The Serbian Version of the eHealth Literacy Questionnaire (eHLQ): Translation, Cultural Adaptation, and Validation Study among Primary Healthcare users

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Branko Vujkovic[1*] MD, MSc; Voin Brkovic[2*] MD, ASS; Ana Paji?i?[1*] MD; Vedrana Pavlovic[2*] Dr med, Phd; Dejana Stanisavljevic[2*] Prof Dr Med; Dušanka Krajnovi?[3*] Prof Dr; Aleksandra Jovic Vranes[2*] Prof Dr Med

[1]Institute of Public Health of Sabac Sabac RS
[2]Medical Faculty University of Belgrade Belgrade RS
[3]Faculty of Pharmacy University of Belgrade Belgrade RS
[*]these authors contributed equally

Corresponding Author:
Branko Vujkovic MD, MSc
Institute of Public Health of Sabac
1 Jovana Cvijica
Sabac
RS

Abstract

Background: The increasing digitization of the health system requires the users of health services to have sufficient competence in the use of digital health (DH) technologies. As DH services are increasingly developing and becoming more interactive in Serbia and everywhere in the world, a comprehensive instrument for measuring digital health literacy (DHL) is needed.

Objective: The aim of this study was to translate, culturally adapt, and investigate the psychometric properties of the Serbian version of the eHealth Literacy Questionnaire (eHLQ), to evaluate DHL in the population of primary healthcare (PHC) users in Serbia, and to explore factors associated with their DHL.

Methods: The validation study was conducted in eight PHC centers in the territory of the Macva district in Western Serbia. A stratified sampling method was used to obtain a representative sample. Translation Integrity Procedure was followed to adapt the questionnaire to the Serbian language. The psychometric properties of the Serbian version of the eHLQ were analyzed through the examination of factorial structure, internal consistency, and test-retest reliability.. Descriptive statistics were calculated to determine participant characteristics. Differences between groups were tested by the students' t-test and analysis of variance. Univariable and multivariable linear regression analyses were used to determine factors related to eHealth literacy.

Results: A total of 475 PHC users were enrolled. The mean age was 51.0 ± 17.3 years (range 19–94 years), and most participants were female (69.1%).. Confirmatory factor analysis validated the seven-factor structure of the questionnaire. Values for fit indices IFI (0.955) and CFI (0.954) were above the cut-off of ? 0.95. The RMSEA value of 0.051 (0.047–0.055) was below the suggested value of ? 0.06. Cronbach's ? of the entire scale was 0.95, indicating excellent scale reliability., with the Cronbach ? ranging from 0.81 to 0.90 for domains. The ICC ranged from 0.63 to 0.82, indicating moderate to good test-retest reliability. The highest eHealth literacy mean scores were obtained for the understanding of health concepts and language (2.86 ± 0.32) and feel safe and in control domains (2.89 ± 0.33), The statistically significant differences for all seven eHLQ scores were observed for age, education, perceived material status, perceived health status, information and communication technology use, and occupation (except Domain 4). In multivariable regression models, ICT use and age under 65 years old were associated with higher values of all domain scores except the domain feel safe and in control for variable age.

Conclusions: This study demonstrates that the Serbian version of the eHLQ can be a useful tool in the measurement of DHL and in the planning of DH interventions at the population and individual level due to its strong psychometric properties in the Serbian context.

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Branko M. Vujkovic,[1] Voin Brkovic,[2] Ana Pajicic,[1] Vedrana Pavlovic,[2] Dejana Stanisavljevic,[2] Dusanka Krajnovic,[3] Aleksandra Jovic Vranes[2]

Affiliations

[1] Institute of Public Health of Sabac, Serbia

[2] Medical Faculty, University of Belgrade, Serbia

[3] Faculty of Pharmacy, University of Belgrade, Serbia

Abstract

Background: The increasing digitization of the health system requires the users of health services to

have sufficient competence in the use of digital health (DH) technologies. As DH services are increasingly developing and becoming more interactive in Serbia and everywhere in the world, a comprehensive instrument for measuring eHealth literacy (EHL) is needed.

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Results: A total of 475 PHC users were enrolled. The mean age was 51.0 (SD 17.3; range 19-94) years, and most participants were female (328/475, 69.1%).Confirmatory factor analysis validated the seven-factor structure of the questionnaire. Values for fit indices IFI (0.96) and CFI (0.95) were above the cut-off of ≥ 0.95. The RMSEA value of 0.05 (0.05–0.06) was below the suggested value of ≤ 0.06. Cronbach α of the entire scale was 0.95, indicating excellent scale reliability, with the Cronbach α ranging from 0.81 to 0.90 for domains. The ICC ranged from 0.63 to 0.82, indicating moderate to good test-retest reliability. The highest eHealth literacy mean scores were obtained for the *understanding of health concepts and language* (mean 2.86, SD 0.32) and *feel safe and in control* domains (mean 2.89, SD 0.33), The statistically significant differences for all seven eHLQ scores were observed for age, education, perceived material status, perceived health status, searching for

health information on the internet, and occupation (except Domain 4). In multivariable regression models, searching for health information on the internet and age under 65 years old were associated with higher values of all domain scores except the domain *feel safe and in control* for variable age.

Conclusions: This study demonstrates that the Serbian version of the eHLQ can be a useful tool in the measurement of EHL and in the planning of DH interventions at the population and individual level due to its strong psychometric properties in the Serbian context.

Keywords: eHealth; digital health; eHLQ; eHealth literacy; digital health literacy; primary healthcare; Serbia; Questionnaire; technology; communication;

Introduction

Background

The increasing digitization of the health system requires the users of health services to have sufficient competence in the use of digital health (DH) technologies. The use of DH technologies for health, also called eHealth, has brought a revolution in the way we diagnose and treat patients and take care of health. eHealth is also defined as “the use of information and communication technologies in support of health and health-related fields” [1].

eHealth is often presented as a possible solution for numerous challenges in the health system, including a lack of health personnel, an aging population, and the comorbidities of several chronic diseases [2].

Digital technologies can strengthen health systems, improve health financing and public health, and also increase the availability of health services to vulnerable groups. eHealth and the data obtained in this way are particularly useful for the prevention and control of chronic non-communicable diseases and care for the young, but also for the elderly and for preparing a better response to future emergencies and health risks caused by climate change [3]. Digital technologies can provide a new tool for educating patients and improving their health literacy [4]. Instead of being a passive participant in health care, eHealth solutions allow individuals to be active participants [5].

It is estimated that about half of all patients search for information about their health problems on the Internet before seeking professional advice [6]. It is believed that six out of 10 Europeans use the Internet to solve health concerns, and nine out of 10 trust the information they find [7]. This information can be wrong or incomplete, and if not critically evaluated, can lead to the adoption of behaviors that can potentially harm our health [8].

Today, digital spaces have become a central environment for communication and engagement, learning, and work, but also for disease prevention and health promotion. This has led

to the development of a new dimension of health literacy: the emergence of eHealth literacy (EHL). For the adequate implementation of eHealth services, the users of these services must be eHealth literate [9].

EHLcan be defined as “the ability to search, find, understand, and evaluate health information from electronic sources and apply the acquired knowledge to approaching or solving health problems” [10]. Good EHL is directly related to improving health outcomes, reducing healthcare costs, increasing users’ motivation to seek health information, better knowledge about chronic diseases, adopting preventive health behaviors, and better self-perception and care for one’s health [6–8].

As a superdeterminant of health, EHL has added significant complexity to the way users of health system services, health workers, and digital technologies interact. Health portals and telehealth systems have enabled service users to communicate remotely with service providers; cloud-based electronic health records have enabled patients to manage diagnostic data with clinicians; and wearable devices and apps have enabled users to self-manage their conditions. The increased complexity of interacting in the digital world requires additional skills and competencies from people using eHealth. However, with the increased complexity of the DH landscape, scholars have called for a more comprehensive view and have included elements related to users’ cognitive skills, communication elements, social and cultural context, or system-level attributes [11–13]. Some researchers talk about DH literacy, as an evolved concept of EHL and its impact on health, but if we take into account the existence of analog computing, EHL is definitely a more correct term,and as a relatively new area, it needs further research [14].

The coronavirus disease 2019 (COVID-19) pandemic has made it clear how important it is to have access to digital platforms. Digital technologies, such as mobile phones, have made it possible to quickly trace contacts, check symptoms, seek advice, obtain necessary information, and engage in public communication and education. Access to digital spaces is particularly important when

mobility is limited or when people live in rural or remote areas. Compared to traditional communication strategies, digital spaces support “accessibility and expansion of access to health information to diverse population groups, regardless of age, education, race or ethnicity, and location” and may encourage further development of health literacy [15, 16]. On the other hand, a meta-analysis by Estrella et al. showed that EHL is significantly related to sociodemographic, economic, and cultural factors [17].

The rapid transition to online health services and digital communication with health professionals due to the COVID-19 pandemic has accelerated the level of digital exclusion in certain population groups, such as those with low levels of electronic literacy or insufficient access to digital devices [18].

The benefits of digitization in healthcare may be unused due to unequal opportunities to use digital resources [19]. Recent studies have shown that EHL interventions have a positive effect on the health and health care of older adults, and therefore it is important to provide support and guidance to older adults to narrow the aging technology gap [20, 21].

Previous work

Regardless of the population of interest, the need for reliable Internet navigation is particularly important for health issues where the consequences of using poor quality, misleading, or false information are high [22]. By providing tools and resources to evaluate online health information and critically evaluate eHealth resources, we offer an opportunity to protect consumers from harm while empowering them [12, 13]. To provide relevant tools to help users navigate eHealth, an understanding of what healthcare users have at the outset, or their EHL, is required.

EHL is generally lower among older adults with chronic non-communicable diseases and is characterized by reluctance to change their usual healthcare routines, and concerns that mobile health apps will replace doctors’ visits. On the other hand, a study by Kouri et al. showed that mobile health innovations have the potential to help the elderly population manage chronic diseases more

effectively [22].

In the era of digitization of health systems, EHL is a significant predictor of an individual's health condition. As a determinant of health, EHL is important in the analysis of the health system of each country. Previous research has shown that a satisfactory level of EHL is needed for citizens to actively participate in making correct health decisions and participating in healthcare [23].

Study in the field of EHL has attracted the attention of a significant number of researchers, both in the field of healthcare and in other areas of public life. A low level of EHL exposes both the individual and an entire society to loss (health, economic, and social loss). Strategies to strengthen EHL should be developed as part of life-long learning skills, and healthcare professionals should embrace improving EHL as part of regular patient care activities [24].

To develop and implement strategies to strengthen EHL, an adequate instrument for measuring EHL is needed, which also allows evaluation of the effects of implementing those strategies on increasing EHL at the individual and population level [25]. The Serbian government prioritizes promoting healthcare and citizen health through digitization of services, as stated in the "Digitalization program in the healthcare system of the Republic of Serbia" [26]. This includes connecting facilities with advanced software for secure data exchange and enabling consumers to use information and communication technologies for health support, but it is also necessary to empower users of health services to "use information and communication technologies in support of health and health-related fields" [1, 26]. As eHealth services are increasingly developing and becoming more interactive in Serbia, and everywhere in the world, a comprehensive instrument for measuring EHL is necessary [27].

The eHealth Literacy Questionnaire (eHLQ) is currently licensed for use in more than 12 countries, and its ongoing translations and cultural adaptations indicate that the instrument is robust across various contexts [28]. However, the instrument has not yet been translated into Serbian.

Goal of this study

The aim of this study was to translate, culturally adapt, and investigate the psychometric properties of a Serbian version of the eHLQ, to evaluate EHL in the population of primary healthcare (PHC) users in Serbia, and to explore factors associated with EHL.

Methods

Study Design

This was a cross-sectional study conducted from April 1 to April 30, 2023, in eight state-owned PHC centers in the territory of the Macva district. Both qualitative and quantitative research methods were used in this study.

Data Collection

The participants of the study were PHC consumers who were recruited from PHC centers waiting rooms in eight local municipalities of the Macva administrative district in Western Serbia, who were over 19 years of age, with adequate cognitive abilities to fill out the questionnaire independently. We used a stratified sampling method. In the first step, the variable for stratification was the type of settlement. By dividing into urban and rural settlements, two strata were obtained. In the second step, the variable for stratification was the age of the respondents, and by dividing them into young, middle-aged, and older respondents, six strata were obtained. The selection of respondents was carried out proportionally to the size of the stratum. The required number of respondents to examine the psychometric properties of the EHL eHLQ was 475, as defined by the questionnaire's creator [28]. The criteria for exclusion from the research were respondents under 19 years of age, a health condition that prevented a respondent from filling out the questionnaire, if the Serbian language was not a respondent's first language, illiterate persons, and refusal of participation by a respondent.

Three trained examiners delivered paper-based questionnaires to all consumers of PHC who met the criteria for inclusion in the study at the PHC centers waiting rooms. Participants had to fill out the questionnaire at the PHC center. Because the topic of our study included digital use and literacy competencies, we chose to consistently administer paper-based questionnaires.

The data collection consisted of administering the Serbian eHLQ along with asking general questions about owning a digital device and seeking for health information on the Internet.

We also collected demographic data on participants' age, sex, education, work situation, and health status.

Ethical Considerations

Ethical approval was granted by the Ethical Review Board at the Medical Faculty, University of Belgrade (no. 17/IX-5) and the Ethics Committees of PHC institutions. Participation was voluntary and anonymous. All participants gave informed consent to participate in the study, and all data were anonymized. No compensation was offered to the respondents. All steps were managed according to the ethical principles described in the Helsinki Declaration [29].

The eHealth Literacy Questionnaire

The eHLQ contains 35 items on seven scales representing the eHealth Literacy Framework domains: using technology to process health information, understanding health concepts and language, ability to actively engage with digital services, feeling safe and in control, being motivated to engage with digital services, access to digital services that work, and digital services that suit individual needs. Each scale consists of four to six items on a 4-point Likert scale ranging from "strongly disagree" to "strongly agree." Scale scores range from 1 to 4, calculated on an index by averaging item scores within each scale with equal weighting. Each scale is presented separately, and no overall eHLQ score is calculated. Higher scores indicate higher abilities [28].

Translation, Cultural Adaptation, and Pretesting

The license to translate the English version of the eHLQ to Serbian (TE2203IG) was obtained from Swinburne University, Australia. As required by the eHLQ developers, we used the translation integrity procedure (TIP) to maintain equivalence between the original (English) and translated (Serbian) versions of the instrument while ensuring the linguistic and cultural appropriateness of the Serbian version. The process was further facilitated by using clear "item intent" descriptions [30, 31].

One of the eHLQ's developers (Lars Kayser) chaired the TIP process. The translation and adaptation team included two native Serbian forward translators (AM, RJ), one native English back

translator (DZ), a cognitive interviewer team, and academic professionals (BV, VB, AJV, AP), all fluent in Serbian and English. All three translators had excellent English and Serbian language skills. The translation and cultural adaptation process involved three steps:

(1) The original English eHLQ questionnaire was translated independently into Serbian by the two forward translators. The translators then used the item intent descriptions, which thoroughly explained the intent of each item and scale, as a guide when synthesizing their translations. During the following team discussion, the best statements for each item were chosen and combined to form the first version of the Serbian eHLQ.

(2) The first version of the Serbian eHLQ was back-translated by a native English-speaking translator who had never seen the original version of the instrument. The Serbian-to-English back-translation was then compared with the English version of the eHLQ, and the items were discussed by the team to achieve consensus on the preferred version of the Serbian eHLQ. The preferred Serbian eHLQ was then tested using cognitive interviews. Cognitive interviewing is valuable for ensuring accurate interpretations of items when translating and validating a questionnaire in another language and culture. The process of cognitive interviewing allows researchers to discover and correct items that are not interpreted as intended, thereby avoiding the future collection of inaccurate data. Cognitive interviewing does not require a large sample size, but the sample should represent demographic variety [31, 32].

Cognitive interviews were conducted with 20 adults (12 women) aged 27 to 63 (median 50) years, with varying educational backgrounds. The respondents were given a printed version of the questionnaire and were carefully observed while answering the items. The interviewer (BV, AP) then went through each item with the individual respondents, focusing on items the respondents appeared to find difficult. The main questions were as follows: “What were you thinking about when you were answering that item?” and “Can you tell me why you selected that answer?” Participants were encouraged to elaborate on their interpretations of the items. A protocol was used for making notes

during the interviews, which were also recorded, transcribed, and analyzed using a text summary [31].

Results from the cognitive interviews revealed that although most items were understood as intended, minor revisions were needed to clarify a few items and instructions. The following corrections were made throughout the Serbian eHLQ:

- The Serbian term “organizujem informacije o svom zdravlju” (organize my health information) was replaced by “upravljam informacijama o svom zdravlju” (manage information about my health) in Item 25.
- The Serbian term “u sisteme zdravstvenih tehnologija” (into health technology systems) was replaced by “u digitalne zdravstvene sisteme” (into eHealth systems) in Item 8.

When we reached an agreement on all formulations, the final version of the Serbian eHLQ was considered ready to be psychometrically tested.

Statistical Analysis

Descriptive statistics were calculated to determine participant characteristics. The psychometric properties of the Serbian version of the eHLQ were analyzed through the examination of factorial structure and internal consistency (reliability). Confirmatory factor analysis (CFA) was performed to confirm the original seven-dimensional structure of the eHLQ. The absolute goodness-of-fit of the seven-dimensional model was evaluated using the chi-square test (*P* values that are < .05 signify that a model may be a bad fit for the data, whereas values >.05 may render the model a good fit) and three additional fit measures: the comparative fit index (CFI), the incremental fit index (IFI) and the root mean square error of approximation (RMSEA). Values of CFI and IFI above 0.95 were considered adequate, whereas RMSEA values below 0.06 indicated an acceptable model fit. The CFA was conducted using Amos 21 (IBM SPSS Inc., Chicago, IL, 2012). To measure reliability, we assessed internal consistency and test-retest reliability. The internal consistency of the eHLQ was evaluated using Cronbach α coefficient (ranges from 0 to 1, with the latter meaning perfect

reliability). Test-retest reliability was evaluated using the intraclass correlation coefficient (ICC). Differences between groups were tested by the students' t-test and analysis of variance. Univariable and multivariable linear regression analyses were used to determine factors related to eHealth literacy. The results were expressed as linear regression coefficients (B) and their 95% confidence intervals (CI). All tests were two-tailed. $P < .05$ was considered statistically significant. The IBM SPSS 21 (Chicago, IL, 2012) package was used for these analyses.

Results

Demographic Characteristics of Participants

The Serbian version of the eHLQ questionnaire was completed by 475 primary healthcare users. The mean age of the participants was 51.0 (SD 17.3; range 19-94) years, and most participants were female (328/475, 69.1%). The majority of the participants were married (339/475, 71.4%) and had completed secondary education or higher (409/475, 86.1%). More than half of the participants (278/474, 58.6%) were employees, and 57.1% (266/466) of the sample did not have any longstanding illnesses. The perceived material status was bad in 10.5% (49/466), regular in 50.4% (235/466), and good in 39.1% (182/466). One-half of the participants (235/466, 50.4%) perceived their health as good to excellent, 35.2% (164/466) as regular, and 14.4% (67/466) as bad. A high percentage of participants owned digital devices (431/475, 90.7%), but 28.5% (133/466) did not search for any web-based information about health. The participants' demographics are summarized in Table 1.

Table 1. Participant demographics.

Variables	n (%)
Age	
<65 years	343 (72.2)
≥ 65 years	132 (27.8)
Sex	

Male	147 (30.9)
Female	328 (69.1)
Place of living	
City	313 (65.9)
Other	162 (34.1)
Education	
Incomplete secondary	66 (13.9)
Complete secondary	263 (55.4)
Higher education	146 (30.7)
Marital status	
Married	339 (71.4)
Single, separated, widowed	136 (28.6)
Occupation	
Employed	278 (58.6)
Unemployed	196 (41.4)
Perceived material status	
Very bad, bad	49 (10.5)
Neutral	235 (50.4)
Good, very good	182 (39.1)
Chronic disease	
Yes	200 (42.9)
No	266 (57.1)
Perceived health status	
Very bad, bad	67 (14.4)
Neutral	164 (35.2)
Good, very good	235 (50.4)
Digital device	
Yes	431 (90.7)
No	44 (9.3)
Searching for health information on the Internet	
Never	133 (28.5)
Rarely	271 (58.2)
Frequently	62 (13.3)

Descriptive statistics of eHLQ domain scores are presented in Table 2.

Table 2. eHLQ domain scores, internal consistency and test-retest reliability.

Domains	mean (SD)	Cronbach α	ICC (95% CI)
(1) **Using tech**nology to process health information	2.51 (0.33)	0.90	0.63 (0.22–0.82)

(2) Understanding of **health concepts** and language	2.86 (0.32)	0.81	0.79 (0.57–0.90)
(3) Ability to actively **engage** with digital services	2.71 (0.35)	0.90	0.82 (0.62–0.91)
(4) **Feel safe** and in control	2.89 (0.33)	0.82	0.81 (0.61–0.91)
(5) **Motivated** to engage with digital services	2.59 (0.41)	0.85	0.65 (0.26–0.83)
(6) **Access** to digital services that work	2.57 (0.45)	0.83	0.73 (0.43–0.87)
(7) Digital services that **suit** individual **needs**	2.55 (0.27)	0.89	0.81 (0.60–0.91)

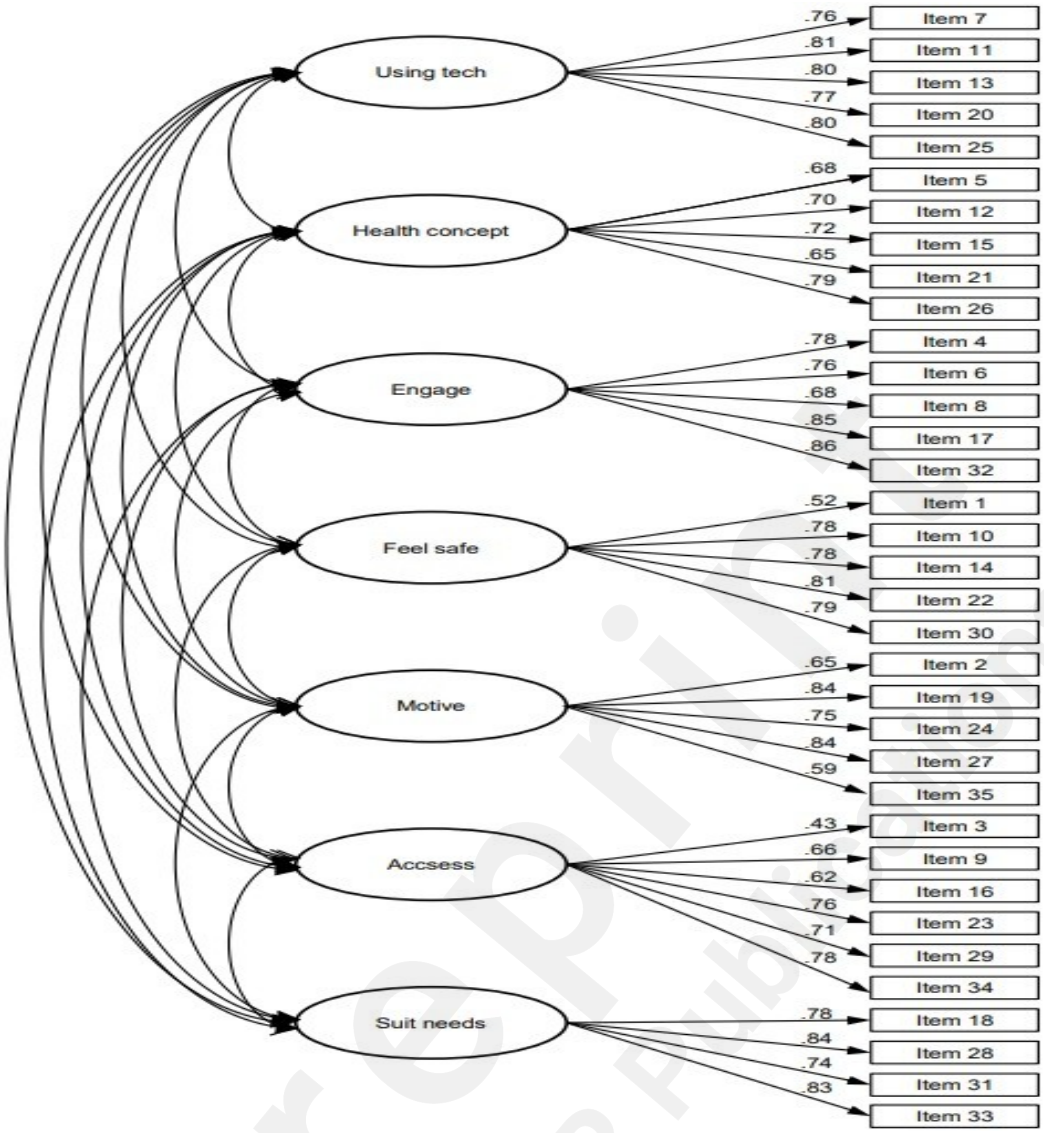
Abbreviations: CI = confidence intervals; ICC = intraclass correlation coefficient.

The highest eHealth literacy mean scores were obtained for the *understanding of health concepts and language* (mean 2.86, SD 0.32) and *feel safe and in control* domains (mean 2.89, SD0.33), while the lowest values were for *using technology to process health information* (mean 2.51, SD 0.33), *digital services that suit individual needs* (mean 2.55, SD 0.27), and *access to digital services that work* (mean 2.57, SD 0.45) domains.

Psychometric Properties

The seven-factor structure of the eHLQ has been validated with maximum likelihood confirmatory analysis, and the results demonstrated a good fit of the data to the hypothesized seven-factor model. The chi-square test rejected the seven-dimensional model (χ^2 = 1,001.9, P < .001), as we expected, due to the large sample size. Values for fit indices IFI (0.96) and CFI (0.95) were above the cut-off of ≥ 0.95. The RMSEA value of 0.05 (0.05–0.06) was below the suggested value of ≤ 0.06. All standardized factor loadings were statistically significant and ranged from 0.43 to 0.86 (see Figure 1).

Figure 1. Standardized factor loadings of the seven-factor structure of the eHLQ.



Analysis of the internal consistency of the Serbian version of the eHLQ showed that the Cronbach α of the entire scale (Items 1–35) was 0.95, indicating excellent scale reliability. The alpha coefficients of the seven domains were estimated to be 0.90 for Domain 1, 0.81 for Domain 2, 0.90 for Domain 3, 0.82 for Domain 4, 0.85 for Domain 5, 0.83 for Domain 6, and 0.89 for Domain 7. For the test-retest, 30 participants completed the retest, and the ICC ranged from 0.63 to 0.82, indicating moderate to good test-retest reliability. Test–retest reliability showed moderate agreement for two domains (ICC 0.63 and 0.65) and good agreement for five domains (ICC from 0.73 to 0.82) (Table 2).

The statistically significant differences for all seven eHLQ scores were observed for age,

education, perceived material status, perceived health status, searching for health information on the Internet, and occupation (except Domain 4). Participants under 65 years old scored higher in every eHLQ domain when compared with those over 65 years old. Female participants had higher scores than male participants in *using technology to process health information* and the *ability to actively engage with digital service* domains. No significant difference was obtained concerning marital status. Subjects with completed secondary education or higher showed a higher level of eHealth literacy compared to those with incomplete secondary education. Employed participants scored higher in every eHLQ domain when compared with the unemployed, except for Domain 4. Subjects with better-perceived material and health status showed a higher level of eHealth literacy (see Table 3).

Table 3. Associations among sociodemographic factors and eHLQ domain scores.

Variables	**Using tech** mean (SD)	**Health concepts** mean (SD)	**Engage** mean (SD)	**Feel safe** mean (SD)	**Motive** mean (SD)	**Access** mean (SD)	**Suit needs** mean (SD)
Age							
<65 years	2.66(0.58)	2.95(0.44)	2.96(0.52)	2.93(0.51)	2.70(0.56)	2.70(0.51)	2.71(0.57)
≥ 65 years	2.12(0.61)	2.61(0.44)	2.08(0.57)	2.78(0.49)	2.31(0.50)	2.24(0.46)	2.11(0.50)
t-test (*P*)	**<.001**	**<.001**	**<.001**	**.003**	**<.001**	**<.001**	**<.001**
Sex							
Male	2.42(0.64)	2.82(0.43)	2.55(0.67)	2.88(0.55)	2.54(0.58)	2.50(0.54)	2.50(0.61)
Female	2.55(0.63)	2.88(0.48)	2.79(0.65)	2.89(0.48)	2.61(0.57)	2.60(0.53)	2.58(0.61)
t-test (*P*)	**.04**	.21	**<.001**	.79	.27	.07	.10
Place of living							
City	2.55(0.63)	2.88(0.45)	2.77(0.65)	2.85(0.49)	2.58(0.57)	2.56(0.55)	2.58(0.62)
Other	2.43(0.65)	2.81(0.48)	2.60(0.68)	2.96(0.53)	2.59(0.57)	2.59(0.62)	2.49(0.60)
t-test (*P*)	.05	.12	**.007**	**.03**	.85	.52	.13
Education							
Incomplete secondary	2.45(0.68)	2.60(0.53)	2.22(0.71)	2.77(0.47)	2.38(0.55)	2.37(0.55)	2.22(0.69)
Complete secondary	2.55(0.64)	2.89(0.46)	2.71(0.64)	2.94(0.52)	2.64(0.59)	2.61(0.54)	2.59(0.60)
Higher education	2.56(0.57)	2.91(0.40)	2.93(0.56)	2.85(0.49)	2.60(0.53)	2.59(0.50)	2.62(0.55)
ANOVA (*P*)	**.001**	**<.001**	**<.001**	**.03**	**.005**	**.004**	**<.001**

Marital status							
Married	2.53(0.61)	2.85(0.47)	2.74(0.64)	2.86(0.51)	2.58(0.57)	2.57(0.53)	2.54(0.61)
Single, separated, widowed	2.47(0.69)	2.87(0.45)	2.66(0.73)	2.96(0.49)	2.61(0.59)	2.58(0.56)	2.55(0.64)
t-test (*P*)	.36	.67	.24	.06	.61	.76	.82
Occupation							
Employed	2.64(0.56)	2.94(0.44)	2.97(0.49)	2.92(0.52)	2.68(0.56)	2.70(0.50)	2.72(0.55)
Unemployed	2.33(0.69)	2.74(0.47)	2.35(0.72)	2.85(0.49)	2.46(0.57)	2.40(0.53)	2.31(0.63)
t-test (*P*)	**<.001**	**<.001**	**<.001**	.12	**<.001**	**<.001**	**<.001**
Perceived material status							
Very bad, bad	2.20(0.62)	2.53(0.49)	2.22(0.59)	2.59(0.57)	2.34(0.60)	2.23(0.48)	2.15(0.55)
Neutral	2.44(0.63)	2.82(0.45)	2.68(0.66)	2.88(0.47)	2.51(0.57)	2.54(0.54)	2.50(0.63)
Good, very good	2.65(0.62)	2.30(0.43)	2.89(0.64)	2.98(0.52)	2.73(0.54)	2.69(0.52)	2.69(0.57)
ANOVA (*P*)	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**
Perceived health status							
Very bad, bad	2.31(0.71)	2.70(0.52)	2.26(0.69)	2.81(0.51)	2.43(0.57)	2.36(0.51)	2.31(0.58)
Neutral	2.40(0.64)	2.76(0.50)	2.57(0.64)	2.83(0.52)	2.49(0.61)	2.46(0.55)	2.38(0.61)
Good, very good	2.63(0.59)	2.98(0.39)	2.94(0.59)	2.95(0.49)	2.70(0.53)	2.70(0.50)	2.72(0.59)
ANOVA (*P*)	**<.001**	**<.001**	**<.001**	**.02**	**<.001**	**<.001**	**<.001**
Searching for health information on the Internet							
Never	1.96(0.56)	2.60(0.48)	2.14(0.67)	2.78(0.53)	2.23(0.55)	2.28(0.53)	2.14(0.62)
Rarely	2.67(0.52)	2.96(0.40)	2.94(0.51)	2.93(0.50)	2.70(0.53)	2.67(0.48)	2.69(0.54)
Frequently	2.92(0.54)	2.95(0.51)	2.96(0.54)	2.96(0.50)	2.82(0.49)	2.72(0.54)	2.76(0.57)
ANOVA (*P*)	**<.001**	**<.001**	**<.001**	**.008**	**<.001**	**<.001**	**<.001**

Abbreviations: ANOVA = analysis of variance.

In multivariable regression models, searching for health information on the Internet and age under 65 years old were associated with higher values of all domain scores except the domain *feel safe and in control* for variable age (Table 4). Secondary education or higher was positively associated with the domain *understanding of health concepts and language* and *the ability to actively engage with digital services.* Domains of *ability to actively engage with digital services, motivation*

to engage with digital services, access to digital services that work, and *digital services that suit individual needs* were all negatively affected by chronic disease. Having a material status that was considered to be good or very good was associated with higher values of domains for *understanding of health concepts and language, feeling safe and in control, access to digital services that work,* and *digital services that suit individual needs.* Place of living and marital status were found to be negatively correlated to the *feel safe and in control* domain.

Table 4. Regression models of variables associated with eHLQ domain scores.

eHLQ domains	**B (95% CI)**	***P* value**
Using technology		
Searching for health information on the Internet	0.46 (0.37 to 0.54)	**<.001**
Age	0.29(0.17 to 0.40)	**<.001**
Health concepts		
Age	0.21 (0.11 to 0.30)	**<.001**
Searching for health information on the Internet	0.13 (0.06 to 0.20)	**<.001**
Material status	0.19 (0.06 to 0.33)	**.006**
Education	0.15 (0.02 to 0.27)	**.02**
Engage		
Age	0.61 (0.49 to 0.73)	**<.001**
Searching for health information on the Internet	0.29 (0.21 to 0.37)	**<.001**
Chronic disease	-0.17 (-0.27 to-0.06)	**.001**
Education	0.20 (0.06 to 0.35)	**.005**
Feel safe		
Material status	0.33 (0.18 to 0.48)	**<.001**
Place of living	-0.15 (-0.24 to-0.05)	**.003**
Searching for health information on the Internet	0.10 (0.03 to 0.18)	**.005**
Marital status	-0.13 (-0.23 to-0.03)	**.01**
Motive		
Searching for health information on the Internet	0.28 (0.20 to 0.36)	**<.001**
Chronic disease	-0.14 (-0.25 to-0.03)	**.01**
Age	0.16 (0.04 to 0.29)	**.01**
Access		
Age	0.28 (0.16 to 0.40)	**<.001**
Searching for health information on the Internet	0.16 (0.08 to 0.24)	**<.001**
Chronic disease	-0.11 (-0.21 to-0.01)	**.04**
Material status	0.16 (0.01 to 0.31)	**.04**
Suit needs		

Age	0.39 (0.26 to 0.52)	**<.001**
Searching for health information on the Internet	0.23 (0.15 to 0.32)	**<.001**
Chronic disease	-0.13 (-0.24 to-0.02)	**.02**
Material status	0.17 (0.003 to 0.34)	**.046**

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Discussion

Principal Findings

One of the primary goals of the digitalization program in the Republic of Serbia's healthcare system is to establish and support the development of a health system that places the patient at the center (also known as a "patient-centered approach"). More than eighty patient associations, organizations, and associations were contacted during the preparation of this document; and they acknowledged the benefits of digitization, but they also identified a number of needs and difficult aspects, such as the low levels of eHealth literacy of their members, as well as all patients in Serbia [26].

In this study, we used a well-defined translation and cultural adaptation process to reproduce the original instrument’s concepts and meanings. We evaluated the psychometric properties of the Serbian version of the eHLQ in the population of PHC users and explored factors associated with EHL. Our data from a sample of PHC users from urban and rural municipalities demonstrated that the Serbian eHLQ has strong psychometric properties and is in line with the psychometric outcomes of the versions in English and other languages [1, 27, 33, 34].

Based on previous recommendations for examining the validity of a translated instrument, this study used qualitative and quantitative approaches. During the first phase, we adopted TIP, which includes a multistep translation and review process and detailed item intent descriptions [30, 31]. Results of the cognitive interviews and several review board meetings resulted in our revising a few words that were considered problematic in a Serbian context; however, most items on the Serbian eHLQ were understood as intended, and its equivalence to the original and translated versions was maintained [28].

The overall findings of the study provide evidence for the good validity and reliability of the Serbian eHLQ. Confirmatory factor analysis validated the seven-factor structure of the questionnaire. According to the pre-established CFI, IFI, and RMSEA thresholds, the original seven-dimensional

model can be considered acceptable. Only the chi-square test revealed a bad fit for the seven-dimensional model analyzed due to the large sample size. All standardized factor loadings were statistically significant and ranged from 0.43 to 0.86. These findings are in accordance with previous validation studies conducted in other populations that confirmed the seven-factor structure of the questionnaire [1, 27, 28, 34].

Analysis of the internal consistency of the Serbian version of the eHLQ showed that the Cronbach α of the entire scale was 0.95, indicating excellent scale reliability. All scales demonstrated good internal consistency, with a Cronbach α of > 0.80, and ICC ranged from 0.63 to 0.82, indicating moderate to good test-retest reliability. The lowest value was for Domain 2, *understanding of health concepts and language* [27, 28, 33], which was consistent with Danish, Australian, Taiwan, and Swedish eHLQ validation studies.

The majority of the participants in our study were married and had completed secondary education or higher. More than half of the participants were employed and did not have any longstanding illnesses. Every 10th PHC user in our sample had a bad perceived material status, while half of the participants considered their health to be good to excellent. A high percentage of participants owned digital devices, but more than a quarter of the sample did not search for any web-based information about health, showing that patients with limited use of eHealth were well represented in the study sample.

The highest eHealth Literacy mean scores were obtained for Domain 2, *understanding of health concepts and language*, and Domain 4, *feel safe and in control*, while the lowest values were for Domain 1, *using technology to process health information;* Domain 7, *digital services that suit individual needs;* and Domain 6, *access to digital services that work*. The lowest scores were obtained for domains that depend mostly on interaction with DH services and the accessability of technology. This finding concurred with the results of a study by Garcia-Garcia et al. [8].

Previous studies have already shown that EHL significantly depends on sociodemographic

factors [7, 8, 17]. In our study, statistically significant differences for all seven eHLQ scores were observed for age, education, perceived material status, perceived health status, searching for health information on the Internet, and occupation (except Domain 4, *feel safe and in control*). Female participants had higher scores than male participants in Domain 1, u*sing technology to process health information* and Domain 3, *ability to actively engage with digital services.* Literature data on gender influencing EHL was inconclusive because some studies have positioned female gender as a protective factor while other studies have reported higher scores in male participants [8]. Based on previous research on EHL in Serbia, female gender has been consistently associated with better eHealth literacy across age-specific populations, and women tend to use more primary and specialized care compared to men [35].

Participants under 65 years old scored higher in every eHLQ domain when compared with those over 65 years old. Age-specific results are similar in other studies, which have stated that older age is associated with decreased adoption and usage of healthcare technologies and holds the most prejudice against them [1, 8, 36].

Subjects with completed secondary education or higher showed a higher level of eHealth literacy compared to those with incomplete secondary education, as in other studies [1, 7, 33, 36]. The population with completed secondary education or higher in our study had statistically significantly higher eHLQ scores, with the exception of Domain 4, *feel safe and in control*; Domain 5, *motivated to engage with digital services*; and Domain 6, *access to digital services that work*. People with lower education used eHealth less often [1, 34, 36]. However, having more education did not mean that the patients felt safer or had better access to eHealth. These results are consistent with some literature data, but the higher score could also be a result of a difference in interpretation between these two groups [1, 8, 33]. The Serbian version of the eHLQ could be a promising tool to understand digital access at different educational levels, as in other contexts [34].

No significant difference was obtained concerning marital status despite the study of Garcia-

Garcia et al., where those who were single, separated, or widowed scored significantly lower for Domain 1, *using technology to process health information*; Domain 4, *feel safe and in control*; Domain 5, *motivated to engage with digital services*; and Domain 6, *access to digital services that work*, indicating that people who are "alone" might face challenges in these areas [8].

Employed participants scored higher in every eHLQ domain when compared with the unemployed, except for Domain 4. The majority of jobs in contemporary society require good digital skills [34].

In our study, searching for health information on the Internet and age under 65 years old were associated with higher values of all domain scores except Domain 4, *feel safe and in control*, for variable age. Subjects with better-perceived material and health status were found to have a positive association with better DHL, with the exception of Domain 4, *feel safe and in control*. Domain 3, *ability to actively engage with digital services*; Domain 5, *motivated to engage with digital services*; Domain 6, *access to digital services that work*; and Domain 7, *digital services that suit individual needs* were all negatively affected by chronic disease. In line with the data from the literature, health status is one of the crucial determinants of healthcare technology adoption [8].

Although previous instruments, such as the Serbian version of the eHealth Literacy Scale, have focused on individuals' competencies, the eHLQ has the added perspective of interaction between the individual and the eHealth systems in Serbia [27, 35.

Limitations

Considering that this was a cross-sectional study, it is impossible to determine causality. Only associations can be interpreted from this data. Collected data may also be subject to errors due to subjective reporting or the selective memory of respondents. This study included only PHC patients from the Macva district of Western Serbia. Future testing of the Serbian eHLQ in different contexts in Serbia may strengthen the validity of the instrument.

Conclusion

The present study provided evidence for the appropriate metric properties of the Serbian version of eHLQ. Searching for health information on the Internet and age were factors influencing almost all scale domains. This study demonstrates that the Serbian version of the eHLQ can be a useful instrument in measuring EHL and in planning eHelth interventions at the population and individual level. It is a useful tool for understanding the socioeconomic determinants of digital access inequity. The Serbian eHLQ can represent a basis for further research, and its results could establish complex connections with the way users of health system services, health workers, and digital technologies interact, which will help policymakers evaluate and implement new eHealth interventions.

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Data availability statement

On behalf of the Questionnaire Licence Agreement, Swinburne University of Technology is the owner of the license for use of the Serbian version of the eHLQ, and if you would like to access this tool, please contact Ms. Kerrie Paulger at kpaulger@swin.edu.au.

All other data sets generated during and/or analyzed during this study are not publicly available due to Institute of Public Health of Sabac policy, but are available from the corresponding author on reasonable request.

Conflicts of Interest: None declared.

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Abbreviations

ANOVA	Analysis of variance
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence intervals
DH	Digital health
EHL	Electronic health literacy
eHLQ	eHealth Literacy Questionnaire
ICC	Intraclass correlation coefficient
ICT	Information and communication technology

IFI	Incremental fit index
PHC	Primary health care
RMSEA	Root mean square error of approximation
TIP	Translation integrity procedure

Supplementary Files

Untitled.
URL: http://asset.jmir.pub/assets/9efe1d25812e2ae2624a50a88e359759.docx

Tracked revision.
URL: http://asset.jmir.pub/assets/791ed63ace4d54dda0ad353b9300a222.docx

Figures

Standardized factor loadings of the seven-factor structure of the eHLQ.