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## Abstract

Introduction: This study aims to establish the validity-reliability of the Turkish version of adult e-Healthy Diet Literacy Scale and to determine its relationship with the Health Literacy Instrument Scale (short-form), the Digital Healthy Diet Literacy Scale, and participants' characteristics. Material and Methods: Drawing on a methodological and descriptive design, this research was performed in two steps. It was conducted with 240 participants in the first step and 879 participants in the second step. The participants filled out the eHealthy Diet Literacy Scale, Health Literacy Instrument Scale (short-form), and Digital Healthy Diet Literacy Scale. The questionnaire form was sent to the participants online. Results: Cronbach's alpha coefficient for the 11-item e-Healthy Diet Literacy scale was found to be 0.555. There was a significant relationship between the Health Literacy Instrument Scale (short-Form) and age groups, educational level, occupations, marital status, BMI, weekly physical activity and chronic disease status. Conclusions: This study evaluated the Turkish validity and reliability of the e-HDL, which was originally designed in Taiwan as a valid and reliable tool to evaluate the individuals' ability to access, understand, appraise, and apply healthy diet information.



## Keywords

diet literacy; digital healthy; health literacy; scale





## Cover Page Footnote

The authors are grateful to all the people who contributed to the conducting of the study.

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*Article*

# Validity-reliability of the e-Healthy Diet Literacy Scale in Turkish adults

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## 1. Introduction

A healthy lifestyle is behavior-related and connected with the efforts and activities of individuals to protect and improve their health [1]. The literacy and education level of the society helps people raise their awareness, develop critical thinking skills about their sustainable health and transform them into behavior [2]. Health literacy is essential to provide behavioral changes within health improvement activities/programs. Health literacy is also considered an important component of public health and a crucial factor in public health strategies to protect people from disease [3, 2].

Health literacy is defined as the ability of individuals to find, understand, judge, and apply health information for the prevention and treatment of diseases throughout their lives [4, 5, 6]. Poor health literacy is associated with poor health decisions and outcomes. People with poor health literacy are unable to effectively communicate with their healthcare providers. By contrast, high health literacy helps people live a quality life [6].

Unhealthy eating behaviors have become a global problem, triggering many chronic diseases as they are increasing day by day. It is known that chronic diseases largely occur

due to lifestyle changes, except for aging [7]. For this reason, encouraging society to eat healthily is crucial for the development and protection of health [8].

Healthy diet literacy or food literacy emerged as a sub-dimension of health literacy [9]. Healthy diet literacy is recognized as a key part of the strategic plan to promote an individual's healthy eating behaviors and positive health outcomes. It is of paramount importance for an individual to evaluate their knowledge, skills, and behaviors about health to make healthy diet decisions, identify the level of need, plan diet, select, prepare and consume foods [10].

Internet, which is a means of accessing information in today's age, is a highly effective communication tool in delivering information to large masses. The active use of the Internet offers many advantages in the field of health, just like in any other field. Thanks to the Internet, it is now possible to access health-related information quickly and easily [4]. The Internet has been more popular as a means of accessing information including both written information, and audio and video sharing [11]. This research is particularly significant in that it will hopefully help health professionals, dietitians, and educators evaluate individuals' overall perspectives on health and diet. From this standpoint, this research aims to establish the Turkish validity and reliability of the e-Healthy Diet Literacy Scale and to determine its relationship with the Health Literacy Instrument Scale (short form), the Digital Healthy Diet Literacy Scale, and the participants' characteristics.

## 2. Materials and Methods

### *2.1. Location, time, and sample selection of the research*

This study aims to establish the Turkish validity and reliability of the e-Healthy Diet Literacy Scale and to determine its relationship with the Health Literacy Instrument Scale (short form) and the Digital Healthy Diet Literacy Scale. Drawing on a methodological and descriptive design, this research was carried out in two steps.

This research was conducted with individuals aged between 18–65 who reside in Turkey in October 2021. The participants took part in this research via electronic media. The survey link created through Google Forms was sent to the participants via social media (Instagram), WhatsApp groups, and e-mail. Data collection and analyzes were carried out in 2 stages. First of all, to perform the validity and reliability study of the scale, the number of the participants must be 20 times the sample size; therefore, 240 adults participated in this study. After ensuring the validity and reliability of the scale with 240 people, the relationship of the scale to other scales was analyzed in the second stage with 879 adults. Totally, 879 adults participated in this study voluntarily.

### *2.2. Ethics*

To adapt the e-Healthy Diet Literacy Scale to Turkish, Tuyen Van Duong, who designed this scale, was contacted via e-mail, and necessary permissions were obtained for the adaptation. The required data on the scale and its stages were provided by Tuyen Van Duong via e-mail. This research was approved by the Erzincan Binali Yıldırım University Human Research Ethics Committee (Date: 18.12.2020, Protocol No:11/26). The form containing information on this research was digitally sent to the participants and their consent was obtained.

### *2.3. Data collection tools*

#### 2.3.1. Questionnaire form

This form includes questions about the participants' socio-demographic characteristics (gender, age, education attainment, employment, marital status, physical activity status, health problems) and anthropometric measurements. The anthropometric measurements were obtained through participant statements (body weight and height).

2.3.2. e-Healthy Diet Literacy Scale

The e-Healthy Diet Literacy Scale was designed by Tuyen Van Duong et al. in 2020 [10]. The e-Healthy Diet Literacy Scale has 4 sub-dimensions, which are "Accessing", "Understanding", "Appraising" and "Applying." The Accessing sub-dimension was measured using a 5-Likert type scale anchored by 1 (never) to 5 (every day); the Appraising sub-dimension was measured using a 5-Likert type scale anchored by 1 (strongly dis-agree) to 5 (strongly agree); the Applying sub-dimension was evaluated using a 5-Likert type scale anchored by 1 (never) to 5 (always). The Understanding sub-dimension was evaluated through the options of yes/no/I don't know. The option "yes" was worth 5 points, whereas "no" or "I don't know" was worth 1 point. The total score from the scale is calculated by the sum of the scores of the answers given to all the items [10].

The English text created by the author of the scale was used in the language validity of the e-Healthy Diet Literacy Scale. The language validity process included 2 steps: the translation of the scale from English to Turkish and its back translation from Turkish to English [12]. In the first step, the scale was translated from English to Turkish by two different linguists who had a good command of both Turkish and English and were academicians. In the second step, the researchers discussed the scale questions, agreed on the appropriate expressions, and created the tool. Lastly, the text was back-translated into English by a professional translator whose native language is English. The scale that was back-translated into English was compared with the original English scale. There was no significant change identified in the meaning of the scale items, and the language validity of the scale was achieved.

The Davis technique was used for the content validity of the scale. After the scale, which was back-translated into English, was compared with the original, the resulting Turkish form was evaluated by 5 field experts in Turkey (including a professor in the field of public health nutrition, a public health specialist, a dietitian specializing in public health, a pharmacist and a communication specialist). Necessary revisions were per-formed with the rating criterion determined for the measurement value of each item, and the Turkish scale was finalized. According to the Davis technique, experts scored the relevance of the items as (1) "irrelevant", (2) "somewhat relevant", (3) "quite relevant", and (4) "highly relevant" [13]. In this technique, the number of the experts who marked (3) and (4) was divided by the total number of the experts, and the "content validity index" for the item was found to be 0.90.

To determine the comprehensibility of the scales in terms of language and meaning, the first translation and expert opinions were evaluated. Then, the final version of the scales was completed by 30 individuals who had similar characteristics with those who participated in the study but were not included. After the necessary revisions were made based on the feedback provided, the Turkish adaptation of the scale was completed.

2.3.3. Health Literacy Instrument-Short Form (HLS-SF12)

The Health Literacy Instrument-Short Form was developed by Duong et al. in 2019 [5]. The scale was adapted to Turkish by Yılmaz & Eskici (2021), and the internal consistency was found to be 0.856 [14]. The formula (Index = (Mean-1) × 50/3) was used to assess the scale. To calculate the mean, the total score on the scale was divided by the number of items on the scale. The index value calculated with the formula varying between 0 and 50, and a higher score indicated better health literacy, as stated in a similar study (2). The scale was of a 4-point Likert type ranging from 1 (very difficult) to 4 (very easy) and consisted of 12 items.

2.3.4. Digital Healthy Diet Literacy Scale

Healthy eating behaviors have gained more significance in supporting the immunity system, especially during the Covid-19 pandemic. The ability to access correct information is crucial for people to embrace healthy eating behaviors. Therefore, the Health Literacy

Instrument-Short Form was expanded with the "Digital Healthy Diet Literacy Scale," which includes four questions on diet and which was designed by Duong et al. in 2020 [8]. The scale was adapted to Turkish by Yılmaz & Eskici (2021), and the internal consistency was found to be 0.785 [14]. The formula (Index = (Mean-1) × 50/3) was used to evaluate the scale. The index value calculated with the formula varying between 0 and 50, and a higher score indicated better health literacy, as stated in a similar study (7). The scale had a 4-point Likert type ranging from 1 (very difficult) to 4 (very easy) and consisted of 4 items.

*2.4. Statistical analysis*

All data obtained from the research were analyzed through SPSS 22.0 and LISREL 5.53 statistical package programs. The Bartlett test was conducted to decide whether the data were relevant for factor analysis, and the Kaiser-Meyer-Olkin (KMO) test was per-formed for sample adequacy. Further, Explanatory Factor Analysis (EFA) was used to determine the construct validity of the scales, and Confirmatory Factor Analysis (CFA) was used to confirm the construct validity. Pearson's correlation analysis was carried out to analyze the correlation between the scores of the items and the total test scores. The relationship between the scale scores was investigated by calculating Pearson's correlation coefficient. Cronbach's alpha was calculated for internal consistency to determine the reliability of the developed scales.

The normality of the distribution of numeric variables was evaluated using the Kolmogorov-Smirnov test. Baseline characteristics for continuous variables were shown by mean (standard deviation) and percentage for categorical variables. The Independent Sample T-test or one-way Anova test was performed for continuous variables. The bivariate binary/multinomial logistic regression models and multivariate binary/multinomial logistic regression models (adjusted for age and gender) were used to analyze the potential association between e-Healthy Diet Literacy Scale, Health Literacy Instrument-Short Form, Digital Healthy Diet Literacy Scale, and participants' characteristics. The level of statistical significance was set at $p < 0.05$.

**3. Results**

The Kaiser-Meyer-Olkin (KMO) test was conducted to test whether the sample size was relevant for factor analysis. The analysis showed that the KMO value was 0.636. A KMO value greater than 0.50 indicates that the sample size is sufficient [15]. Also, the results of the Bartlett test of Sphericity show that the chi-square value was acceptable ($\chi^2(10) = 508.990$; $p < 0.05$). The e-Healthy Diet Literacy Scale, which includes 11 items in 4-point Likert type, was administered to 240 participants. The scale items were scored from 1 to 5 points. Explanatory factor analysis (EFA) was performed to determine the factorial structure of the scale and its validity. It was found that there were four factors with eigenvalues greater than 1 on the 11-item scale. The variances regarding the factors indicated that the scale was predominantly explained in 4 sub-dimensions. Therefore, the EFA was restricted to four factors and then reperformed. It was observed that 63% of the feature deter-mined by four factors was measured. Table 1 demonstrates the factor loadings, item-total correlations, and Cronbach's Alpha coefficient of 11 items, as revealed in the EFA. The results on the factor loads showed that all items had factor loads above 0.30. Also, it was ascertained that the factor loads of the items varied between 0.541 and 0.911 and the item-total correlations varied between 0.234 and 0.675. The Cronbach's alpha coefficient of the 11-item scale was found to be 0.555 and low reliability was obtained. Following the EFA, Confirmatory Factor Analysis (CFA) was performed to confirm the factorial structure of the scale. Since the assumption of multiple normalities between the items was not met, parameter estimation was carried out using the Asymptotic Covariance Matrix with the Robust Unweighted Least Squares-ULS method. The CFA yielded that t values of all items were found to be significant ($p < 0.05$). Hence, there was no need to remove any item from the scale.

**Table 1.** E-Healthy Diet Literacy Scale (e-HDL) factor loads, item total correlations, and Cronbach alpha confidence coefficient

| Factors | Items | Factor load | Item-total correlation | Cronbach alpha coefficient |
|---|---|---|---|---|
| Accessing | ***In the last year, how often have you …*** | | | 0.787 |
| | 1 – … searched for healthy eating information from into the internet during the last one year? | .826 | .647 | |
| | 2 – … searched for healthy eating information from an institutional/official website: public research institutes, governmental institutions, ministry of health, health promotion administration, hospital website, …? | .818 | .639 | |
| | 3 – … searched for healthy eating information from a non-institutional website: advertisement, commercial, blog, …? | .812 | .597 | |
| Understanding | ***The following information usually appeared on*** the ***internet; do you think it is correct that…?*** | | | 0.481 |
| | 4 – … "not eating starch can help achieve weight loss effect"? | .651 | .286 | |
| | 5 – … "to control blood sugar, you should try to avoid eating sweet fruit"? | .679 | .340 | |
| | 6 – … "if you worry about high cholesterol, you should try to avoid eating yolk"? | .541 | .254 | |
| | 7 – … "food additives are harmful to the human body"? | .606 | .234 | |
| Appraising | ***On the scale from 1 (totally disagree) to 5 (totally agree), to what extent could you say…?*** | | | 0.805 |
| | 8 – … the online healthy diet information provided from institutional channels is more trustworthy than that from noninstitutional channels? | .911 | .675 | |
| | 9 – … the online healthy diet information provided by dietitians, healthcare providers is usually more trustworthy than other sources? | .906 | .675 | |
| Applying | ***On the scale from 1 (never) to 5 (all the time), how often have you …?*** | | | 0.582 |
| | 10 – … ever posted your personal opinion on the incorrect healthy eating information on the internet? | .829 | .418 | |
| | 11 – … discussed with your health care professional the nutrition information you found? | .710 | .418 | |

A total of 879 individuals, including 259 (29.5%) men and 620 (70.5%) women, participated in this research. The participants' mean age was 31.6 ± 11.1 years old. There was a significant relationship between the Health Literacy Instrument Scale-Short Form and the age groups, educational level, occupations, marital status, body mass index, weekly physical activity, and chronic disease status ($p < 0.05$). A significant relationship was found between education levels and the Digital Healthy Diet Literacy Scale ($p < 0.05$). This study further found a significant relationship between e-Healthy Diet Literacy Scale (e-HDL) and gender, education level, occupation, weekly physical activity, and spending time on looking for nutrition information on the Internet ($p < 0.05$) (Table 2).

Those with a high score on the Health Literacy Scale-Short Form were more likely to have a master's degree or a higher degree (OR = 1.050, $p = 0.010$) and have a normal body structure (OR = 1.049, $p = 0.032$). Furthermore, these people were less likely to use YouTube to access information (OR = 0.967, $p = 0.026$). A high score on the Digital Healthy Diet Literacy Scale was associated with insufficient weekly physical activity (OR = 1.027, $p = 0.014$). Those with a high score on the e-Healthy Diet Literacy Scale were more likely to have a master's degree or higher (OR= 1.116, $p = 0.001$) and have a high risk of pre-obesity (OR = 1.060, $p = 0.042$). However, these people were less likely to be unemployed (OR = 0.894, $p < 0.001$), use Instagram to access information (OR = 0.958, $p = 0.026$,) and spend time looking for information about herbal treatments and cures on the Internet (OR = 0.928, $p = 0.001$) (Table 3–4).

**Table 2.** Psychological techniques to improve DS performance in competition

| Variables | Total | Health Literacy Scale-Short Form (HLS-SF) | *p* | Digital Healthy Diet Literacy Scale (DDL) | *p* | E-Healthy Diet Literacy Scale (e-HDL) | *p* |
|---|---|---|---|---|---|---|---|
| **Gender*** | | | | | | | |
| Male | 259(29.5) | 30.5±8.1 | 0.647 | 25.4±10.7 | 0.347 | 29.9±6.7 | **0.001** |
| Female | 620(70.5) | 30.8±8.6 | | 24.7±10.4 | | 31.5±6.6 | |
| **Age** | | | | | | | |
| 18–30 | 472(53.7) | 31.5±8.1 | **<0.001** | 24.6±10.2 | 0.066 | 31.1±6.7 | 0.990 |
| 31–44 | 275(31.3) | 30.7±8.6 | | 26.0±11.2 | | 31.0±6.6 | |
| 45–64 | 132(15.0) | 27.9±8.5 | | 23.5±9.8 | | 31.0±6.4 | |
| **Education attainment** | | | | | | | |
| Senior high school and below | 235(26.7) | 29.6±8.3 | **0.001** | 23.1±10.4 | **<0.001** | 29.8±6.5 | **<0.001** |
| Bachelor's degree | 530(60.3) | 30.7±8.2 | | 24.9±10.6 | | 31.0±6.5 | |
| Master's degree and above | 114(13.0) | 33.1±9.3 | | 28.4±9.4 | | 34.1±6.5 | |
| **Employment status** | | | | | | | |
| Healthcare employee | 172(19.6) | 32.0±8.8 | **0.012** | 26.4±10.2 | 0.100 | 33.9±6.4 | **<0.001** |
| Officer | 186(21.2) | 30.6±8.7 | | 25.6±10.6 | | 31.6±6.9 | |
| Student | 234(26.6) | 31.5±7.7 | | 24.7±10.1 | | 30.2±6.4 | |
| Not working | 105(11.9) | 28.8±8.8 | | 23.5±10.8 | | 29.1±6.3 | |
| Housewife | 72(8.2) | 29.7±8.5 | | 22.8±11.4 | | 31.3±5.6 | |
| Worker/Private sector | 110(12.5) | 29.5±7.9 | | 24.5±10.4 | | 29.4±6.5 | |
| **Marital status** | | | | | | | |
| Married | 393(44.7) | 30.2±8.6 | **0.029** | 25.3±10.4 | 0.414 | 31.4±6.4 | 0.154 |
| Never married | 453(51.5) | 31.3±8.0 | | 24.7±10.4 | | 30.8±6.8 | |
| Divorced | 33(3.8) | 28.1±10.1 | | 22.9±12.6 | | 29.4+6.9 | |
| **Body Mass Index (BMI – kg/m²)** | | | | | | | |
| Underweight (<18.5 kg/m²) | 40(4.6) | 28.8±9.9 | **0.012** | 23.2±11.5 | 0.412 | 29.1±7.4 | 0.104 |
| Normal weight (18.5–24.9 kg/m²) | 469(53.4) | 31.6±8.3 | | 25.3±9.8 | | 31.5±6.7 | |
| Overweight (25–29.9 kg/m²) | 261(29.7) | 30.0±7.8 | | 24.8±11.1 | | 30.9±6.4 | |
| Obese (>30 kg/m²) | 109(12.4) | 29.5±30.5 | | 23.8±11.2 | | 30.4+6.4 | |
| **Physical Activity Status*** | | | | | | | |
| Sufficient | 343(39.0) | 31.6±8.2 | **0.014** | 25.1±10.7 | 0.633 | 31.7±7.1 | **0.032** |
| Insufficient | 536(61.0) | 30.1±8.5 | | 24.7±10.4 | | 30.7±6.3 | |
| **Health problem/diagnosis*** | | | | | | | |
| Yes | 819(93.2) | 30.9±8.2 | **0.002** | 25.1±10.4 | 0.125 | 31.1±6.6 | 0.851 |
| No | 60(6.8) | 27.1±8.2 | | 22.1±9.5 | | 30.8±5.7 | |
| **The most used social media tool to access information** | | | | | | | |
| Google | 683(77.7) | 31.1±8.2 | 0.123 | 25.1±10.2 | 0.649 | 31.2±6.6 | 0.285 |
| Twitter | 22(2.5) | 30.8±9.9 | | 24.2±11.9 | | 31.8±6.9 | |
| YouTube | 86(9.8) | 29.2±8.2 | | 25.0±11.7 | | 30.5±6.4 | |
| Instagram | 88(10.0) | 29.4+9.6 | | 23.6±11.0 | | 29.9±6.8 | |
| **The most searched topic on nutrition on the Internet** | | | | | | | |
| Dietary treatments of diseases, recommendations | 115(13.1) | 30.3±9.2 | 0.279 | 24.3±10.2 | 0.848 | 32.7±7.1 | **0.010** |
| Treatments with herbal cures | 111(12.6) | 29.8±7.8 | | 25.4±10.7 | | 30.0±6.6 | |
| Healthy cooking | 332(37.8) | 31.4±8.7 | | 24.9±10.8 | | 31.4±6.5 | |
| Nutritional supplements | 97(11.0) | 31.3±8.1 | | 25.4±9.8 | | 29.7±7.1 | |
| Functional foods | 79(9.0) | 29.5+7.4 | | 25.6±10.4 | | 30.5±6.1 | |
| Diet programs | 145(16.5) | 30.7±8.4 | | 24.1±10.4 | | 31.0±6.1 | |

**Independent Sample T-Test, One-Way Anova Test, $p < 0.05$*

**Table 3.** Association between participants' socio-demographic characteristics and their Health Literacy Scale-Short Form and Digital Healthy Diet Literacy Scale via bi- and multivariate binary/multinomial logistic regression models (n = 879)

| Variables | Health Literacy Scale-Short Form (HLS-SF) | | | | Digital Healthy Diet Literacy Scale (DDL) | | | |
|---|---|---|---|---|---|---|---|---|
| | OR (95% CI) | *p* | OR (95% CI) | *p* | OR (95% CI) | *p* | OR (95% CI) | *p* |
| **Education attainment** | | | | | | | | |
| Senior high school and below | Reference | | Reference | | Reference | | Reference | |
| Bachelor's degree | 1.009(0.990–1.029) | 0.354 | 1.006(0.983–1.030) | 0.604 | 1.010 (0.994–1.026) | 0.213 | 1.012(0.993–1.028) | 0.217 |
| Master's degree and above | 1.031(1.001–1.062) | **0.044** | 1.050)1.012–1.090) | **0.010** | 1.031(1.006–1.056) | **0.015** | 1.021(0.992–1.050) | 0.165 |
| **Employment status** | | | | | | | | |
| Healthcare employee | Reference | | Reference | | Reference | | Reference | |
| Officer | 0.984(0.958–1.011) | 0.242 | 1.005(0.973–1.038) | 0.755 | 1.004(0.982–1.006) | 0.721 | 0.993(0.967–1.018) | 0.598 |
| Student | 1.004(0.979–1.030) | 0.745 | 0.998(0.965–1.032) | 0.912 | 0.995(0.974–1.016) | 0.622 | 1.005(0.978–1.032) | 0.744 |
| Not working | 0.967(0.937–0.998) | **0.039** | 0.989(0.954–1.026) | 0.535 | 0.998(0.972–1.024) | 0.864 | 0.989(0.960–1.019) | 0.458 |
| Housewife | 0.981(0.946–1.016) | 0.293 | 1.005(0.965–1.046) | 0.813 | 0.980 (0.952–1.008) | 0.158 | 0.979(0.948–1.010) | 0.184 |
| Worker/Private sector | 0.974(0.944–1.005) | 0.097 | 0.984(0.950–1.019) | 0.362 | 1.005(0.979–1.035) | 0.716 | 0.993(0.65–1.021) | 0.615 |
| **Marital status** | | | | | | | | |
| Married | Reference | | Reference | | Reference | | Reference | |
| Never married | 1.022(1.004–1.040) | **0.014** | 0.996(0.972–1.020) | 0.746 | 0.991(0.977–1.005) | 0.211 | 0.999(0.980–1.019) | 0.926 |
| Divorced | 0.981(0.938–1.025) | 0.395 | 0.984(0.942–1.029) | 0.486 | 0.991(0.956–1.028) | 0.644 | 0.983(0.948–1.019) | 0.346 |
| **Body Mass Index (BMI – kg/m²)** | | | | | | | | |
| Underweight (<18.5 kg/m²) | Reference | | Reference | | Reference | | Reference | |
| Normal weight (18.5–24.9 kg/m²) | 1.032(0.991–1.075) | 0.125 | 1.049(1.004–1.096) | **0.032** | 1.003(0.970–1.037) | 0.866 | 0.995(0.961–1.030) | 0.779 |
| Overweight (25–29.9 kg/m²) | 1.009(0.968–1.052) | 0.664 | 1.032(0.985–1.081) | 0.187 | 1.006(0.972–1.041) | 0.725 | 0.994(0.958–1.032) | 0.760 |
| Obese (>30 kg/m²) | 1.007(0.962–1.053) | 0.773 | 1.038(0.987–1.092) | 0.151 | 0.999(0.963–1.037) | 0.969 | 0.991(0.951–1.132) | 0.657 |
| **Physical Activity Status*** | | | | | | | | |
| Sufficient | Reference | | Reference | | Reference | | Reference | |
| Insufficient | 1.021(1.003–1.039) | **0.022** | 1.017(0.999–1.035) | 0.060 | 1.023(0.999–1.043) | 0.056 | 1.027(1.005–1.050) | **0.014** |
| **Health problem/diagnosis*** | | | | | | | | |
| Yes | Reference | | Reference | | Reference | | Reference | |
| No | 0.958(0.928–0.989) | **0.009** | 0.986(0.951–1.022) | 0.442 | 1.017 (0.976–1.056) | 0.423 | 1.017(0.971–1.064) | 0.483 |
| **The most used social media tool to access information** | | | | | | | | |
| Google | Reference | | Reference | | Reference | | Reference | |
| Twitter | 0.998(0.946–1.053) | 0.941 | 0.983(0.925–1.044) | 0.571 | 0.990(0.948–1.034) | 0.659 | 0.988(0.943–1.036) | 0.623 |
| YouTube | 0.973(0.946–1.001) | 0.055 | 0.967(0.939–0.969) | **0.026** | 1.010(0.986–1.033) | 0.427 | 1.004(0.980–1.028) | 0.735 |
| Instagram | 0.213(0.955–1.010) | 0.213 | 0.975(0.946–1.004) | 0.089 | 0.996(0.973–1.019) | 0.705 | 0.998(0.974–1.023) | 0.884 |
| **The most searched topic on nutrition on the Internet** | | | | | | | | |
| Dietary treatments of diseases, recommendations | Reference | | Reference | | Reference | | Reference | |
| Treatments with herbal cures | 0.991(0.959–1.025) | 0.607 | 0.997(0.961–1.035) | 0.892 | 1.023(0.996–1.052) | 0.100 | 1.021(0.991–1.052) | 0.179 |
| Healthy cooking | 1.017(0.990–1.045) | 0.220 | 1.019(0.989–1.049) | 0.218 | 1.006(0.984–1.028) | 0.580 | 1.008(0.984–1.032) | 0.531 |
| Nutritional supplements | 1.015(0.981–1.051) | 0.385 | 1.004(0.967–1.044) | 0.818 | 1.018(0.990–1.047) | 0.217 | 1.022(0.991–1.053) | 0.167 |
| Functional foods | 0.984(0.949–1.020) | 0.369 | 0.970(0.931–1.011) | 0.152 | 1.026(0.996–1.057) | 0.093 | 1.030(0.997–1.064) | 0.076 |
| Diet programs | 1.003(0.972–1.034) | 0.859 | 1.001(0.968–1.034) | 0.972 | 1.004(0.979–1.029) | 0.765 | 1.003(0.976–1.030) | 0.836 |

**Adjusted for age, and gender.*

**Table 4.** Association between participants' socio-demographic characteristics and their e-Healthy Diet Literacy Scale via bi- and multi-variate binary/multinomial logistic regression models (n = 879)

| Variables | e-Healthy Diet Literacy Scale (e-HDL) | | | |
|---|---|---|---|---|
| | OR (95% CI) | *p* | OR (95% CI)* | *p* |
| **Education attainment** | | | | |
| Senior high school and below | Reference | | Reference | |
| Bachelor's degree | 1.024(0.999–1.049) | 0.057 | 1.027(0.998–1.057) | 0.066 |
| Master's degree and above | 1.090(1.051–1.131) | **<0.001** | 1.116(1.066–1.169) | **<0.001** |
| **Employment status** | | | | |
| Healthcare employee | Reference | | Reference | |
| Officer | 0.947(0.916–0.979) | **0.001** | 0.961(0.922–1.001) | 0.056 |
| Student | 0.917(0.887–0.947) | **<0.001** | 0.931(0.892–0.971) | **0.001** |
| Not working | 0.898(0.863–0.935) | **<0.001** | 0.894(0.853–0.936) | **<0.001** |
| Housewife | 0.950(0.909–0.993) | **0.024** | 0.947(0.899–0.998) | **0.041** |
| Worker/Private sector | 0.900(0.865–0.936) | **<0.001** | 0.913(0.873–0.955) | **<0.001** |
| **Marital status** | | | | |
| Married | Reference | | Reference | |
| Never married | 0.986(0.965–1.007) | 0.187 | 0.987(0.958–1.018) | 0.406 |
| Divorced | 0.963(0.911–1.018) | 0.179 | 0.956(0.904–1.010) | 0.107 |
| **Body Mass Index (BMI – kg/m²)** | | | | |
| Underweight (<18.5 kg/m²) | Reference | | Reference | |
| Normal weight (18.5–24.9 kg/m²) | 1.046(0.995–1.101) | 0.079 | 1.054(1.000–1.111) | **0.049** |
| Overweight (25–29.9 kg/m²) | 1.036(0.984–1.056) | 0.182 | 1.060(1.002–1.122) | **0.042** |
| Obese (>30 kg/m²) | 1.029(0.972–1.088) | 0.326 | 1.044(0.981–1.111) | 0.177 |
| **Physical Activity Status*** | | | | |
| Sufficient | Reference | | Reference | |
| Insufficient | 0.994 (0.980–1.009) | 0.438 | 0.993(0.979–1.008) | 0.366 |
| **Health problem/diagnosis*** | | | | |
| Yes | Reference | | Reference | |
| No | 0.987(0.961–1.014) | 0.344 | 0.980(0.951–1.010) | 0.195 |
| **The most used social media tool to access information** | | | | |
| Google | Reference | | Reference | |
| Twitter | 1.017(0.952–1.086) | 0.614 | 1.050(0.974–1.131) | 0.202 |
| YouTube | 0.986(0.956–1.021) | 0.425 | 0.997(0.960–1.035) | 0.859 |
| Instagram | 0.976(0.943–1.011) | 0.172 | 0.958(0.922–0.995) | **0.026** |
| **The most searched topic on nutrition on the Internet** | | | | |
| Dietary treatments of diseases, recommendations | Reference | | Reference | |
| Treatments with herbal cures | 0.934(0.896–0.973) | **0.001** | 0.928(0.887–0.972) | **0.001** |
| Healthy cooking | 0.967(0.935–1.000) | **0.049** | 0.963(0.929–0.998) | **0.039** |
| Nutritional supplements | 0.926(0.887–0.967) | **<0.001** | 0.925(0.882–0.970) | **0.001** |
| Functional foods | 0.945(0.984–1.020) | **0.015** | 0.947(0.902–0.994) | **0.029** |
| Diet programs | 0.960(0.924–0.998) | **0.039** | 0.953(0.915–0.993) | **0.021** |

**Adjusted for age, and gender.*

Table 5 presents the correlations between the participants and their scores on the scale. It shows that the Health Literacy Instrument Scale (short form) had a statistically weak relationship with the Digital Healthy Diet Literacy Scale (0.34) and the e-Healthy Diet Literacy Scale (0.15). There was a significant but weak relationship between the Digital Healthy Diet Literacy Scale and the e-Healthy Diet Literacy Scale (0.24) as well.

The goodness of fit indices for the model-data fit of the four-factor 11-item scale are shown in Table 6. It can be said that the goodness of fit indices is within acceptable limits, and thus the four-dimensional structure of this scale is confirmed.

**Table 5.** The relationship between individuals' Health Literacy Scale-Short Form, Digital Healthy Diet Literacy Scale and E-Healthy Diet Literacy Scale scores

| | Health Literacy Scale-Short Form (HLS-SF) | Digital Healthy Diet Literacy Scale (DDL) | E-Healthy Diet Literacy Scale (e-HDL) |
|---|---|---|---|
| Health Literacy Scale-Short Form (HLS-SF) | 1 | | |
| Digital Healthy Diet Literacy Scale (DDL) | 0.347** | 1 | |
| E-Healthy Diet Literacy Scale (e-HDL) | 0.153** | 0.241** | 1 |

**Table 6.** Goodness of fit indices and reference values

| Goodness of fit indices | Construct Performance | Reference value * |
|---|---|---|
| $X^2/df$ | 39.69/38=1.04 | $1 < x^2/df < 5$ |
| GFI | 0.99 | >0.90 |
| CFI | 1.00 | >0.90 |
| NFI | 0.99 | >0.90 |
| NNFI | 1.02 | >0.90 |
| RFI | 0.98 | >0.85 |

*[*Ref: 16,17,18]. $\chi^2/sd$ – Chi-Square, RMSEA – Root Mean Square Error of Approximation, SRMR – Standardized Root Mean Square Residual, GFI – Goodness of Fit Index, CFI – Comparative Fit Index, NFI – Normed Fit Index, NNFI – Non-Normed Fit Index, RFI – Relative Fit.*

## 4. Discussion

The E-Healthy Diet Literacy Scale (e-HDLQ) was developed to evaluate individuals' ability to access, understand, appraise, and apply information about a healthy diet. The E-Healthy Diet Literacy Scale (e-HDLQ), with its reliability and validity ensured in Tai-wan, has been applied in various Asian and European countries [8]. This research has intended to establish the Turkish validity and reliability of the e-Healthy Diet Literacy Scale which includes 11-item in a 4-point Likert-type. The results on the factor loads showed that all items had factor loads above 0.30. Also, it was ascertained that the factor loads of the items varied between 0.541 and 0.911 and the item-total correlations varied between 0.234 and 0.675. Experts stated that the items with an item-total correlation of 0.30 and above were well-differentiated, and the items with a correlation between 0.20 and 0.30 could be tested when necessary [19]. Therefore, the item correlations of the scale in the "Understanding" sub-dimension were acceptable for the 4th, 6th, and 7th items. Nevertheless, the correlations of all the remaining items were well-differentiated. The Cronbach's Alpha coefficient of the 11-item scale was found to be 0.555, and low reliability was obtained. In the literature, the reliability of Cronbach's alpha coefficient is reported as follows: 0.40 and below – unreliable; 0.40–0.59 – low reliability; 0.60–0.79 – reliable, and 0.80–1.00 – highly reliable [13]. Following the EFA, Confirmatory Factor Analysis (CFA) was performed to confirm the factorial structure of the scale. Since the assumption of

multiple normalities between the items was not met, parameter estimation was carried out using the Asymptotic Covariance Matrix with the Robust Unweighted Least Squares-ULS method. The CFA showed that t values of all items were found significant ($p < 0.05$). There was no need to remove any item from the scale. In this study, the factor loads were between 0.45 and 0.82, and all above 0.40. A factor load higher than 0.40 is desired [20]. Duong et al. (2020) in Taiwan found the Cronbach's alpha value to be 0.64.

Health literacy aims to help people make health-related sound decisions and take appropriate actions to manage their health. The ability to access, understand, appraise and apply health-related information is essential in health care. This is also important for disease prevention and health promotion. However, it is affected by some factors [21, 22]. There was a significant relationship between the Health Literacy Instrument Scale-Short Form and age groups, educational level, occupations, marital status, body mass index, weekly physical activity, and chronic disease status ($p < 0.05$). The mean scores of the Health Literacy Scale were found higher in those aged 19–30, with a master's degree or a higher degree, working in the healthcare sector, single, with a normal BMI, with adequate physical activity levels, and with chronic diseases. Duong et al. [8] ascertained that the HL score was higher in women, those aged 31–44, with a master's degree or a higher degree, with a normal BMI, and with no health problems.

The Digital Healthy Diet Literacy Scale, which is intended to assess changes in eating behaviors among nursing and medical students during the COVID-19 pandemic at 10 state universities in Vietnam, refers to the ability to accessing, understanding, appraising, and applying information on a digital healthy diet to improve healthy eating behaviors and related health outcomes [8]. In this study, a significant relationship was found between the Digital Healthy Diet Literacy Scale applied to the general population aged 18–64 and the educational level ($p < 0.001$); those with a master's degree or a higher degree had higher scores.

Furthermore, this study found a significant relationship between the e-Healthy Diet Literacy Scale (e-HDL) and gender, education level, occupation, weekly physical activity, and spending time on searching for information in nutrition on the Internet. The mean scores of the e-Healthy Diet Literacy Scale were found higher in women, those with a master's degree or higher degree, serving in the healthcare sector, with adequate physical activity levels, and those who searched for "diet treatments and recommendations for diseases" on the Internet. In a study conducted (8), researchers ascertained that e-HDL score was significantly higher in women, those aged 18–30, those who have a master's degree or a higher level, who are single and do not have any health problems. Social media is a useful communication tool that facilitates accessing information about nutrition and diet [23]. People often search the Internet, especially looking for information about health. Duong et al. reported that individuals mostly do research on food safety and food therapy on the Internet [8].

Those with a high score on the Health Literacy Scale-Short Form were more likely to have a master's degree or a higher degree (OR = 1.050, $p = 0.010$) and have a normal body structure (OR = 1.049, $p = 0.032$). By contrast, these people were less likely to use YouTube to access information (OR = 0.967, $p = 0.026$). A high score on the Digital Healthy Diet Literacy Scale was associated with insufficient weekly physical activity (OR = 1.027, $p = 0.014$). Those with a high score on the e-Healthy Diet Literacy Scale were more likely to have a master's degree or higher (OR = 1.116, $p = 0.001$) and have a high risk of pre-obesity (OR = 1.060, $p = 0.042$). However, these people were less likely to be unemployed (OR = 0.894, $p < 0.001$), use Instagram to access information (OR = 0.958, $p = 0.026$), and spend time looking form information about herbal treatments and cures on the Internet (OR = 0.928, $p = 0.001$).

The Health Literacy Instrument Scale (short form) had a statistically weak relationship with the Digital Healthy Diet Literacy Scale (0.34) and the e-Healthy Diet Literacy Scale (0.15). There was a significant but weak relationship between the Digital Healthy Diet Literacy Scale and the e-Healthy Diet Literacy Scale (0.24) as well.

One of the limitations of the study is the fact that this was a cross-sectional study, and thus a causal association between HLS-SF, DDL, and e-HDL cannot be determined. Secondly, body weight and height measures were obtained through self-report, which may be a source of bias.

## 5. Conclusions

A healthy diet has not only preventive but also therapeutic effects on health. Today, the growing popularity of fast foods and an increased habit of eating out for several reasons, such as saving time, and the confusing information about nutrition on the Internet, have entailed the development of a valid and reliable method to evaluate people's knowledge and behaviors about healthy eating. This study evaluated the Turkish validity and reliability of the e-HDL, which was originally designed in Taiwan as a valid and reliable tool to evaluate the individuals' ability to access, understand, appraise, and apply healthy diet information. The Turkish version of the e-Healthy Diet Literacy Scale is intended for assessing the healthy diet literacy of individuals aged 18–65. The scores in all of the three scales were found higher in the participants with a master's degree or higher degree, a normal BMI, adequate physical activity, and chronic diseases. It further reports that the Health Literacy Instrument Scale (short form) has a statistically weak relationship with the Digital Healthy Diet Literacy Scale and the e-Healthy Diet Literacy Scale.

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