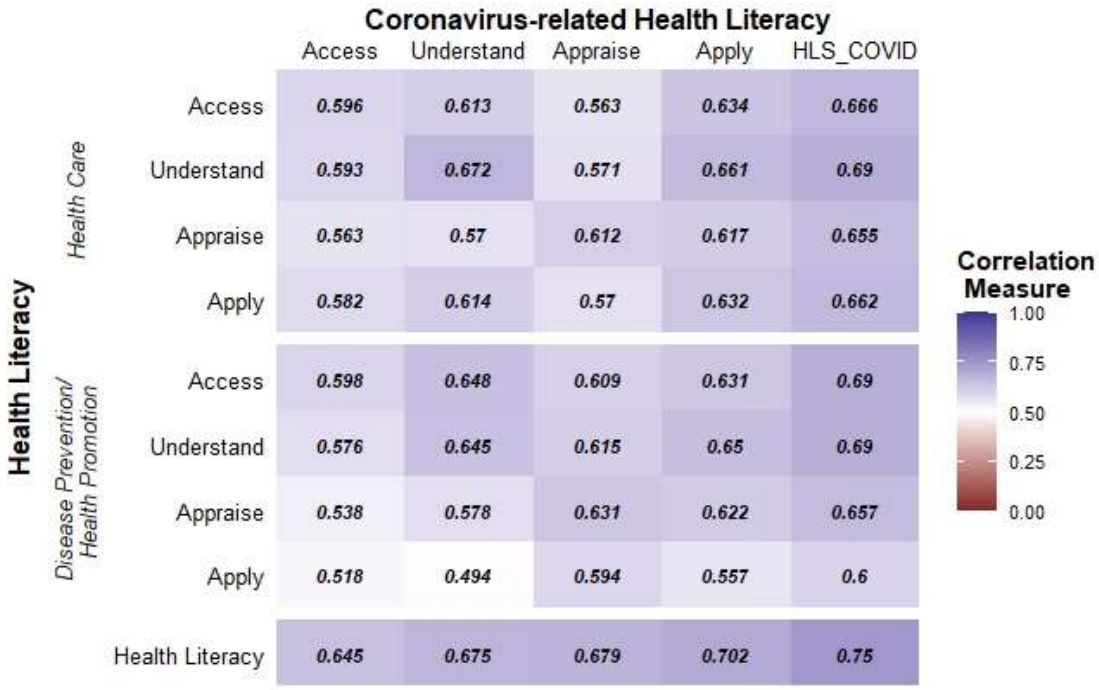


**Figure 3.** The Spearman rho correlation coefficients between Health Literacy and Coronavirus-Related Health Literacy scale scores. *(all p value<0.05)*

**Reproducibility (Test-retest reliability):** Figure 4 presents the Bland-Altman graphs showing the difference between the test and retest scores (y-axis) against the mean of the two measurements (x-axis) with ICC values. The HLS-COVID-TR had a test-retest reliability value greater than 0.90 (excellent reliability) and an ICC value of 0.967 (95%CI: 0.961 – 0.972).

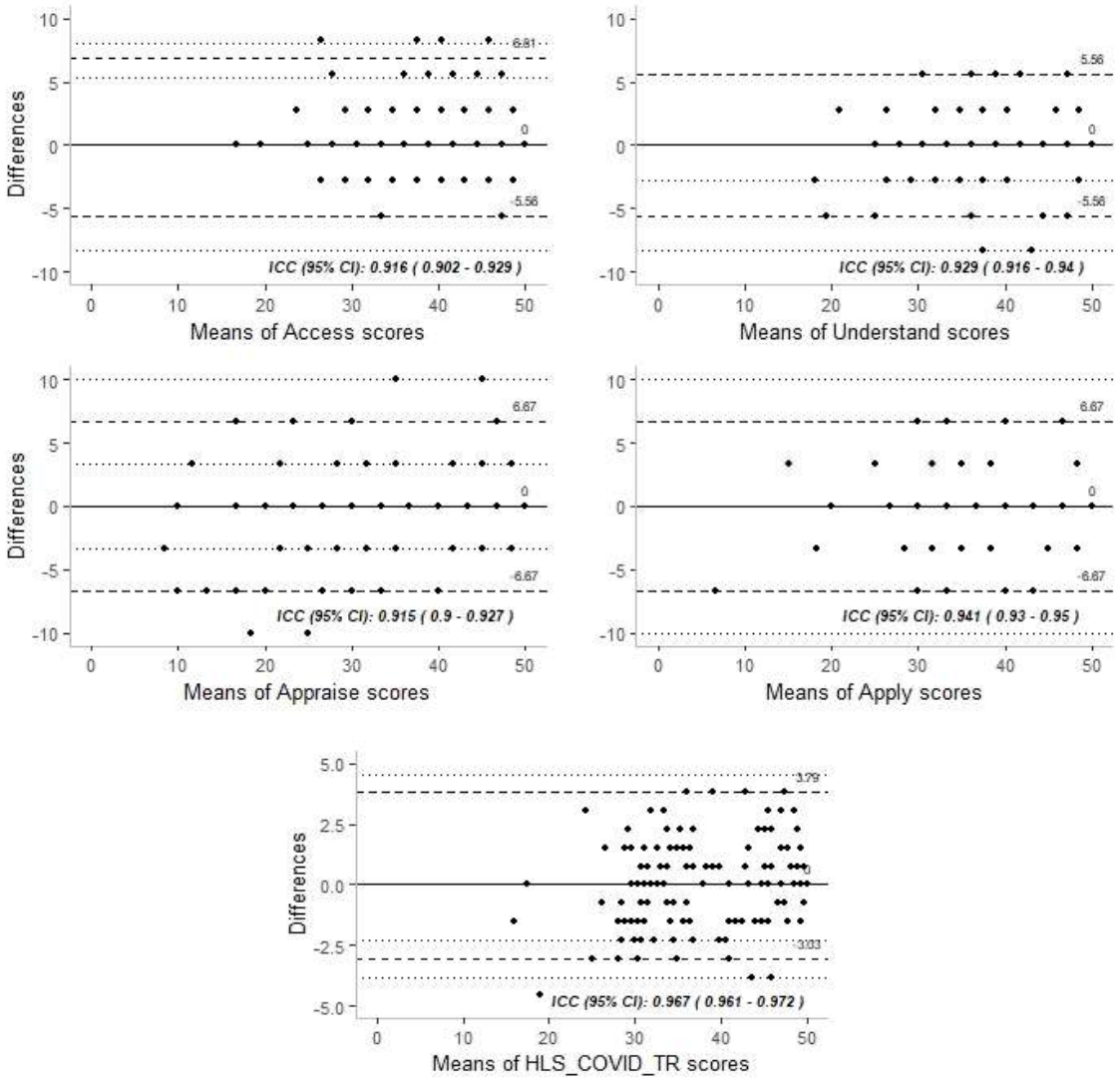


**Figure 4.** The Bland–Altman plots for the Coronavirus-related Health Literacy (sub)scale test and retest values based on nonparametric quantile estimators. *(The dashed lines represent the nonparametric limits of agreement and median of differences. The dotted lines represent 95% CI based on the binomial distribution)*

**Associations Between HLS-COVID-TR Scores and Other Factors:** Students had a median age of 20 years (min:18, max:38; Q1:20–Q3:22). Most students were women (86.1%). We used the cutoff values suggested by Okan et al. (25) for the HLS-COVID-TR total score and transformed scores on the transformed metric to mean scores on the original response format. A mean score of ≤2.5 (25.0) indicated inadequate HL. A mean score between >2.5 and <3 (25.0-33.33) indicated problematic HL. A mean score of ≥3 (33.33) indicated sufficient HL. Students had a median HLS-COVID-TR score of 37.1 (Q1:32.6–Q3:46.2). Most students had sufficient HL (71.8%; n=387). A quarter of the students had problematic HL (24.5%; n=132). The remaining students had inadequate HL (3.7%; n=20). Students who were mentally affected by the pandemic had a significantly lower HLS-COVID-TR score (Median:35.6; Q1:31.8–Q3:45.5) than those who were not (Median:38.6; Q1:33.3–Q3:47.0) ($p < 0.05$). Students who knew about the COVID-19 infection very well (Median:50.0; Q1:47–Q3:50) and those who had no confusion regarding the COVID-19 infection (Median:47.7; Q1:36.6–Q3:50) had high HLS-COVID-TR scores ($p < 0.001$) (Table 4). Though not shown in Tables, students who learned about COVID-19 from mass media (n=475; 88.1%), social media (n=442; 82.0%), and the sources of the Ministry of Health (COVID-19 guides and public service ads) (n=408; 75.7%) had sufficient HL (71.6%, 72.2%, and 72.3%, respectively).

**Table 4.** Demographic characteristics, COVID-19 and coronavirus-related health literacy levels (n=539).

| Variables | n (%) | HLS-COVID-TR levels | | | p* | HLS-COVID-TR scores | p** |
|---|---|---|---|---|---|---|---|
| | | Inadequate | Problematic | Sufficient | | Median (Q1-Q3) | |
| | | n (%) | n (%) | n (%) | | | |
| **HLS-COVID-TR** | 539 (100.0) | 20 (3.7) | 132 (24.5) | 387 (71.8) | - | 37.1 (32.5 - 46.2) | - |
| **Gender** | | | | | | | |
| Female | 464 (86.1) | 16 (3.4) | 118 (25.4) | 330 (71.2) | 0.361 | 37.1 (31.8 - 46.2) | 0.682 |
| Male | 75 (13.9) | 4 (5.3) | 14 (18.7) | 57 (76.0) | | 36.4 (33.3 - 47.7) | |
| **Grade level (year)** | | | | | | | |
| First | 153 (28.4) | 5 (3.3) | 37 (24.2) | 111 (72.5) | 0.282 | 37.1 (32.6 - 45.5) | 0.149 |
| Second | 152 (28.2) | 4 (2.6) | 32 (21.1) | 116 (76.3) | | 37.9 (33.3 – 47.0) | |
| Third | 124 (23.0) | 7 (5.6) | 27 (21.8) | 90 (72.6) | | 37.5 (31.3 - 47.7) | |
| Fourth | 110 (20.4) | 4 (3.6) | 36 (32.7) | 70 (63.6) | | 34.1 (30.3 - 44.9) | |
| **Mother's education** | | | | | | | |
| Primary education and lower | 358 (66.4) | 15 (4.2) | 92 (25.7) | 251 (70.1) | 0.590 | 37.1 (31.8 - 47) | 0.994 |
| High school education | 116 (21.5) | 2 (1.7) | 25 (21.6) | 89 (76.7) | | 36.4 (33.3 - 43.9) | |
| University and higher | 65 (12.1) | 3 (4.6) | 15 (23.1) | 47 (72.3) | | 35.6 (32.2 - 47.3) | |
| **Father's education** | | | | | | | |
| Primary education and lower | 245 (45.5) | 9 (3.7) | 58 (23.7) | 178 (72.6) | 0.940 | 36.4 (32.6 - 45.5) | 0.831 |
| High school education | 142 (26.3) | 6 (4.2) | 38 (26.8) | 98 (69.0) | | 37.1 (31.8 - 47) | |
| University and higher | 152 (28.2) | 5 (3.3) | 36 (23.7) | 111 (73.0) | | 36.4 (31.8 - 47) | |
| **Income status perception** | | | | | | | |
| Middle-income status | 315 (58.4) | 10 (3.2) | 81 (25.7) | 224 (71.1) | 0.236 | 35.6 (31.8 - 46.2) | 0.170 |
| High-income status | 95 (17.6) | 5 (5.3) | 15 (15.8) | 75 (78.9) | | 40.9 (33.3 - 47.7) | |
| Low-income status | 129 (23.9) | 5 (3.9) | 36 (27.9) | 88 (68.2) | | 35.6 (31.8 - 46.6) | |
| **The impact of the pandemic on life** | | | | | | | |
| Less socialization (Yes) | 452 (83.9) | 17 (3.8) | 117 (25.9) | 318 (70.4) | 0.217 | 36.7 (31.8 - 46.2) | 0.181 |
| Less physical activity (Yes) | 412 (76.4) | 16 (3.9) | 99 (24.0) | 297 (72.1) | 0.855 | 37.9 (32.6 - 47) | 0.264 |
| Weight-gain (Yes) | 213 (39.5) | 7 (3.3) | 56 (26.3) | 150 (70.4) | 0.694 | 36.4 (31.8 - 47) | 0.994 |
| Affecting my mental health | | | | | | | |
| Yes | 295 (54.7) | 15 (5.1) | 77 (26.1) | 203 (68.8) | 0.090 | 35.6 (31.8 - 45.5) | **0.026** |
| No | 244 (45.3) | 5 (2.0) | 55 (22.5) | 184 (75.4) | | 38.6 (33.3 – 47.0) | |
| **Informed about the COVID-19** | | | | | | | |
| Not well at all | 37 (6.9) | 1 (2.7) | 7 (18.9) | 29 (78.4)[a,b] | **0.001** | 42.4 (33.3 - 49.2) [a] | **< 0.001** |
| Not so well | 102 (18.9) | 5 (4.9) | 32 (31.4) | 65 (63.7)[b] | | 35.6 (31.1 - 47.2) [a] | |
| Undecided | 137 (25.4) | 11 (8.0) | 38 (27.7) | 88 (64.2)[b] | | 34.1 (29.9 - 43.2) [b] | |
| Well | 236 (43.8) | 3 (1.3) | 54 (22.9) | 179 (75.8)[a,b] | | 37.1 (33.3 - 46) [a] | |
| Very well | 27 (5.0) | 0 (0.0) | 1 (3.7) | 26 (96.3)[a] | | 50 (47 - 50) [a] | |
| **Confused about COVID-19 information** | | | | | | | |
| Yes, "very confused." | 45 (8.4) | 3 (6.7) | 7 (15.6) | 35 (77.8)[a,b,c] | **< 0.001** | 37.1 (33.3 - 47) [a] | **< 0.001** |
| Yes, "somewhat confused." | 232 (43.0) | 12 (5.2) | 81 (34.9) | 139 (59.9)[c] | | 33.3 (30.3 - 41.7) [a] | |
| No, "barely confused." | 194 (36.0) | 4 (2.1) | 40 (20.6) | 150 (77.3)[b] | | 39.8 (33.3 - 47) [a] | |
| Not confused at all | 68 (12.6) | 1 (1.5) | 4 (5.9) | 63 (92.6)[a] | | 47.7 (36.6 - 50) [b] | |

*Data were expressed as frequency and percentage or median (quartile 1- quartile 3). The transformed scores (0-50) with the formula [(mean of original response format [1-4] - 1)*(50/3)]) was used for the HLS-COVID-TR overall scores' descriptive statistics. When the mean score was "≤25," ">25.0 -<33.33," and "≥33.33," the health literacy levels were determined as "inadequate health literacy," "problematic health literacy," and "sufficient health literacy," respectively.*

**p-value was obtained from the Chi_square Pearson test for categorical comparisons.*

***p-value was obtained from the Mann-Whitney U test for variables with two categories or the Kruskal-Wallis test for variables with more than two categories. Bold face p-value<0.05.*

*[a,b] The groups shown by different letters were different with respect to HLS-COVID-TR overall scores/percentages.*

## DISCUSSION

The current COVID-19 pandemic caused by SARS-CoV-2 is associated with high mortality and morbidity. Almost all countries have allocated new ad hoc budgets and human power to health services to combat the pandemic (42). Low health literacy is associated with increased healthcare costs (10). Therefore, strategies for preventing COVID-19 are of paramount significance. Today, people can use the Internet and other applications to get information, which is rapidly accessible when and where needed. However, online users sometimes have difficulty accessing accurate and reliable information (4). This is also true for undergraduate students as they are bombarded with misinformation about the pandemic. They are also considered an at-risk group for COVID-19 (8). Therefore, they should be aware of infodemic and be able to access the right information and put it into practice. Some instruments measure general HL, but none focus on coronavirus-related HL. Okan et al. (25) developed the HLS-COVID-Q22

to measure the coronavirus-related HL of a German population aged > 15 years.

In the present study, the HLS-COVID-TR had the same items (n=22) and subscales (access, understand, appraise, and apply) as the original version. This result shows that the terminology of the THLS-32 and HLS-COVID-Q22 is consistent with the HLS-EU-Q. The CFA also revealed that the HLS-COVID-TR had the same factor structure as the original version. Each subscale of the HLS-COVID-TR had an internal consistency of higher than 0.90. The four subscales of the HLS-COVID-Q22 also have high internal consistency (access= 0.891; understand= 0.923; appraise= 0.922; apply= 0.962). The subscales of the HLS-COVID-TR had higher internal consistency values than those reported by Okan et al. (25). This result indicates that the HLS-COVID-TR can be used to measure health science students' coronavirus-related HL.

Almost three-quarters of the students had "sufficient HL" (71.8%), while a quarter of the students had "problematic HL" (24.5%). Okan et al. (25) reported that almost half the students had "sufficient HL." The high health literacy levels in the present study may be because the sample consisted of health science students. Adapting the HLS-COVID-TR to health science students can help healthcare professionals access the right information about COVID-19 and put it into practice.

Students who stated that they knew about COVID-19 very well had high HLS-COVID-TR scores, indicating sufficient HL. It is also noteworthy that students who had high HLS-COVID-TR scores were affected by infodemic the least. Papagiannis et al. (24) determined that almost nine in ten healthcare professionals had a good knowledge of COVID-19. The researchers also pointed out that the healthcare professionals with high knowledge scores had more positive attitudes towards preventive measures. Chung et al. (43) argue that we should focus on strategies that promote well-known hygiene practices and infection-specific HL during the COVID-19 pandemic. Okan et al. (25) found that adults with low HL experienced more confusion, which is consistent with our results. People who access the right information and use it properly have more positive health attitudes.

The COVID-19 pandemic has affected every sphere of social life, such as physical activities, sleep patterns, eating habits, and mental health. The pandemic has impacted college students significantly (16, 44, 45). Our students who were adversely affected by the pandemic had lower HL levels than those who were not. Peksoy-Kaya and Kaplan (16) also reported that almost half the nursing students were adversely affected by the pandemic. Nguyen et al. (7) argue that HL can be a protective factor on mental health and quality of life in people who have tested positive for

## CONCLUSION

The HLS-COVID-TR has the necessary psychometric properties for college students in Turkey. This study administered the scale to health science students because they will be working in healthcare institutions and providing care for people who have tested positive for COVID-19. After graduation, health science students will be responsible for accessing and conveying the right information, taking preventive measures, and being role models for society. Therefore, we can use the HLS-COVID-TR to assess students' coronavirus-related HL skills. In this way, colleges can revise their curricula and design interventions to help students with inadequate/problematic HL.

The scale consists of 22 items and four subscales (access, understand, appraise, apply). The items are rated on a four-point Likert-type scale. A mean score of ≤2.5 indicates "inadequate HL." A mean score of >2.5–<3 indicates "problematic HL." A mean score of ≥3 indicates "sufficient HL."

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