

SHORT THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PhD)

Vaccination and COVID-related health literacy among the adult
Hungarian population

by Gabriella Mátyás

Supervisor: Dr. Éva Bíró



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By Gabriella Mátyás, Expert in Public Health (MSc degree)

Supervisor: Dr. Éva Bíró, PhD

Doctoral School of Health Sciences, University of Debrecen

Head of the Defense Committee:	Prof. Dr. Mariann Harangi, PhD, DSc
Reviewers:	Dr. Katalin Szendi, PhD Renáta Jávorné Dr. Erdei, PhD
Members of the Defense Committee:	Dr. András Terebessy, PhD Dr. Viktor Dombrádi, PhD

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Faculty of Medicine, University of Debrecen
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1. Introduction

1.1. The public health significance of vaccines and vaccination programmes

Public health considers the development of vaccines and the implementation of vaccination programmes as one of its greatest achievements. Vaccines have helped lower the mortality and morbidity from infectious diseases that previously resulted in disability or death. Since its launch by the World Health Organization (WHO) in 1974, the Expanded Programme on Immunization has prevented at least 154 million deaths worldwide and reduced the mortality rate among children under five by 40%. Its greatest successes have been the eradication of smallpox and the near-total elimination of polio, as well as reducing the number of measles-related deaths by 73% between 2000 and 2018. Infections caused by certain bacteria and viruses can also increase the risk of developing particular non-communicable diseases. According to some estimates, non-communicable diseases resulting from infections account for around 8% of the disease burden measured in disability-adjusted life years (DALYs).

Vaccination policies vary significantly between European countries. Broadly speaking, two models can be distinguished: mandatory and recommended vaccination policies. However, even in countries with a mandatory model, certain vaccines may be recommended, which allows for flexibility in addressing public health needs. Hungary's mandatory vaccination programme currently covers 12 infectious diseases, with a vaccination coverage rate of over 99%. Recommended vaccines for the general population include those against coronavirus disease 2019 (COVID-19), meningococcal C, human papillomavirus (HPV) and influenza.

Despite vaccines being highly effective at preventing infections, disabilities and deaths caused by vaccine-preventable diseases, the WHO listed vaccine hesitancy as one of the top 10 threats to global health in 2019. In 2018, the European Parliament also issued a resolution on declining vaccination rates and vaccine hesitancy. The pandemic has further strengthened anti-vaccination movements, with concerns about vaccine safety increasing due to the infodemic and rapid vaccine development. In Hungary, the mandatory vaccination model makes it difficult to obtain a realistic picture of the true level of anti-vaccination beliefs.

1.2. The role of health literacy in vaccine-related decisions

According to Sørensen et al., health literacy (HL) is defined as the knowledge, motivation, and competence that determine individuals' ability to access, understand, evaluate, and apply health information to make health-related decisions. The relationship between HL and the acceptance and uptake of vaccines is controversial; systematic reviews show mixed results, and the association depends on factors such as age, the disease that the vaccine is attempting to prevent and the questionnaire used to measure HL. The two different methods of measuring HL may also contribute to the unclear relationship between HL and vaccine-related decisions. HL can be measured using either objective (performance-based) methods, or subjective (self-assessed) methods. The tasks in performance-based HL questionnaires measure individuals' actual cognitive abilities. In contrast, in questionnaires measuring self-assessed HL, the individual themselves judges how easy or difficult they find health-related tasks. Subjective HL questionnaires are more sensitive to individual and cultural influences — such as social desirability or health-related beliefs — than objective tests.

The concept of vaccination literacy (VHL) evolved from HL. According to the most comprehensive definition, attributed to Lorini et al., VHL “is related to health literacy. It encompasses the knowledge, motivation, and competencies of individuals and communities to access, understand, critically evaluate, and apply information on immunisation, vaccines, vaccination programmes, and the organisational processes required to access vaccines.” Michel and Goldberg state that the main determinants of vaccine-related decision-making are HL and VHL. HL and VHL help individuals access and evaluate health- and vaccine-related information. VHL, like HL, can be measured both objectively and subjectively.

COVID-related health literacy (COVID-HL) assesses health-related decision-making in the context of the COVID-19 pandemic. It is essential for effective pandemic control as it assesses the competencies required to prevent infection, reduce transmission, and increase vaccine uptake. There are also two ways to measure COVID-HL: objective and subjective.

2. Literature review

2.1. Previous Hungarian studies on health literacy

Over the last decade, Hungarian researchers have become interested in HL and its measurement. Several studies have assessed HL at the population level. In 2015, data obtained using the NVS (Newest Vital Sign) and the HLS-EU-Q47 (the 47-item HLS-EU questionnaire

measuring HL) indicated that approximately 69% of the population most probably had adequate objective HL, as measured by the NVS scale. Meanwhile, 12% of the population had inadequate HL, while 19% had probably limited HL. Based on results measured using the HLS-EU-Q47 scale, approximately half of the sample (48%) had an adequate level of subjective HL, while 19% and 33% had insufficient or problematic levels, respectively. Among respondents with adequate HL, the proportion with excellent HL was very low (10%). In a cross-sectional study conducted in 2019, HL levels were assessed using the validated Hungarian versions of the NVS and BRIEF (Brief Health Literacy Screening Tool) questionnaires on a nationally representative sample of adults. Using the NVS, around half of the population (54%) had an adequate, while 17.9% had an inadequate and 28.1% had a probably limited level of objective HL. Using the BRIEF, only 29.8% of the population had adequate, while 34.3% had insufficient and 35.9% had marginal subjective HL.

In 2019, Hungary joined the M-POHL international network (the World Health Organization Action Network on Measuring Population and Organizational Health Literacy), which coordinates the development of various HL questionnaires and international surveys under the aegis of the WHO European Region. As part of the HLS₁₉ (the European Health Literacy Population Survey 2019–2021), led by M-POHL and using the HLS₁₉-Q12 (the 12-item HL scale of the HLS₁₉), the subjective HL levels of the population were assessed at the end of 2020. A sample of 1,205 people, representative of the Hungarian population, was used for this assessment. According to the results, 10.7% of the population had an inadequate, 30.4% had a problematic, 49.8% had an adequate, and 9.1% had an excellent level of subjective HL.

Prior to our study, no representative research had measured levels of VHL and COVID-HL in the adult Hungarian population. A questionnaire measuring parental HL — parents' skills relating to decisions concerning their children's health — also assessed parents' knowledge of vaccinations in Hungary. A study involving 430 households measured the VHL of Hungarian parents in 2017, focusing on the HPV vaccine. Subjective VHL was assessed in this study using the HLS-VAC scale, which was based on four items from the HLS-EU-Q47 questionnaire. Subjective HL was assessed using the HLS-EU-Q16 scale (the 16-item HLS-EU questionnaire). The results indicated that parents' VHL was adequate. Higher levels of HL were associated with higher levels of VHL and more favourable attitudes towards vaccination.

The subjective VHL level of the Hungarian population was retrospectively calculated based on data from a 2015 survey where the HLS-EU-Q47 scale was used. The results indicated that the VHL level of the adult population was problematic. Based on the results of two studies

conducted in 2015 and 2017, parents were found to have a higher VHL level than the general population. This phenomenon is likely due to the fact that parents facing health-related issues and decisions more frequently.

2.2. Previous Hungarian studies on vaccine confidence and vaccine hesitancy

In 2022, the level of vaccine confidence in Hungary was 41.3%. A growing gap in vaccine confidence levels can be observed between the 18–34 age group and those aged 65 and over. Vaccine confidence is generally higher among healthcare professionals than in the general population. In 2022, it was almost doubled (86.2%) compared to the general population in Hungary. A survey conducted in eight countries found that the acceptance rate of the COVID-19 vaccine was particularly low in Hungary (47%). A survey of the Hungarian population in 2021 revealed that 48.2% of respondents expressed their willingness to receive the COVID-19 vaccine. Among these respondents, those aged 59 and over, and those with higher educational level, were more willing to be vaccinated. Another Hungarian study found that supporters of the government, people aged 60 and over, and those who had recovered from COVID-19 were more likely to be vaccinated. A survey conducted during the first semester of the 2021–22 academic year found that the acceptance rate of the COVID-19 vaccine among Hungarian medical students (88.6%) was higher than in the general population.

2.3. Objectives

As it is highlighted above, HL plays a significant role in vaccine-related decisions and in the efforts to combat the COVID-19 pandemic. Before we started our research, several scales measuring HL had already been validated in Hungarian. These scales allowed us to assess various skills and competencies. However, the range of measurement scales was not comprehensive. For example, we did not have a suitable scale for measuring COVID-HL.

Neither VHL nor COVID-HL levels had previously been assessed at a population level in Hungary, although efforts had been made to assess parents' VHL. In order to evaluate these levels, we require validated measurement scales in Hungarian that have already been used in other international studies so that our results can be compared. Once these scales have been validated and the determinants of VHL and COVID-HL have been identified, it will be possible to plan interventions and provide population-level policy support for these specific forms of

HL. To address the previously mentioned research gap, we have formulated two main objectives for our research, to which we have also assigned specific sub-objectives:

1. Investigation of VHL among the adult Hungarian population

Objective 1.1: One of our objectives was to validate the Hungarian version of the HLS₁₉-VAC, a VHL questionnaire, which is used in international research.

Objective 1.2: A further objective was to use the validated questionnaire to determine the level of VHL among the adult Hungarian population using a representative sample.

Objective 1.3: We sought to identify the determinants of VHL among the adult Hungarian population.

2. Assessment of COVID-HL among the adult Hungarian population

Objective 2.1: Our objective was to determine the level of COVID-HL among the Hungarian population using a Hungarian version of the HLS-COVID-Q22 questionnaire that has already been used in international research.

Objective 2.2: A further objective was to identify the determinants of COVID-HL among the adult Hungarian population.

Objective 2.3: Another objective was to identify the factors influencing the uptake or refusal of the COVID-19 vaccine among the adult Hungarian population.

3. Methods

3.1. Assessment of vaccination literacy and validation of the questionnaire

3.1.1. Study design and sampling

As part of the HLS₁₉ project, we conducted a nationwide, cross-sectional survey of 1,205 people aged 18 and over, in accordance with the international protocols. The polling company responsible for data collection employed a multi-stage, proportionally stratified, probability sampling method. The first stratum of the sampling procedure consisted of regions, and the second consisted of settlement types. Specific settlements were selected from these strata using probability-proportional-to-size (PPS) sampling. Subsequently, the number of individuals to be included from each settlement type within each region was determined. The number of

individuals to be included in the sample from each settlement type within each region was then determined based on the proportion of the basic population in relation to the total adult population divided by region, as well as the proportion of each settlement type within the region. Once the individual settlements and the number of interviews to be conducted in each had been determined, telephone numbers were selected from the online public telephone book. A two-stage quota stratification was applied during the fieldwork. The first level was based on a combination of region and settlement type, and the second level comprised a four-dimensional quota matrix of sex, age group, education and settlement type.

3.1.2. Data collection

Due to the COVID-19 pandemic, data collection was carried out using computer-assisted telephone interviewing (CATI), conducted by a polling company in December 2020. The study was approved by the Medical Research Council Scientific and Research Committee (IV/10181-3/2020/EKU). In accordance with the Declaration of Helsinki, informed consent was obtained from all participants.

We collected data on several topics using a questionnaire compiled in accordance with the international HLS₁₉ protocol. Questions were asked about sociodemographic data, self-perceived health and social support, information-seeking behaviour on health topics, HL and VHL.

Sociodemographic data

In our study, we collected the following sociodemographic data: sex, age, education, childrearing, participation in health profession training, self-perceived social status, and financial deprivation. When processing the data, we defined three age groups: 18–35, 36–65, and over 65. The highest level of education was classified into four categories: primary education; secondary education without baccalaureate; secondary education with baccalaureate; and tertiary education. Self-perceived social status was measured using a 10-point Likert scale, with level 1 representing the lowest social status and level 10 representing the highest. According to the HLS₁₉ methodology, we classified social status as low for scores below 5 and acceptable for scores of 5 and above. To determine financial deprivation, we considered difficulties paying utility bills and necessary medical examinations, treatments, and medicines. Each question could be answered using a 4-point Likert scale, with response options ranging from “very difficult” to “very easy”. The resulting score ranged from 0 to 100, based on the combined percentage of “difficult” and “very difficult” responses. Accordingly, higher

scores indicated more severe financial deprivation, and scores above 50 were treated as “deprived” in the analysis.

Self-perceived health and social support

Self-perceived health was assessed using a 5-point Likert scale (1 – “very bad”, 5 – “very good”) based on a question from the European Health Interview Survey 2019 (EHIS2019). Self-perceived social support was assessed using the Oslo Social Support Scale, with scores below 8 indicating poor support, between 9 and 11 indicating moderate support, and above 11 indicating strong support.

Searching for information on health topics

We used multiple-choice questions – where the number of answers was not limited – to investigate the sources of information that respondents used to obtain information on health topics. The response options offered were: 1) healthcare professionals; 2) digital sources; 3) lay people; 4) written materials; 5) telephone information line; 6) complementary, alternative, or unconventional practitioners.

Health literacy and vaccination literacy

HL levels were assessed using the 12-item HLS₁₉-Q12 scale. Respondents were asked to select the option that best described them from a 4-point Likert scale for each question. This scale ranged from “very easy” to “very difficult”. The total score was calculated if respondents answered at least 80% of the questions. Scores ranged from 0 to 100 and were calculated as the percentage of “easy” and “very easy” responses; a higher score indicates a higher level of HL. The Hungarian version of the scale showed good internal consistency (Cronbach’s alpha: 0.82).

VHL was measured using the HLS₁₉-VAC scale, which assesses four aspects of information management regarding vaccinations, each with one item: How easy or difficult would you say it is to find information on recommended vaccinations for you or your family?; understand why you or your family may need vaccinations?; judge which vaccinations you or your family may need?; and decide if you should have a flu vaccination? Respondents were asked to answer these questions using a 4-point Likert scale, choosing from options ranging from “very easy” to “very difficult”. For valid responses, scores ranged from 0 to 100, calculated as the percentage of “easy” and “very easy” responses; a higher score indicates a higher level of VHL. Prior to the VHL survey, the polling company tested the comprehensibility of the Hungarian HLS₁₉-VAC scale on a sample of 30 people.

3.1.3. Statistical analysis

Validation of the questionnaire measuring vaccination literacy

We used the terminology of the COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) taxonomy to describe the measurement properties of the HLS₁₉-VAC scale. We measured the internal consistency of the HLS₁₉-VAC scale using Cronbach's alpha and analysed change in alpha when individual items were removed. We considered values between 0.7 and 0.95 to be acceptable in terms of reliability. The Spearman rank correlation was used to measure the relationship between the total HL and VHL scores, taking into account their range and distribution. We calculated the Spearman correlation coefficient (ρ) for both the total sample and the individual sociodemographic subsamples. We consider the correlation moderate if $\rho > 0.4$, and strong if $\rho > 0.6$.

Due to the COVID-19 pandemic, it was not possible to conduct a “test-retest” analysis using repeated data collection. Therefore, we calculated an alternative reliability measure, the Spearman–Brown correlation coefficients, via the “split-half” method. To do this, we randomly divided the items into two groups, calculating the possible scores for each group. We then used the corrected Spearman–Brown correlation coefficients to examine the correlation between the two groups' total scores. We considered the consistency to be moderate for values between 0.50 and 0.69, strong for values between 0.70 and 0.89, and very strong for values above 0.90. Furthermore, we examined the item-total correlations, considering values higher than 0.30 to be acceptable. As a sensitivity test, we also assessed the internal consistency of the HLS₁₉-VAC scale on individual subsamples. We examined the construct validity of the questionnaire using principal component analysis based on a polychoric correlation matrix, as this is better suited to analysing items measured on a 4-point Likert scale than traditional principal component analyses. We used the scree plot to determine the number of factors.

Statistical analyses of the vaccination literacy survey

We performed descriptive analyses on data weighted by age, sex, education, and place of residence, using a 95% confidence interval (95% CI). After checking the validity of the proportional odds assumption, we examined the relationship between the VHL and the sociodemographic variables, social support and self-perceived health using multivariate ordered logistic regression analysis. Due to the limited number of items ($n = 4$) and the resulting discrete score distribution (0, 25, 50, 75 and 100), the VHL score was treated as an ordinal variable in these analyses. We adjusted for self-perceived social status, childrearing and participation in health profession training in the

analyses. The results obtained were reported as odds ratios (OR) and 95% confidence intervals (95% CI). Statistical significance was defined as a p-value of less than 0.05.

Data analysis was performed using the “survey data analysis” module of the Stata/IC 16 statistical package, SPSS 26.0 software, and R version 4.4.3.

3.2. Assessment of COVID-related health literacy

3.2.1. Study design and sampling

A total of 1,200 Hungarian adults took part in the survey. A polling company drawn the sample using a probability sampling method to ensure it was representative of the Hungarian population aged 18 and over who do not live in institutional care and have their permanent residence in Hungary. The sample was based on the latest census data from the Hungarian Central Statistical Office to reflect the national distribution of sex, age groups, regions, and settlement types. In proportionally stratified probability sampling, the stratification process began with the selection of settlements to ensure representativeness of settlement types in Hungary. Within each region, the number of individuals included in the sample was determined by the population proportions.

3.2.2. Data collection

A polling company collected the data using CAPI (computer-assisted personal interviewing) in January and February 2022. The study was approved by the Medical Research Council Scientific and Research Committee (IV/184-1/2022/EKU). Informed consent was obtained from participants in accordance with the Declaration of Helsinki.

To ensure the comparability of the data, questionnaires from several international studies were used to create our own set of questions. Data were collected on sociodemographic variables, self-perceived health and social status, information-seeking behaviour on health topics, COVID-19 infection and associated risk assessment, COVID-HL, and willingness to be vaccinated against COVID-19.

Sociodemographic characteristics and self-perceived health related data

Sociodemographic characteristics were assessed using the following categories: age; sex (male or female); education level (primary education; secondary education; and tertiary education); childrearing; participation in health profession training; type of settlement (capital, city with county rights, town, and village); employment status (active, unemployed, retired,

student); number of family members living together; and partnership/relationship (single living alone; single living in a shared household; living with a legal partner in a shared household; with a legal partner but not cohabiting). Self-perceived social status and health were measured as described in Section 3.1.2. Respondents were asked to rate their subjective perception of family wealth on a scale of 1 to 5, where 1 represented a “very good” situation and 5 represented a “very bad” situation.

Information sources, coronavirus infection and risk perception

We employed multiple-choice questions without limiting the number of answers to investigate the sources of information respondents used to inform themselves about COVID-19. The response options offered were: 1) healthcare professionals; 2) official websites or spokesperson; 3) television or radio; 4) digital sources; 5) international sources, such as the WHO; 6) lay people; 7) written materials; 8) telephone information line; 9) complementary, alternative, or unconventional practitioners; 10) celebrities or influencers; and 11) not seeking information from any source. In a separate question, we asked respondents to select the sources of information they trusted most from this list, allowing them to select a maximum of three options. The 12th response option here was “I don’t trust any of them”.

Among the questions relating to COVID-19 were those asking whether the respondent had had an infection or knew anyone who had. We provided the following response options: (i) confirmed with mild symptoms; (ii) confirmed with severe symptoms; (iii) had similar symptoms but was not tested; or (iv) probably not. (There was no requirement for the test to be carried out by a healthcare professional.) We used a multiple-choice question to assess respondents’ views on whether they were at an increased risk of contracting COVID-19: (i) yes, because of my age; (ii) yes, because I have a chronic disease/I’m overweight; (iii) yes, because of my job; (iv) no; or (v) I don’t know.

COVID-related health literacy

We used the Hungarian version of the HLS-COVID-Q22 questionnaire to assess COVID-HL in the general population. This scale comprises 22 items which were developed based on the HLS-EU-Q16 questionnaire, adapted for COVID-19 and supplemented with six additional questions. Responses to the questions are given on a 4-point Likert scale (1 – “very difficult”, 4 – “very easy”). The mean of the responses indicates the level of COVID-HL, where a higher mean corresponds to a higher level of COVID-HL. In line with the original German study, we used the following categories to determine the level of COVID-HL: the mean response of ≤ 2.5 is “inadequate”, the mean of $> 2.5 - < 3$ is “problematic”, and the mean of $\geq$

3 is “sufficient”. In the original German study, levels of COVID-HL were determined based on the categories of the HLS-EU-Q16 questionnaire (inadequate, problematic, sufficient, and excellent), but during the analysis, the sufficient and excellent categories were combined to form a “sufficient” category. For the binary logistic regression analysis, these three groups were reclassified into two categories: “inadequate–problematic” and “sufficient” COVID-HL. The Cronbach’s alpha value of the original study was an excellent 0.94, while that of the version used here was 0.95.

Willingness to be vaccinated

We also asked respondents about their intentions to get vaccinated against COVID-19 (yes, no, or undecided). We then examined the reasons why those who answered “no” or “not yet decided” to the above question would refuse the COVID-19 vaccine. The following response options were offered: 1) I’m concerned about the long-term effects of the vaccine that are yet unknown. 2) I’m afraid of the side effects of the coronavirus vaccine. 3) I don’t trust vaccines generally. 4) There is a low risk of me becoming seriously ill from the coronavirus. 5) The likelihood that I will catch the coronavirus is low. 6) They exaggerated the impact of the coronavirus. 7) I don’t think the vaccine would prevent me from catching the coronavirus. 8) Due to my condition, the vaccine is not safe for me. 9) Herd immunity will protect me even if I don’t get vaccinated. 10) I’m protected because I have already had the infection. 11) I don’t trust the authorities that approve vaccinations. 12) It’s impossible/hard for me to go and get the vaccine. 13) Other. Respondents could select more than one answer.

In our questionnaire, we also asked respondents to state their reasons for deciding to get vaccinated against COVID-19. They could choose from the following options: 1) So that I don’t get infected or become seriously ill. 2) So that I can return to my normal family and community life. 3) To protect others from infection. 4) Because the protection against the epidemic won’t be effective until the majority of the population is vaccinated. 5) Because there is an increased risk of transmitting the infection during my work. 6) Because I usually take the recommended vaccinations. 7) So that I can feel safe again when I leave my home. 8) So that my child’s studies are not affected by my infection. 9) So that I can return to work. 10) I wouldn’t get the vaccine. 11) Other.

Finally, using a multiple-choice question, we examined the circumstances under which respondents who had previously selected “no” or “I haven’t decided yet” regarding the COVID-19 vaccination would nevertheless decide to get vaccinated. The following response options were provided: 1) It would be convincingly demonstrated that the vaccination reduces the risk

of contracting the coronavirus. 2) It would be convincingly demonstrated that the vaccination reduces the risk of serious illness. 3) It would be convincingly demonstrated that the vaccination is safe. 4) If it were convincingly proven to me that the risk of side effects from the vaccination is low. 5) The scientists would recommend that I get vaccinated. 6) Healthcare workers would recommend that I get vaccinated. 7) I would have easy access the vaccine at home or at work. 8) I would need a protection certificate. 9) I would receive a gift or compensation in return. 10) I could participate in a raffle. 11) It would be compulsory. 12) I wouldn't get the vaccine in any case. 13) Other.

3.2.3. Statistical analysis

We examined the relationship between sociodemographic and health-related variables, risk perception, the consulted and trusted sources of information, and willingness to be vaccinated, by using statistically weighted frequencies (%) by age, sex, education, and settlement type, with the corresponding 95% confidence intervals (95% CI). Using multivariate binary logistic regression, we examined the determinants of COVID-HL and the relationship between it and willingness to vaccinate, adjusting for the following variables: age, sex, education, health profession training, settlement type, number of family members living together, partnerships, employment status, social status, childrearing, subjective family wealth, and self-perceived health. The assumptions of the logistic regression analysis were met. The data were analysed using the “survey data analysis” module of Stata/IC 16 statistical software.

4. Results

4.1. Assessment of vaccination literacy and validation of the questionnaire

4.1.1. Characteristics of the sample

The mean age of the respondents was 48.0 years. The youngest respondent was 18 years old, and the oldest was 91 (standard deviation, SD: 17.5 years). The sample was marked by a slight female majority (53%). The 36–65 age group was the most represented (53%). The largest proportion of respondents (62.5%) had completed secondary education. More than 70% of respondents rated their social status as normal. Almost a third of respondents (34.9%)

experienced financial deprivation, while nearly half rated their health as (very) good, and a similar proportion reported a moderate level of social support.

4.1.2. Searching for information on health-related topics

Almost half of the respondents (49.7%) used digital sources to find information on health-related topics, while healthcare professionals were cited as the second most frequently used source of information (31.6%). Respondents were least likely to turn to complementary, alternative, or unconventional practitioners (0.9%) or telephone information lines (0.4%) for health-related information.

4.1.3. Validation of the vaccination literacy questionnaire

The Cronbach's alpha value, which measures internal consistency, was 0.78. Meanwhile, the "split-half" reliability, which was calculated using the Spearman–Brown correlation coefficient, was 0.725 for the entire sample. The Cronbach's alpha values for the individual subsamples were close to that obtained for the total sample, except for the group aged 65 and over (0.51). Spearman–Brown correlation coefficient values ranged from 0.601 for the childless group to 0.874 for the group with children. The Cronbach's alpha value could be slightly improved by removing the final item ("decide if you should have a flu vaccination"). Item-total correlation coefficients exceeded the minimum acceptable level (0.30) in all cases. The lowest value (0.74) was found for the final item ("decide if you should have a flu vaccination"), and the highest (0.82) for the third item ("judge which vaccinations you or your family may need").

Analysis of the scree plot confirmed the feasibility of a one-factor analysis. During the principal component analysis, one factor was identified that explained 69% of the variance. Factor loadings ranged from 0.73 for "decide if you should have a flu vaccination" to 0.89 for "understanding why you or your family may need a vaccine" and "judge which vaccinations you or your family may need". The uniqueness values ranged from 0.21 to 0.47, indicating that most of the variance between the items was explained by a common factor.

A statistically significant correlation was found between HL and VHL scores in the total sample ($\rho: 0.41, p < 0.001$) and in all subsamples. This suggests that individuals with higher HL levels are more likely to have higher VHL levels. The strongest correlation found between HL and VHL in our study was a moderate positive correlation ($r = 0.49, p < 0.001$) in the subsample having primary education. The weakest correlation between the two variables was found

in the sub-sample of individuals who had tertiary education ($r = 0.32$, $p < 0.001$), indicating a weak positive correlation between HL and VHL levels.

4.1.4. Levels and determinants of vaccination literacy

The weighted mean VHL score in Hungary was 82.4 points (95% CI: 74.9–89.8). Those with only a primary education had the lowest VHL score, while those without financial deprivation had the highest. Over 20% of respondents said it was hardest to determine which vaccines they or their families needed. Understanding why a vaccination was necessary for themselves or their families, however, proved to be the easiest task.

Moderate (OR: 1.93, $p < 0.001$) and strong (OR: 2.19, $p < 0.001$) social support, as well as lack of financial deprivation (OR: 2.05, $p < 0.001$), positively affected the level of VHL. Regarding education, the level of VHL was significantly higher among secondary school graduates without a baccalaureate (OR: 1.50, $p = 0.024$) than among primary school leavers.

4.2. Assessment of COVID-related health literacy

4.2.1. Characteristics of the sample

The mean age of the respondents was 48.7 years. The youngest respondent was 19 and the oldest was 93 years old (SD: 16.6 years). The sample showed a female predominance (53.4%). More than half of the respondents (56.5%) had completed secondary education. Only 12.7% of the sample had undergone health profession training. Almost two-thirds of the respondents (67.2%) were employed, and fewer than a third lived in a village (30%). More than half of the respondents (53.6%) lived with their spouse or partner in a shared household, and around a third (33.8%) were childless. On average, 2.18 people lived in a household, with the largest comprising 8 people. Around a quarter of respondents (28.5%) considered themselves having a low social status. More than half of the respondents (54%) considered their family wealth as average. Almost two-thirds of respondents (61.9%) perceived their health as good or very good.

Only a small group of our sample (5.9%, 95% CI: 4.6–7.5) had a test-confirmed infection with severe symptoms of COVID-19, while a further 26.3% (95% CI: 23.6–29.3) had a confirmed COVID-19 infection with mild symptoms. Almost half of the respondents (45.3%, 95% CI: 42.1–48.6) knew people with mild, confirmed symptoms, while 33.1% (95% CI: 30.2–36.2) reported cases of severe symptoms in their immediate environment.

Respondents were asked to report which risk factors applied to them in relation to a potential infection with COVID-19. The most commonly marked factors were age (21.3%; 95% CI: 18.9–23.9), chronic diseases or obesity (17.1%; 95% CI: 15.0–19.6) and occupation (22.3%; 95% CI: 19.7–25.1). Around one-third of respondents (37.4%; 95% CI: 34.3–40.6) did not consider themselves to be at risk of infection, while 11.4% (95% CI: 9.5–13.6) were uncertain about their risk.

4.2.2. Searching for information and trusted sources of information in relation to the coronavirus

Over two-thirds (69.9%) of respondents stated that they had sought information about COVID-19. The most frequently cited source of information was healthcare professionals (60.2%). Almost half of the respondents used television or radio (53.4%) and other digital sources (49.5%) to search for information. Respondents used complementary, alternative, or unconventional practitioners (9.5%), celebrities (4.6%), and telephone information lines (2.8%) the least frequently.

We also examined which sources respondents considered most reliable. Healthcare professionals ranked highest in trustworthiness (53.4%), followed by official government websites or spokespersons (28.4%). Only around one-fifth of respondents considered television, radio, or other digital sources to be reliable (20.6% and 16.0%, respectively).

4.2.3. Levels and determinants of COVID-related health literacy

Nearly half of our respondents (43.6%, 95% CI: 40.4–46.8) had a sufficient, approximately a quarter (25.2%, 95% CI: 22.5–28.1) had inadequate, and a third (31.3%, 95% CI: 28.3–34.3) had problematic level of COVID-HL. The least difficult task for respondents was finding information about the coronavirus online, while assessing the reliability of information about COVID-19 in the media proved to be the most difficult task.

According to our analysis, females were 1.46 times more likely than males to have a sufficient level of COVID-HL. Tertiary education (OR: 2.26, 95% CI: 1.28–3.99) and a normal social status (OR: 1.74, 95% CI: 1.20–2.51) were found to significantly increase the likelihood of having a sufficient level of COVID-HL. Compared to individuals in a (very) poor financial situation, those in an average or (very) good financial situation were more likely to have a higher level of COVID-HL (OR: 2.08, 95% CI: 1.30–3.34 and OR 3.28, 95% CI: 1.94–5.57,

respectively). Individuals in (very) good self-perceived health were more likely to have sufficient COVID-HL than those in (very) poor health (OR: 2.58; 95% CI: 1.39–4.80).

4.2.4. Willingness to be vaccinated against coronavirus and its determinants

In response to the question about willingness to be vaccinated against COVID-19, 73.1% of respondents (95% CI: 70.1–75.9) said that they were (or had been) willing to receive the vaccine. Nearly a quarter (23.5%, 95% CI: 20.8–26.4) said they would refuse to be vaccinated against COVID-19, and a small proportion (3.4%, 95% CI: 2.4–4.8) said they had not yet decided.

Factors associated with an increased willingness to be vaccinated against COVID-19 include having a problematic level of COVID-HL (OR: 2.55; 95% CI: 1.75–3.72), having a sufficient level of COVID-HL (OR: 2.57; 95% CI: 1.79–3.69), being older (OR: 1.02; 95% CI: 1.01–1.04) and having a tertiary education (OR: 1.98; 95% CI: 1.07–3.65). Conversely, we found a negative association with the following factors: unemployment (OR: 0.47, 95% CI: 0.27–0.83); living in a small town (OR: 0.52, 95% CI: 0.32–0.83); and living in a village (OR: 0.44, 95% CI: 0.27–0.72). No association was found between the other sociodemographic variables and willingness to be vaccinated.

4.2.5. Reasons of vaccine hesitancy in the case of coronavirus

In our study, we also sought to explore the factors that might influence the decision to receive the vaccine against COVID-19. We asked this question of respondents who answered “no” (23.5%, 95% CI: 20.8–26.4) or “undecided” (3.4%, 95% CI: 2.4–4.8) to our question about willingness to be vaccinated against COVID-19. Respondents could select more than one option from the provided choices. Upon examining the reasons for vaccine hesitancy, we found that respondents who have not expressed a willingness to be vaccinated or who have not yet decided whether to receive the vaccine most frequently chose “I’m concerned about the long-term effects of the vaccine that are yet unknown” (14.5%, 95% CI: 12.3–16.9) and “I’m afraid of the side effects of the coronavirus vaccine” (10.7%, 95% CI: 8.8–13.0) as reasons for refusing the COVID-19 vaccine.

4.2.6. Reasons for getting vaccinated against the coronavirus

In our study, we examined the reasons why respondents had decided to get vaccinated against COVID-19 or why they intended to do so in the future. The most common reasons

marked by respondents were as follows: 64.8% (95% CI: 61.6–67.8) said they would get vaccinated to avoid infection or serious illness, while 25.2% (95% CI: 22.6–28.0) said they would do so to protect others from infection. 16.8% of respondents (14.5–19.4%) indicated that they did not wish to receive the vaccine.

We asked the respondents who had previously indicated that they did not wish to receive the COVID-19 vaccine (16.8%) under what circumstances they might nevertheless decide to have it. The most common response was that they would not get vaccinated against COVID-19 (12.4%; 95% CI: 10.3–14.7), while 6.4% (95% CI: 5.0–8.1) stated that they would consider the vaccine if its safety could be convincingly demonstrated. 4.2% of respondents (95% CI: 3.1–5.6) said they would choose to be vaccinated if it could be convincingly demonstrated that the risk of side effects is minimal.

5. Discussion

5.1. Assessment of vaccination literacy and validation of the questionnaire

The primary objective of our research was to assess VHL in a representative sample of Hungarian adults. As part of this effort, we validated the Hungarian version of the HLS₁₉-VAC scale. Using the HLS₁₉-VAC, we then determined the level of VHL in the adult Hungarian population and identified its determinants. Since there was previously neither a validated questionnaire nor a population survey on VHL in the Hungarian population, our study was able to fill a research gap.

During the validation of the questionnaire used to assess VHL, the Cronbach's alpha coefficient measuring the internal consistency of the HLS₁₉-VAC scale (0.78) was higher in our study than the level considered acceptable and also higher than the Cronbach's alpha coefficient (0.72) reported in the international study. The low Cronbach's alpha value observed among older adults suggests that decision-making regarding vaccinations may differ in this group, with independent information-seeking and evaluation likely playing a less dominant role. The high split-half reliability coefficient (0.725) indicates a strong correlation between the two halves of the test, demonstrating the questionnaire's good internal consistency. Our analyses confirm that there is no need to modify the item set to improve the reliability and consistency of the Hungarian version. The HLS₁₉-VAC scale has a unifactorial structure, which is also supported by a Rasch analysis of international HLS₁₉ data. Based on these results, the scale that we have

validated is suitable for use in the general population. Prior to the validation of the HLS₁₉-VAC scale, there was no validated measurement tool available in Hungary that would allow for international comparison. The results obtained from using the scale would form the basis for targeted interventions.

In our study, the VHL score was 82.4 out of 100. However, we cannot directly compare our results with those from 2015 and 2017 in Hungary because the questions included in the VHL scale, the scoring system, and the data collection methods have all changed since then. Similar to previous surveys in Hungary and other HLS₁₉ countries, the task of “judge which vaccinations you or your family may need” caused the most difficulty for respondents in our study. This suggests that respondents may find it difficult to assess which recommendations apply to them. In other words, providing the public with information is not enough; assistance must also be offered to help them interpret it in a personalised manner.

In the HLS₁₉, 10 other countries besides Hungary assessed the level of VHL. Hungary achieved the second-highest VHL score after Portugal (M: 87.1, SD: 22.5). However, when comparing international results, it should be noted that data collection methods and timing differed between participating countries. The impact of the ongoing COVID-19 pandemic and the availability of COVID-19 vaccines and related information may have influenced the survey results. It is also worth noting that the countries measuring VHL in the HLS₁₉ have considerably different vaccination policies. In Austria, Ireland, Germany, Norway, and Portugal, vaccinations are only recommended for children. Belgium has 1 mandatory vaccination, the Czech Republic has 8, Italy and Slovenia have 10, Bulgaria has 11, and Hungary has 12. The number of mandatory vaccinations in a country may influence how vaccinations are viewed. Due to the lack of choice, individuals may not feel the need to seek information about vaccinations, which could affect their VHL level. According to the HLS₁₉, Bulgaria and Hungary have the highest number of mandatory vaccinations. However, Hungary had one of the highest VHL levels among the surveyed countries, while Bulgaria had the lowest. This suggests that alongside vaccination policy, factors such as public trust, education, and communication strategies may also play an important role in shaping VHL levels. This highlights that when comparing VHL levels across different countries, it is not only the level of VHL expressed in scores that must be taken into account, but also other factors such as policy measures, sociodemographic characteristics and public trust.

We identified the lack of financial deprivation, social support and education as positive determinants of VHL. This clearly demonstrates that socioeconomic status influences how

individuals access, interpret and utilise information regarding vaccines and also highlights that VHL is not merely an individual skill but a socially determined phenomenon. All of this emphasises the importance of interventions targeting disadvantaged groups and improving VHL levels in order to achieve better public health outcomes.

People with low VHL may find it difficult to access, understand, and apply health-related information. A VHL-orientated environment, particularly a VHL-orientated healthcare system, can help compensate for these challenges. As healthcare professionals are a trusted source of information for their patients, they should be trained in vaccinology and communication skills, as well as strategies for identifying and supporting patients with inadequate VHL. Patient educators or healthcare assistants can facilitate communication between healthcare professionals and clients. To enable individuals to make informed decisions about vaccinations, they must be provided with reliable, commercially unbiased information through multiple communication channels. It is equally important to build and maintain public trust in public institutions' information channels. Anti-vaccination groups must also be monitored and their arguments refuted, and misinformation regarding health and vaccinations must be combatted.

Social support, a statistically significant determinant of VHL identified in our study, can be strengthened through community projects organised by health mediators and health promotion offices using a HL intervention model. Local events and projects can reach a larger proportion of the local community. Health mediators can assist healthcare professionals in their work by identifying and training community leaders. Information materials used in different communities can be adapted to suit local vaccination cultures and beliefs related to vaccinations, as well as the community's level of VHL. Considering the insights of health mediators, local healthcare professionals, who possess the most detailed knowledge of the community, could execute this task.

Children could receive information about vaccinations from primary school onwards. The development of VHL and HL could be incorporated into the (hidden) curriculum for children and adolescents, while adults could engage in activities designed to develop their HL and VHL as part of lifelong learning.

In our research, we observed a moderate positive correlation between HL and VHL. As VHL evolved from HL, the two concepts partially overlap. Our findings suggest that HL is the foundation of VHL, especially for vulnerable groups such as older adults and those with lower educational level. However, VHL requires specific skills, so interventions targeting

disadvantaged groups need to be developed; focusing on health promotion in general is insufficient for improving the level of VHL.

5.2. Assessment of COVID-related health literacy

The second main objective of our research was to examine COVID-HL in a representative adult sample in Hungary, as no previous research data was available on this topic. Our sub-objectives were to identify the level and determinants of COVID-HL, and we also explored the relationship between COVID-HL and willingness to be vaccinated against COVID-19.

Our results show that less than half of the respondents had a sufficient level of COVID-HL, which is a significantly lower proportion than the sufficient level of HL (58.9%) found in the Hungarian HLS₁₉ study. This finding aligns with our initial expectations, as it reflects the fact that HL encompasses a broader range of skills than the specific, narrow-scope skills measured by COVID-HL. The level of Hungarian respondents' COVID-HL is consistent with that found in other comparable international studies. For example, in an Italian study, 49.3% of respondents had an excellent level of COVID-HL, which corresponds to the sufficient level used in our study. Turkish and German studies, which measured COVID-HL among the adult population, also found similar proportions of sufficient COVID-HL levels: 43.4% and 49.9%, respectively. A multi-site survey conducted in German-speaking cantons in Switzerland found that the proportion of the population with sufficient levels of COVID-HL rose from 54.6% to 63.3% between spring and winter 2020. By contrast, in a study conducted among older adults living in rural Indonesia, only 18% of respondents had a sufficient level of COVID-HL. The results of two studies, one in Turkey and one in Hong Kong, conducted among education workers, differed significantly: 77.6% and 46.3% of respondents, respectively, had a sufficient level of COVID-HL. At around the same time as our research, the HLS-COVID-Q22 questionnaire was also validated among students at the University of Pécs, based on the original German version of the questionnaire. The students' COVID-HL levels were assessed via online data collection using a convenience sample of 100 students (57% sufficient, 28% problematic, and 15% inadequate).

Our study found that certain sociodemographic variables, such as being female, having a tertiary education, having a normal social status and having a better financial situation, were associated with a sufficient level of COVID-HL. A German study arrived at similar conclusions: in their research, females' mean COVID-HL scores were significantly higher than males'. Furthermore, mean scores were higher among those with higher education level and social status. A Turkish study also found a correlation between age, education level, and

COVID-HL. An Italian study demonstrated a correlation between age, financial deprivation, and COVID-HL; in their analysis, sex and education had little effect on the level of COVID-HL. An earlier German study – as well as another Spanish study – found no association between the level of COVID-HL and sex or age. However, both studies found an association between education – a variable associated with HL – and the level of COVID-HL. Our findings can be explained by the social gradient of HL – in this case, COVID-HL – which means that systematic differences in HL levels across different social groups generally follow gradients based on education, employment or social status.

It should be noted that, unlike in the VHL study, our investigation into COVID-HL did not measure the relationship between HL and COVID-HL, which also constitutes a limitation of our study. The moderate positive correlation between HL and VHL identified in the previous part of the research suggests that HL forms the basis of VHL but is not its sole determinant. A similar correlation can be assumed between COVID-HL and HL.

Nearly three-quarters of our respondents expressed their willingness to receive the COVID-19 vaccine. This is consistent with the findings of a previous Hungarian study. However, two other studies, one Hungarian and one international, found vaccination willingness in Hungarian samples to be only 48.2% and 47%, respectively. The discrepancy between these results can be explained by the different dates on which the data was collected. This suggests that willingness to be vaccinated against COVID-19 has increased among the Hungarian population. This aligns with the results of a recent meta-analysis encompassing data from 23 countries, which reported a mean vaccination willingness of 79.1% and indicated an upward trend. The observed increase in willingness to be vaccinated against COVID-19 among the Hungarian population may also stem from the rise in COVID-HL, which may be similar to that observed in Switzerland. This phenomenon may be partly attributable to continuous media coverage of the COVID-19 pandemic and the preventive measures taken.

Concerns about the COVID-19 vaccine's unknown effects and potential side effects seem to have influenced the majority of our respondents who refused to be vaccinated. These concerns primarily relate to the safety of the COVID-19 vaccine, which is of key importance from an intervention perspective. Some studies have also linked fear of injections to vaccine hesitancy. A recent systematic review identified these factors as causes vaccine hesitancy. In our research, the most common reasons for (planned) vaccine uptake were the fear of getting infected and the desire to prevent infecting others. As misinformation and fear of side effects are factors contributing to vaccine hesitancy, it appears that, also in the case of the COVID-19

vaccine, willingness to be vaccinated would improve if we could reassure the public about the vaccine's safety and the minimal amount of side effects. In our study, a group of those not planning to receive the COVID-19 vaccine (16.8% of the total sample) would nevertheless be vaccinated if its safety and the minimal risk of side effects could be demonstrated. A second, smaller group would also decide to be vaccinated if it could be convincingly demonstrated to them that the vaccine can reduce the risk of contracting COVID-19 and of developing severe illness. Reaching out to and persuading these groups could slightly increase the population's vaccination rate. However, a general campaign about vaccines would not be sufficient for these groups. Rather, transparent communication is needed alongside the presentation of scientific evidence that also acknowledges the uncertainties surrounding vaccines. This further underscores the need to improve healthcare communication about vaccines. Clear, understandable, inclusive communication that uses reliable, credible information about vaccines can help reduce vaccine hesitancy across all population segments, particularly vulnerable groups, by making scientific information accessible and understandable to all. Motivational interviewing could be an effective method for engaging with respondents in our sample who categorically refused the vaccine. The traditional information-based approach is ineffective with those who categorically reject the COVID-19 vaccine, as their decision is not primarily driven by a lack of information but by other factors related to values or trust. During a motivational interview, the healthcare professional supports the client's individual decision-making process through collaborative thinking, rather than seeking to persuade them.

The role of HL partly underlies the above communication challenges: in our research, we found a positive correlation between higher levels of COVID-HL and willingness to be vaccinated against COVID-19. In our study, sufficient level of COVID-HL was the strongest predictor of vaccination willingness, emphasising the importance of disease-specific HL. To confirm whether improving COVID-HL levels actually increases willingness to be vaccinated—or whether there is a confounding effect of some third variable – longitudinal studies are needed to explore causal relationships. However, COVID-HL levels are not the only factor influencing decisions regarding COVID-19 vaccines; these are also influenced by the type of vaccine available, political affiliation and age.

Our data also revealed the importance of age and education: older age groups and those with tertiary education were more likely to get vaccinated against COVID-19. A systematic review and meta-analysis identified a positive correlation between higher education level and the willingness to receive the COVID-19 vaccine, whereas another systematic review reported a

contrary finding. Because behavioural factors other than education, such as risk perceptions, trust in authorities, and religion, also influence the acceptance or rejection of vaccines, the impact of education based on systematic reviews is unclear. While we might assume that higher education level is associated with better HL skills, the vaccination decision-making process is so complex that higher education and a more profound understanding of health-related information alone do not necessarily lead to uptake of the vaccine. Two systematic reviews also found a correlation between older age and a higher willingness to receive vaccinations, aligning with our findings.

Tertiary education and older age were found to be protective factors. However, we observed a negative association between vaccine acceptance and unemployment, as well as living in smaller settlements. A study conducted in the United Kingdom found that individuals with lower incomes and lower education levels were more uncertain about vaccination. Unemployed people with fewer social connections may feel less responsible towards others, which could explain their vaccine hesitancy. However, we did not examine this factor in our study. People living in smaller towns and villages have limited access to healthcare services, reducing their chances of obtaining accurate vaccine information from healthcare professionals — a factor that may also lead to hesitancy. The lower willingness to be vaccinated among the unemployed and those living in smaller settlements raises equity issues, as it leaves vulnerable groups less protected against COVID-19. Targeted strategies are needed to reach these groups. To reach people who live in smaller settlements, mobile vaccination points should be set up, vaccination counselling in primary care should be improved, and local health mediators should be involved. Partnerships with job centres and social institutions could help reach the unemployed. For both groups, vaccine-related communication must offer concrete, accessible solutions while considering the challenges faced by clients. For these vulnerable groups, it is particularly important to rethink the role of underused communication channels so that they can access health-related information through channels they use and consider reliable, as they have fewer opportunities to interact with the sources they consider most credible — namely, healthcare professionals. To ensure this, we recommend conducting a systematic needs assessment among these groups when planning future health communication strategies.

As we found no correlation between participation in health profession training, the level of COVID-HL and willingness to be vaccinated against COVID-19; it would be worthwhile to investigate possible reasons for this. For example, we could look at whether there is a correlation between the time elapsed since completing the training, the level of training or work

experience in the healthcare field, and our outcome variables. Furthermore, our findings may suggest a need to review and potentially improve the current national curriculum.

This is important because our research showed that healthcare professionals were the most trusted and frequently used source of information related to COVID-19. 60.2% of respondents relied on them, and more than half estimated them the most reliable. Therefore, if health profession training fails to sufficiently develop either COVID-HL or willingness to be vaccinated, it fails to strengthen the channel through which the public is most accessible and influenceable. Almost half of respondents used television, radio or other digital sources to obtain information, but only a fifth considered them reliable, ranking them well below healthcare professionals. This deep divide between usage and trust also means that, in the case of digital sources, respondents are seeking information from a medium that they themselves do not consider credible. This may cause cognitive dissonance and further increase uncertainty. These results differ from those of the 2020 VHL survey in that digital sources were the most frequently used source of information (49.7%), whereas healthcare professionals took first place in the COVID-HL survey (60.2%). This discrepancy can be explained by the specific context of the COVID-19 pandemic: faced with a serious and unknown disease, the public increasingly turns to direct healthcare advice. This highlights the importance of ensuring the availability of healthcare professionals and their preparedness to communicate effectively about vaccination in epidemic situations. The deep divide between the use of digital information sources and trust in them could be partially narrowed if healthcare professionals — whom respondents consider the most reliable sources — were actively present on the digital platforms most frequently used by the general public (Facebook, Instagram, TikTok, YouTube). At the same time, healthcare professionals cannot simply rely on their professional authority; they must also focus on how to make the content they create appealing and accessible so that they can effectively compete for users' attention, crowding out misinformation. It is particularly important to emphasise an active presence, which encompasses not only content creation but also dialogue with followers, so that any misinformation that may arise in connection with individual messages can be corrected and followers can receive answers to their questions. For these reasons, it would be advisable to incorporate digital health communication into the training of healthcare professionals, which includes competencies for credible and regulated engagement on social media. To distinguish communicators who provide credible health-related content, it would be worthwhile to create an initiative similar to “EgészségKommandó”, which labels health websites that provide credible information.

Nearly a third of respondents never sought information about COVID-19, although information was readily available due to the high level of media attention on the topic. To reach these respondents — who are not actively seeking information — passive information strategies could be employed in the future through the everyday media environment, as this group likely did not obtain information about COVID-19 through traditional health communication channels. In this context, “passive reach” means that health-related information is not sought by the user or recipient but rather appears in the media environment where passive users obtain their information — for example, in news programmes, public service announcements, social media platforms, posters in public spaces, or even entertainment programmes. Communications containing health-related information disseminated in this way can reach groups that are less receptive to health-related issues, especially when this information is delivered by well-known persons or community leaders. Given the significant size of the group that does not actively seek information, it is recommended that future public health communication strategies take this passively informed group into account and formulate messages that are targeted at them and designed to capture their attention within the media environments they use.

Almost one in ten respondents does not trust any single source of information. Therefore, it is important that health-related information provided by official public institutions appears credible and reliable to the public. This is particularly important when it comes to informed decision-making regarding vaccines. To this end, trust in the information channels used by official public institutions must be promoted and maintained.

The fact that judging the reliability of information posed the greatest problem for respondents in our research highlights the importance of health communication, particularly regarding vaccines. Information about vaccines must be tailored to clients’ general and specific (disease- or vaccine-related) HL levels, particularly for those with inadequate HL. When communicating about vaccines, it is also important to use the channels and content types preferred by groups with inadequate HL. As the public regards healthcare professionals as a reliable source of information, their training must cover health communication and vaccinology. The curriculum must address how healthcare professionals can make their communication understandable to clients with low HL. Clients with low HL may find it easier to make decisions regarding vaccinations if they receive simple health messages, as they find it more difficult to interpret and evaluate health- and healthcare-related information. Improving the population’s HL could help people to make vaccine-related decisions and increase their willingness to be vaccinated.

5.3. Strengths and limitations

One of the strengths of the two studies described above is that they were conducted in a large, representative sample of the Hungarian population. We assessed the level of VHL within the framework of an international survey (the HLS₁₉), while the questionnaire used in the COVID-HL survey had been validated in multiple languages. This enabled us to compare our results with those of other studies. However, as our research is a cross-sectional study, it is not suitable for establishing causal relationships between variables. Further research is needed to determine whether the correlations we observed are causal. In our study, some of the respondents (22.2% and 12.7%) had received health profession training. We took this into account as a potential confounding factor in the multivariate model we used. Those with health profession training may have a higher HL level than the general population, and their information-seeking patterns may differ, potentially influencing the correlations observed. Data collection for our VHL study took place shortly before the introduction of the first vaccines against COVID-19, and this sensitive period may have influenced our results, given that vaccines subsequently received significant public attention and became a topic of public discourse. During the first and second waves of the pandemic, the public had ample opportunity to learn about how vaccines work, their risks and benefits, and how to navigate the healthcare system and available treatment pathways in Hungary. These factors may have had a positive impact on VHL levels. Because most of the questionnaires in our study were self-reported, self-reporting bias may have affected the information provided by respondents, as it might not fully reflect their behaviour or attitudes. Furthermore, social desirability may have influenced our respondents when answering questions about sensitive topics such as vaccinations. This may have led to an overestimation of willingness to be vaccinated. During the validation of the Hungarian HLS₁₉-VAC scale, which is used to measure VHL, the analysis of convergent validity was limited to examining exclusively the relationship between the HL and VHL scales. Therefore, the assessment of the relationship between the constructs cannot be considered comprehensive. An empirical examination of discriminant validity was also not feasible for the same measurement tool, as the questionnaire did not include a theoretically independent construct. The content and discriminant validity of the HLS₁₉-VAC scale were assessed only at an international level. However, prior to the VHL study, the polling company tested the comprehensibility of the Hungarian HLS₁₉-VAC scale. The lack of a universally accepted gold-standard measurement tool for VHL limits the assessment of criterion validity. For this reason, our results should be interpreted in light of the above limitations. Since the HL, VHL, and

COVID-HL levels were determined using self-assessment scales, this may introduce self-report bias into the study.

5.4. Conclusions

The results of the two representative cross-sectional studies that we conducted demonstrate that both VHL and COVID-HL are socially determined concepts. Their respective levels and associated factors (e.g., education, financial status, social status, and social support) align with the recognised social gradient of HL. This means that interventions at the individual level are insufficient on their own; community-level, systemic and structural approaches are also necessary, particularly with regard to disadvantaged groups.

The VHL score for the adult Hungarian population was 82.4 points (out of 100), the second highest among countries measuring VHL in the HLS₁₉. However, it is important not to draw conclusions based solely on this result. For instance, the high score may also be influenced by the mandatory vaccination model. It would therefore be worthwhile in future to examine VHL for mandatory and recommended vaccinations separately, analyse the impact of policy measures mandating vaccinations and assess the long-term impact of targeted interventions. The HLS₁₉-VAC scale is reliable and suitable for use with the general population.

According to our data, less than half (43.6%) of the adult Hungarian population had a sufficient level of COVID-HL, which is significantly lower than the sufficient level of HL reported in a previous study (58.9%). This result, which is consistent with international data, confirms that, although there is a link between the two, the level of disease-specific HL does not automatically follow the level of general HL and requires a different promotion. In our study, COVID-HL was the strongest predictor of willingness to be vaccinated against COVID-19, outperforming all sociodemographic variables, which suggests that developing specific HL could be an effective method of increasing willingness to be vaccinated.

Reducing vaccine hesitancy requires a differentiated approach. Transparent communication is necessary to persuade people to get vaccinated against COVID-19. For those who categorically reject the vaccine, motivational interviewing could be an effective approach, as it supports the individual's decision-making process rather than trying to persuade them. The lower willingness to be vaccinated among the unemployed and those living in smaller towns raises equity issues, and structural interventions could be recommended to address these concerns, such as mobile vaccination centres, primary care vaccination counselling, and employment and social partnerships. Healthcare professionals, who are regarded by the public

as the most trustworthy source of information, play a key role; their training must cover vaccinology and communication tailored to different HL levels.

The results of our studies confirm that vaccination-related interventions can only be effective if they consider individual HL levels, socioeconomic status, and the communication needs of the target group. Further research is needed to explore the causes of vaccine hesitancy among the general population, particularly with regard to the COVID-19 vaccine, as these findings could be used in the event of a future pandemic.

6. New findings

1. Validation of the HLS₁₉-VAC scale in Hungarian.

Our study was the first to validate the VHL scale in Hungarian, which can be applied to the general adult population, using a sample that was representative of the adult Hungarian population. The scale is reliable and has a unifactorial structure. It is suitable for measuring VHL, and the results are comparable internationally. While the scale measures VHL in general, the questions can be adapted for disease-specific use if necessary, making it suitable for measuring specific VHL as well.

2. The first population-level assessment of VHL levels in Hungary.

We found that the VHL level of the adult Hungarian population was 82.4 points (out of 100), the second highest among the 11 countries that measured VHL in the HLS₁₉. This was the first study to provide internationally comparable data on the VHL levels of Hungarian adults.

3. The first identification of the determinants of VHL among the Hungarian population.

Our results indicate a significant correlation between a higher level of VHL and the lack of financial deprivation, moderate and strong social support, and higher level of education. Our results confirm that VHL is a socially determined phenomenon.

4. The first population-level assessment of COVID-HL levels in Hungary.

A total of 43.6% of the adult Hungarian population had a sufficient level of COVID-HL. This is the first Hungarian data to provide an internationally comparable assessment of levels of COVID-HL among adults.

5. The first identification of determinants of COVID-HL in Hungary.

Our study was the first to identify the determinants of COVID-HL in the adult Hungarian population: being female, having higher education, normal social status and good financial status show a significant association with a sufficient level of COVID-HL.

6. Identification of the association between COVID-HL and willingness to be vaccinated against COVID-19.

Firstly, using a representative sample of the Hungarian population, we found that COVID-HL is the strongest predictor of willingness to be vaccinated against COVID-19, outperforming all other sociodemographic variables examined. This serves as evidence of the public health importance of disease-specific HL development.

7. Summary

Vaccination literacy (VHL) and COVID-related health literacy (COVID-HL) play a fundamental role in vaccination decisions. However, population-level data on these topics was previously lacking in Hungary. To address this, we conducted two representative cross-sectional surveys of the adult Hungarian population in 2020 and 2022. The first study aimed to validate the Hungarian version of the HLS₁₉-VAC scale and determine VHL levels and determinants in Hungary. The second study aimed to identify the level and determinants of COVID-HL, as well as the factors influencing willingness to be vaccinated against COVID-19.

As a result of our first study, we validated the Hungarian version of the HLS₁₉-VAC scale for measuring VHL (Cronbach's alpha: 0.78). The VHL level was 82.4 points, with respondents finding it most difficult to judge which vaccinations are necessary for themselves or their family. We found a moderate positive correlation between VHL and health literacy (HL) in all sub-samples. We identified the lack of financial deprivation, moderate to strong social support and secondary educational level as determinants of VHL.

According to the results of our second study, 43.6% of respondents had adequate COVID-HL. We found that female sex, tertiary education, belonging to the normal social status in society, and good subjective perception of family wealth were the determinants of sufficient COVID-HL. In our sample, 73.1% of respondents were willing to be vaccinated against COVID-19. The strongest predictor of vaccine acceptance was sufficient COVID-HL. We also found negative associations of vaccine acceptance with unemployment and with living in smaller towns and villages.

Based on our findings, we recommend that vaccinology and HL-based communication, as well as support for clients with inadequate HL levels, should play a greater role in the training of healthcare professionals. We should tailor vaccine communication efforts to different groups, including those who accept vaccines and those who categorically reject them. Efforts should focus on enhancing trust in the healthcare system and ensuring opportunities for communication with healthcare professionals during a pandemic. Furthermore, we recommend conducting longitudinal studies to explore causal relationships.

8. Publication list



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List of publications related to the dissertation

1. Karu, Y. E., **Mátyás, G.**, Vincze, F., Ádány, R., Bíró, É.: Association between COVID-related health literacy and vaccine acceptance: results of a nationwide cross-sectional study in Hungary.
BMC Public Health, 26, 1-13, 2026.
DOI: <http://dx.doi.org/10.1186/s12889-026-26491-5>
IF: 3.6 (2024)
2. **Mátyás, G.**, Vincze, F., Ádány, R., Bíró, É.: Vaccination Literacy and Its Determinants in Hungary: results of a Cross-Sectional Survey.
J. Prim. Care Community Health. 17, 1-10, 2026.
DOI: <http://dx.doi.org/10.1177/21501319251409914>
IF: 2.5 (2024)

List of other publications

3. Szilágyi-Hornyák, E., Nagy-Pénzes, G., **Mátyás, G.**, Ádány, R., Bíró, É.: Experiences of the Development of a Revised, Population-Adjusted Communicative Health Literacy Scale.
Journal of Patient Experience. 12, 1-5, 2025.
DOI: <http://dx.doi.org/10.1177/23743735251401305>
IF: 1.8 (2024)
4. **Mátyás, G.**, Vincze, F., Bíró, É.: Az intervenciók hatásosságát vizsgáló Egészségműveltséget MÉRŐ Calcaryi Charta Kérdőív magyar nyelvű validálása.
Egészségfejlesztés. 64 (1), 41-53, 2023.
DOI: <http://dx.doi.org/10.24365/ef.9624>





5. **Mátyás, G.**, Vincze, F., Bíró, É.: Egészségműveltséget mérő kérdőívek validálása hazai felnőttmintán.
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Front. Public Health. 9, 1-9, 2021.
DOI: <http://dx.doi.org/10.3389/fpubh.2021.724995>
IF: 6.461
7. Bíró, É., **Mátyás, G.**: Egészségfejlesztési konferenciák anno és most.
Egészségfejl. 60 (5), 11-15, 2019.
DOI: <http://dx.doi.org/10.24365/ef.v60i5.550>

Total IF of journals (all publications): 15,068

Total IF of journals (publications related to the dissertation): 6,1

The Candidate's publication data submitted to the Tudóstér have been validated by DEENK on the basis of the Journal Citation Report (Impact Factor) database.

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