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# THE SOCIAL-ECOLOGICAL CONTEXT OF HEALTH LITERACY

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# Editorial: The Social-Ecological Context of Health Literacy

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**Keywords:** social-ecological system, health literacy, determinants of health, editorial, complex intervention

## Editorial on the Research Topic

## The Social-Ecological Context of Health Literacy

## INTRODUCTION

Most recent empirical findings from the WHO European Region indicate a limited ability to find, understand, critically assess and apply health-related information for between 25% (Slovenia) and 72% (Germany) of the adult population (1). Moreover, it has been widely shown that limited health literacy is associated with poor health behavior, lower use of health screenings, more hospitalization and lower general health (2, 3). With regard to economic effects, limited health literacy causes additional costs that range from 3 to 5% of the annual total health care costs (4). Given these findings, it is not surprising that health literacy is high on the public health agenda with 19 Member States of the WHO European Region having a health literacy policy on a national or local level (5).

Although conceptualized as a dual relation between individual skills and the complexity of the system in which health related information is provided (6), health literacy has long been focused on individual capabilities, consequently neglecting the role of the system. The reasons are manifold and include, amongst others, limited knowledge about the interaction of different health literacy dimensions, but also because of a hesitancy toward complex intervention approaches and their evaluation. However, as emphasized by Sentell et al. (7), humans are social beings whose skills and actions are constantly shaped by social and environmental factors. The infodemic, that is, the rapid spread of vast numbers of reliable and unreliable information accompanying the COVID-19 pandemic might serve as a current example (8). Limited health literacy in pandemic times is compounded by the increasing complexity of digital information infrastructures which may lead to information overload, and the difficulty of deciding which information (source) is trustworthy. This exceeds the individual responsibility and requires greater accountability by media providers to create information environments that are not only relevant but also easy to navigate and understand (9).

Against this background, the current Research Topic aims to explore the concept of health literacy within a social-ecological framework of health and build understanding of how it can be developed beyond an individual level at organizational, community, and population levels.

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## HEALTH LITERACY WITHIN A SOCIAL-ECOLOGICAL FRAMEWORK

Social-ecological frameworks of health have several predecessors in various disciplines. Emile Durkheim's concept of society as a level of reality above and beyond the biological level is an early example of thinking in systems (10). Known as the founding father of the General System Theory, von Bertalanffy (11) stressed the need to explain complex phenomena by considering the systems in which they occur and to study them as a whole, including not only their parts but their interactions within and without. This has been taken up and further developed by Uri Bronfenbrenner with his ecological system theory. With the aim of developing a model for child development, Bronfenbrenner assumed that human development takes place in a complex ecological environment which he conceived as "a set of nested structures, each inside the next, like a set of Russian dolls" [(12), p. 3]. While his theory initially included five systems (micro-, meso-, exo-, macro- and chronosystems), Bronfenbrenner later emphasized the relevance of biological and genetic aspects of human development.

These developments have had a significant impact on public health research and one of the most prominent examples is the rainbow model of health determinants of Dahlgren and Whitehead (13). Through a series of layers, this model visualizes the major interconnected domains of factors impacting on population health. Below the overarching societal environment (e.g., political, socioeconomic and cultural conditions), living and working conditions are posited such as education, housing or unemployment. Another level includes social factors influencing health such as social support from friends, family and the neighborhood, while behavioral actions (e.g., physical activity, nutrition) are summarized as individual lifestyle factors. Although widely used, there are only a few examples embedding health literacy in a social-ecological context. In their recent article, Schulenkorf et al. (14) report the results of an interview study with experts about their definition of child and adolescent health literacy. Using Bronfenbrenner's socio-ecological model, aspects of personal health literacy were mentioned most often while factors related to the organizational environment were mentioned the least. Another example comes from Rowland et al. (5) who developed a Health Literacy Policy Model to analyze health literacy policies in the WHO European Region on four societal levels (system, organization, communities, and individuals) along six vectors (e.g., education, lived environment, employment, media, digital health, health services).

## SUMMARY OF THE ARTICLES

This Research Topic comprises 14 articles, most coming from Europe (e.g., Hungary, Germany, Portugal), followed by Asia (Afghanistan, China) and North America. They draw on a range of empirical methods including quantitative ( $n = 9$ ), qualitative methods ( $n = 1$ ), mixed methods

(including a review and qualitative data), and three concept articles.

Applying the rainbow model by Dahlgren and Whitehead (13) most articles ( $n = 9$ ) address the individual level exclusively or with some links to other layers. For example, Schneider et al. report a first attempt to measure mental health literacy among adults from Zurich/Switzerland. Results indicate a low mental health literacy for almost half of the respondents. In another study Chawłowska et al. explore reproductive health literacy and fertility awareness among Polish female students and report highest knowledge scores for older and medical university students. Gender and age-specific studies come from Afghanistan (Harsch et al.) and Hungary (Papp-Zipernovszky et al.), while a study by Tsakpounidou et al. shows low levels of stroke-related knowledge amongst pre-school aged children. Tang et al. focus on two aspects of health literacy, that is, information seeking and evaluation among African American individuals.

Some of these studies link the individual level with some aspects of the living and working environment. These mostly include educational and socio-economic aspects such as the study by Harsch et al. which reveals education as a significant predictor of low health literacy in women from Afghanistan. Gomes da Silva et al. confirm the important role of the educational status for COVID-19 related health knowledge among Portuguese adults. Carl et al. take a more general perspective regarding the relevance of the environment for the physical activity-related health competence (PAHCO) model and extract three potential solutions for the relationship between competence and environment.

With regard to the community, Li et al. observe substantial geographic variation in health literacy in their population-based study covering 25 provinces of China. Educational level and socioeconomic status are significantly associated with health literacy, and these relations vary across the regions. In turn, Bíró et al. report no relationship in health literacy by place of residence (capital, urban, rural) but educational attainment and social support prove to be significant determinants of health literacy with some variations between different types of settlement. Thus, this study addresses the social network level of the rainbow model. Dadaczynski et al. focus more directly on the community and school level by introducing a fully tailored-based gamified intervention framework that aims at strengthening navigation health literacy. As emphasized by Dahlgren and Whitehead (13), unemployment and health care reflect living and working conditions that impact health. Both determinants are addressed by Samkange-Zeeb et al. and Szabó et al. While the first group collate evidence on health literacy among unemployed people through triangulating interviews and scoping review data, the latter measure the comprehension of available patient educational materials among different user groups.

Last but not least, one article address the wider political context shown in the outermost layer of the Dahlgren-Whitehead model. In their concept analysis, Schulenkorf et al. link the mandatory curriculum on media



literacy with dimensions of health literacy. Following their line of argument, health literacy could be more easily implemented in schools if aligned systematically with the curriculum and instruction on media and digital literacy.

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KD wrote the first draft of the manuscript. SS, ÉB, and KK revised the manuscript. All authors contributed to the manuscript and approved the submitted version.

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# Reproductive Health Literacy and Fertility Awareness Among Polish Female Students

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The falling fertility indicators and high prevalence of infertility in Poland make it important for people of reproductive age to have good knowledge of their own fertility in order to be able to take care of their reproductive health. This paper examines reproductive health literacy and fertility awareness among Polish female students. It can help identify gaps in reproductive health education in Poland. The study group included 456 women aged 18–29, who were students of 6 public universities located in Poznań, Poland. The method used was a survey using a self-developed questionnaire assessing the students' knowledge of female and male fertility-related physiology and fertility patterns. The respondents' knowledge was assessed on the basis of the percentage of correct answers. Regression analysis and univariate analysis of variance were used to explore relationships between the students' knowledge and their age, year of study, university and source(s) of information. The average score of correct answers was 55.8%. Older students and medical university students were the most knowledgeable. 93.4% of the respondents correctly identified the optimum age for a woman to have the first child from the point of view of achieving pregnancy fast. Over 90% of the respondents knew such fertility-compromising risks as smoking, diseases and psychological distress. There was much poorer awareness of the adverse effect of unbalanced diet, irregular sleep, and long-lasting physical effort. 47.1% of the students reported gaining information from a number of sources, but as many as 28.3% said their only source was primary or middle school classes. Reproductive health knowledge among the young female students is incomplete, especially as regards lifestyle-related risks. They should be encouraged to supplement it by consulting reliable sources such as health professionals. It is advisable to ensure that the curricula of medical university students provide thorough knowledge in this area, and to arrange suitable electives for students from other universities. As primary and secondary school classes remain an important source of information, quality teaching at these levels should be offered with a focus on making the knowledge as practical and operational as possible. Relevant graduate, postgraduate and in-service courses should be available to professionals responsible for spreading reproductive health knowledge.

**Keywords:** knowledge, health literacy, fertility awareness, reproductive health, Poland, young women, students

## INTRODUCTION

Fertility and reproductive health (RH) are important aspects of life, both for people of reproductive age and for the whole community. In Europe, the total fertility rate (TFR) has been falling within the last couple of decades, contributing to the new demography of Europe—a rapid ageing of the region (1). The trends for Poland are no different. The TFR for Poland has been below 1.5 since 1997 (2) and is expected to remain at the sub-replacement level (below 2.1). As a result, the age structure of the population is changing, leading to a steady growth of the economic old age dependency ratio, i.e., the ratio between the inactive elderly aged 65+ and the number of the employed. It is projected to rise in the whole EU from 43.1% in 2016 to 68.5% in 2070, but Poland is to reach the highest rate of all Member States (92.5%) (1).

One of the reasons behind such trends is delayed childbearing, which may be a risk factor for adverse pregnancy outcomes and pregnancy complications (3–5). Although advanced maternal age is associated with a number of health-related and developmental benefits (6, 7), it also contributes to higher prevalence of infertility, growing need for infertility treatment and assisted reproductive technology (ART), involuntary childlessness, and the resulting serious psychological distress of infertile couples (8–11). There are no current data available on the prevalence of infertility in Poland. It is estimated to be similar to the prevalence observed in other developed countries and affect 15–20% of all couples (12, 13). However, there are studies showing the scale of involuntary childlessness and the main reasons behind it. The mean personal ideal number of children for Poles aged 25–39 years is 2.12 (women) and 1.99 (men), while the actual numbers are 1.27 and 0.82, respectively, which demonstrates a considerable fertility gap between ideals and life (14). A vast majority of people of reproductive age in Poland have childbearing intentions; only 13% of childless men and 12% of childless women aged 18–39 interviewed in 2014 intended to remain childless (15). In the group of childless people who intended to have children within the next 3 years, only 33% of men and 34% of women succeeded, 39% of women and 40% of men postponed parenthood, and 26% of women and 27% of men abandoned their plans (16). The most important barriers to having the first child faced by Poles aged 20–39 years turned out to be the lack of partner (27.8%), low standard of living (22.8%), infertility (14.4%), and uncertain future (8.8%). The top barriers to having the second child are low standard of living (31.8%), infertility (12.2%), uncertain future (11.1%), and high costs of raising children (7.9%). The importance of economic barriers grows with an increasing number of children, while the importance of infertility grows with increasing age and, strikingly, with decreasing education level (17, 18). Young Poles of both sexes are more willing to become parents when they have stable and regular income. Young Polish mothers are

more willing to become mothers again when they feel they are able to reconcile family and work life and are supported by their partners in everyday chores (19). In a study of childless Polish women aged 37–46 years, 56% of the respondents had no stable partner, but among those who had partners and wanted to have children, the most important reasons for remaining childless were problems getting pregnant (23.7%) or other health problems such as chronic illnesses or disabilities (21.2%) (20). Thus, the three recurrent modifiable factors affecting childbearing in Poland seem to be (i) economic instability, (ii) work-family tensions, and (iii) health problems (including infertility). Given the above, there is a need for comprehensive social and public health policies that could reduce involuntary childlessness and the related distress at an individual level, and at the same time alleviate population ageing at the societal level. The policies cannot address such issues as the lack of an appropriate partner, but can and should aim to, (i) support economically stable work and living settings, (ii) promote gender equality and work-family reconciliation, and last but not least, (iii) intensify health education and promotion, particularly with respect to RH.

Taking care of one's RH pertains to a wide range of areas, such as general care for one's health, obtaining detailed information on RH physiology, increasing one's fertility awareness (FA), i.e., learning to identify fertile and infertile phases of a woman's menstrual cycle, as well as avoiding factors with adverse impact on RH. Having sound knowledge in this domain is crucial for making informed decisions and shaping healthy attitudes and practices.

Young female students are the one demographic group for which the knowledge in the field of human fertility is essential, for two important reasons. Firstly, many of them are going to have children in the near future, which is why it is important for them to know how their reproductive system works. Secondly, they will soon graduate, which means that they are about to be among the best educated young people in Poland. It is, by the way, quite a populous group, as 53.7% of Polish women aged 25–34 (21) and 52% of the women who gave birth in 2016 (22) have tertiary education. Therefore, their competence should not be limited to the area of their studies, but should extend to other areas, in particular to those directly related to their own health and well-being of the families they are going to build. Considering all the aspects discussed above, we believed it would be interesting to explore RH knowledge among Polish female university students.

## MATERIALS AND METHODS

### Participants

The study included a group of 456 women aged 18–29 (mean age =  $21.95 \pm 2.45$  years), who were students of higher educational institutions and came from rural (26.87%) and urban (73.13%) areas throughout Poland. 98.9% of the participants were nulliparous, whereas 1.1% had children. Only 1 of the 5 parous participants declared that her pregnancy had been intended. The survey was conducted in Poznań, one of the largest university cities in Poland, at 6 public universities: Poznań University of Medical Sciences ( $n = 178$ ), Poznań University of Life Sciences ( $n = 58$ ), Poznań University of Economics and Business ( $n =$

**Abbreviations:** ANOVA, analysis of variance; ART, assisted reproductive technology; EFL, education for family life; FA, fertility awareness; Q, question (in the survey questionnaire); RH, reproductive health; STI, sexually transmitted infection; TFR, total fertility rate.

58), Academy of Music in Poznan ( $n = 31$ ), Poznan University of Technology ( $n = 55$ ), and Adam Mickiewicz University ( $n = 76$ ). The criteria for selecting women to participate in the survey were: (i) age between 18 and 29 years; (ii) being a current student. Prior to the study, each respondent had been informed of the purpose of the study, the entity responsible for carrying it out, the way the results would be used, as well as the voluntary and anonymous nature of participation.

## Research Tool

The research method used was a survey. The respondents were interviewed face to face with the use of a self-developed questionnaire composed of 20 questions: 18 closed-ended ones (2 yes/no questions, 14 disjunctive multiple choice questions, and 2 conjunctive multiple choice questions), 1 semi-open question and 1 open question. Seventeen of the twenty questions assessed the respondents' knowledge of female and male fertility-related physiology and fertility patterns. Two questions determined the respondents' maternity status. One question explored the source(s) of the respondents' fertility knowledge. There was also a separate part with questions establishing the respondents' demographic and social details. An English version of the questionnaire is attached as **Additional File 1**.

## Data Analyses

The respondents' knowledge was assessed on the basis of the percentage of correct answers to individual questions. Where not indicated otherwise, the percentages given below are the proportions of correct answers in the whole study group. Whenever a respondent failed to provide an answer, it was regarded as an incorrect answer. After the initial computational analyses of the socio-demographic characteristics of the study sample as well as calculations of the proportions of correct answers in particular subject areas, further analyses were carried out with use of STATISTICA *Project file Version 10*. Univariate analysis of variance (ANOVA test) was performed to explore possible relationships between the students' knowledge and their age, university and source(s) of information.  $P$ -values of  $p \leq 0.05$  were considered significant. Multiple regression analysis was used to estimate the effect of age and year of study on the respondents' knowledge.

## RESULTS

55.8% of the answers to the 17 knowledge-related questions were correct (see **Figure 1**). The average individual score was 9.49 points out of 17 (55.8%), and the median individual score was 9. As regards the knowledge of different age groups within the study group, the percentages were as follows: 1st group (18–21 years old) – 52.9%, 2nd group – (22–24 years old) – 57.6%, and 3rd group (25–29 years old) – 60.3%. To estimate how age and year of study influenced the respondents' knowledge, multiple regression analysis was used. The model turned out significant [ $F_{(2, 449)} = 13.565$ ;  $p < 0.0001$ ], and the two predictors together accounted for only 6% of the variance in knowledge ( $R^2 = 0.057$ ). The influence of the year of study was found statistically significant

( $\beta = 0.23$ ;  $t = 3.128$ ,  $p < 0.0001$ ), but the influence of age was not ( $\beta = 0.01$ ;  $t = 0.117$ ,  $p > 0.05$ ).

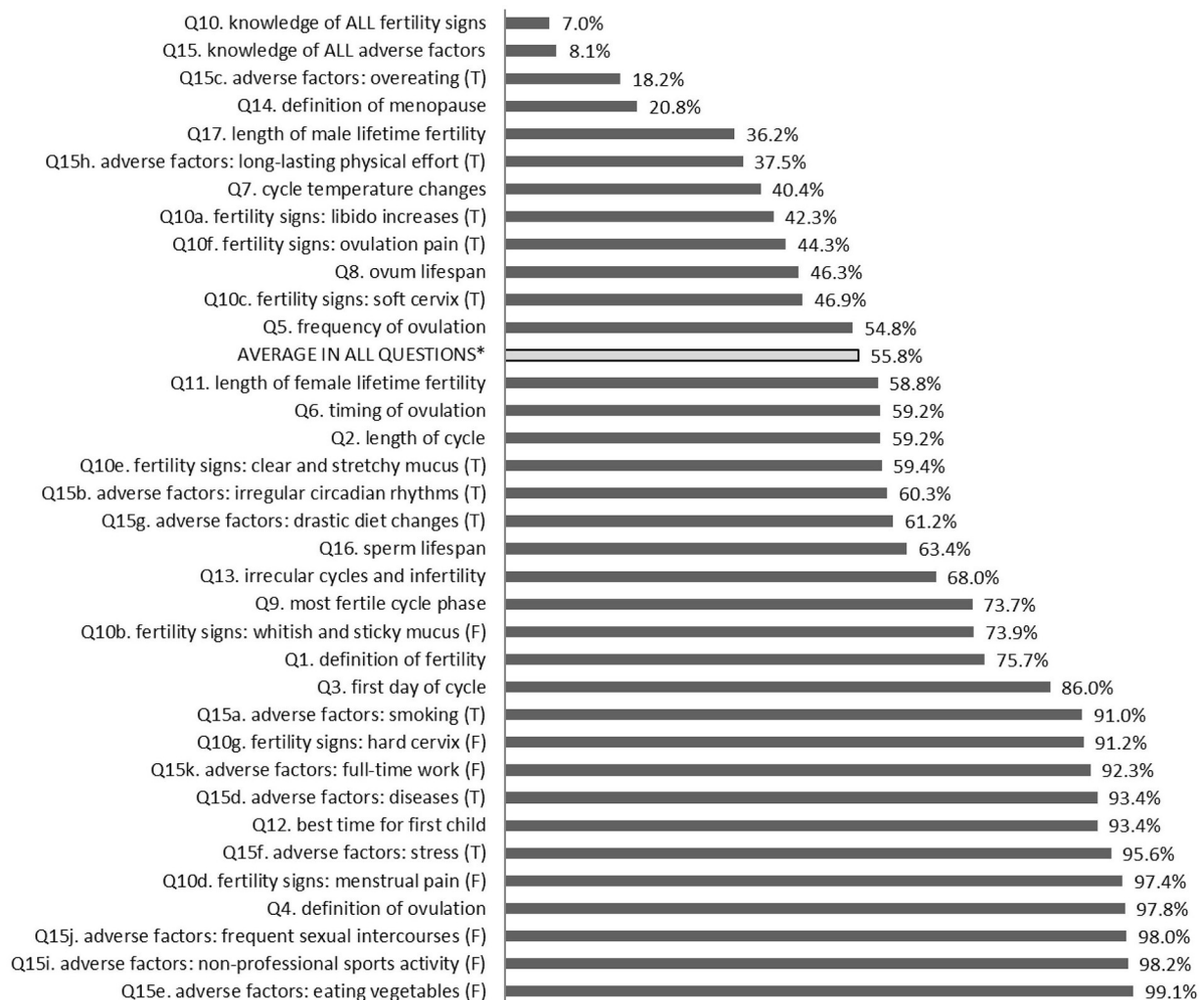
None of the respondents replied correctly to all the questions. It should be noted that the questionnaire was not an easy one. The two conjunctive multiple choice questions, each having a set of correct answers, were particularly demanding: the question regarding symptoms of ovulation, and the question about fertility-affecting factors. Only fully correct answers were counted as correct, also in respect of the two questions. If the hardest questions were not taken into account, the proportion of correct answers (and the mean score) would reach 62.2%. Rather than rate these results as satisfactory or unsatisfactory, the authors would like to point to the areas which turned out particularly difficult to the participants, as well as discuss the questions presenting statistically significant differences in knowledge between age groups, universities and sources of information.

As it has already been mentioned above, the questions which presented a big challenge to the participants were those which required indicating a whole set of correct answers. The first of them, question no. 10 (Q10), referred to fertility signs, i.e., a set of symptoms characteristic for the most fertile period of the cycle. There were seven possible symptoms (Q10a–Q10g) to choose from conjunctively, including 4 correct ones. Only 7.0% ( $n = 32$ ) of the respondents managed to identify the whole set correctly, the vast majority of them ( $n = 27$ ) attending the medical university. However, if the questions about the symptoms were treated as seven separate subquestions, the share of correct answers for specific symptoms would range from 42.3–97.4%, and the mean for all the symptoms would be 65.1% (see **Table 1**).

Statistically significant differences were found between the 3 age groups as regards the knowledge of fertile cervical mucus characteristics: the older the students were, the more often they gave correct answers. The respondents were better at identifying the symptoms that are *not* present during the fertile phase (the cervix is *not* hard, cervical mucus is *not* whitish or sticky, menstrual pain does *not* occur) than at indicating those that can actually be observed (libido increases, the cervix is soft, cervical mucus is clear and stretchy, ovulation pain occurs). Most of the students did not know that libido was heightened during the most fertile phase.

The second question that proved problematic was the one about the factors adversely affecting human reproductive potential (Q15). The list included 11 factors (Q15a–Q15k), 7 of which were correct. All the factors were identified correctly by only 8.1% ( $n = 37$ ) of the interviewees, most of them from the University of Medical Sciences and the University of Life Sciences. Again, with this question treated as 11 separate subquestions, the scores for specific factors range from 18.2 to 99.1%, and the average score for all the factors reaches 76.8% (see **Table 2**).

The students had excellent knowledge of a few risks (stress, diseases, smoking), but much poorer knowledge of other factors (overeating, irregular circadian rhythms, long-lasting physical effort). The awareness of the latter factors was directly proportional to the age of the respondents. Interestingly, in the



**FIGURE 1 |** Percentages of correct answers to particular questionnaire questions. \*Excluding the results in the subquestions 10a-g and 15a-k; T, true; F, false.

question about non-professional sports activity the proportions were inverted, i.e., the younger the respondents were, the more correct they were in claiming that such activity does not have an adverse effect on fertility. The analysis of the sources of information showed that the women seeking information from professional sources had slightly more accurate knowledge of the fertility-compromising factors (see **Additional File 2**).

The next difficult question was the one where the students were asked to choose the right definition of menopause (Q14). The average percentage of correct answers was only 20.8%. The respondents' age influenced their awareness—the older they were, the more they knew about it. Detailed differences between the age groups with respect to this question, as well as to other questions where the differences were statistically significant, are presented in **Table 3**.

Fifty-seven percent of the whole study group believed that menopause is the period in a life of a woman when her fertility gradually ceases. The medical students were the group with the

highest percentage of correct answers (see **Additional File 3**). The poorest performance was recorded in the students who named parents as their source of information (no correct answers), whereas the best scores were observed in those who obtained information from health professionals and "other sources" (e.g., university courses, natural family planning courses, leaflets, siblings; see **Additional File 2**).

The question with a somewhat bigger proportion of correct answers (36.2%) was the one about the length of male fertility during a healthy man's life (Q17). By way of comparison, the percentage of correct answers to the question about the length of female fertility (Q11) was 58.8%. When asked about the lifespan of a sperm (Q16) and an ovum (Q8), the respondents had better knowledge on the male reproductive cell (63.4%) than on the female cell (46.3%).

A question concerning a more observable subject matter—the changes of basal body temperature (BBT) during the cycle (Q7)—yielded very diverse answers, depending on the source



**TABLE 1 |** Knowledge of fertility signs in different age groups.

Knowledge* of:	Age (percentage of participants in a given age group)				<i>p</i>	<i>SD</i>	<i>SE</i>
	Mean <i>n</i> = 456	18–21 (42.8%)	22–24 (48.5%)	25–29 (8.8%)			
Q10a. fertility signs: libido increases (T)	42.3%	38.50%	43.40%	55.00%	> 0.05	0.49	0.02
Q10b. fertility signs: whitish and sticky mucus (F)	73.9%	66.20%	79.20%	82.50%	<b>≤0.005</b>	0.44	0.02
Q10c. fertility signs: soft cervix (T)	46.9%	41.50%	51.60%	47.50%	> 0.05	0.50	0.02
Q10d. fertility signs: menstrual pain (F)	97.4%	95.90%	98.60%	97.50%	> 0.05	0.16	0.01
Q10e. fertility signs: clear and stretchy mucus (T)	59.4%	51.30%	65.20%	67.50%	<b>≤0.05</b>	0.49	0.02
Q10f. fertility signs: ovulation pain (T)	44.3%	40.50%	46.60%	50.00%	> 0.05	0.50	0.02
Q10g. fertility signs: hard cervix (F)	91.2%	87.70%	93.20%	97.50%	> 0.05	0.28	0.01

\*As a proportion of correct answers.

T, true; F, false.

*p* ≤ 0.05 (in bold) were considered significant.

**TABLE 2 |** Knowledge of the factors which may adversely affect fertility in different age groups.

Knowledge* of:	Age (percentage of participants in a given age group)				<i>p</i>	<i>SD</i>	<i>SE</i>
	Mean <i>n</i> = 456	18–21 (42.8%)	22–24 (48.5%)	25–29 (8.8%)			
Q15a. adverse factors: smoking (T)	91.0%	91.8%	90.5%	90.0%	> 0.05	0.29	0.01
Q15b. adverse factors: irregular circadian rhythms (T)	60.3%	46.7%	69.2%	75.0%	<b>≤0.001</b>	0.49	0.02
Q15c. adverse factors: overeating (T)	18.2%	11.3%	22.6%	25.0%	<b>≤0.05</b>	0.39	0.02
Q15d. adverse factors: diseases (T)	93.4%	92.8%	93.7%	95.0%	> 0.05	0.25	0.01
Q15e. adverse factors: eating vegetables (F)	99.1%	100.0%	98.6%	97.5%	> 0.05	0.09	0.00
Q15f. adverse factors: stress (T)	95.6%	93.3%	96.8%	100.0%	> 0.05	0.21	0.01
Q15g. adverse factors: drastic diet changes (T)	61.2%	55.9%	64.3%	65.0%	> 0.05	0.49	0.02
Q15h. adverse factors: long-lasting physical effort (T)	37.5%	28.7%	42.5%	52.5%	<b>≤0.001</b>	0.48	0.02
Q15i. adverse factors: non-professional sports activity (F)	98.2%	100.0%	97.3%	92.5%	<b>≤0.005</b>	0.13	0.01
Q15j. adverse factors: frequent sexual intercourses (F)	98.0%	99.0%	97.3%	97.5%	> 0.05	0.14	0.01
Q15k. adverse factors: full-time work (F)	92.3%	92.8%	92.3%	92.5%	> 0.05	0.27	0.01

\*As a proportion of correct answers.

T, true; F, false.

*p* ≤ 0.05 (in bold) were considered significant.

**TABLE 3 |** Knowledge differences between age groups.

Knowledge* of:	Age (percentage of participants in a given age group)				<i>p</i> **	<i>SD</i>	<i>SE</i>
	Mean <i>n</i> = 456	18–21 (42.8%)	22–24 (48.5%)	25–29 (8.8%)			
Q1. definition of fertility	75.7%	72.8%	80.1%	65.0%	≤0.05	0.62	0.03
Q3. first day of cycle	86.0%	83.6%	89.6%	82.6%	0.0408	0.61	0.03
Q10b. fertility signs: whitish and sticky mucus (F)	73.9%	66.2%	79.2%	82.5%	≤0.005	0.44	0.02
Q10e. fertility signs: clear and stretchy mucus (T)	59.4%	51.3%	65.2%	67.5%	≤0.05	0.49	0.02
Q14. definition of menopause	20.8%	12.8%	26.2%	30.0%	0.0037	1.06	0.05
Q15b. adverse factors: irregular circadian rhythms (T)	60.3%	46.7%	69.2%	75.0%	≤0.001	0.49	0.02
Q15c. adverse factors: overeating (T)	18.2%	11.3%	22.6%	25.0%	≤0.05	0.39	0.02
Q15h. adverse factors: long-lasting physical effort (T)	37.5%	28.7%	42.5%	52.5%	≤0.001	0.48	0.02
Q15i. adverse factors: non-professional sports activity (F)	98.2%	100.0%	97.3%	92.5%	≤0.005	0.13	0.01
AVERAGE IN ALL QUESTIONS***	55.8%	52.9%	57.6%	60.3%	–	0.15	0.01

\*As a proportion of correct answers.

\*\*Only the statistically significant results are presented.

\*\*\*Excluding the results in the subquestions 10a–g and 15a–k.

T, true; F, false.

of information (see **Additional File 2**). While 40.4% on average gave correct answers, the proportion ranged from 87.5% in the subjects who relied on the information obtained from parents to 28.6% in those who gained it from peers.

When asked if ovulation occurs in every cycle (Q5), over a half of the respondents (54.8%) answered correctly. Medical students had much better knowledge (71.9%, see **Additional File 3**). The answers to the question about the timing of ovulation during the cycle (Q6) were very divergent across groups with different sources of information. The lowest percentage of correct responses (25.0%) was observed in the respondents informed by parents. They usually believed that ovulation occurs exactly in the middle of the cycle. The highest score (79.2%) was achieved by the women who based their answers on the information from the media (see **Additional File 2**). On average, 59.2% of all the answers to this question were correct.

The same proportion of correct answers (59.2%) was observed in the question about the length of a menstrual cycle (Q2). A quarter of the respondents were of the opinion that a cycle lasts 26–28 days, whereas the scope is a bit broader: 22–35 days. Given the fact that approximately 2 in 3 women have cycles which are 25–30 days long (23), the submitted answers may be based on the subjects' own experience.

When asked about the relation between irregular cycles and infertility (Q13), most of the respondents (68.0%) were aware that infertility is related to other factors apart from cycle length. The levels of knowledge in this area did not depend on any of the factors analysed in the present study.

73.7% of the respondents knew which cycle phase is the most fertile (Q9). Their knowledge varied depending on the university, with the medical university students scoring significantly better than others (82.0%, see **Additional File 3**).

In one question the respondents were asked to provide a definition for fertility (Q1). Only the answers fully conveying the meaning of the following definition, e.g., “the ability to reproduce,” were deemed correct. 75.7% of the interviewed females provided correct definitions, which seems quite a good result given the fact that it was an open-ended question. The 2nd age group had the highest number of correct answers, whereas the oldest group scored the lowest (see **Table 3**).

The majority of the study group knew on which day the female menstrual cycle begins (Q3), and the average share of correct answers reached 86.0%. It was the highest in the 2nd age group (89.6%, see **Table 3**), and among the medical school students (94.9%, see **Additional File 3**).

Also the vast majority of the respondents (93.4%) answered correctly when asked about the optimum age for a woman to give birth to the first child (Q12). All of the respondents who relied on the information from parents were correct about it, compared to only 71.4% of those informed by peers (see **Additional File 2**).

The question which turned out the easiest was the one where the respondents were asked to define ovulation (Q4)—the proportion of correct answers reached 97.8%. Once again, the medical students were the most knowledgeable (see **Additional File 3**). There were big differences between the groups using different sources of information. The proportion of correct answers equalled 100% in the women informed by

health professionals and parents. The score was much lower (71.4%) in the respondents who identified peers as their source of information (see **Additional File 2**).

## DISCUSSION

The general level of RH knowledge found in the present study is consistent with similar global research. In a systematic review that included 71 articles published worldwide between 1994 and 2017, Pedro et al. (24) compared the knowledge of people of reproductive age in the world and found the reported knowledge levels to be mostly low (<40% of correct answers) to average (40–59% correct answers). On this scale, the general knowledge of the respondents of the present study (55.8%) would be rated as average. Trying to identify the variables associated with different knowledge levels, the authors of the review reported generally higher levels in women, people of higher education, those having difficulty conceiving, and those who had planned their pregnancies. They were also higher among medical or health students than among students of other areas, which is consistent with the results of the present study (24).

As regards the detailed results of the present study, it seems that the knowledge of Polish female students is incomplete and patchy. Firstly, most of the respondents tend to have better knowledge in the areas either close to their own experience or relevant to them at a given time—perhaps the areas which they feel personally motivated to explore or which are likely to be discussed during patient—gynaecologist interactions. Since they are all in reproductive age, they are well-informed about the basic menstruation and ovulation facts such as which day is the first day of the menstrual cycle and which phase is the most fertile phase of the cycle. The findings are corroborated by a large study of 2019 conducted on 20,002 Polish women (mean age 27.7 years, 71% with higher education) (25), in which the questions about the first day of the menstrual cycle and the average length of the cycle had more than 90% correct answers. Similarly, in a study by Makara-Studzińska et al., 200 students of different Polish universities were well aware of the first day of the female menstrual cycle (26). Also in a 2010 study by Deluga and Wiśniewska carried out among women aged 18–31 years, 90.3% of the interviewed females knew which day it was (27).

On the other hand, there are a few subjects where the study group had poor scores. Perhaps these were the areas remote from the participants' everyday experience or considered to be irrelevant for the time being, the areas where their personal motivation to seek information was weaker, and where their knowledge depended more on formal education. Thus, the questions with markedly better and markedly worse results identified in the present study may reflect, respectively, the areas of focus and neglect in RH education in Poland. For example, the participants had poor knowledge of menopause, which is a period still decades ahead for most of them. Similarly, their awareness of fertility signs was limited, though found to be generally increasing with age (see **Table 1**). Fertility signs were also a demanding subject for the participants of the study by Warzecha et al. (25)—they had the most difficulty answering

the question about the time of the cycle when BBT increases (10.4% of correct answers). The young women presumably sought to avoid pregnancy rather than achieve it, and preferred such contraceptive methods (e.g., hormonal contraception) that made their own fertility signs absent or altered. According to Zgliczyńska et al., 51% of Polish female contraception users aged 18–35 years rely on hormonal contraception, while 13%—on natural family planning based on observing one's fertility signs (28). The present study was not concerned with practices, including contraceptive practices, so it is not possible to check if the students more knowledgeable about fertility signs used that knowledge for natural family planning. However, an American study of 2012 found that the respondents who used natural family planning or withdrawal as contraception had slightly better, though still inaccurate, awareness of fertility signs. These two groups seemed more interested in observing fertility symptoms (29).

Another topic where the respondents displayed fragmentary knowledge was the factors which may adversely affect fertility. Few of the participants were able to name them all. A number of factors (stress, diseases, and smoking) were identified correctly by the vast majority of the students. Surprisingly, some other risks (overeating, long-lasting physical effort, irregular sleep patterns) were selected markedly less often. It may seem that the young women do not realise how these lifestyle-related factors may influence their present and future lives. The fertility-compromising risk factors that were readily recognised may be among the behavioural risk factors often mentioned in other health-related contexts. The international review by Pedro et al. found good knowledge of lifestyle-related infertility risk factors (smoking, alcohol, and substance use) in most of the reviewed research and attributed it to the fact that they are common and generally well-recognised risk factors for other well-known chronic diseases such as cardiac disease and cancer. The awareness of these risk factors was generally higher in well-educated groups and in people trying to conceive (24). The members of the latter group were interviewed in a study carried out in 79 countries (83.2% women, 53.9% with university education), and the risk factor correctly identified by most of the participants was smoking, whereas the poorly recognised factors included sexually transmitted infections (STIs), age over 40 years and obesity in women, and mumps after puberty in men (30, 31). In a Canadian study among childless women aged 20–50 years (81% with at least college education), most participants were aware of the adverse effect of STIs (82.2%), and abnormal woman's weight (66.2%) (32). Fertility clinic patients interviewed by Homan and Norman readily identified such lifestyle-related risk factors as smoking, being over- or underweight, taking recreational drugs, and stress (33). By way of comparison, only 38% of the women not trying to conceive interviewed as part of the American Fertility IQ 2011 survey were aware that reproductive health may be affected by smoking and 21% knew the harmful effect of too much physical exercise, but a majority knew about the adverse effect of stress and abnormal weight (34).

Interestingly, the area where the participants of the present study scored relatively well was the knowledge of selected not

directly observable fertility aspects. The vast majority knew that ovulation is “a release of an ovum from an ovarian follicle,” 63.4%—how long a sperm lives, and 46.3%—how long an ovum lives. The last question was also answered correctly by 44.3% of young women in another Polish study, with nearly 2/3 of the participants being university students (27). In the study by Warzecha et al., 62.5% of the young Polish women (71% with higher education) correctly identified the fallopian tube as the part of the genital tract where fertilisation usually takes place (25). These relatively good results regarding “technical” aspects of reproduction may result from study sampling that favoured populations with or during university education (and in the case of the present study—during medical or health-related university education). On the other hand, such results may suggest that Polish education focuses on the mechanistic model of the human body rather than on making RH education practical, close to students' experience, and delivered—as international standards (35) recommend—in an interactive way and with systematic youth participation. In practice, Polish children and adolescents are taught the basics of human reproduction in biology classes. In addition, there is a subject called education for family life (EFL) introduced in 1999 for pupils aged 9–10 and above until the completion of secondary education. Its curriculum includes sexual and RH education, but tends to concentrate on traditional family values and roles. Although it is obligatory for schools to provide 14 h of EFL a year, it is optional for pupils to attend the classes. The subject is often neglected by schools and disparaged by students. The attendance in primary schools reaches 73%, but only 37–51% in different kinds of secondary schools (36). The teaching methods reported by the attendees are basically lectures (90%), as well as film presentations (48%), discussions (44%), and team work (32%). However, only 87% of the attendees felt they were allowed to ask questions, and 40% were not permitted to discuss anything with either the teacher or classmates. Fifty-five percent felt they were allowed to express their opinions freely (37). Such a learning environment is hardly conducive to convincing young people that RH is relevant to them and constitutes a vital part of their lives. Selected elements of RH education (mostly natural family planning methods) are provided to would-be spouses at premarital family counselling meetings required by the Catholic Church before concluding a marriage. The median age of a Polish woman contracting the first marriage is nearly 28 years (38), which means that this additional education comes quite late for many young women. Therefore, it can be assumed that EFL classes often remain their primary source of RH information until they become university students.

The results of the present study also point to the differences in reliability and quality of the information obtained from various sources (see **Additional File 2**). As can be seen, almost a half of the study participants indicated using a few sources of information. This group achieved quite good results. Of the other half that indicated single sources, most relied on middle or high school classes, with mediocre results—an indication that formal school education is failing. The use of other sources, including university courses, was reported by 8.3% of the students and produced the best results. The students who relied on



either the media or health professionals had relatively good knowledge as well. The participants who were informed by peers scored much poorer than those informed by parents, but it should be noted that both the groups were small and the conclusions should be treated with caution. In contrast, American females (34) claimed that they acquired RH knowledge from their gynaecologists (49%), then from family and friends (29%), from the Internet (17%), from their general practitioners (16%), and from other sources. Australian women (39) most often looked for information on the Internet and in books, while only 18% of Australians obtained it from doctors. The Internet is a very popular source of health-related information in Poland (27, 40–42) as well as abroad (39, 43–47), but the quality and reliability of the information presented there varies a lot. Since the use of only one source of information was not sufficient for our respondents, it seems crucial to ensure that the available sources provide quality and up-to-date information. It seems that even in the groups where motivation to expand knowledge is high, the level of knowledge may be insufficient owing to poor quality information. For example, while 86.8% of the interviewed patients of ART clinics actively tried to improve their FA using various sources of information and 68.2% attempted timed intercourse within the fertile window of the menstrual cycle, only 12.7% were able to identify this window correctly (39).

Finally, the results of this study may indirectly point to the gap between the participants' knowledge and their practices. Even though this study did not explore the participants' practices in the sphere of RH, some conclusions about them can be reached by comparing our results with practices of Polish women reported by other researchers. For instance, the present results show that Polish women are aware of age-related fertility decline or at least of the optimum age for a woman to become a first-time mother. In the present study, the optimum age was defined as the biological peak of female fertility with the shortest waiting time to pregnancy (48, 49). In another Polish study by Deluga and Wiśniewska, 85.8% of the interviewees knew correctly when the best time for having the first child was. Yet, only 29.7% of the respondents declared that they intended to give birth to their first child before 26 years of age (27). Demographic data from Poland confirm the tendency to either postpone or forgo parenthood. The mean age of first-time mothers rose in Poland from 23.7 to 27.2 between 1995 and 2016 (50), reflecting a similar trend in OECD countries, where the mean between the same years rose from 26.0 to 28.9 (51). The median age of Polish mothers at first birth in 2016 was 29.9 (50). At the same time, the interval between the births of the first and the second child in Poland rose from 3.5 years for women born in the years 1960–1964 to 4.7 years for the 1975–1979 cohort (15). Between 2010 and 2014, the proportion of Polish childless women planning to become mothers later than in the next 3 years increased from 44 to 52% (15). Unfortunately, a marked increase of waiting time to pregnancy can be observed in women aged over 35 years. In 2014, the waiting times of a year or more were observed in only 4–5% of first-time Polish mothers aged 25–29, but in as many as 25% of mothers aged 35+ (49). Since women's knowledge of the optimum childbearing age is not enough to change their decisions, it is imperative to

educate them on the factors which may help to maintain their reproductive potential beyond the optimum age. The present study demonstrated the women's limited knowledge of the factors adversely affecting fertility, thus pointing to a big gap to fill in Polish RH education.

People's reluctance to treat RH as a personally relevant issue can sometimes be observed in global FA research. As a result of such an attitude, personal risks tend to be underestimated, while chances of success—overestimated. For instance, the fertility clinic patients who took part in the study by Homan and Norman (33) correctly identified obesity as an infertility risk factor, yet a half of the obese women in the sample did not find their weight to be a factor affecting their own fertility. Another interesting example given by Pedro et al. was an observation that high awareness of age-related fertility decline was frequently accompanied by a belief that the decline starts later than it actually does. In addition, the chances of achieving pregnancy both spontaneously and through fertility treatment were often overestimated (24). Canadian researchers (32) discovered that 90.3% of the interviewed childless women knew about the age-related fertility decline, but 72.9% believed that good health and fitness in women aged over 30 years is a better indicator of fertility than age. Ottawa students surveyed in another Canadian study (52) overestimated fertility of women in their thirties as well as success rates of assisted reproductive technologies. The overoptimistic perception of parenthood chances were also observed in the USA (34), Denmark (53), Sweden (54), Nigeria (55), and Australia (56).

Another difference between knowing and doing that follows from the comparison of the present results with the available research is the neglect of primary and secondary disease prevention among Polish women of reproductive age. While the vast majority (93.4%) of our respondents were aware of the adverse effect of diseases on fertility, only about a half of young Polish women report attending gynaecological check-ups on a regular basis, and the other half make an appointment only when they have a problem or urgently need a consultation (27). Contrary to the Polish clinical care guidelines recommending that the initial routine gynaecologic visit should take place between the ages of 12 and 15 years (57), only a small proportion of Polish women (16.4%) have it before the age of 16 (58). What is more, young Polish women are affected by a number of lifestyle-related risk factors for non-communicable diseases and infertility. Although the prevalence of tobacco smoking in women aged 20–29 has fallen from 21% in 1996 to 18.7% in 2018, the falling trend has slowed down in the last few years (59). Approximately one third of Polish women aged 20–35 are overweight or obese (60, 61). About 1 in 2 Polish students report not having enough sleep, largely due to poor sleep hygiene and bedtime procrastination, which is more prevalent in students than in non-students, and in women than in men (62, 63). It appears that the knowledge of young Poles does not always translate into practices.

Although the present study provided an interesting picture of young Polish women, the authors admit that its design had some

limitations. The first was the use of the questionnaire specially developed for the purposes of this study instead of a standardised questionnaire, which makes the findings more difficult to compare with other research on FA and RH knowledge. The second limitation was the use of a convenient sample, which limited the generality of the study.

The findings presented here suggest that the overall RH knowledge of young Polish female students is limited and patchy. As can be expected, the best knowledge can be found in medical university students and in the oldest age group. There is strikingly poor awareness of some fertility-compromising behaviours such as unbalanced diet, excessive physical effort and irregular sleep. It may indicate that the young women do not realise how these lifestyle-related factors may influence their present and future lives. What is more, in the light of other research, it seems that the theoretical knowledge does not translate into practices even in the areas where awareness is relatively high. Education which is currently available may have limited effect on behaviours and decisions related to reproductive health and, consequently, on redressing fertility gap and population decline.

Tackling these problems requires using a number of diverse strategies tailored to address the needs of the Polish population. As it has been stated above, the available research indicates that there is a need in Poland for multi-faceted activities targeting primarily economic instability, work-family tensions, and health problems (including infertility), which seem to be the three main obstacles to childbearing in Poland. As regards the first two kinds of solutions, a few reforms have been implemented within the last 10 years: the extension of paid maternal leave (partly transferable to fathers) and parental leave to a total of 52 weeks, extension of institutional care for children under 3 years old, and introduction of a generous monthly child allowance for every child. Young Polish parents interviewed by Suwada (64) considered these solutions to be helpful, but insufficient and in need of integrating with better gender equality policies, labour market policies, and housing policies.

Regarding the third type of solutions, i.e., RH promotion and education, Polish policymakers have only recently realised its importance. The national public health policy paper called the National Health Programme for the years 2016–2020 formulates 6 main goals of the Polish public health to be achieved through intersectoral collaboration. One of the goals is “contributing to improved reproductive health” (65, 66). Two out of the five activities included in this goal are related to RH research and guideline development, and the remaining 3 activities are closely connected with evidence-based RH education of the general public as well as would-be and current health professionals and educators. Unfortunately, only 1.03% of all the activities undertaken as part of the Programme in the years 2016–2018 were dedicated to the RH goal (67). It may suggest that the need for action has been recognised in Poland, but the urgency of the action probably has not.

High-quality health education is necessary for turning mere health knowledge into health literacy defined as the ability not only to read, understand, and apply new information, but also to “exert greater control over life events and situations” (68). High-quality, equitable (69), and widely available

health education is necessary for making informed choices. Interventions aimed at increasing health literacy and tailored to patients’ needs have been found to be effective or at least promising tools for changing health knowledge and behaviours (70–72). That is why it is imperative to further explore the gaps in RH education in Poland in order to make it more operational and practical, more interesting, and relevant to young people’s everyday experience, and more comprehensive in terms of balancing the present focus on family values and pregnancy prevention with the content aimed at improving their FA and teaching them to look after their reproductive potential. Since nearly a third of the study participants relied on the information obtained during secondary school classes, it is advisable to pay special attention to examining and subsequent redesigning of the curricula of these classes. To redress the knowledge gaps observed in current university students, it should be ensured that medical university courses provide thorough RH/FA knowledge. It is particularly important with respect to would-be gynaecologists, who might become a more trusted source of evidence-based information for their patients if they were better trained in terms of health education skills and RH literacy. At other universities, elective courses should be arranged to advocate health-promoting and health-protective behaviours and to encourage young people to broaden their knowledge with the help of reliable sources of information such as health professionals. Relevant graduate, postgraduate and in-service courses should be available to future and present professionals responsible for spreading RH knowledge: teachers, health educators, school counsellors, and psychologists. The key messages of RH education should be the fact that our RH is a function of our general health status, and that our lifestyles directly influence them both.

## PLAIN ENGLISH SUMMARY

Poland is experiencing a decline in fertility: women tend to have fewer children and postpone motherhood to their 30s and 40s, which may cause problems getting pregnant. That is why especially young people should have knowledge sufficient to enable them to take care of their reproductive health. We decided to assess their knowledge by surveying Polish female university students. Four hundred and fifty-six students completed a questionnaire testing the knowledge of female and male reproductive physiology. In general, the students’ knowledge was found to be incomplete. Better results were observed in the oldest age group and among medical university students. Over 90% of the respondents knew some fertility-compromising risks (smoking, diseases, stress), but few were aware of the adverse effect of unbalanced diet, irregular sleep, and long-lasting physical effort. Nearly a third said their only source of reproductive health knowledge was primary or secondary school classes. Therefore, it is crucial to provide high quality education at this level. Also university students as well as present and future teachers and health educators should be offered additional reproductive health courses. The education in this area should be as practical as possible to

convince young people of the importance of looking after one's reproductive health.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

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EC, BK, and AL conceived its idea. BK and RS worked on the statistics and tables. BK and JK wrote the core of the manuscript. EC coordinated its further development. EC and AL contributed to the discussion and developed the figure. All authors made substantial contributions to the conception and design of this paper, read, revised, and approved the final manuscript.

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# Health Literacy and Health Behavior Among Women in Ghazni, Afghanistan

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**Background:** Health literacy is a determinant of health and assessed globally to inform the development of health interventions. However, little is known about health literacy in countries with one of the poorest health indicators worldwide, such as Afghanistan. Studies worldwide demonstrate that women play a key role in developing health literacy. Hence, this study's purpose is to explore health literacy of women in Afghanistan and the associated factors.

**Methods:** From May to June 2017, we randomly recruited 7–10 women per day at the hospital in Ghazni, a representative province of Afghanistan. Two trained female interviewers interviewed 322 women (15–61 years old) orally in Dari or Pashto on a voluntary basis and assessed their health literacy using the HLS-EU-Q16, associated socio-demographics, and health behavior.

**Results:** Health literacy of women (among educated and illiterates) is low even compared to other Asian countries. Health literacy is linked to age and education. We found mixed evidence of the relationship between health literacy and contextual factors, help-seeking, and health-related behavior.

**Conclusion:** This study provides novel data on health literacy and astonishing insights into its association with health behavior of women in Afghanistan, thus contributing to health status. The study calls for recognition of health literacy as a public health challenge be addressed in Afghanistan and other low-income countries affected by crises.

**Keywords:** Afghanistan, health-behavior, health literacy, HLS-EU-Q, illiterate, low-income country, women

## INTRODUCTION

Recently, health literacy (HL) moved from the margins to the mainstream of health research because of its relevance for quality of care, disease prevention, and quality of life. Health literacy is a critical determinant of health, an asset for public health and an outcome of health promotion activities such as health education (1). Hence, researchers and policymakers recommend assessing health literacy, identifying vulnerable groups, and developing interventions to improve health literacy on this basis (2). Initially, most research originated from English-speaking countries (e.g., USA, Canada, and Australia), but other industrialized countries, such as many European Countries,

quickly followed, and the countries of the global South and Asia are recently catching up (3–7). Nevertheless, crisis-affected and least-income countries are omitted, although assessing and improving health literacy there is supposed to contribute significantly to improving general health and the situation in the country and to achieving the sustainable development goals. Afghanistan is one of these most affected countries and at the same time places incredibly high challenges on research. Since—as far as we know—no health literacy research has been conducted in Afghanistan. Hence, we wanted to close the gap and explore the level of health literacy and provide relevant data for policymakers and practitioners and expand our knowledge of the nature of health literacy and related factors in war-torn and crisis-affected countries that have been neglected by health literacy research so far.

Various understandings of health literacy exist, the most prominent of which are those of the WHO (8), the Institute of Medicine (US) (9) and Sørensen et al., “Health literacy is closely linked to literacy and entails the knowledge, motivation and competences to access, understand, appraise, and apply information to form judgement and make decisions in terms of healthcare, disease prevention, and health promotion in everyday life during the life course.” (10) Health literacy is “more than the ability to read and comprehend health information” (11) and includes functional, interactive, and moreover critical health literacy (1). Consequently, numerous health literacy tools are available (12), such as performance-based screening tools for patients’ functional health literacy, for example the Test of Functional Health Literacy of Adults (TOFHLA), the Rapid Estimate of Literacy in Medicine (REALM) and the Newest Vital Sign (NVS) (13–16) or self-reported health literacy tools that aim at capturing a more comprehensive understanding of health literacy, such as the European Health Literacy Questionnaire (HLS-EU-Q) and the Health Literacy Questionnaire (HLQ) (17, 18).

Besides differences in levels of health literacy between countries, research shows that a substantial proportion of people have difficulties dealing with health information even within each country worldwide (19). The European Health Literacy Survey indicated 30–63% of the population have limited health literacy, depending on the European country considered (7). This trend is reflected in the Asian Health Literacy Survey demonstrating similar or even worse results in six countries (20). The various studies on health literacy revealed the association of health literacy with certain determinants of health, primarily e.g., gender, age, education, financial deprivation, and social status (6, 21). Furthermore, studies identified health literacy as a determinant to health mediated by health-related choices and multiple health behaviors, including help-seeking behavior, reproductive health, and eating behavior (21–25).

However, little empirical evidence exists on the determinants of health, health behavior, or their interplay with health literacy in Afghanistan. Afghanistan’s public health indicators are among the worst globally: e.g., infant mortality rate is 62/1,000, up to three-times higher than in neighboring countries (26).

Due to the ongoing war since 1978, scientific studies are comparatively rare and even studies on health, reproductive health or healthy lifestyle are scarce in Afghanistan, almost non-existing in remote areas and, furthermore, data is doubtful. A high percentage of the population in Afghanistan is illiterate [on average, an estimated 38.2% of Afghans are literate [52% of men, 24.2% of women] (27)]. The group of Afghan women is unique because of the historical context and the drastic changes in women’s access to education in recent decades. While girls were officially banned from attending schools in the 1990s, the attendance has increased considerably since 2001 (28, 29).

In health literacy research, a few studies target women in low and middle-income countries (30), but little is known about health literacy level in a population with interrupted or lacking education.

## Assumptions, Research questions, and Aims

Therefore, we wanted to examine the following assumptions: (a) Due to lack of/or interrupted school education, literacy and health literacy levels of many women in Afghanistan might be low. (b) Due to one of the lowest literacy rates worldwide, the level of health literacy in Afghanistan could be one of the lowest around the world. Hence, we used the HLS-EU-16 to facilitate comparability with findings from other countries, particularly in the European and Asian health literacy surveys (10, 20). (c) The health literacy level could be influenced by determinants namely higher educational attainment, younger age, higher socioeconomic status, living closer to the health center, and having better access to transportation and information and communication technologies (ICT). Access and ICTs can increase the likelihood of being exposed to more health information and thus contribute to improved health literacy (31, 32). (d) Bearing in mind the association of health literacy with education and age, age groups might differ in their health literacy level, a higher level of HL might be associated with seeking help at the hospital/medical center and with more health-promoting behavior. Therefore, our main research questions were:

- What is the health literacy level of women in Afghanistan?
- How high is Afghans’ health literacy in comparison to other countries?
- What are the main determinants of health literacy in Afghanistan?
- Is health literacy associated with help-seeking and with health-related behavior?

Our aim is to present descriptive results of our health literacy survey in Afghanistan, to compare it with population health literacy of populations globally, and to discuss the complex relationship between literacy, health literacy, and health behavior for crisis-affected low-income countries. Notably, the study identifies practical approaches to meet the need to improve the population’s health literacy and make healthcare, disease prevention, and health promotion more accessible to the people of Afghanistan (11, 33, 34).



## DATA AND METHODS

### Research Area

We have conducted the survey in Hazarajat in four of the most densely populated districts of Ghazni province: Jaghori, Malistan, Nahoor, and Qarabagh. These districts are representative of the geography of Afghanistan with a study area of ~7,355 square kilometers and an altitude difference of more than 2,000 m. Only one hospital—the Shuhada Hospital—and 25 health centers operate in these districts.

### Sample and Data Collection

Various security-related, geographical, and cultural challenges in Afghanistan pose difficulties for research among Afghan women outside the main cities. Firstly, women should conduct interviews with women. Secondly, it was impossible for female interviewers to travel to villages and interview randomly selected women because of security reasons (35). Therefore, we have chosen the most suitable approach and interviewed women coming to Shuhada Hospital either for personal treatment or for accompanying a patient. For 2 months—20 May–20 July 2017—we randomly selected 7–10 women per day aged 15 years or older. Due to the high number of illiterates, two trained female nurses and staff obtained oral informed consent and conducted the interviews orally on a voluntary basis. To ensure the highest attainable standard of participant safety, we took several measures. Interviews with women were conducted under close supervision of Shuhada Hospital management. Participation did not pose a safety risk because the subjects were interviewed in a designated office within the hospital. The interviewers explained that the data collected would be used for scientific research and would not include personal information such as name, address, and telephone number. They also informed respondents that they could refuse to answer any question if they did not feel comfortable doing so and that they could stop the interview at any time if they wished without any disadvantage. Apparently, respondents felt comfortable with the procedure and in the interview situation, as only a few respondents refused to answer some questions (mainly questions about satisfaction with sex life in the Quality of Life Questionnaire), but no woman ended the interview before completion.

Furthermore, we also interviewed male heads of households in their villages, but this sample is described in other articles (35, 36). The Ministry of Public Health in Afghanistan and the head of the Shuhada Hospital approved the study protocol.

### Questionnaire

Due to our desire to look at health and health literacy from various perspectives, we have created a questionnaire and selected questions based on the content, relevance and cultural appropriateness. The questionnaire comprised 102 items, including 45 socio-demographic and health-related items, 15 items of the European Health Literacy Questionnaire (HLS-EU-Q16), 18 items of Quality of Life (WHOQOL-BREF) (37), 8 items of the Spirituality, Religion, Personal Beliefs Questionnaire (WHOQOL-SRPB-BREF) (38), and 16 items of the Questionnaire for Patient Empowerment (39).

We used the HLS-EU-Q16 questionnaire developed by Pelikan et al. (40), shortened by Röthlin et al. (41) slightly modified and translated into Dari from the Swedish study by Wängdahl et al. (45) and translated this version into Pashto. To control the quality of our translation, we asked a heterogeneous group of people from Ghazni province if and how they understood the items and modified it based on their comments. The HLS-EU-Q16 focuses on how people find, understand, appraise, and apply information in three domains: health care, disease prevention, and health promotion. It consists of 16 items describing health-specific interactive tasks, the difficulty of which the interviewee is asked to rate on a four-point Likert scale: “very difficult” = 1, “rather difficult” = 2, “rather easy” = 3, or “very easy” = 4 with an additional option of “I don’t know” (18). In this study, we excluded one of the original 16 items: Item seven (“How easy/difficult is it for you to follow instructions from your doctor or pharmacist?”), which the Afghan field team considered irrelevant, since doctors have their own pharmacy in this district, so distinguishing between doctors and pharmacists could be confusing.

In general, the very high Cronbach’s alpha  $\alpha = 0.991$  (items: 15, cases: 322) of the Health literacy scale can be regarded as valid for appropriate internal consistency of the items (7).

### Statistical Analysis

For data management, we adhered to the guidelines of the HLS-EU survey on inclusion and exclusion criteria and restricted the samples to participants 15 years and older, and to those answering at least 80% of the questions (41). Hence, we needed to exclude 2 out of 324 women because of their age (age 12 and 13), but no person was excluded due to missing values.

Besides descriptive analysis (range, minimum, maximum values of the items), we calculated the level of health literacy based on the mean value of the answers given per person. The score 1 symbolized the lowest mean score (= all items are very difficult) and 4 the highest mean score (= all items are very easy). Unlike the proposed procedure in the HLS-EU (40), we did not transform the 4-point Likert scale into a dichotomous scale. The reasons for this were that we would lose a great deal of variance within the responses by dichotomizing them. Other studies on people with low education show that in this group the loss of variance would be particularly strong and that we could not further investigate which determinants explain this existing difference. In addition, we assumed that the subjects had good reasons for selecting the respective level and thus we wanted to take their assessment into account. However, because our intention was to investigate the health literacy of women with no or little schooling, we considered the 4-point Likert scale to be the most appropriate. Next, we calculated the total mean HL score and its standard deviation and compared the total HL score with other countries. For this purpose, we standardized the HL score to a uniform metric of 0 to 50 as proposed by Röthlin et al. (41). The calculation formula is:  $\text{Index} = (\text{mean} - 1) * 50 / 3$ . Additionally, we subdivided the health literacy score of the short HLS-EU-Q into three levels at the cut-off of 25 and 37.4 points (equivalent to the subdivision of the HLS-EU-Q16 at 8 and 12 points). 0–25 points were defined to be the lowest level

as “inadequate HL,” 25–37.4 as “problematic HL” and 37.5–50 as “sufficient HL” (7, 20, 40). We transformed the sociodemographic determinant “education” from a three categorical variable into a dichotomous variable (no education vs. some education) and occupation from a four categorical variable into a dichotomous variable (working at home vs. working outside, for instance, as teacher, governmental or NGO employee).

We examined the relationship between health literacy and other factors, namely age, education, further sociodemographic data, and health-related behaviors, by calculating bivariate correlation. Thereby we used Pearson correlation coefficient ( $r$ ) for two continuous-variables, point-biserial correlation coefficient ( $r_{pb}$ ) for one binary variable and one continuous-level variable, odds ratios ( $OR$ ) for bimodal variables, and chi-square tests ( $\chi^2$ ) for multi-optional variables using estimated percentage and absolute numbers. To assess the proportion of variance in HL, which is explained by sociodemographic data, we performed a multivariate linear regression model for general health literacy index as a dependent variable and education, age, main occupation (housewife or own occupation) and marital status as predictors.

## RESULTS

A total of 322 women at the hospital from the following districts participated in the study: Jaghori ( $N = 242$  women), Malistan ( $N = 77$ ), Nahoor ( $N = 3$ ), and Qarabagh ( $N = 2$ ). At the time of the interview, 58.7% reported being sick, whereas 41.3% were not ill but were accompanying another person. The participants' age varied between 15 and 61 years (average 30.33), with more than half of the participants between 20 and 29 ( $N = 144$ ) and only 26 women aged 50 and above.

Educational attainment was relatively poor. 59.6% women reported to be illiterate, 4.0% had basic education in reading and writing and approximately one out of three (36.3%) had formal or higher education.

**Table 1** shows the characteristics of the sample. The majority of participants were married (83.2%) (**Table 1**), with 18-year-olds and younger people more likely to be single than married. 23.6% of women had no children, the majority reported up to nine pregnancies, and 16 women had 10–16 pregnancies. At the time of the interview, 20.2% were pregnant. Households were large with an average of 9.5 people (from 2 to 30) and an average of 3.1 literate persons. The most common occupation for 9 out of 10 women (89.1%) was “working at home,” a small number (3.1%) of the women were employed by the government or an NGO, and 1.2% were teachers. The main source of income cited by the women was remittances (25.2%), followed by farming (25.3%) and business (42.9%) and 6.5% salary when employed by the government or an NGO.

Concerning contextual factors, the women interviewed in the hospital reported that 41.0% had access to a river, 97.8% to a road and 43.8% to a car. Most, but not all women had access to information and communication technologies such as electricity (89.1%), phone (88.8%), TV (75.5%), and the Internet (23.3%).

**TABLE 1 |** Sample characteristics.

Determinants	Female Patients/Attendees
<b>Sample size</b>	$N = 322$
<b>Age (years)</b>	$M = 30.33$ ( $R$ : 15; 61)
Age groups	< 20: $N = 36$ 20 → 29: $N = 144$ 30 → 39: $N = 72$ 40 → 49: $N = 44$ 50 ≤: $N = 26$
<b>Marital status (%)</b>	82.7% married 17.3% single
<b>Education (%)</b>	59.6% illiterate 4.0% Basic reading & writing 36.3% formal education
<b>Profession (main occupation) (%)</b>	89.1% work at home 6.5% others 3.1% government/NGO employed 1.2% teachers
<b>Main source of income (%)</b>	42.6% business 25.6% remittances 25.3% farming 6.5% government/NGO employed
<b>Household size</b>	$M = 9.56$ ( $\pm 5.3$ ) ( $R$ : 2; 30)
<b>Number of literate people in household</b>	$M = 3.18$ ( $\pm 2.13$ )
<b>Patients/Attendees (%)</b>	58.7% sick/patient 41.3% not sick: accompanying person

$N$ , absolute Numbers;  $M$ , Mean;  $R$ , Range;  $\pm$ , Standard deviation.

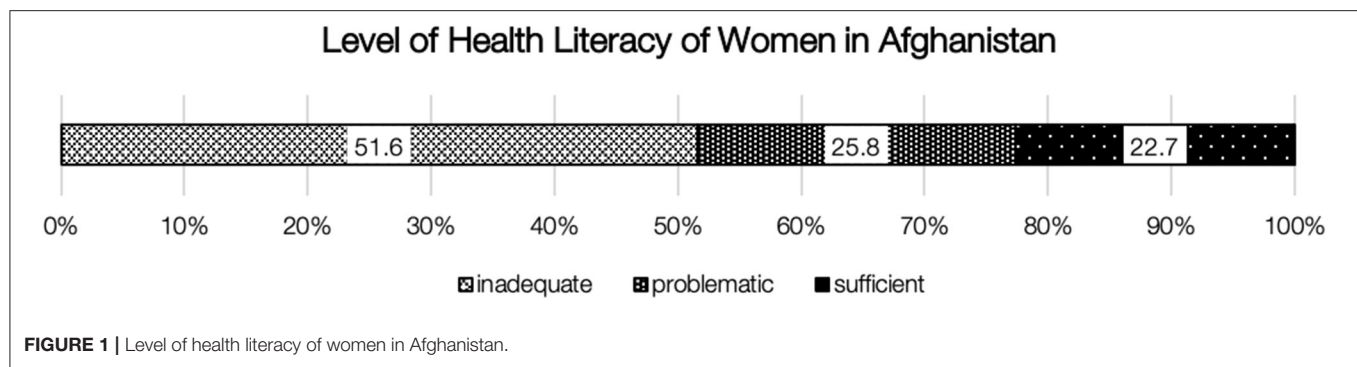
## Health Literacy of Women in Afghanistan

**Figure 1** illustrates the women's level of health literacy. In our study, about half of all women (51.6%) had an inadequate level of health literacy as measured with the HLS-EU-Q16. One out of four women (25.8%) had problematic HL, and more than one-fifth of the women (22.7%) had sufficient HL.

Noteworthy differences exist in the self-reported responses related to the HLS-EU-Q16 scale, as some items (activities) were classified by the majority of respondents as easier and other items (activities) as more difficult. Women had the greatest difficulties with tasks related to evaluating recommendations e.g., “judging when to get a second opinion” (Item 5) (64.60% of women said it was rather or very difficult) and “judging which everyday behavior is related to health” (Item 16) (60.56%). However, most women (54.3%) reported that “understanding the advice on health given by family members” (Item 14) was the easiest of all tasks. Nevertheless, rarely all respondents found all items very/rather difficult or very/rather easy (see **Table 2** on the single items and distribution).

## Health Literacy of Women in Afghanistan Compared to Other Countries

**Figure 2** illustrates our data compared to the findings of two other studies. The first comparison refers to the six countries in the Asian survey using the HLS-EU-Q. The second is with three selected results from the original HLS-EU survey: the study's



**TABLE 2 |** Overview of the European Health Literacy Survey Questionnaire 16 (HLS-EU-Q16) items and the distribution of the answers given by women in Afghanistan.

Items of the European Health Literacy Survey Questionnaire 16 (HLS-EU-Q16) "On a scale from one to four how easy do you find it to ...?"		Mean (1–4)	SD	% (rather) easy	Confidence interval
I1	Find information on treatments that concern you	2.33	1.16	47.35%	(41.86–52.84)
I2	Find out where to get professional help when ill	2.30	1.17	45.96%	(40.49–51.44)
I3	Understand what your doctor says	2.35	1.17	48.76%	(43.27–54.25)
I4	Understand instruction taking medication	2.48	1.2	55.59%	(50.13–61.05)
I5	Judge when to get second opinion	2.11	1.17	35.40%	(30.15–40.65)
I6	Use information doctor gives to make decisions	2.35	1.18	49.07%	(43.58–54.56)
I8	Find information on how to manage Mental health problems	2.18	1.13	40.68%	(35.29–46.08)
I9	Understand health warnings lifestyle	2.52	1.25	56.70%	(51.25–62.15)
I10	Understand why you need screening	2.34	1.15	49.69%	(44.20–55.18)
I11	Judge reliability of health information in media	2.44	1.19	54.35%	(48.88–59.82)
I12	Decide how to protect from illness based on media	2.44	1.2	53.42%	(47.94–58.89)
I13	Find out about activities good for mental well-being	2.23	1.14	40.68%	(35.29–46.08)
I14	Understand advice on health from family members or friends	2.41	1.17	54.35%	(48.88–59.82)
I15	Understand information in media on how to get healthier	2.46	1.2	54.66%	(49.19–60.12)
I16	Judge which everyday behavior is related to health	2.14	1.19	39.44%	(34.07–44.81)

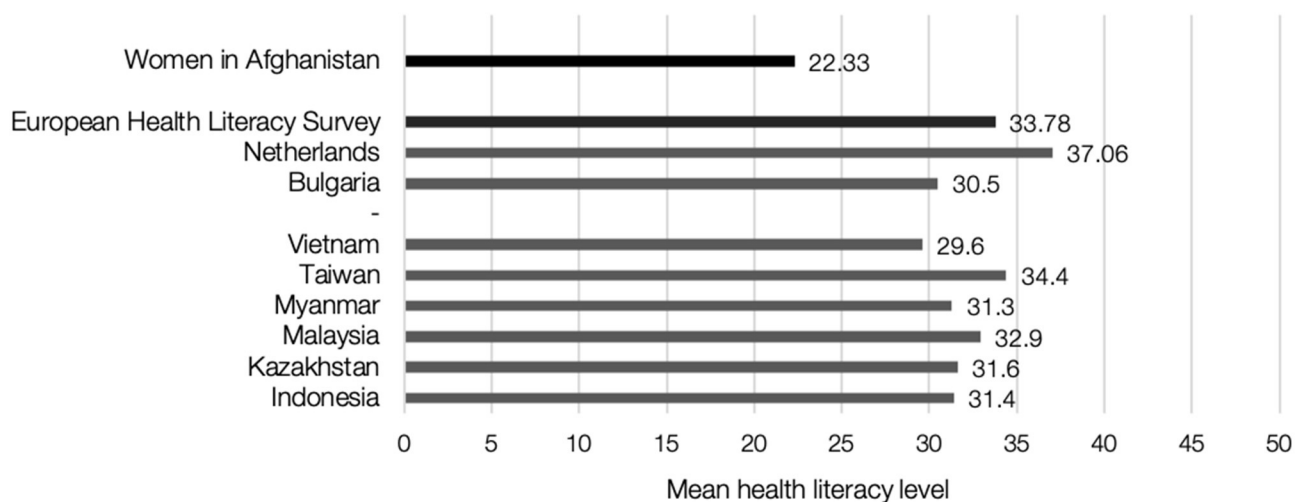
average, the country with the lowest HL level, Bulgaria, and the country with the highest HL level, the Netherlands (7, 20). The average HL score in our study is lower than in any other study. However, any comparison should be made with caution, as the results of the Asian and European studies include on the one hand both male and female and on the other hand only literates.

## Determinants of Women's Level of Health Literacy

When analyzing the association of HL with various factors, we found a very heterogeneous picture. Based on raw correlations, HL was associated with age and education. The highest bivariate correlation existed between health literacy and education ( $r = 0.779$ ,  $p < 0.001$ ), followed by age ( $r = -0.462$ ,  $p < 0.001$ ), marital status ( $r = -0.385$ ,  $p < 0.001$ ), not working at home ( $r = 0.378$ ,  $p < 0.001$ ). Women with some education were 73.5 times more likely to have sufficient HL (Odds Ratio (OR) = 73.5 [95% Confidence Interval (CI): 22.33, 241.97]) than illiterates. However, in order to be able to explain the correlation of health

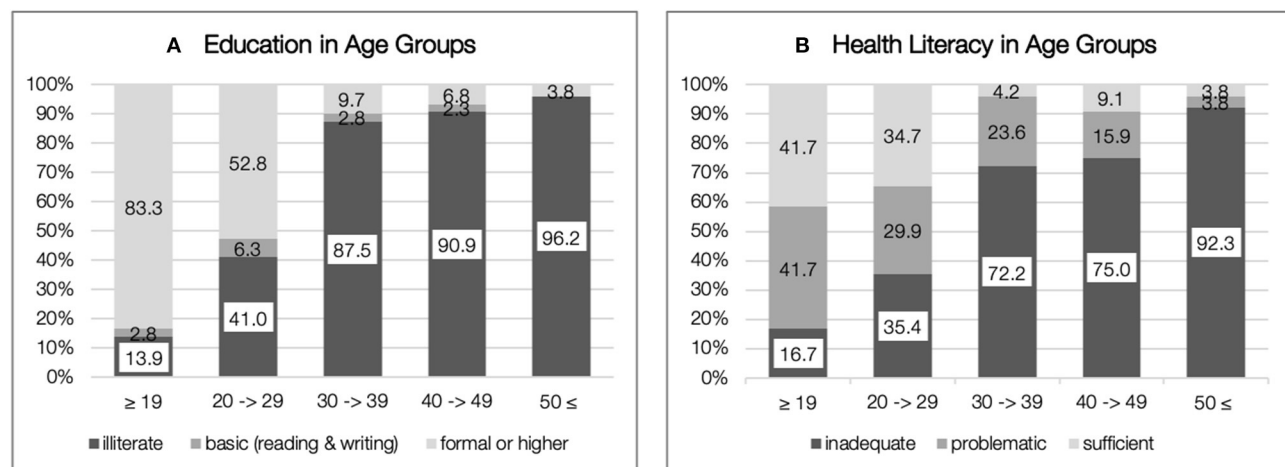
literacy with age and education qualitatively, a more detailed examination of the sample in the different age groups and their educational levels is necessary at first. Women in Afghanistan are particularly affected by the historical changes in the country and their impact on the education sector. While under Taliban rule women were denied access to schooling, after 2001 massive investments were made in expanding the education system and girls' education. The unequal distribution in access to education is reflected in our sample. **Figure 3A** shows the distribution of educational attainment per age group. While the share of women with formal and higher education is highest among those under 20 years of age (83.3%), the share of women between 20 and 29 years of age with formal education is still 52.8%, decreasing significantly in the higher age groups. Given this knowledge, we can analyze the distribution of health literacy in the age groups in a more differentiated way (**Figure 3B**). Again, a noticeable increase in the proportion of women with inadequate health literacy is evident in the age groups of 30. Remarkably, despite the high proportion of young women with formal and higher schooling, not all have equally adequate health literacy. The comparison of the distribution of schooling and health literacy

### Health Literacy of Women in Afghanistan Compared to other Countries



**FIGURE 2 |** Health literacy of women in Afghanistan compared to other countries.

### Comparison of the Distribution of Education in Age Groups vs. Health Literacy in Age Groups



**FIGURE 3 |** Comparison of the distribution of education in age groups vs. health literacy in age groups. (A) Education in age groups. (B) Health literacy in age groups.

in the age groups invites us to take a more differentiated look at the sample and to explore possible explanations for the large differences not only in the individuals themselves but also in historical changes.

We performed a multivariate linear regression analysis, using education, age, and socioeconomical status (SES) (with marital status, and profession (not working at home) as proxies) as predictors of health literacy. These variables explained up to 60.5% of the variance (adjusted  $R^2$ ) [ $\chi^2(4) = 124.97, p = 0.001$ ],

as presented in **Table 3**. Education proved to be the strongest predictor in this regression model and when controlled for education, all other factors were no longer significant.

We examined the assumption that people who had easier access to *infrastructure* (transportation and technology) were more likely to be exposed to health-related information and therefore more likely to have higher HL. This assumption is partially supported by our data, when controlled for education and age, only small correlations existed between the level of



**TABLE 3 |** Determinants of Women's Health Literacy—multivariate linear regression model.

Model		Coefficients <sup>a</sup>		Standardized coefficients		Sig.
		Unstandardized coefficients		Beta	t	
		B	Std. Error			
1	(Constant)	56.678	2.459		23.048	<0.001
	Age	−0.712	0.076	−0.462	−9.314	<0.001
2	(Constant)	28.316	2.383		11.883	<0.001
	Age	−0.108	0.064	−0.070	−1.678	0.094
	Illiterates vs. Educated	24.914	1.416	0.735	17.593	<0.001
3	(Constant)	28.025	2.377		11.788	<0.001
	Age	−0.100	0.064	−0.065	−1.562	0.119
	Illiterates vs. Educated	23.981	1.490	0.708	16.094	<0.001
	Occupation: work at home vs. work outside	3.992	2.061	0.075	1.937	0.054
4	(Constant)	28.341	2.722		10.411	<0.001
	Age	−0.096	0.066	−0.063	−1.454	0.147
	Illiterates vs. Educated	23.920	1.514	0.706	15.795	<0.001
	Occupation: work at home vs. work outside	3.796	2.220	0.071	1.710	0.088
	Marital Status	−0.465	1.946	−0.010	−0.239	0.811

<sup>a</sup>Dependent Variable: Health Literacy (measured with the adapted HLS-EU-Q16 on a 4-point-Likert scale).

HL and access to electricity ( $r = 0.152$ ), Internet ( $r = 0.120$ ,  $p = 0.033$ ), and TV ( $r = 0.231$ ,  $p < 0.001$ ). Certain social/household characteristics were associated with the HL level, for example, a small positive correlation existed between the number of literate people in the household and HL level ( $r = 0.147$ ,  $p = 0.009$ ). This finding suggests the extraordinary importance of education not only for the individual but also at the family or household level. Furthermore, HL was positively associated with occupation, as women who worked at home were more likely to have lower HL level than women who worked elsewhere (e.g., teacher, NGO employees, and others) [ $\chi^2(6) = 68.399$ ,  $p < 0.001$ ,  $\Phi = 0.461$ ].

## Health Literacy and Help-Seeking Behavior and Health-Related Behavior

We explored the relationship between HL and other factors that could be influenced by HL (e.g., help-seeking and health-related behavior) (see **Table 4**).

Regarding *help-seeking behavior*, we asked the participants what they would do in certain cases. In case of sickness, three out of four (74.2%) women would seek advice from a doctor or a health center. Traditional treatment was also important (21.7%). Additionally, 3.4% of women would consult mullahs (religious persons who take care of mosques and teach Islamic subjects) on health matters, and 0.6% of women local experts (such as elderly, wise, village leaders). The woman's choice for these experts was not associated with the HL level. In case a pregnant woman is unconscious, almost 9 out of 10 (87.6%) women recommended taking the woman to the doctor or health center; 7.8% would recommend the mullah and 4.7% the local nurse. The recommended person is associated with the level of health literacy [ $\chi^2(4) = 18.506$ ,  $p = 0.001$ ]. So, women with

sufficient HL go to the doctor more often than expected and women with inadequate HL go to the mullah.

Concerning reproductive health, information on the prevention of unplanned pregnancy (34.75%) was not common among women, but a positive association existed with having information and a higher HL level [OR = 3.61 (95% CI: 1.84, 7.08)]. Only 29.1% of women reported using contraceptives, while women with sufficient health literacy were 2.81 times more likely (95% CI: 1.44, 5.49) to use contraceptives than women with problematic and inadequate HL. The use of contraceptives was to a great extent perceived as a sin, with nearly one in two women (45.03%) agreeing with the statement. We found a moderate correlation between evaluating contraceptives as a sin and a lower HL level ( $rpb = -0.366$ ,  $p < 0.001$ ). As a result, women with higher education were 0.24 times more likely to consider the use of contraceptives as a sin (OR = 0.24 (95% CI: 0.18, 0.44)] than illiterate women. Concerning the period of pregnancy and birth, only 19% of women reported to be aware of the complexity of the pregnancy period. The HL level has a moderate positive association with an awareness of the complexity ( $rpb = 0.303$ ,  $p < 0.01$ ). Controlled for education, none of these four items are significant anymore. **Table 4** below shows the distribution of family health-related questions overall and in relation to health literacy.

The level of health literacy was associated with the help-seeking behavior during pregnancy. Women with a higher HL level were more likely to seek help from the doctor ( $r = 0.311$ ,  $p < 0.001$ ), to visit the doctor more often ( $rpb = 0.351$ ,  $p < 0.001$ ) and to give birth in a health center ( $r = 0.375$ ,  $p < 0.001$ ) than women with low HL level. The HL level was also significantly associated with breastfeeding behavior. Women with a higher HL level rated breastfeeding as more important ( $r = 0.186$ ,  $p = 0.001$ ), started breastfeeding earlier after the baby's birth

**TABLE 4 |** Relationship of health literacy level and health practices.

	Total	Inadequate HL (N = 166; 51.6%)	Problematic HL (N = 83; 25.8%)	Sufficient HL (N = 73; 22.7%)	Significance <sup>(a)</sup>
HELP SEEKING BEHAVIOR					
Where to go in case of sickness					
(%) (N = 322)	D: 74.2	D: 69.3	D: 81.9	D: 76.7	ns
_doctor/health center (D)	T: 21.7	T: 24.1	T: 16.9	T: 21.9	
_traditional treatment (T)	M: 3.4	M: 6.0	M: 1.2	M: 0.0	
_mullah (M)	LE: 0.6	LE: 0.6	LE: 0.0	LE: 1.4	
_local expert (LE)					
Where to take an unconscious woman when she is pregnant (%)					
(N = 322)	D: 87.6	D: 81.3	D: 94.0	D: 94.5	$\chi^2$ (4) = 18.506, $p < 0.001$
_doctor/health center (D)	LN: 4.7	LN: 4.8	LN: 3.6	LN: 5.5	
_local nurse (LN)	M: 7.8	M: 13.9	M: 2.4	M: 0.0	
_mullah (M)					
REPRODUCTIVE HEALTH—PREVENTION					
Having info on how to prevent unplanned pregnancy (“Yes”) (%)					
(N = 268)	34.7 (CI: 28.97–40.44)	28.3	33.3	60.5	$rpb = 0.128$ , $p = 0.037$
Using contraceptives (“Yes”) (%)					
(N = 268)	29.1 (CI: 23.63–34.58)	25.2	25.8	48.8	ns
Use of contraceptives perceived as a sin (“Yes”) (%) (N = 322)					
	45.03 (CI: 39.57–50.49)	62.7	31.3	20.5	$rpb = -0.366$ , $p < 0.001$
Being aware of complexity of pregnancy (“Yes”) (%) (N = 268)					
	19 (CI: 15–24)	10.1	24.2	46.5	$rpb = 0.303$ , $p < 0.001$
PREGNANCY PERIOD					
Number of pregnancies (Nr.)					
(N = 322)	3.45 (R: 0–16)	4.92 (R: 0–16)	2.47 (R: 0–11)	1.21 (R: 0–6)	$r = -0.474$ , $p < 0.001$
Doctor visits during pregnancy (“Yes”) (%) (N = 268)					
	51.5 (CI: 45–58)	37.7	63.6	83.7	$rpb = 0.296$ , $p < 0.001$
Number of Doctor visits (Nr.)					
(N = 246)	2.91 (R: 0–15)	1.99 (R: 0–9)	4.00 (R: 0–15)	4.82 (R: 0–9)	$r = 0.380$ , $p < 0.001$
Child born in health center (“Yes”) (%) (N = 246)					
	51.2 (CI: 45–58)	38.3	60.3	87.2	$rpb = 0.375$ , $p < 0.001$
Number of children born in health center (Nr.) (N = 246)					
	1.2 (R: 0–8)	1.06 (R: 0–8)	1.36 (R: 0–5)	1.49 (R: 0–5)	$r = 0.210$ , $p < 0.001$
FEEDING THE CHILD					
Importance of breastfeeding					
(very/important) (%) (N = 322)	91.4	92.8	98.8	98.6	$r = 0.184$ , $p < 0.001$
First breastfeeding after birth in hours (N = 267)					
	17.36 (R: 0–73)	22.52 (R: 0–73)	11.3 (R: 0–73)	7.86 (R: 0–73)	$r = -0.358$ , $p < 0.001$
Breastfeeding is the first nutrition given to a newborn (%) (N = 268)					
	70.5	63.5	74.2	90.7	$r = 0.167$ , $p < 0.001$
NUTRITION					
Vegetable consumption (%)					
(N = 322)					$\chi^2$ (8) = 30.617, $p < 0.001$
_daily (D)	D: 18.3	D: 12.0	D: 22.9	D: 27.4	
_weekly (W)	W: 9.0	W: 5.4	W: 12.0	W: 13.7	
_monthly (M)	M: 8.4	M: 7.2	M: 4.8	M: 15.1	
_seasonally (S)	S: 50.0	S: 55.4	S: 53.0	S: 34.2	
_not consuming (N)	N: 14.3	N: 19.9	N: 7.2	N: 9.6	
Fruit consumption (%) (N = 322)					
_daily (D)	D: 14.1	D: 7.0	D: 15.8	D: 30.2	$\chi^2$ (6) = 39.90, $p < 0.001$
_weekly (W)	W: 10.1	W: 6.3	W: 9.2	W: 20.6	
_seasonally (S)	S: 63.6	S: 69.6	S: 69.7	S: 41.3	
_not consuming (N)	N: 12.1	N: 17.1	N: 5.3	N: 7.9	

CI, Confidence Interval; M, Mean; N, absolute Numbers of respondents; Nr, Number stated by the respondents; ns, not significant; R, range; r, correlation coefficient; rpb, point-biserial correlation coefficient.

<sup>(a)</sup>Statistical significance was calculated in three ways. For variables with multiple responses, the chi-square was calculated. For variables with "Yes" vs. no or numerical responses, the variable was correlated with the interval-scaled sum score of HL.

(on average after 7.86 h (sufficient HL) compared to 22.52 h (inadequate HL)) and were more likely to breastfeed the child rather giving the child oil or other food [ $OR = 4.88$ , (95%  $CI$ : 1.68, 14.15)] than women with a lower HL level.

Eating behavior was also associated with health literacy: women with “sufficient HL” were more likely to drink warm tea (compared to hot or cold tea) and to eat vegetables and fruits on a daily basis. In contrast, women with lower HL were more likely never to eat vegetables or fruit. Controlled for age and education, the association with fruit consumption remained significant, but not with tea or vegetable consumption.

## DISCUSSION

Every research project in Afghanistan faces various difficulties, which are even more challenging in remote areas outside the large cities (e.g., safety, security, corruption, access to regions, illiteracy, unfamiliarity with research, capacity of research assistants, travel restrictions). In light of these challenges, we endeavored to achieve the highest standard of research in the given context while collecting data relevant to research and practice concurrently. Nonetheless, our study is limited in terms of method, context and data collection process, as well as policy relevance. The first limitations are related to the method and instrument used. Consistent with a standardized health literacy assessment, we used the HLS-EU-Q16 questionnaire and assessed the level of health literacy among women at the hospital in Central Afghanistan. However, this questionnaire only captures one side of health literacy the individual's perspective on his/her own skills and abilities and does not assess the demands and complexity of the health system and situation. Therefore, we can only conclude that women's health literacy level is low, but we cannot specify why. Possible explanations for the low level of HL are lack of education, lack of sufficient health centers in this region, high demands of the hospital, lack of health knowledge and health awareness campaigns etc. but this is not empirically proven in longitudinal studies or studies that assess both sides of health literacy (6). Hence further studies are necessary that explore these aspects in detail, describe their relationship and the development over time. Nevertheless, combining a globally questionnaire with locally relevant questions helps to discuss the adequacy of this common health literacy assessment for populations in distinct regions. Although we identified a need to improve health literacy, our data clearly show that health literacy is associated with education and better health practices.

Secondly, limitations are linked to the context, data collection process and sample. As we conducted the interviews orally by hospital representatives in the Shuhada Hospital, we could not completely eliminate reporting bias and social acceptability bias. Therefore, it is likely that women reported more positively, and the actual level of women's health literacy is worse. Due to the fact that we could not carry out a rigorous random sampling across Afghanistan or the province, our sample and the findings are not representative of all of Afghanistan. However, by randomly selecting women in one hospital in Central Afghanistan over an extended period of time, we sought to collect data from

women whose characteristics are representative of this area. Comparing our sample characteristics with those of other study populations in the study area and in Afghanistan, we found them to be very similar (42, 43). Thus, our sample is a good representative of women in this remote area and that our data is the best available and generalizable for Ghazni province or even the Hazarajat.

Thirdly, limitations exit with respect to policy relevance. We originally intended to collect representative data on health literacy in Afghanistan to inform the Afghan government about the level of health literacy among the Afghan population, identify vulnerable groups, and support policy making. However, this was not feasible, primarily for security reasons. So, we refrained from conducting a general assessment of health literacy across the country and focused on examining health literacy and associated determinants, as well as health practices in more detail in one region. As the population in the remote region in central Afghanistan is very vulnerable, our data will help on the one hand the government formulate tailored policy recommendations for this highly at-risk group and on the other hand assist health professionals in this area to address the specific needs identified. Furthermore, this targeted approach is consistent with our research ethic that research should not be conducted merely for the sake of research, but that it should also directly contribute to making a difference in the lives of the study participants.

In light of these challenges, the consequential decisions and resulting limitations, our study was the most feasible and offers unique insights into health literacy, health practices, quality of life, and religious beliefs of women in Central Afghanistan. To provide a detailed analysis of health literacy and related factors, we choose to focus on health literacy in this article and discuss quality of life and spiritual and religious beliefs in other articles (35, 44).

Our study shows that the HL level and literacy rates of women in Afghanistan are low and among the lowest rates compared to other countries worldwide. To the best of our knowledge, only one other study has examined the health literacy of Afghans. Wängdahl et al. interviewed refugees shortly after their arrival in Sweden, including 33 participants from Afghanistan. Of these (male!) Afghans, 29.9% had inadequate, 40.7% problematic and 29.6% sufficient health literacy as measured by the HLS-EU-16 questionnaire (45). However, our female sample differs substantially from the participants in the Swedish study, thus limiting comparison. Generally, our female sample in Afghanistan has lower levels of HL than other countries which is in line with the empirical evidence that lower education levels are associated with lower HL. This was also observed among the male heads of household in Central Afghanistan (35). Nevertheless, it remains surprising that although the mean level of health literacy is low, it is comparably higher than expected. The comparison between European and Asian countries reveals that the included Asian countries have, on average, slightly lower levels of health literacy than European countries measured with the HLS-EU-Q16 developed in and for Europe. Additionally, the studies show that also European countries e.g., Bulgaria, report lower HL than other Asian countries, so a mere comparison of continents is not sufficient, but it points out that a more



profound analysis is helpful. A comparison between the Asian countries and Afghanistan also shows that the countries included in the Asia HL survey are neither war-torn, nor among the least developed countries, nor do they have a large number of illiterate people like Afghanistan. This illustrates that the study populations and the contexts in each country differ already significantly from the other countries, making a true comparison nearly impossible. Given the lack of research on health literacy in least developed countries, we could only compare our findings with the data available in the European and Asian surveys and now empirically confirm the assumption that women in Afghanistan have very low levels of health literacy. Yet, to understand this low number properly, we need to include more contextual factors and interpret this quantitative data qualitatively. A first explanation for the low level of health literacy is that educational attainment, an important determinant of health literacy, is generally low among women in Afghanistan. In addition, because health centers are sparse, access to health information is low and skills to engage with health (system) related information are rarely systematically developed. Further studies are needed.

In general, our findings are consistent with the extensive scientific evidence, indicating that determinants of health, particularly educational attainment, are major factors explaining the level of HL (7). Contrary to other studies (4, 20), our study revealed only a minor correlation between HL and age. The relationship between education, age and health literacy may be part of a cohort effect, as younger women had more access to the Afghan education system than older women (29, 46). Moreover, social status is significantly correlated with HL, which is evident from the correlation between structural resources and self-reported health literacy. This confirms the relationship between social inequalities and health inequalities (47, 48).

Additionally, this study provides unique insights into everyday health topics such as reproductive health, help-seeking behavior and dietary pattern of women in Ghazni Province. These findings may help explain the high rates of under-five mortality (91.1/1,000), maternal mortality (396/100,000), and stunted children (40.9%) (49). The study could also identify various relationships between health-related behavior and self-reported health literacy, by considering structural factors.

While illiterate people are usually excluded in research studies due to existing barriers, we have succeeded in including illiterates by means of face-to-face interviews. In accordance with the traditional understandings of functional HL and its measures such as TOHFLA or REALM, illiterates should have virtually no health literacy (50). Though a substantial number of illiterates in our study reported problematic HL, a considerable number of them also reported sufficient HL. This is plausible as the HLS-EU-Q measures comprehensive HL that goes beyond functional HL and focuses on tasks and interaction between people and social services (6, 51). Furthermore, the health systems in low-income countries may be absent or less accessible, located far from many people, often very simple and thus easier to navigate than in high-income countries whose health system might provide more services, easier accessible and better specialized. In our study, strong associations exist between the availability of a

nearby health center and the likelihood of seeking medical care from a health professional. For example, having a hospital makes people more likely to seek care there and less likely to seek help from a mullah or to use traditional treatment. Some people, despite having almost no formal education, have sufficient competencies to behave healthy in everyday life. In this sense, the study supports the argument for universal precaution, which takes into account that all people should be treated as at risk for low HL unless they show sufficient HL (21). The response pattern to survey items such as “understanding easily what your friends say” reveals the personal (verbal) interaction with a relevant person, which can strongly influence health literacy and which, especially in developing countries, formal education is unlikely to have the same importance for everyday life practice as in industrialized countries. Therefore, health literacy should be better understood as a social practice and a shared skill (52).

Many health policy approaches assume that improving access to technical infrastructure in remote areas leads to an improvement in health literacy. This assumption could not be confirmed in our data because, first, access to information and communication technology in rural and remote areas of Afghanistan is low generally (42) and, second, we found no link between access to it and a woman's self-reported HL (if controlled for education and age). Hence, based on the results of this study, this assumption is not complex or differentiated enough. According to studies from highly industrialized countries, Internet access does not automatically determine the level of HL (or e-health literacy), as it depends on the individual's media use and on tools for adequately assessing (e) health literacy.

Lastly, this research also provides new insights into the development of General Generalized Resistance Resources (GRR) to cope with adversity and to combat chaos (entropy) (53). Health literacy, a macrosocial GRR, can be structured according to contexts other than traditional learning and curative environments. As noted earlier, a considerable number of illiterates displayed sufficient HL. Despite adversities, these women were able to build their sense of coherence (54) (referred to as a critical asset to fight chaos) based on daily experiences in which they could comprehend, manage, and invest in their progress toward the ease-pole of the dysfunctionality-functionality continuum (53). Not surprisingly, the network and verbal interaction increase these women's GRR. This will determine either a decline or a relative increase in health experiences toward the maximum ease in an environment such as Ghazni, will be a learning lesson in overcoming adversity (55).

A salutogenic perspective will shed new light on the interplay between life orientation and the development process of health literacy, particularly in countries of the Global South.

## CONCLUSION

The study aimed to increase evidence for HL in Asia and crisis-affected countries, by providing novel data on health

literacy in Afghanistan. Compared to other Asian countries, the self-reported HL level of women in the Ghazni Province in Afghanistan is low. This could be explained by the high illiteracy rate, a consequence of political events in Afghanistan. Although (formal) level of education is the strongest predictor of a person's individual HL level, this study clearly reveals that illiterate people can be health literate and behave healthily.

This cross-sectional study illuminates contextual factors, various health-related behaviors, and health literacy and their interrelationship. The forthcoming studies and interventions contribute to enhancing our understanding of the complex relationship between literacy, HL, health behavior, quality of life etc. However, cross-sectional studies such as this cannot inform us about the process of acquiring and shaping health literacy or health behavior. In our view, more research—including ethnographic research—is needed both to thoroughly investigate the relationship between contextual factors, health literacy, help-seeking behavior, and health-related practices in everyday life and to explore the development of health literacy and behavior in daily lives. Hereby, a salutogenic understanding of people's competencies and resources of action is promising. Based on this deeper understanding, further interventions to improve health literacy in schools and in daily practice should be developed. The recommendation to implement more interventions to further improve women's HL is in line with the Afghan Government's strategy: "gender mainstreamed in all health promotion interventions and effective health literacy messaging to women and girls" (33). Finally, access to infrastructure and electronic devices is not automatically linked to higher levels of HL, hence improving new technologies in Afghanistan cannot be the stand-alone strategy for improving health literacy. A more comprehensive strategy is needed encompassing health literacy as a shared social practice and as a complex and urgent public health challenge for the people of Afghanistan that should be addressed.

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## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

SH: data analysis and writing the article. AJ: data collection and reviewing the article. EJ: data collection. LS-N: reviewing the article. KS: reviewing the article. DS: reviewing the article. UB: writing the article. All authors contributed to the article and approved the submitted version.

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# What About the Environment? How the Physical Activity–Related Health Competence Model Can Benefit From Health Literacy Research

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Research cultivates a multitude of frameworks, models, and theories with different determinants internal and/or external to the individual contributing to the understanding and explaining of physical activity levels. The physical activity–related health competence (PAHCO) model can be located at the interface between research of health literacy and physical activity. Because of its primary person orientation, however, the model has not yet undergone discussions on the relevance of the environment. Encouraged by the developments in the area of health literacy, the goal of the present perspective article was to stimulate some initial reflections on potential solutions for the competence–environment relationship within the PAHCO model. We extracted three potential solutions for this issue. Dubbed the solution of integration, we first discussed that the PAHCO model could be placed into overarching, more holistic, and abstract models of health-enhancing physical activity, such as the capability approach or the socioecological model. Applying a solution of elaboration, researchers could second substantiate existing components of the PAHCO model, such as control competence or self-regulation competence, by further explanations. Characterizing the solution of extension, it would third be possible to introduce (a) separate competence component(s) that highlight(s) the manageability of the environment, for instance, by establishing a (socio)ecological competence. The article concludes with a short overview of potential empirical approaches, given their potential to assist researchers in identifying preferences for the theoretical advancement and to put the development on a stronger evidence base.

**Keywords:** physical activity, structure, interaction, PAHCO model, physical literacy

## INTRODUCTION

### Health Promotion and the Role of Physical Activity

Because health is regarded as the precious asset in today's society, being healthy or behaving accordingly is of great importance for every individual. However, maintaining and promoting health are not only an individual concern but also a public health issue and is therefore on the agenda of research, policy, and practice. Supported by the considerable accumulation of evidence (1, 2), physical activity has been identified as an important resource for the maintenance or improvement of health. Hence, initiatives addressing physically (in)active lifestyles have gained increasing importance over the last decades [e.g., Global Action on Physical Activity 2018–2030 (GAPPA), see (3)]. Recognizing the importance of physical activity and launching initiatives for its



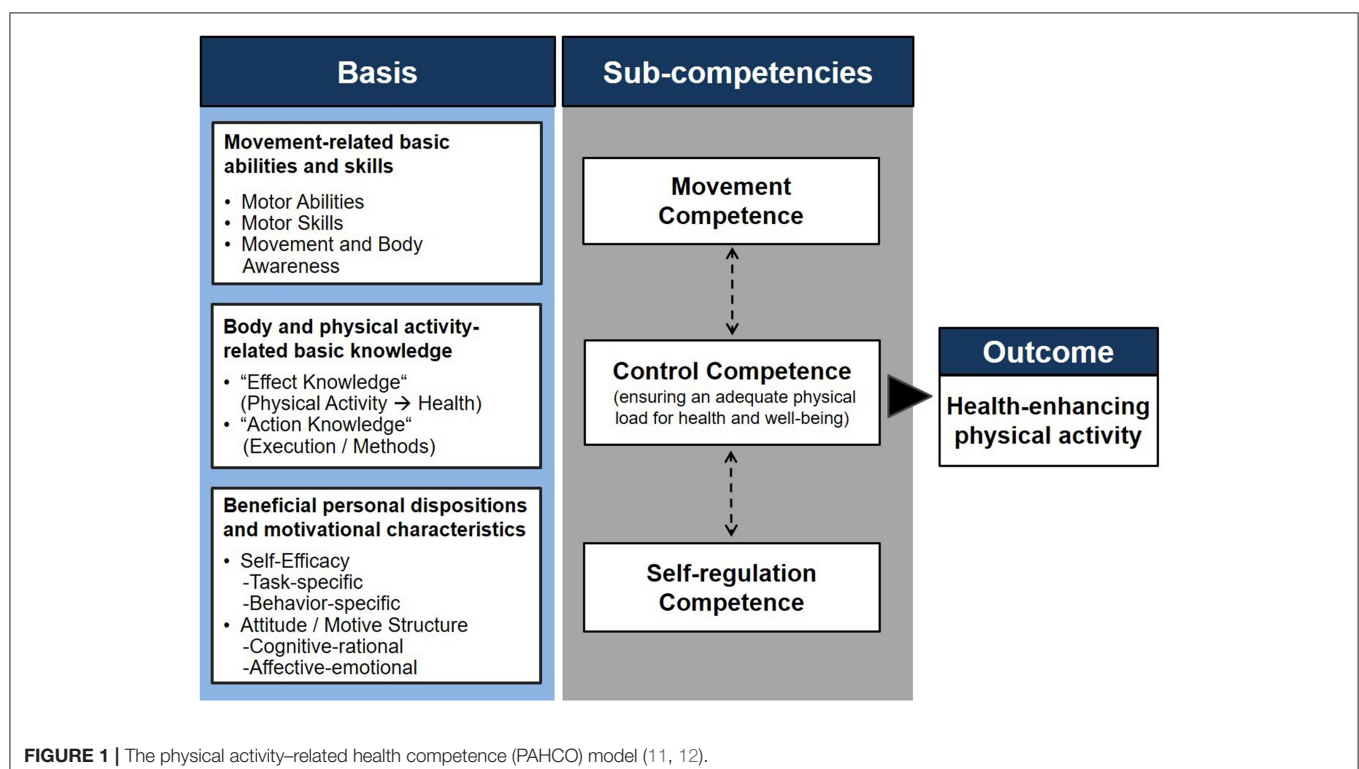
promotion are accompanied by the question of which interventions are most effective. However, this question is difficult to answer in the light of the available evidence. Nevertheless, when developing interventions to promote physical activity in individuals, it is necessary to understand why some people are physically active and others not (4).

## Person-Related Approaches for Physical Activity: The Physical Activity–Related Health Competence Model as an Example

As highlighted by a current historical synthesis, research cultivates different theoretical approaches to explain changes in human physical activity behavior (5). In this context, theoretical concepts addressing individual competences or literacy have recently become the focus of discussion with a high relevance also for behavior change. The notion of competence has its scholarly roots in the psycholinguistics but has received most attention in the educational sciences (6). The term implicates that individuals should possess or acquire latent dispositions, delimitable from actual performance (7, 8), which empower them to lead a certain lifestyle (9). In temporal regards, competence detaches from the short-term horizon and rather stresses that qualifications and resources can be maintained over a longer period (10). Taken together, these conceptual conditions make the notion of competence attractive for the long-term development of health-enhancing physical activity (HEPA), for behavior change interventions, and for physical activity promotion and health promotion in particular.

As one of these approaches drawing on the general ideas of competence, the physical activity–related health competence (PAHCO) model (9, 11) posits that individuals require three integrated subcompetences to lead a healthy, physically active lifestyle (**Figure 1**). First, people need movement competence, which describes the direct motor-related requirements allowing individuals to master activities of daily living and to participate in planned exercise. As a motivational–volitional requirement, the second area, self-regulation competence, guarantees the regular execution of physical activities necessary to induce adaptations for health. As more of a qualitative dimension, the third area, control competence, does not merely follow the formula “the more, the better.” Rather, this area ensures that the loads and characteristics of physical activity and exercise meet the individual’s requirements to promote both physical (e.g., adequate exercise stimulus, avoidance of overload) and psychological (e.g., avoidance of sports addiction, promotion of mental well-being) health. These three subcompetences are, in turn, the result of the integration of knowledge, abilities/skills, and attitudes (13)—the so-called basic elements [for an extensive outline, see (9, 11)].

The PAHCO model with its multidimensional and integrative view has recently been used in different target groups and settings attributable to both prevention (12, 14–19) and rehabilitation (12, 20–23). However, when reviewing the first conceptual–theoretical articles, it becomes obvious that environmental factors hardly play any role within this competence approach (11, 24). Congruent with the function of models in general (25) and in line with a mostly person-focused view of competence



**FIGURE 1 |** The physical activity–related health competence (PAHCO) model (11, 12).

(6), PAHCO adopts a selective perspective on a phenomenon through the concentration on individual determinants for a healthy, physically active lifestyle. This may partially explain why previous empirical articles on PAHCO revealed promising yet not fully satisfactory levels of explanation for indicators of HEPA. Depending on the target group, PAHCO could explain between 10 and 53% of the variance in indicators of PA and health (11, 15, 26). In any case, the PAHCO model does not yet represent those influencing factors outside the person or the interaction of the individual with the environment to achieve beneficial levels of physical activity. Therefore, there is potential for the PAHCO model to better harmonize with central assumptions of the socioecological approach for health (27). The socioecological approach has experienced a considerable growth trajectory within behavior change literature on physical activity over the last two decades (5), which can be explained, to a large extent, by the fact that the corresponding models consider different explanatory levels simultaneously, from the individual to the environment (28). In one of these endeavors, for instance, Bauman and colleagues (29) listed several determinants at the individual, behavioral, social, environmental, and political level that contribute to explaining physical activity. In this regard, the latest discussions of PAHCO focused on the individual and behavioral levels within this differentiation, whereas the social, environmental, and political levels have not been addressed in detail so far.

## The Role of the Environment in Health Literacy Research

With its consideration of person-related determinants for health, the PAHCO model shows significant parallels and overlaps to the research field of health literacy (9). According to a widespread definition, health literacy comprises people's qualifications "to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life" (30). The information aspect, which has been extracted separately in a content analysis across different studies (30), stands at the core of the concept and exerts an instrumental ("in order to") value by determining subsequent evaluations ("judgments") and decisions. Despite the emphasis of the information aspect and the associated importance of cognitive processing (including perceptions, understanding, appraising, and the deduction of plans and intentions for action), a multitude of research endeavors underlined the social embeddedness of the individual's health literacy (31–34). The widespread integrated model of health literacy comprises social as well as environmental determinants, and, following a public health perspective, it welcomes population-level efforts, thereby postulating participation and equity as potential outcomes (30). Accordingly, the scientific discussion on the relevance of the environment has gained momentum (35–37). For instance, the research activities have yielded the construct of organizational health literacy as a beneficial characteristic of institutions or systems supporting people to navigate, understand, and use information and services to take care of their health (34, 38, 39). The considerations of the environment also permeated the

action plans of several countries (40), which provide national efforts with an adequate framework for health promotion. Taken together, the emphasis of social embeddedness and the release of action plans reflect that health literacy is no longer the sole responsibility of individuals but is also an issue of the general public and thus a matter of political acting. These tendencies have turned health literacy into a concept that has detached from the mere person-relatedness (41).

In this regard, health literacy research, as a related research field being one step ahead, might serve as an example for showing how successive discussions on the role of the environment may stimulate the advancement of a person-related concept. Inspired by the developments of the adjacent health literacy field, the present perspective article provides some initial considerations regarding potential solutions how to better account for the relevance of the environment within the PAHCO model. In the present article, PAHCO is used as a specific example for person-related approaches for physical activity. In the long run, this journey toward a more holistic approach may culminate in a better convergence of person-related and environmental determinants for HEPA, as requested by GAPP (3) and biopsychosocial integration efforts (42). From an interventional perspective, this may lead to a better knowledge of social determinants and implementation conditions of HEPA or, depending on the solution preferred, to an activity-related empowerment of individuals interacting with the environment. Ultimately, we derived three potential solutions for the PAHCO model; an overview is given in **Table 1**.

## POTENTIAL SOLUTIONS FOR THE PAHCO MODEL

### Integration

As a first solution, it could be possible to embed PAHCO into a broader, ideally well-established, framework underscoring the interaction between the individual and the environment. For example, researchers could define PAHCO as constituting the intrapersonal level within the social ecological model of physical activity (28). The intrapersonal factors, in turn, interact with the surrounding layers of the model (27). As a second example, it might be possible to integrate the PAHCO model into the health capability approach (43–45), which relies on Giddens' (46) dualistic assumptions of structure and agency. When choosing this solution of integration, researchers may detail the theoretical integration [which has already been partially caught up in the context of PAHCO, see (9)] in order to ensure that both approaches can be brought together. In this context, theory of science calls for ensuring commensurability between model components (47, 48). This solution, however, bears the risk of increased model complexity and even theoretical oversaturation, as supported by a meta-analysis demonstrating that physical activity interventions are less efficient if they are based on a combination of theories instead of a single theory (49).

### Elaboration

As a second solution, researchers could incorporate the manageability of environmental influences into existing



**TABLE 1** | An overview of the three potential solutions.

Solution	Abstract characterization	Theoretical consequence for the PAHCO model	Associated empirical consequence for the PAHCO model
(1) Integration	The model is integrated into a broader framework that considers both individual and environmental factors	The PAHCO model has to be integrated into a broader framework (e.g., the socioecological model or the capability approach)	The existing operationalizations of PAHCO must fit within the (operationalizations of the) broader framework
(2) Elaboration	Existing model components are basically compatible with environmental factors; however, they must still be elaborated conceptually	The subcompetences (movement, control, and self-regulation competence) of the PAHCO model have to be elaborated by discussing the role of the environment	Authors should develop an operationalization of the new component facet, which should then empirically fit to the theoretically postulated (existing) model component
(3) Extension	The conceptualization of model components is not compatible with the environment; a numerical extension of model components is undertaken	Introduction of a fourth PAHCO subcompetence (e.g., potentially dubbed "socioecological competence")	Authors should develop an operationalization of the new model component, which should (i) delimit from the other components and (ii) provide a substantial explanation for relevant outcomes

PAHCO, physical activity-related health competence.

competence components. This solution presupposes that existing conceptualizations of PAHCO components are basically compatible with the intended incorporation. Notably, in this case, it is not the environment *per se* that enters the competence structure model of PAHCO. In line with an interactionist understanding of competences (50, 51), it is rather the individual manageability of social, structural, environmental, or political demands and challenges that this model solution considers essential for the execution of HEPA. In any way, this solution calls for an elaboration of conceptual descriptions of existing competence components. More specifically, these descriptions should target facets of existing components that reflect the manageability of environmental demands, for instance, if the physical activities must be executed in a regular manner (self-regulation competence) or if adequate physical loads must be chosen for physical health and psychological well-being (control competence). Currently, some single model-related descriptions appear promising, as they address the overcoming of barriers and mention the importance of situation-adequate reactions (11, 24), and may thus serve as a starting point for further elaboration.

## Extension

If the management of structural-environmental demands is not sufficiently compatible with or captured by existing model components, a final option may consist in formulating an additional competence component into the PAHCO model. Within the three competence-environment relationships, this option can be referred to as to the solution of extension. For instance, a fourth competence component could be introduced at the subcompetence level of PAHCO, potentially denoted as (socio)ecological competence. This new competence component could be primarily formed by the coupling of social and environmental perceptions with other beneficial dispositions, such as self-efficacy (27, 52). However, this solution makes it necessary to find arguments that (a) justify the use of the new construct in the context of HEPA, e.g., (socio)ecological competence, (b) empirically support an effect of this component on indicators of HEPA, (c) underline the conceptual gain beyond

the established model components (ideally supported by data showing discriminant/incremental validity), and (d) bring the new concept to the same theoretical level as the remaining model components, including the integrative and interrelated ideas.

## DISCUSSION AND FUTURE DIRECTIONS

This perspective article worked out three potential solutions, using the PAHCO model as an example, how the role of the environment might be considered in competence-oriented endeavors for physical activity. The solution of integration section Integration relies on the theoretical characteristics of an overarching framework or theory, whereas the solutions of elaboration section Elaboration and extension section Extension incorporate the manageability of environmental demands into potentially commensurable components through the specific lens of competence. The three solutions might have both theoretical and practical values for the field of physical activity promotion and health promotion and hence can be subject of future discussions. Of course, the present contribution does not claim to present an exhaustive list of solutions. For instance, it might be conceivable to include environmental factors pragmatically to multivariate analyses with person-related measurements. This solution bridging the two pillars of individual and environment, however, remains theoretically expandable, as the plea for conceptual integration and compatibility/commensurability remains unaddressed.

Ideally, the "new" or evolved theoretical model finds its support in empirical data as well. Opposed to a confirmatory approach, empirical data can already be used at an earlier stage of theory advancement. Identifiable as an explorative approach, researchers could develop valid and reliable operationalizations of "manageability of the environment." Subsequently, it could be tested whether the new measurements (a) can be rather assigned to already existing model facets (e.g., self-regulation competence) or (b) whether they form a separately extractable subcompetence factor. In this specific case, statistical model comparisons using a validated, hierarchical assessment instrument (12, 26) could give

researchers an initial hint of whether to prefer the (a) elaborating or (b) extending solution of PAHCO.

The solution preferred, in turn, determines the implications that are drawn when the ideas of the advanced model are translated into an intervention. The solution of integration may more strongly shift the focus from the individual to the environment. Through the lens of this solution, modifications targeting the organizational or social level appear promising when they significantly improve the conditions for the promotion of competences. The solutions of elaboration and extension, in contrast, would put more emphasis on the individual management and perceptions of environmental demands. Therefore, the associated measures could substantially complement person-centered approaches for physical activity, such as behavioral counseling (53).

In summary, the advancement of person-related concepts, which have found broad acceptance in behavior change literature, presents a difficult and complex matter. Nevertheless, theoretical advances underpinned by empirical arguments might have the potential to approach the requested amalgamation of person-related and environmental factors for physical activity, unified under the integrative perspective of competences. We assume that discussions on the role of the environment are urgent, leading to an extension of existing perspectives, such as adopted by the PAHCO model. In this regard, health literacy research can be ascribed a pioneering role as the field was successful in systematically advancing such discussions.

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## CONCLUSION

The present article aimed at transcending the person-related concept of PAHCO by stimulating reflections on the role of the environment for HEPA. With the integrating, elaborating, and extending solutions, the authors suggested three options how to potentially guide the advancement of such a concept. Future research articles, either dealing with a person-related HEPA concept or with PAHCO in specific, are invited to use the present perspective as a starting point for ongoing, more detailed conceptualizations. Ideally, researchers find both theoretical and empirical arguments to justify their extension strategy.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## AUTHOR CONTRIBUTIONS

JC initiated/promoted the advancement of theory, drafted/revised the manuscript, and organized the discussion process. EG wrote a part of the introduction and contributed substantially to the theoretical discussions. KP provided important feedback and supervised the whole advancement of theory. All authors contributed to the article and approved the submitted version.

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# Health Literacy and Regional Heterogeneities in China: A Population-Based Study

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**Background:** Health literacy is essential to population health, yet few studies have described the geographic variation in health literacy in China. This study aimed to investigate the level of health literacy, its regional heterogeneities, as well as influencing factors of health literacy in 25 provinces or municipalities in China.

**Methods:** The study was conducted among residents aged 15–69 years from 25 provinces or municipalities in China in 2017. Health literacy was measured using the Chinese Health Literacy Scale. MapInfo software was used to map the geographic distribution. Multiple logistic regression was used to adjust for the factors associated with the health literacy level in the overall and regional samples.

**Results:** A total of 3,482 participants were included in the study, comprising 1,792 (51.5%) males and 1,690 (48.5%) females. Notable geographic variation was observed in health literacy levels. The proportion of respondents with adequate health literacy was 22.3% overall, 33.0% in the eastern region, 23.1% in the central region, and 17.6% in the western region. The proportion of adequate health literacy in the different provinces and municipalities ranged from 10.5% (Xinjiang) to 47.0% (Beijing). Being a female [odds ratio (OR) = 1.353; 95% confidence interval (CI): 1.146–1.597], having a high education level [OR ranging from 2.794 (CI: 1.469–5.314) to 9.458 (CI: 5.251–17.036)], having a high economic status [OR ranging from 1.537 (CI: 1.248–1.891) to 1.850 (CI: 1.498–2.284)], having a good self-rated health status [OR ranging from 2.793 (CI: 1.534–5.083) to 3.003 (CI: 1.672–5.395)], and having frequent community health education (OR = 1.588; 95% CI: 1.066–2.365) were independently associated with adequate health literacy.

**Conclusions:** The health literacy level in the 25 provinces or municipalities of China is relatively low compared to the developed countries, and there are heterogeneities among different regions, between urban and rural areas, and among different social groups. Tailored health education and promotion strategies are needed for different subgroups of residents.

**Keywords:** health literacy, regional heterogeneities, health literacy scale, distribution characteristics, influencing factors



## INTRODUCTION

Health literacy refers to the ability of individuals to acquire and understand basic health information and services and to use them to make informed decisions to maintain and promote their health (1). The definition of health literacy that has been proposed by the WHO was designed to include the promotion and improvement of individual and community health (2). In different countries, the measurement tools and research perspectives of health literacy are different, and the standards are not uniform (3).

Many studies with various methodologies have shown that deficiencies in health literacy are related to poor life expectancy and quality of life, poor healthcare utilization and health outcomes (relatively high mortality rates and poor overall health status), and health disparities (4–7). The economic implications of low health literacy are substantial, with some estimates accounting for up to 5% of health care costs annually (8). People with limited health literacy may not properly understand health information from health practitioners or the media, and cannot effectively utilize healthcare (9); these deficiencies may be associated with reduced life expectancy and increased health care costs (9). Improvements in health literacy are an effective and easy way to improve health (10). Governments and national agencies in the USA, China, Australia, and some European countries have developed national strategies and targets to improve health literacy in their populations (11).

Health literacy research began late in China. In 2008, based on research results and experiences pertaining to health literacy at home and abroad, the former Ministry of Health of China organized medical and health experts to define the 66 basic components of Chinese health literacy and compiled the Chinese Health Literacy Monitoring Questionnaire. In the same year, the first survey of health literacy was conducted nationwide. The survey results showed that the overall level of health literacy among Chinese people was 6.48% (12).

China covers a vast geographical area, divided into three geographical regions: the eastern region, the central region, and the western region, and the conditions in different regions vary widely (13). The level and status of economic and social development differ on a regional basis (13). Additionally, health disparities persist among China's three geographic regions: eastern, central and western (14). Health outcomes are generally poorer in the western region than in the central or eastern region (13). Additionally, the level of health literacy is affected by social factors, such as the economy and culture (15).

Few studies have described the geographic variation in health literacy in China. This study aimed to investigate the levels of health literacy in Chinese residents from 25 provinces or municipalities and the heterogeneity of health literacy among regions. This information will provide scientific evidence to facilitate tailored health promotion strategies in different economic and cultural contexts.

**Abbreviations:** Adequate HL, Adequate health literacy; Limited HL, Limited health literacy.

## MATERIALS AND METHODS

### Study Design

This was a cross-sectional study of health literacy and its geographic heterogeneity in 25 provinces or municipalities of China, independent of the national monitoring survey. Health literacy was measured using the Chinese Health Literacy Scale. The study subjects were permanent residents aged 15–69 years who had continuously lived in the survey areas for more than 6 months. We excluded those aged below 15 because this age group usually haven't completed basic compulsory education yet. Residents with cognitive impairment or hearing loss were excluded from the study.

The research protocol was reviewed and approved by the Medical Ethics Committee of Central South University. All participants aged 16 and older who agreed to participate in the study signed an informed consent form at the beginning of the survey. Written informed consent was obtained from a parent or guardian for participants under 16 years old.

### Sampling Methods

We selected 25 provinces out of all 31 provincial administrative regions in mainland China. The other 6 provinces were not selected due to difficulty of getting support from the local governments and limited funding. The selected 25 provinces are diverse in geography, economic level, population etc. A multistage, stratified, probability proportional to size sampling was used. Based on the hierarchical administrative system and 2010 Chinese Census data (16), sampling was undertaken across the following five stages: (a) 2–3 counties were randomly selected in each province according to regional and population factors, (b) one street (township) was randomly selected within each county, (c) one community was randomly selected within each street (township), (d) 40–50 households were randomly selected from each community according to the community's resident roster, and (e) one eligible respondent was randomly selected from each selected household. The sample size ( $N = 2,419$ ) was calculated to ensure a proportion estimation of adequate health literacy with  $\alpha = 0.05$  based on a conservative assumption of a 15% proportion.

### Study Measures

#### Demographic Characteristics

The socio-demographic characteristics collected in this study included gender (male or female), age (15–29, 30–49, or 50–69 years), place of residence (eastern, central or western region), community type (urban or rural community), marital status (single or married), education level (elementary school and below, junior high school, senior high school, or college and above), and economic status (poor, medium, or good). The surveyed residences were divided into the eastern, central, and western regions according to the region classification in the China Health Statistics Yearbook. Economic status was divided into the poor, medium, and good categories, with the cutoff points being 75 and 125% of the median annual household income per capita.



## Health Literacy

The Chinese Health Literacy Scale, prepared by the Chinese Center for Health Education, was used to measure health literacy. This scale assesses health Knowledge, attitudes, behaviors and skills that are necessary to address real-world health problems and consists of 6 dimensions (17). The overall Cronbach's alpha of the scale was 0.95, and the Spearman-Brown coefficient was 0.94 (18). Confirmatory factor analysis showed that the scale measured a unidimensional construct with three highly correlated factors (18): (a) basic knowledge and attitudes (BKA), (b) healthy lifestyles and behaviors (HLB), and (c) health-related skills (HRS). The scale covers six domains: scientific views of health (SVH), prevention and treatment of infectious diseases (PTID), prevention and treatment of chronic diseases (PTCD), safety and first aid (SFA), basic medical care (BMC), and health information (HI).

There are three types of questions on the scale: true or false (with 1 point given for each correct response), single answer (a multiple-choice question with only one correct answer, where 1 point is given for each correct response), and multiple answer (a multiple-choice question with more than one correct answer, where two points are for each correct response). For the multiple-answer questions, a correct response was defined as one that contained all of the correct answers and none of the incorrect ones.

The maximum total score of the scale is 66 points, with the maximum total scores of the three dimensions being 28 (BKA), 22 (HLB), and 16 (HRS) points. The maximum total scores for SVH, PTID, PTCD, SFA, BMC, and HI are 11, 7, 12, 14, 14, and 8 points, respectively.

A total score of 53 (80% of 66) points or above was considered to indicate adequate health literacy. A score of 0–52 was considered to indicate limited health literacy. The health literacy level was defined as the proportion of participants who had adequate health literacy out of the total number of participants. The judgment criterion for adequate health literacy in each dimension or domain was  $\geq 80\%$  of the total score for the dimension or domain (18, 19).

## Health Status

The self-evaluated health status was used as the evaluation index and was divided into good, fair, and poor levels. The original question was, "What do you think of your health status in the past year?"

## Community Health Education

We used the number of health lectures given by the primary care practitioners as a proxy measure of community health education, determined by a question, "How many health lectures did you attend in your community during the past three years?" The self-reported frequency of participation in community health education was divided into three categories (0 times, 1–9 times, and  $\geq 10$  times).

## Survey Method

In the pre-investigation phase, a certain number of respondents were randomly selected from the sample locations for

pre-surveys, focusing on whether the questionnaire items were unambiguous and clearly understood. The results showed that the respondents could understand the contents of the questionnaires. In the formal investigation phase, face-to-face interviews were conducted at each participants' home or other public places at the participants' convenience. Putonghua, which is China's uniform language was used in the interviews. For participants who did not understand Putonghua, one family member who could speak Putonghua was invited as interpreter for the interview. Information was collected using paper-based questionnaires by field investigators based on the interviews. In the re-testing phase, which was 2 weeks after the formal investigation, 155 respondents were randomly selected from the overall sample using a computer-based simple random sampling technique, and the investigators re-tested those subjects by phone. All phases of the investigation were conducted by trained investigators. Prior to the investigation, all investigators were given uniform training for this survey. The investigation was conducted from January to April 2017.

## Statistical Analyses

Statistical analysis was conducted with SPSS version 19.0 (IBM Corp., Armonk, NY, USA) and MapInfo Professional version 7.0 (Pitney Bowes MapInfo Corp., Stamford, USA). An integrity check was performed before submitting the questionnaire, and questionnaires with missing values were not included in the analysis. Prior to the analysis, data were screened for outliers and out-of-range values. No outliers or out-of-range values were found. The general conditions and health literacy of the sample were statistically described as the mean  $\pm$  standard deviation, composition ratio, median, and frequency distribution table. In order to evaluate the factors of health literacy, the health literacy scores were dichotomized into two categories: adequate and limited. The chi-squared ( $\chi^2$ ) test was used to compare the health literacy levels among different characteristic groups. The geographic variations of health literacy levels were described using MapInfo software, and the National Platform for Common Geospatial Information Services of China provided the map. A series of multiple logistic regressions was used to adjust for the relevant factors associated with the health literacy level in the total and regional samples. The logistic regression analyses were performed with gender, age group, marital status, community type, education level, economic status, self-rated health status, and frequency of participation in community health education as the independent variables; adequate health literacy served as the dependent variable in the overall and regional samples. An adequate health literacy equation was established using a multiple logistic regression model with stepwise forward selection. In all hypothesis tests, two-sided *P*-values of  $<0.05$  were taken to indicate statistical significance.

## RESULTS

### Basic Characteristics

Among the 3,600 surveyed people, 3,482 valid questionnaires without apparent logical errors or missing items were obtained, yielding an effective response rate of 96.7% (3,482/3,600) for

the questionnaire. The test-retest reliability of the scale score was 0.953. The respondents included 566 (16.3%) individuals in the eastern region, 1,397 (40.1%) in the central region, and 1,519 (43.6%) in the western region (Table 1). The male: female ratio was 1.06:1, and the average age was  $34.27 \pm 13.72$  years. The education level of the respondents was mainly college and above, accounting for 51.3% of the sample. The ethnic group was mainly Han, accounting for 81.5% of the sample. With respect to marital status, the majority of participants (57.7%) were married. The median annual income per capita was 20,000 CNY. A majority (60.6%) of the respondents had not participated in community health education within the past 3 years. No statistically significant difference was found in the gender composition ( $\chi^2 = 4.962$ ,  $P = 0.084$ ) or age composition

( $\chi^2 = 7.201$ ,  $P = 0.126$ ) of the respondents among the eastern, central, and western regions.

## Distribution of Health Literacy

The univariate analysis showed significant differences in health literacy by gender, age, region, community type, education level, self-rated health status, economic status, and frequency of participation in community health education (Table 1). We found that school-age group (15–24) had significantly higher health literacy than above-school-age groups, indicating that school education can effectively promote health literacy.

The proportion of respondents with adequate health literacy was 22.3% (778/3,482) overall, 33.0% (187/566) in the eastern region, 23.1% (323/1,397) in the central region, and 17.6%

**TABLE 1** | Association between health literacy level and basic characteristics.

Characteristics	Health literacy		Percentage (%)	$\chi^2$	P-value
	Adequate HL (%)	Limited HL (%)			
Gender				13.060	<0.001
Male	356 (45.8)	1,436 (53.1)	1,792 (51.5)		
Female	422 (54.2)	1,268 (46.9)	1,690 (48.5)		
Age group (years)				28.972	<0.001
15–29	392 (50.4)	1,192 (44.1)	1,584 (45.5)		
30–49	325 (41.8)	1,104 (40.8)	1,429 (41.0)		
50–69	61 (7.8)	408 (15.1)	469 (13.5)		
Region				57.142	<0.001
Eastern region	187 (24.0)	379 (14.0)	566 (16.3)		
Central region	323 (41.5)	1,074 (39.7)	1,397 (40.1)		
Western region	268 (34.4)	1,251 (46.3)	1,519 (43.6)		
Community type				8.700	0.003
Urban	488 (62.7)	1,536 (56.8)	2,024 (58.1)		
Rural	290 (37.3)	1,168 (43.2)	1,458 (41.9)		
Education level				174.930	<0.001
Elementary school and below	12 (1.5)	314 (11.6)	326 (9.4)		
Junior high school	55 (7.1)	487 (18.0)	542 (15.6)		
Senior high school	173 (22.2)	654 (24.2)	827 (23.8)		
College and above	538 (69.2)	1,249 (46.2)	1,787 (51.3)		
Marital status				3.621	0.058
Single	352 (45.2)	1,120 (41.4)	1,472 (42.3)		
Married	426 (54.8)	1,584 (58.6)	2,010 (57.7)		
Self-rated health status				23.071	<0.001
Good	559 (71.9)	1,795 (66.4)	2,354 (67.6)		
Fair	206 (26.5)	757 (28.0)	963 (27.7)		
Poor	13 (1.7)	152 (5.6)	165 (4.7)		
Economic status				65.537	<0.001
Good	294 (37.8)	704 (26.0)	998 (28.7)		
Medium	285 (36.6)	913 (33.8)	1,198 (34.4)		
Poor	199 (25.6)	1,087 (40.2)	1,286 (36.9)		
Community health education (frequency)				7.429	0.024
0	442 (56.8)	1,667 (61.6)	2,109 (60.6)		
1–9	296 (38.0)	937 (34.7)	1,233 (35.4)		
$\geq 10$	40 (5.1)	100 (3.7)	140 (4.0)		

Adequate HL, adequate health literacy; limited HL, limited health literacy.

**TABLE 2 |** Percentage of participants with adequate health literacy in different regions by dimensions and domains.

Dimensions/ domains	Eastern region ( <i>n</i> = 566) (%)	Central region ( <i>n</i> = 1,397) (%)	Western region ( <i>n</i> = 1,519) (%)	Total ( <i>n</i> = 3,482) (%)
<b>Three dimensions</b>				
BAK	52.8	43.7	37.0	42.2*
HLB	26.3	18.4	13.9	17.7*
HRS	38.2	28.3	24.0	28.0*
<b>Six domains</b>				
SVH	64.1	62.1	55.9	59.7*
PTID	25.4	22.3	23.9	23.5
PTCD	30.4	25.1	19.3	23.4*
SFA	72.8	63.1	58.5	62.7*
BMC	31.8	22.8	19.7	22.9*
HI	40.3	33.4	28.6	32.4*
Health literacy level	33.0	23.1	17.6	22.3*

\**P* < 0.05.

BAK, basic knowledge and attitudes; HLB, healthy lifestyles and behaviors; HRS, health-related skills; SVH, scientific views of health; PTID, prevention and treatment of infectious diseases; PTCD, prevention and treatment of chronic diseases; SFA, safety and first aid; BMC, basic medical care; HI, health information.

(268/1,519) in the western region (Table 2). The proportions of BAK, HLB, and HRS were 42.2, 17.7, and 28.0%, respectively. From high to low, the proportions of health literacy in different dimensions were 62.7% for SFA literacy, 59.7% for SVH, 32.4% for HI, 23.5% for PTID, 23.4% for PTCD, and 22.9% for BMC. Except for PTID, statistically significant differences were found in all dimensions and domains of health literacy among individuals from different regions (Table 2).

Figure 1 shows the provincial geographical map for the proportion of respondents with adequate health literacy. Notable geographic variation was observed in the health literacy level. The proportion of adequate health literacy ranged from 10.5% (Xinjiang) to 47.0% (Beijing).

## The Factors Influencing Health Literacy Levels in Different Regions

A further multivariate logistic regression was conducted to determine the factors of adequate health literacy. The logistic regression modeling, as shown in Table 3, demonstrated that five factors (that is, respondent's gender, education level, economic status, health status and community health education) remained significant after controlling for all the other factors. Among the five factors of health literacy, having a high education level and having a good self-rated health status were over twice as likely to have an adequate health literacy as their counterparts, with an odds ratio ranging from 2.793 to 9.458.

This study showed that the factors affecting health literacy varied somewhat by region. High education levels, good economic status and good self-rated health status were correlated with higher health literacy levels in the eastern region. Among

participants in the central region, health literacy was significantly associated with gender, education level, economic status and community health education. Female gender, high education level, and frequent community health education in the past 3 years were correlated with the higher health literacy levels of people in the western region (Table 3).

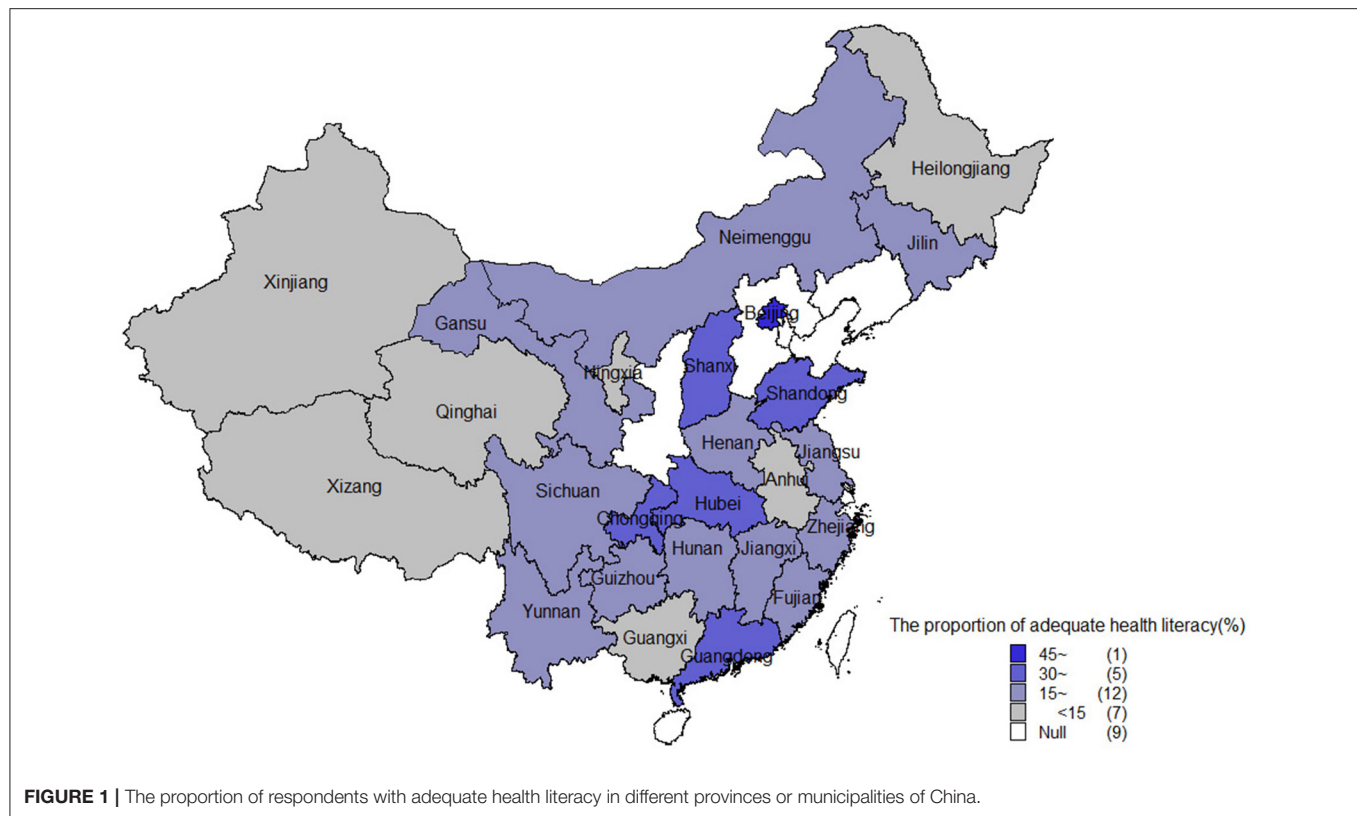
## DISCUSSION

### Health Literacy and Its Distribution Characteristics

There are some differences in the definition of health literacy across different countries. The measurement tools and research perspectives are different, and the standards are not uniform. Therefore, it is difficult to directly compare health literacy levels among individuals in different countries. The National Assessment of Adult Literacy has reported that 36% of the United States adult population has basic or less-than-basic health literacy. Limited health literacy was especially common in Hispanic (66%), black (58%), and American Indian and Alaskan Native (48%) populations (4, 20). Nearly 19% of African American adults had a serious lack of health literacy (21).

In this study, the health literacy level was 22.3%. These findings indicated that the health literacy level of the study subjects have improved significantly in the past decade. However, less than a quarter of the participants had adequate health literacy. Furthermore, their health literacy level is still low. Previous studies have shown that the proportions of people with adequate health literacy in the United States, the United Kingdom and Japan were 64, 88.6, and 72.3%, respectively (20, 22, 23). In terms of scores on different dimensions, the participants' scores in the dimension of BAK were higher than those in the dimension of HLB. This finding demonstrated that study subjects exhibited inconsistency between knowledge and practice in health literacy, and health knowledge was not effectively translated into HLB. Under health education knowledge and belief theory, behavior change is divided into three consecutive processes: acquiring knowledge, generating beliefs, and forming behaviors. The acquisition of health knowledge is relatively easy. The transformation from knowledge into belief and then into healthy behavior is a relatively long process that is influenced by many factors, both internal and external (2).

Among the six types of health literacy, BMC literacy and chronic disease prevention literacy were relatively low, especially in the western region, which indicates the need to strengthen the understanding of scientific medical treatment, rational drug use and chronic disease prevention. In recent years, the incidence of chronic diseases in China has increased significantly, but public knowledge regarding common chronic diseases such as diabetes and high blood pressure is generally low. The phenomenon of "three high and three low" is common in the domain of PTCD and is characterized by a high incidence and prevalence of chronic diseases, a high rate of disability, low knowledge, a low control rate, and a low treatment rate. It is therefore



necessary to further strengthen health education on chronic disease prevention and treatment (24).

This study showed that there were significant differences in the levels of health literacy among people in different regions, with the highest levels in the eastern region, the second-highest levels in the central region, and the lowest levels in the western region, which was consistent with the results of previous research (25). The proportion of adequate health literacy in different provinces or municipalities ranged from 10.5 to 47.0%. This might be attributable to the differences in socioeconomic status and health education resources across the sites (10, 26). These geographic disparities suggest that health practitioners and health promotion systems need to assess health literacy levels in their own settings rather than rely on national data.

A previous study showed that health literacy was a comprehensive performance of the level of social and economic development of a country or a region (15). The heterogeneity in health literacy among people in different regions was also a true reflection of the imbalance in the development of economic, cultural, and medical resources in different regions of China (13). Differences between the three regions suggest that differences in economic and cultural context may play a role in health literacy (27). This means that while national measures to improve health literacy might be appropriate for some issues, the approaches used to improve the health literacy levels of people in different regions should be adapted to local conditions.

## Factors Affecting Health Literacy and the Emphasis on Health Literacy Promotion in Different Regions

This study found that health literacy was strongly associated with education. A higher education level was independently associated with a higher health literacy level, which is consistent with the conclusions of previous studies (28–30). A better-educated person has a stronger ability to understand, analyse, and judge scientific views, making it easier to acquire and understand health literacy-related knowledge. People with lower education levels obtained less health-related information and had less experience interacting with health professionals than the general population did (31). Therefore, health education interventions should be designed based on a clear understanding of the patterns of resources available in specific groups defined by education levels.

The results of the present study revealed a significant correlation between economic status and health literacy in the eastern and central regions. This result is consistent with the findings of previous studies that showed that low socioeconomic status was correlated with low health literacy and a positive relationship between personal income and health literacy (22, 32, 33). From the perspective of economics, middle- and high-income individuals have their basic survival needs met, and so they can focus on improving their quality of life. As a result, their demand for health care services is higher than that of low-income individuals, and they can invest more attention and energy in their own health (34). Health promotion programmes may be

**TABLE 3 |** Multiple logistic regression analysis of factors influencing adequate health literacy.

Regions	Variables	OR	95% CI of OR	
All regions (n = 3,482)				
	Gender			
	Male	ref		
	Female	1.353	1.146	1.597
	Education level			
	Elementary school and below	ref		
	Junior high school	2.794	1.469	5.314
	Senior high school	6.092	3.333	11.134
	College and above	9.458	5.251	17.036
	Economic status			
	Poor	ref		
	Medium	1.537	1.248	1.891
	Good	1.850	1.498	2.284
	Health status			
	Poor	ref		
	Fair	2.793	1.534	5.083
	Good	3.003	1.672	5.395
	Community health education			
	0	ref		
	1–9	1.140	0.958	1.356
	≥10	1.588	1.066	2.365
Eastern region (n = 566)				
	Education level			
	Elementary school and below	ref		
	Junior high school	1.368	0.387	4.830
	Senior high school	4.596	1.499	14.089
	College and above	5.470	1.814	16.492
	Economic status			
	Poor	ref		
	Medium	1.591	1.033	2.713
	Good	2.635	1.572	4.416
	Health status			
	Poor	ref		
	Fair	1.323	0.499	3.513
	Good	2.490	1.173	6.372
Central region (n = 1,397)				
	Gender			
	Male	ref		
	Female	1.519	1.172	1.970
	Education level			
	Elementary school and below	ref		
	Junior high school	3.690	1.377	9.884
	Senior high school	5.351	2.079	13.776
	College and above	9.158	3.649	22.988
	Economic status			
	Poor	ref		
	Medium	1.507	1.082	2.100
	Good	1.719	1.225	2.412
	Community health education			
	0	ref		

(Continued)

**TABLE 3 |** Continued

Regions	Variables	OR	95% CI of OR	
	1–9	1.254	1.054	1.647
	≥10	4.331	1.910	9.817
<b>Western region (n = 1,519)</b>				
	<b>Gender</b>			
	Male	ref		
	Female	1.331	1.012	1.750
	<b>Education level</b>			
	Elementary school and below	ref		
	Junior high school	3.630	1.044	12.625
	Senior high school	9.986	3.081	32.369
	College and above	17.551	5.516	55.843
	<b>Community health education</b>			
	0	ref		
	1–9	1.501	1.222	4.031
	≥10	3.736	1.327	10.513

less effective for groups with low economic status because of their poor perception of their own health status, their low use of health education resources and their limited access to relevant educational services and social support (26).

This study found a significant association between adequate health literacy and self-rated health status. This finding is consistent with those of previous studies on health literacy among office workers (35). However, we also found that self-rated health status was not significantly associated with adequate health literacy in the central and western regions. A possible explanation is that in the central and western regions, because of non-health factors such as increased economic and life pressures and less access to health education knowledge and health services, some people are seldom concerned about their own health status even if their physical condition is poor. The studies evaluating the relationship between health literacy and gender yielded mixed results. Studies by Cavanaugh and Tang Chi showed that women's health literacy level was higher than that of men, which was the exact opposite of the findings of Yan et al. (7, 25, 36). This contrast might be due to differences in the sample population and the region. This study showed that being female was predictive of increased health literacy levels. Women are more willing than men to obtain health information through various channels and are more active in obtaining health information (37). After stratification by area was performed, being female was correlated with adequate health literacy in the central and western regions, which might be due to the relative lack of health care resources in the central and western regions, and there are fewer ways for people to obtain health-related information. In the eastern region, various forms of health education information were available, and gender difference was not significant factor of the health literacy level.

Since 2011, Chinese health departments have vigorously promoted "The National Healthy Lifestyle Action," which is based on knowledge presentation, health consultation and



physical examination screening. This program is a roving health popularization activity that is conducted by urban and rural communities (38). The present study revealed that health literacy was significantly associated with community health education after adjustments were made for other factors. In the central and western regions, people who received more community health education within 3 years had higher health literacy. Popularizing health knowledge through face-to-face community health education activities is an effective way of improving the health literacy levels of people in the central and western regions. Moreover, there may be some shortcomings in health education and health promotion in those regions, and access to health knowledge is not as extensive there as it is in the eastern region. Thus, strengthening the publicity of health knowledge through various channels will be especially helpful in improving the health literacy levels of people in the central and western regions. Community health education should combine multiple approaches based on a clear understanding of the patterns of resources available among different socio-demographic groups, such as those specifically focused on disadvantaged groups, and develop the capacity of the community as a whole to act using the social resources available (26).

This study has several limitations that can be improved in further research. First, we didn't include the other six provinces in mainland China, which may have different levels of health literacy from the selected 25 provinces and municipalities, considering the large diversity in different province of China. As a result, our conclusion may not be representative to the whole national level of health literacy in China. Future study may consider including all 31 provinces and municipalities to gain a full picture. Second, we did not assess the risky health behaviors (tobacco, alcohol and drug use) of the participants in this particular study, but these behaviors will be evaluated in future studies. Third, some items in this study were self-reported. We obtained data through self-reported items, such as self-rated health status. Self-reporting is prone to bias, which makes respondents more likely to provide socially desirable answers. The effect of self-reporting bias cannot be excluded in the present investigation. In addition, a cross-sectional research design was adopted in this study, which means that cause-effect conclusions could not be drawn. Despite these limitations, this study covered 25 provinces or municipalities in different regions of China and examined the level of health literacy, as well as the factors related to it. A focus was on the differences by region. This study provides a reference for developing strategies and measures to improve health literacy.

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## CONCLUSIONS

The health literacy level of the participants from the 25 provinces or municipalities is relatively low compared to the developed countries, with evident heterogeneities among different regions, between urban and rural areas, and among different social groups. Tailored health education and promotion strategies are needed for different subgroups of residents.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical Ethics Committee of Central South University. Written informed consent to participate in this study was provided by the participants or their legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

ZL performed the statistical analysis and drafted the manuscript. ZL, YT, and ZG participated in the design of the study and revision of the paper. ZL and LQ participated in data collection. All authors contributed to the article and approved the submitted version.

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# Generation Gaps in Digital Health Literacy and Their Impact on Health Information Seeking Behavior and Health Empowerment in Hungary

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**Background:** Today the internet is a major source of health information, and younger generations have more confidence in their digital information seeking skills and awareness of online resources than older generations. Older generations, however, are more in demand of health services. The aim of our study was to explore these generational differences as related to self-perceived eHealth literacy and health care system utilization.

**Methods:** A cross-sectional survey study with 522 subjects was done in Hungary. Every subject belonged to one of four generations (Baby boomers, X, Y, and Z). The Web-based survey was designed and tested in English-speaking countries and translated into Hungarian for the present study. Variables include Internet health information seeking, eHealth literacy (measured by eHeals score), the self-perceived gain in empowerment by that information, and the number of health care appointments. One-way ANOVA was used for comparing the scores of the generations, and correlational and linear regression analysis was employed within the generations for further data analysis.

**Results:** We found significant differences among the generations in eHealth literacy as well as in the self-perceived gain in empowerment: while Boomers were the generation with the lowest eHeals scores, they showed the highest empowerment. Internet health information seeking behavior showed no differences. While subjects who use the Internet more frequently to search for health information have worse self-rated health status, the ones with higher eHeals scores report better subjective health status. We also identified the associations of the above variables within the older generations (Boomers and X) with the frequency of using health-care services: within the generation of Boomers the number of health care appointments was only associated with Internet health information seeking, while in Generation X with eHeals.

**Conclusions:** Baby boomers seek Internet health information as often as the younger generations, which provides a solid motivation for developing their eHealth literacy skills.

We find it crucial to plan the Hungarian health promotion programmes utilizing this high frequency of Internet health information seeking, since the eHealth literacy skills of older generations have an effect on their subjective health status, and they are the most capable of applying information in making decisions.

**Keywords:** generations, internet health information seeking, eHealth literacy, eHeals, health empowerment

## INTRODUCTION

Reviewing the health literacy (HL) literature, Martensson and Hensing (1) found that in one strain of definitions the complexity of HL is stressed due to its dynamic nature, the multidimensional interrelations it keeps, and the embeddedness in a social or cultural context. In research it includes the interactive and critical type of HL (2), which deals with the contexts other than health institutions where health-related information is collected from (e.g., the Internet) as well as with the ways and actions this information is used. In the present paper we follow the social-ecological model of HL by examining a specific context of health information seeking and the related skills, namely the Internet. Furthermore, we attempt to reveal generational differences as a social phenomenon underlying health information seeking and eHealth.

eHealth is defined as “the use of information and communication technology (ICT) for health” (3). Gilstad (4) established eHL as “the ability to identify and define a health problem, to communicate, seek, understand, appraise and apply eHealth information and welfare technologies in the cultural, social and situational frame and to use the knowledge critically in order to solve the health problem.” (p. 69). Generational differences shown in eHealth could also be interpreted within this framework.

According to McCrindle and Wolfinger (5) generations are groups of individuals who live in the same period and are influenced by the same technologies and experiences. The generational differences in social characteristics may result in variations in one’s ability to employ technologies (6, 7), to use diverse strategies for health information seeking on the Web (IHISB) and to show different levels of digital HL. Furthermore, the literature also shows generational differences regarding health in relation to changes in lifestyle, and to health status (8). Being aware of these generational differences may be of great importance in forming health policy decisions and the health care market. Finally, we include self-perceived gain in empowerment from using Internet health information as a variable to tap into the application of the information and another variable, the utilization of the healthcare system that is related to the institutional aspects of HL.

## Internet Health Information Seeking Behavior

The internet seems to be the most popular source of health information (9). Andreassen et al. (10) found that among European citizens, 71% of Internet users utilize the Internet for health purposes. They also reported that young age, higher

education, white-collar or no paid job, number of visits to the general practitioner during the past year, long-term illness or disabilities and good subjective health assessment are positively affecting the use of the Internet for health purposes. According to more recent data, published in 2020 by Eurostat, 55% of individuals used the internet for seeking health information in 2020 within the 27 European countries (11). Specifically in Hungary 63% of individuals used the internet for health information seeking (11).

Jiang and Street (12) studied the health outcomes of Internet health information seeking behavior (IHISB) by testing a moderated mediation pathway model based on the three-stage model of health promotion (13, 14). According to their findings, IHISB affects general physical and emotional health outcomes. This effect is mediated by the access to social support resources, which is positively moderated by users’ online health information seeking experience (12). Whether IHISB improves the patient-physician relationship (15) depends on the previous quality of the relationship as well as on whether patients discuss information they’ve accessed online.

## eHealth Literacy

Some aspects of IHISB, such as its frequency and the kind of sources it relies on, have proved to be an indirect measurement of eHL (16, 17). According to Norman and Skinner eHL is “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” (18). As proposed in their Lily model, eHealth literacy consists of three contextual literacies (health literacy, computer literacy, and science literacy) and three analytical literacies (traditional literacy, information literacy, and media literacy) (18). Gilstad supplemented this model with the acknowledgment of the bodily experience of a health challenge, the procedural literacy of handling the tools and technologies, the contextual and the cultural literacy and the communicative expertise (4).

Noorgard et al. (19) introduced the newest eHealth Literacy Framework, consisting of seven dimensions. They used concept mapping involving patients, health professionals and medical informatics experts to generate their model. The following domains of eHL were identified: “Ability to process information,” “Engagement in own health,” “Ability to engage actively with digital services,” “Feeling safe and in control,” “Motivation to engage with digital services,” “Having access to systems that work,” and “Digital services that suit individual needs.” Their framework provides insights into one’s ability to understand, access and use e-health technologies (19).



Although, according to Neter and Brainin (20), research on the effects of eHL on health outcomes is still in its early stage, Diviani et al. (21) found that eHL is positively associated with the ability to evaluate and trust online health information. Furthermore, the higher the level of eHL is for an individual, the better health outcomes (e.g., better self-rated health status) (22, 23) they may achieve, through better communication with their physician, practicing more health behaviors (e.g., higher likelihood of undergoing cancer screening, eating a balanced diet or doing physical exercise) (24, 25), better understanding of their condition, and increased use of medical insurance (20, 26, 27).

Understanding the sociodemographic context of IHISB and eHL is becoming increasingly significant as the Internet becomes the major source of health information seeking. Age particularly is a major factor that influences both eHL (28–30) and IHISB (31, 32). However, validating the Hungarian eHeals scale Zrubka et al. (17) reported only a significant negative but weak correlation between age and eHeals scores. They found that being over 65 years of age is a risk factor in lacking an appropriate level of digital HL, which is in accordance with our previous results considering the level of functional HL in the Hungarian population (33). In our attempt of measuring eHeals and its associations we rely on a more complex age-based comparison, namely, generational differences.

## Generations

A generation is defined by a birth period of 20–25 years, in other words as long as it takes for the group to be born, grow up and have children (34, 35). The generations might have common attitudes, values and beliefs as they were born in the same period and lived through similar experiences of social, political and economic events during their youth (35). McCrindle and Wolfinger (5) distinguish seven categories of generations by year of birth: Federation Generation (1901–1924), Builders (1925–1945), Baby Boomers (1946–1964), Generation X (1965–1979), Generation Y (1980–1994), Generation Z (1995–2009) and Generation Alpha (2010–). In the following we summarize the attitude and skills toward technology and health needs of the four generations who participated in our research.

### Baby Boomers (1946–1964)

The generation of baby boomers were born after the Second World War (36). Boomers were young when computerized systems became a part of everyday life. As they are an aging generation, health is an important issue for them (37). While they maintain a higher awareness in certain consumption choices, including bodily maintenance, diet, and exercise (38) and are more willing to take a greater role in their own health care, they are not particularly healthy (24).

Baby boomers and the previous generation most commonly use their electronic devices to seek internet health information (39). Medlock et al. (40) examined which information resources the Internet-using seniors (67–78 years) turn to and trust for health information. The most commonly used and trusted health information sources were health professionals, pharmacists and

the Internet. The higher use of the Internet was associated with higher use of other sources. Participants used diverse sources for different types of information. The Internet was most often used for seeking information about symptoms, prognosis and treatment options, whereas health professionals were asked for information on medications, side effects, coping, practical care and nutrition or exercise.

HL seems to deteriorate with aging, and lower HL has a negative impact on health care access, chronic disease management and health status (41, 42). These also come with increased health care costs, more medication errors, ineffective patient-provider communication and inefficient use of health care services (43). According to the findings of Choi and Dinitto (44), eHL is also negatively associated with age. Tennant et al. (45) examined the relationship between sociodemographic variables, the use of electronic devices and Web 2.0. for health information and eHL among baby boomers and older adults (being 50 years of age or over). They found that within this population younger age, higher education, use of more electronic devices and the use of Web 2.0 platforms are associated with higher levels of eHL. The direct antecedent of our research was conducted by Schulz et al. (37) focusing on the relationships between IHISB, eHL and specific health outcomes, i.e., the number of consultations with one's GP and self-rated health status among anglo-saxon baby boomers. They found moderate relationships between IHISB, eHL and perceived gain in empowerment, while there was no direct association between eHL and utilization of the health care system, but indirect effect paths via the former variables.

### Generation X (1965–1979)

Individuals belonging to generation X had to grow up in economic uncertainty due to the recessions of the early 1980's and 1990's. Societal uncertainty was also a general fact due to the increase of divorces or both parents working (46, 47). Hence the majority of this generation became independent at a young age (48). The technical ability of this generation tends to be strong (49, 50). They were the first generation to grow up when the Internet started to make health information available (51). They rely on technology (52) and social media (53) very much when it comes to their healthcare needs (51). Seventy-four percentage of them said in a research that they would rather visit the doctor through telemedicine than in person (52).

They are more skeptical toward healthcare systems compared to preceding generations and they prefer doctors as a source of information about health (54). They trust their physicians more than the generation Y (55). They are motivated to look for information in numerous sources such as: family members, co-workers, doctors, pharmaceutical company websites, medical journals, news websites and books (51).

### Generation Y (1980–1994)

The Y generation grew up in a period of economic growth (56). The individuals in this generation cohort are technologically competent (57, 58) as they manage their lives and daily activities with the help of digital technologies (48). They are referred to as “the first generation of digital natives” (59). According to Kim



and Son (25), the main source of health information for 18–39-year-old adults is the Internet. eHL was found to be associated with patterns of health behaviors in this generation. Bianca Mitu (60) also reported that 18–31-year-old people with medium or high eHL use more than one source of information and a variety of online search strategies. The majority of her respondents (81 %) said that the Internet was the first thing they chose when they wanted to find health or healthcare information, but only 51% of them considered it a reliable source of information.

### Generation Z (1995–2009)

Generation Z has got no experience of life before the Internet, technology was already accessible for them at a very young age (61). This generation is accustomed to interacting in a world that is connected all the time by means of advanced technology (e.g., tablet, smartphone, social media) (62).

Using focus group interviews Gray et al. (63) explored students' (between 11 and 19 years) perceptions and experiences of using the internet for seeking information about health and medicines. The internet was considered a primary general information source for this generation. They relied on radio and television alongside the Internet, which they preferred to books and leaflets. Adolescents perceived the internet as an alternative source of information for health problems and thought they might be able to avoid a visit to a health professional or be empowered from online information within the medical encounter.

College students with higher eHL are more likely to practice positive health behaviors (64). According to Stelfox et al. (65) students between 17 and 26 years often use the Internet to find health information and they feel comfortable using it. Nonetheless many of them have weak eHL skills related to searching for, retrieving, using and evaluating sources of eHealth information. Robb and Shellenbarger (66) state that college students (18–24 years) are able to retrieve health information on their own, but they are not confident enough about their knowledge to make decisions about health options independently. They are probably more reliant on their parents considering their health decisions.

### Comparisons Alongside Age and Generations

Miller and Bell (32) examined the age differences in the role of trust and ease of search in predicting IHISB among four age groups (18–34, 35–49, 50–64, 65+). They concluded that the internet is a popular source of health information and that IHISB is negatively associated with age, with trust in the found information and with the perceived easiness of health information searches.

Aguilar-Palacio et al. (8) analyzed the micro- and macro factors affecting self-rated health and what role generational belonging plays in this relation. They divided their sample into four generations (silent generation—born before 1946, baby boomers, generation X and Y). They found that self-assessed health becomes worse with the aging of generations. Within the silent generation and the baby boomers, age was a more important factor, as for the self-assessed health of older individuals, it had an exponential effect.

Paige et al. (30) examined the attributes of the eHeals scale among Generation Y (18–35 years), X (36–51 years) and Baby boomers together with the Silent Generation (52–84 years). They proposed a 3-factor (information awareness, information seeking, information engagement) eHeals measurement model and concluded that it is valid for these age group comparisons. They found that older individuals have significantly lower eHeals score, smaller awareness of eHealth resources and less confidence in their information seeking and engagement skills on the Internet than younger people.

Magsamen-Conrad (7) investigated generational differences in new communication technology (NCT) use and eHL, among builders, boomers and generation X and Y. They found that builders had the fewest available resources and the lowest knowledge to use NCTs and the lowest eHL across all of the age groups. Baby boomers perceived to have more resources and knowledge about NCT use than builders but perceived less resources than the generation X.

Across different age-groups studies also provide empirical evidence for the negative association of HL and health care system utilization (37). The relationship between higher HL and less frequent use of health care services varies across countries (67), different patient groups (19) and it was dependent on the measured variable of the health service use (e.g., contacts to emergency services or hospital admissions vs. appointments at the GP or other health professionals). In the European HL project (67) long term health condition, self-perceived health status and gender predicted the frequency of visits by the doctor.

### Hypotheses

Our overall question is whether there are differences between IHISB, eHL (measured by eHeals) and empowerment across four generations in Hungary. Within this question we further focus on the relationships between these variables and certain health outcomes (self-rated health status, health care utilization) across the generations. The literature reviewed above enabled the formulation of the following six hypotheses:

We expect no generational differences in the use of the Internet for health purposes (68).

Following Paige et al.'s results (30) we hypothesize that older generations have lower eHeals score than younger ones.

We suppose that eHeals scores positively correlate with IHISB across all generations (17, 37).

In our fourth hypothesis we assume that the frequency of IHISB affects the utilization of the health care system in Generation X and Baby boomers, but eHeals scores do not (37, 67).

Good and bad subjective health status are associated with higher frequency of IHISB and higher eHeals scores across generations (10, 17), so we suggest a curvilinear relationship.

Following Robb and Shellenbarger's results (66), Generation Z got the least empowerment from using the Internet.

Our last assumption is that the frequency of IHISB and the eHeals score do not correlate with empowerment, but these variables determine together the measured health outcomes (subjective health status and the utilization of the healthcare system) (69, 70).

## MATERIALS AND METHODS

### Sampling and Data Collection Procedure

Our cross-sectional study comprised collecting data from 522 subjects (155 male, 29.7%) belonging to four age cohorts in Hungary (Baby boomers, X, Y and Z generations), using a Web-based survey designed and tested in English-speaking countries (37). We aimed at having at least forty subjects in each age cohorts for group comparison, except in the group of Baby boomers, in which we aimed at least one hundred and fifty for comparing their data with the international ones. The data collection between 2018 January and June was carried out by part-time or full-time psychology students, who collected forty questionnaires each via convenience sampling in their own online environment as their course requirements. The subjects were asked to fill out an online 30-min-questionnaire about health-related issues. After having read an informed consent they agreed to participate by clicking a box in the first page of the online questionnaire. Further subjects were systematically selected between November 2018 and May 2020 by trying to make a more heterogeneous sample along gender and education. For doing this we used the Hungarian Statistical Office data regarding the Hungarian population in terms of proportion of gender and education. This phase took place—mainly by sending the link of the questionnaire online—in companies and retirement homes in Hungary. Ethical approval was obtained from the Psychology Ethical Committee of Universities in Hungary (111/2017). 11.9% ( $N = 62$ ) of the sample possessed primary school education, 10.5% ( $N = 55$ ) completed vocational school, 19.3% ( $N = 101$ ) had a high-school graduation, 18.8% ( $N = 98$ ) secondary grammar school education, and 38.9% ( $N = 203$ ) graduated from college or university (Table 1 contains the sociodemographic characteristics of the sample).

### Measurements

Our main variables include IHISB, eHL (measured by eHeals), the self-perceived gain in empowerment by that information, and the number of health care appointments in the previous year. As we stated above—in a collaboration with Peter Schulz—we adopted an English test battery designed by Schulz et al. (37) to measure internet health behavior and health status of Anglo-saxon baby boomers.

We used a forward and back-translation procedure in order to create a conceptually equivalent Hungarian version of the test battery to the original English version. First, two English teachers, one of them is also a psychologist translated the items independently to Hungarian. Then a third independent bilingual person back-translated these to check for any inconsistencies. The final version of the test battery was designed by a professional group in health studies based on all the translations and the notes of the interpreters.

Internet health information seeking behavior was measured by 10 items describing different activities that are examples of Web-based information seeking, e.g., “I’ve looked online to try to diagnose a health condition,” “I’ve read or watched someone else’s commentary or experience online about health-related issues.” The frequency of these behaviors was also asked using a 5-point

scale ranging from “never” to “very often.” The 10 items were averaged to produce our variable of IHISB. The scale was found to be reliable (Cronbach alpha = 0.794, mean = 2.08, SD = 0.59,  $N = 263$ ).

eHealth Literacy was measured by eHEALS (71), which comprises 8 items designed to measure awareness (items 1, 2), searching (items 3, 4), appraisal of health resources (items 6, 7), and utilization of electronic health information (items 5, 8). The scale is appropriate to measure self-reported ability to find, apprehend and use information on the internet as an indicator of the users’ eHealth literacy. The items scored on a 5-point Likert-scale ranging from “strongly disagree” to “strongly agree.” Higher scores indicate greater self-reported skill. The scale was found to be reliable (Cronbach alpha = 0.94, mean = 29.54, SD = 7.217,  $N = 491$ ).

Self-perceived gain in empowerment was measured by seven items designed by Schulz et al. (37). They covered self-perceived changes, e.g., In general, as a result of searching for health information online... “I feel more connected to others with a similar problem,” or “I can communicate more effectively with my health professional(s),” attributed to the use of the Internet. The items scored on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” with higher scores indicating higher self-perceived gain in empowerment. Using the measure produced reliable data (Cronbach alpha = 0.86, mean = 21.06, SD = 6.05,  $N = 489$ ).

Our dependent variables were utilization of the health care system and self-rated health status. Unlike Schulz et al. (37) we not only measured the number of medical consultations with one’s GP in the past 12 months, but also appointments with other health professionals, contacts to emergency services and hospital admissions. The number of visits was coded as 0, 1 time, 2 times, 3, 4, 5 to 9, and 10 or more times.

Self-Rated Health was measured by a single item: 1-bad/2-not too good/3-optimal/4-very good/5- excellent (24, 37).

Gender (male/female), age (year of birth), race (predefined categories e.g., Hungarian, Slovak or Roma identity), marital status (predefined categories e.g., I have never been legally married or registered in a civil union / I am a widow or widower or surviving civil union partner/I am legally married), educational attainment (predefined categories: Primary school/Vocational school/Secondary grammar school/High school/College or University), occupational status (predefined categories e.g., Employed full-time/Retired/Unemployed), income (open ended question: What was your total income from all sources before taxes last year) and the presence of chronic disease(s) (predefined categories e.g., None/Diabetes/Other) were self-reported by the participants (Table 1 contains the proportion of gender, generation (based on age) and education in the sample).

## RESULTS

The statistical analysis of the data was performed using IBM SPSS for Windows 22 (72). One-way ANOVA was used for comparing the scores of the cohort-groups, and

**TABLE 1** | Socio-demographic characteristics of the sample ( $N = 522$ ).

Full sample size		$N = 522$		
Socio demographic characteristics	Variables	Number of participants	Percentage	Missing values
Gender	Female	365	69.9%	2
	Male	155	29.7%	
Education	Primary school	62	11.9%	3
	Vocational school	55	10.5%	
	Secondary grammar school	101	19.3%	
	High school	98	18.8%	
	College/university	203	38.9%	
Generation (calculation is based on the variable "Year of birth")	Generation Z	43	8.5%	16
	Generation Y	185	35.4%	
	Generation X	122	23.4%	
	Baby Boomers	156	29.9%	

**TABLE 2** | Means and Standard deviations of IHISB (a composite score of Internet Health Information Seeking Behavior) and eHEALS scores in generations of Baby boomers, X, Y, and Z.

Generation	IHISB (missing values: 251)			eHEALS (missing values: 44)		
	N	M	SD	N	M	SD
Baby Boomers	57	2.05	0.66	140	28.22	7.39
Generation X	72	2.06	0.53	117	29.7	7.31
Generation Y	110	2.11	0.62	180	30.93	6.8
Generation Z	32	2.14	0.53	41	29.15	5.36

correlational and linear regression analysis was employed within the Baby boomer generation for further data analysis<sup>1</sup>. We agreed that the statistically significant  $p$ -value should be  $< 0.05$ .

## Hypotheses Testing

Our first hypothesis assumed that there are no differences among generations in the frequency of performing IHISB. Since our variable does not follow normal distribution (Kolmogorov-Smirnov test is 0.11), we used the Kruskal-Wallis test to compare the distribution in the four generations. We found no significant differences ( $p_{\text{IHISB}} = 0.54$ ) (Table 2 contains the Means and Standard deviations of the variables in each generation), which supports our hypothesis.

In our second hypothesis we expected older generations to possess lower eHeals score than younger ones. This variable does not follow normal distribution in our sample (Kolmogorov-Smirnov test is 0.106), therefore we used the Kruskal-Wallis test to compare the distribution in the four generations. The difference was significant ( $p = 0.001$ ) (Table 2 contains the Means and Standard deviations in each generation), so we ran the Dunn-Bonferroni rank-based *post-hoc* analysis, which indicated

a significant difference ( $p = 0.001$ ) between Baby Boomers and Generation Y in the expected direction.

We supposed that eHeals score positively correlated with IHISB across all generations. To test this hypothesis, first we used Spearman rank correlation in the whole sample, then within each generation. Significant associations were found in the whole sample [ $\rho(265) = 0.25, p < 0.000$ ] and in generation Y [ $\rho(105) = 0.297, p = 0.002$ ]. Both in the Baby boomer generation [ $\rho(52) = 0.201, p = 0.145$ ] and in generation Z [ $\rho(29) = 0.241, p = 0.191$ ] IHISB measured by the averaged frequency of certain related activities did not show correlation with eHeals, but eHeals had an association with the averaged frequency from whom (oneself, family, friend, colleague, health professional, other) they search health information in the Internet [ $\rho(62)_{\text{Boomers}} = 0.33, p = 0.008$ ;  $\rho(33)_{\text{Generation Z}} = 0.405, p = 0.016$ ]. In Generation X none of the variables correlated with each other. These results partially support our hypothesis.

In our fourth hypothesis we assumed that the averaged frequency of IHISB affects the utilization of the health care system in Generation X and Baby boomers, but eHeals score does not. First, we used Spearman rank correlation to test the associations of these variables. In the case of Baby boomers, IHISB showed a weak but significant correlation with regular health care utilization [ $\rho(54) = 0.302, p = 0.024$ ], but eHeals had no relation with it. In Generation X, however, we found the contradictory pattern: eHeals has a weak but significant correlation with health care use by appointments [ $\rho(115) = 0.244, p = 0.08$ ], but IHISB has not. In a linear regression model, eHeals affected health care utilization significantly ( $R^2 = 0.06$ ; Beta = 0.239;  $p = 0.009$ ) in Generation X. These results partially support our hypothesis.

We hypothesized that the extreme values of subjective health status are associated with higher frequency of IHISB and higher eHeals in the whole sample. First, we used Spearman rank correlation to test this hypothesis, which showed significant but weak correlations between both subjective health status and IHISB [ $\rho(175) = -0.138, p = 0.021$ ] and subjective health

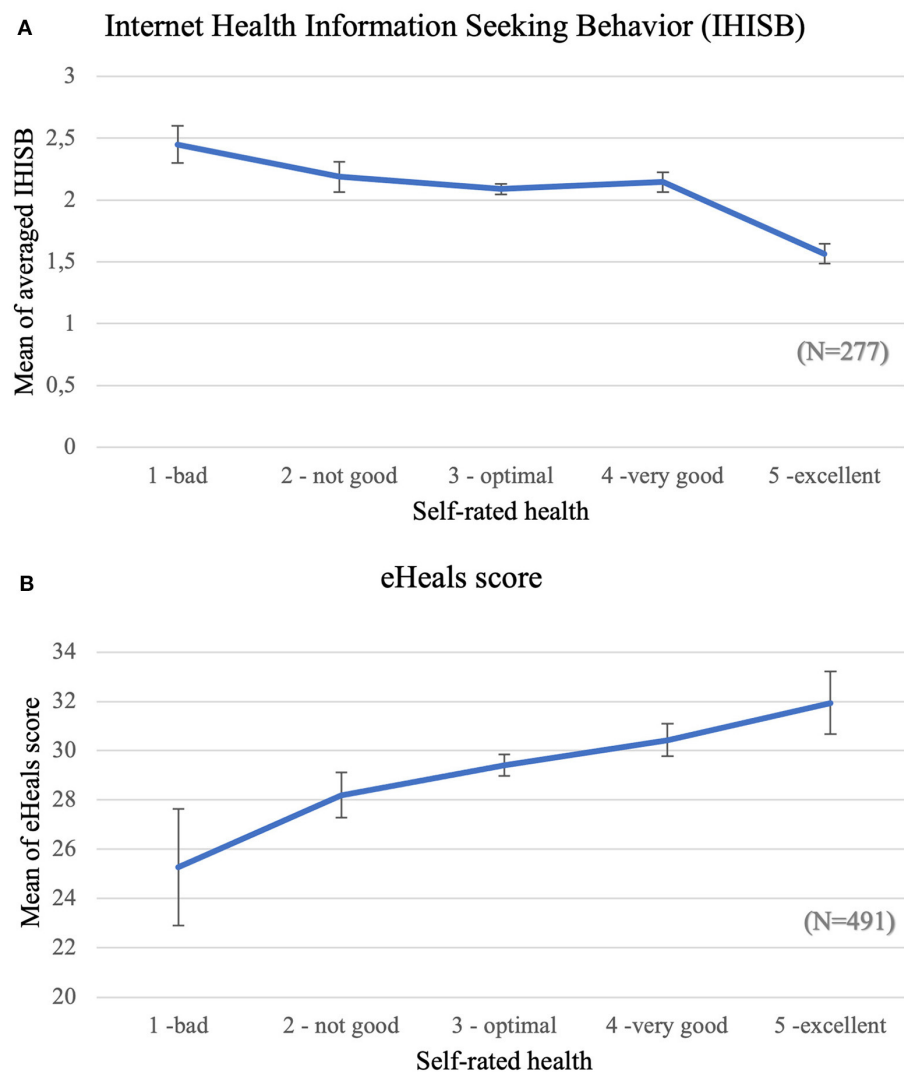
<sup>1</sup>The study materials and the details of all analyses are available from the corresponding author upon request.

status and eHeals [ $\rho(489) = 0.164, p < 0.000$ ] but in the opposite directions: while subjects who use the Internet more frequently to search for health information have worse self-rated health status, the ones with higher eHeals score report better subjective health status. Then we used the Kruskal-Wallis trial to test the distributions of IHISB and eHeals scores in each subjective health category. Both variables show significant differences alongside self-rated health status ( $p_{\text{IHISB}} = 0.001$ ;  $p_{\text{eHEALS}} = 0.006$ ) but not in the expected U-shape directions (see **Figures 1A,B**).

Beside self-rated health status, we also measured the presence of chronic disease with a question inquiring about 10 chronic diseases. Since we currently work on a project that deals with the association between HL and openness to new technologies among patients living with type-2 diabetes, we made some preliminary analyses comparing eHeals and IHISB alongside

three groups: subjects without a chronic disease, diabetic patients and people living with a chronic illness other than diabetes. According to the Kruskal Wallis trial neither eHeals nor IHISB show difference between the three groups ( $p = 0.383, p = 0.067$  respectively).

In our sixth hypothesis we assumed Generation Z gained the least empowerment from using the Internet. Since empowerment had a normal distribution in our sample (Kolmogorov-Smirnov test is 0.53,  $p = 0.06$ ) we used One-way ANOVA to test this. It shows a continuous decrease in the score of empowerment across the generations from Boomers to Generation Z, and a significant difference between the generations [ $F_3 = 3.23, p = 0.011$ ], especially between Boomers and Generation Z (Bonferroni's *post hoc* test  $MD = 3.50, p = 0.006$ ). (The difference between the other generations and generation Z was on the level of tendency.) This result supports our hypothesis.



**FIGURE 1 |** The distribution of **(A)** IHISB (a composite score of Internet Health Information Seeking Behavior) and **(B)** eHEALS values across self-rated health categories.



Our last assumption was that IHISB and eHeals do not correlate with empowerment but these variables together will determine subjective health status and the utilization of the healthcare system. To test this, first we used Spearman rank correlation between IHISB, eHeals and empowerment. The results indicate significant moderate correlations between the variables:  $\rho(271)_{\text{IHISB-empowerment}} = 0.54$ ,  $p < 0.000$  and  $\rho(471)_{\text{EHEALS-empowerment}} = 0.414$ ,  $p < 0.000$ . Then, we set up different linear regression models with the dependent variables, self-rated health status, using the health care system by appointment and using the health care system in emergency. The independent variables were IHISB, eHeals and empowerment. The result of the linear regression model (with Enter method) became significant in the following cases: self-rated health status is determined independently by eHeals ( $R^2 = 0.023$ , Beta = 0.167,  $p = 0.001$ ), but not by empowerment, visiting a doctor or a health-care professional by appointment is determined ( $R^2 = 0.024$ , Beta = 0.153,  $p = 0.034$ ) independently by empowerment but not IHISB, and using the health care system in emergency is both determined by eHeals negatively ( $R^2 = 0.018$ , Beta =  $-0.108$ ,  $p = 0.04$ ) and empowerment (Beta = 0.145,  $p = 0.006$ ). These do not support our original hypothesis, but give plausible results.

## DISCUSSION

We aimed to explore generational differences in IHISB and digital HL (measured by eHeals) first in Hungary, as well as a self-rated and a more objective application of these skills (perceived empowerment and health care utilization). By involving a more complex social phenomenon (generation), a special context (Internet) and application in our research we have taken a further step into the direction of more contextualized, and at the same time more complex research of eHL.

Although Hack-Handa and Pinter (68) did not find it possible to compare Hungarian generations alongside IHISB due to the difficulties of reaching Generation Z and Baby Boomers representatively only via online platforms, we decided to use the more complex age-based category considering its significance in the attitude toward using technology (5–7) and in health status (8, 24).

In our first hypothesis we assumed no differences among generations in the frequency of producing IHISB, which was reported previously—mainly using age or age groups as variables—by Hungarian (17, 68) results, but not international (7, 10, 32) findings. Our findings support Hungarian results, since there were no differences in IHISB between the generations. It means that Hungarians between the age of 18 and 72 searched health information on the Internet equally frequently. Already in 2014, Tóth et al. (73) reported that in Hungary a significant majority of Internet users (87%) use the Internet to search health-related information, and we approached subjects who use the Internet for health purposes. Considering more recent data, Eurostat reported that in 2020, 63% of individuals used the internet for health information seeking in Hungary (11), which is above the average 55% of the 27 European countries. Our results

detail this with the finding that the relatively high health-related Internet-usage does not differ between the generations.

In spite of the similar frequency of IHISB across the generations, the elder among them had less digital skills in finding information on the Web I (7, 30). The result of our second hypothesis also supported these international findings: there was a significant difference between Baby Boomers and Generation Y in the expected direction, i.e., the former generation had lower eHeals scores.

Although older generations have smaller awareness of eHealth resources and less confidence in their information seeking and engagement skills on the Internet than younger ones (30), college students (18–24 years) belonging to Generation Y and Z were not confident enough to make decisions about health options independently (66). In our sixth hypothesis we assumed and proved that empowerment gained by using the Internet decreased with age and was the lowest in Generation Z. This result is in accordance with the literature and can be crucial to plan health promotion programmes. It seems that younger generations need development in decision-making skills, while older ones need to be taught the effective use of the Internet. These shed further light on previous conclusions that highlighted older patients, who usually need the most medical attention, are the ones that lack the skills to use electronic health information and services effectively (26, 44, 74). However, the differences between the generations in eHeals scores can be interpreted in other ways as well. On the one hand, elders may face more complex situations, in which access to Internet-based information are more difficult and not so evident. This can result in lower eHeals scores. On the other hand, eHeals is a self-perceived assessment of health related digital skills, which means that digital natives may overestimate their competence in finding information on the Internet. To make clearer interpretation in future research eHL competence needs to be assessed.

The relationship between self-reported eHL skills (measured by eHeals) and IHISB seems to be more complicated if we look at it across generations (Hypothesis 3): only Generation Y showed a positive correlation between these variables. Baby boomers and Generation Z use their better self-reported eHL skills to search more health-information on the Web for others. While self-reported eHL skills and searching behavior did not associate with each other in Generation X. In the literature, Mitu (60) also reported that 18–31-year-old people (belonging mostly to Generation Y) with higher eHL produced more advanced IHISB (used more sources of information). Schulz et al. (37) found a moderate relationship between IHISB and eHeals in the Boomers generation, while Tennant et al.'s results (45) turned the attention toward differences within the older generations: younger age, more education, use of more electronic devices and the use of Web 2.0 platforms were associated with higher levels of eHL. In sum, it seems that more variety and frequency of IHISB might not be a sensitive variable in relation to the level of eHL skills, while being in relationship with others to search for can be a motivating factor for using eHL skills. We can use this latter explanation also in Generation Z: they are young enough not to deal extensively with their health, but if there is another person in their environment to search for health-related information on the



Web, better eHL skills go along with more search. The technical ability of Generation X tends to be strong (49, 50) and in Hungary their overall health status is not very good. Taking these two into consideration, we can assume that this generation might search health-related information on the Web independently of their digital HL skills due to their needs and their belief that they are good in using this technology.

As outcome variables we used self-rated health status and the utilization of the healthcare system in their relation to IHISB, eHeals and empowerment. In our fourth hypothesis we assumed that in the case of Baby boomers and Generation X - when subjects need to focus on health problems - the utilization of the healthcare system is affected by IHISB, but not by eHeals score. According to our results in the case of Baby boomers IHISB showed a weak but significant correlation with regular health care utilization, but eHeals has no relation with it, which is in accordance with Schulz et al.'s (37) findings with path analysis. While in case of Generation X our results contradicted our expectations, because eHeals had a weak but significant correlation with health care use by appointments, and IHISB had not. We even could describe a causal effect from self-reported eHL to health care utilization in this generation. Seemingly, this positive relationship opposes not only Schulz et al.'s results (37), but also international ones that claim a negative association of HL and health care system utilization (37). In fact, our finding is in accordance with the literature that stresses the role of the measured variable of the health service use (67). The positive correlation in our sample was found between self-perceived eHL and the number of visits by a health professional by appointment. Conclusively, in Generation X digital skills (measured by eHeals) rather than Internet-seeking behavior affect the preventive, in-time interventive and regular maintaining visits to doctors. In this generation higher eHL might indicate higher awareness of health issues.

Regarding self-rated health status a U-shape relation was found between this outcome variable and IHISB and eHL in Hungary (17). Our results showed a different pattern: while subjects who use the Internet more frequently to search for health information have worse self-rated health status, the ones with higher self-perceived digital HL skills report better subjective health status. The latter relation is well-known between HL and subjective health status (75), and some international results also show that the higher the level of eHL is for an individual, the better self-rated health status he/she reports (22, 23).

Our last assumption was based on the Health Empowerment Model (HEM) (69, 70), which claims that HL and empowerment are different constructs, they do not correlate with each other, but they determine together certain health outcomes. We found significant moderate correlations both between IHISB and empowerment and eHeals and empowerment, which contradict our expectations. Self-rated health status was determined independently by eHeals, whereas visiting a health-care professional was predicted by empowerment. We can interpret it as doing something for our health needs empowerment. We revealed another determination: using the health care system in emergency is negatively determined by eHeals and positively by empowerment. So the ones who use

healthcare services abruptly possess weaker self-reported eHL, but higher empowerment skills. They might belong to the category that HEM calls dangerous self-managers with low HL and high empowerment.

## Limitations

Although we consider the generational approach as a strength of our study, other scholars may find it an artificial theoretical construct. Other divisions of the age groups based on more detailed social and contextual information about the use of technology can be equally fruitful.

The main limitation of our study is the number of answers to the items. Although we collected a considerable number of responses, the degree of freedom varies heavily between statistical trials, because the instruction let the participants leave out sensitive questions.

Another limitation might be that we did not use validated instruments. However, the questionnaire was developed and used successfully previously in Anglo-saxon countries, and the reliability analyses showed good values of all the measurements in our sample.

Finally, although we used in the supplementary data collection phase the representative proportion of the Hungarian population in terms of gender and education that is provided by the Hungarian Statistical Office we did not manage to establish a representative sample. This lack of representativeness for the Hungarian population limits the generalizability of our results.

## CONCLUSION

We found using "generations" in digital health related topics more beneficial than age due to their common attitudes and skills toward technology and to their more similar health status and utilization of health care services. According to our knowledge our study is the first that focuses on generational differences in IHISB, self-perceived eHL (measured by eHeals) and related health outcomes in Hungary. Considering the Internet health information seeking the older generations (baby boomers and Generation x) shows the same frequency as the younger ones, which gives a solid motivation for developing their eHealth literacy skills. We find it crucial to plan the Hungarian health promotion programmes utilizing this high frequency of Internet health information seeking, since the eHealth literacy skills of older generations have an effect on their subjective health status, and gaining the relevant information regarding their health on the internet they are the most capable of applying it in making decisions. Our results also call the attention for the needs of Generation Z: to make better health decisions they need education in reflecting on the gained information and in applying it.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article are available from the corresponding author upon request.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Psychology Ethical Committee of Universities in Hungary (111/2017). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

OP-Z contributed to the conceptualization of the research process, organized the research process, performed data analysis, wrote the first draft, and finalized the final version of the manuscript. MH performed literature review and contributed to the writing of the first draft. PS and MC conceptualized

the research process and critically reviewed and developed the manuscript. All authors contributed to the article and approved the submitted version.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Baseline Stroke Literacy of Young Children Based on “FAST 112 Heroes” Program

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**Background:** Young children are often unaware of emergency health conditions, such as stroke, and could serve as important vehicles to save the lives of their grandparents, who are more likely to suffer a stroke. An important aspect for the evaluation of public awareness on stroke signs and related emergency procedures is to examine the level of baseline stroke knowledge children have and whether they understand when to seek medical care on time.

**Objective:** To examine the level of stroke symptomatology knowledge in children as well as evaluate their preparedness in stroke response before their participation in the educational program “FAST (Face, Arms, Speech, Time) 112 Heroes.”

**Methods:** For the purpose of this work, a questionnaire was developed and adapted to preschoolers’ needs. The present study involved 123 children (65 boys, 58 girls, aged 4–6.5 years; mean age: 5.30, S.D.: 0.59) from two cities in Greece. Five multiple-choice animated pictures, that were age-appropriate, were administered to each child, along with verbal explanations provided by the investigator.

**Results:** More than half of the participants ( $n = 65$ , 52.8%) could recognize the symptom of face drooping, 53 children (43.1%) could identify the symptom of arm hemiparesis/hemiplegia and 92 children (74.8%) were able to answer the question regarding speech disturbances. However, the number of correct answers to the question regarding the appropriate course of action in case of a stroke was the lowest among all the questions (10.6% of participants gave a correct answer). Furthermore gender and age did not play a significant role ( $p = 0.571$  and  $0.635$ , respectively).

**Conclusion:** Although more than half of the enrolled preschool children could recognize stroke symptoms before their participation in the educational program, their baseline stroke knowledge, prior to their training, is low. Concurrently, they do not have sufficient knowledge on how to react appropriately in the event of a stroke. Therefore, awareness programs focusing on developing stroke literacy to children are needed, to ensure children will seek urgent medical care in case of a stroke.

**Keywords:** children, baseline knowledge, health literacy, preschoolers, stroke, stroke awareness, stroke knowledge



## INTRODUCTION

It is estimated that one million people suffer a stroke worldwide (1). During a stroke, every minute counts, as the sooner a patient receives medical attention, the better the chance for surviving and preventing disability. Worldwide, stroke is not only the second highest cause of death, but also a leading cause of a chronic disability (2), dementia and depression (3). Strokes can be classified into ischemic or hemorrhagic, with ischemia being responsible for the majority of strokes (4). The successful management of stroke is based on rapid reperfusion of intravenous thrombolysis or endovascular thrombectomy, that can reduce a possible disability, but both of them are time-critical (5). There are restricted “time windows” in which these treatments are most efficient. Thus, reducing the time from stroke to arrival at the hospital is the key to maximize the benefits of these therapies as “time is brain.” Nevertheless, statistics show that, on average, the public still lacks basic stroke knowledge and patients continue to arrive in the emergency not fast enough (6). Pre-hospital delay, due to poor public recognition of stroke symptoms, limits the number of patients suitable for proven therapy and increases the incidence of permanent brain injury (7).

Timely medical care depends on the public’s awareness of stroke signs, particularly by family members, friends, and bystanders that are in key position to act fast and call a medical emergency number in time. Children are in key position to witness a stroke as they spend a lot of time with grandparents in various cultures (8), who are in higher risk of suffering a stroke (9). Therefore, children can act as adjustment levers for better stroke outcomes in society (10).

Educational interventions about stroke, such as “Hip Hop Stroke” (10) and “Stroke 112” (11) are estimated to be effective for both children and family members through in-house communication. In this regard, the FAST (Face, Arms, Speech, Time) 112 Heroes educational program (12), is unique in that it addresses preschool children who are still in the process of developing communication and learning skills. Creating automatic knowledge gains at this age, by increasing the recognition of stroke symptoms, will lead to increasing stroke knowledge to the children’s parents (13). Even if children won’t be in a position to seek medical help for a family member, the knowledge transferred to them and their extended family will be of benefit. This will build their understanding and awareness on how to act appropriately through their own cultural lens and create systematic educational changes that will ultimately affect the wider stroke community.

Many studies have been conducted to evaluate stroke awareness in adult populations (14, 15). However, little is known in the stroke knowledge research about young populations, especially in Greece. In some cultures, children spend a lot of time with people who may be at risk for stroke. For this reason, more data is needed about their stroke knowledge. Therefore, we created a questionnaire to evaluate the stroke preparedness of young children.

Our primary goal is to evaluate preschoolers’ knowledge levels on stroke symptomatology and the appropriate course of action

in case of a stroke before their participation in the educational program FAST 112 Heroes. Our secondary goal is to inspire researchers to design more educational interventions, in Greece, that will educate children on stroke signs and teach them the adequate chain of actions in the event of witnessing a stroke.

## MATERIALS AND METHODS

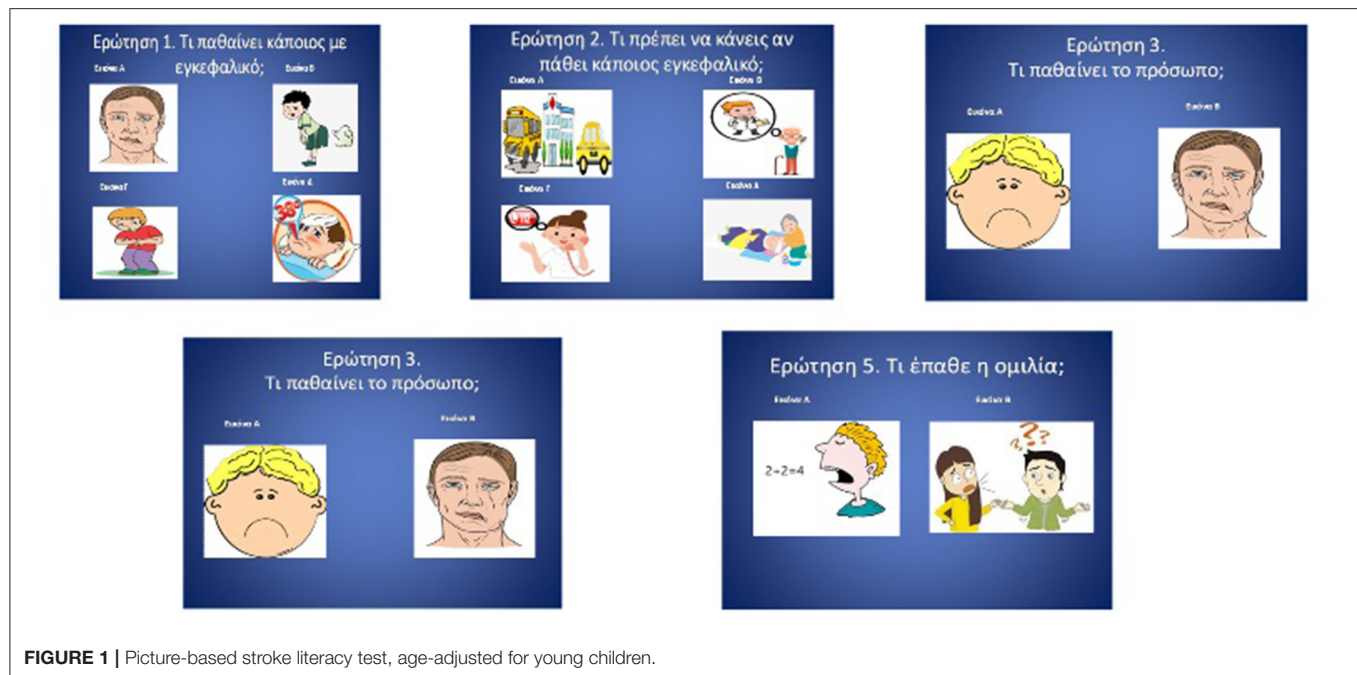
Traditional questionnaires involved examining baseline stroke knowledge (16), which was translated and modified in Greek by bilingual personnel from the Department of Educational and Social Policy (with two-fold back translation). In brief, all images were used as stimuli and contained five age-appropriate, multiple choice questions in animated pictures with headings in the Greek language. To account for the fact that most kindergarten children cannot read, the questionnaire had five multiple choice questions that featured animated pictures and a verbal explanation, provided by the investigator, a technique that has been proven to be age-appropriate for preschoolers (17). The two first questions contained four possible answers while the other three questions contained two possible answers. Each question had only one correct answer. The questionnaire items and the verbal explanations are shown in **Figure 1** and **Table 1**, respectively.

In order to check the validity of the questionnaire, we conducted a focus group with members of the “Super Grand League Team,” a team of professionals that involves kindergarten teachers, speech language pathologists, psychologists, and special education teachers (12). The focus group unanimously agreed regarding the content of the questions. Minor modifications were suggested, for example removing a question regarding the FAST acronym (i.e., “What does each letter of the F.A.S.T. mnemonic represent?”).

Before the children’s knowledge assessments, both information sheets and consent forms were handed out to the participants’ parents, who all gave their permission for their children to participate in the study. The questionnaire was administered individually to each child, before the implementation of the program, in a quiet classroom, on a school day, without distractions. The session began with some introductory questions, such as “What is your name,” “How old are you,” and “Have you ever heard the term ‘stroke?’” All responses were verbally collected as well as written down by the examiner. The mean time for the completion of the questionnaire was 5 min.

## Participants

Of the 137 children recruited from the Northern Greece cities of Thessaloniki and Alexandroupolis, 123 children (65 boys, 58 girls, aged 4–6.5 years; mean age: 5.3, S.D.: 0.59), participated in the study. Exclusion criteria included special needs and other neurological difficulties. All children were kindergarten students, attending public schools. Some age categories (e.g., 4- and 4.5-years- old) included only a few children, leading to difficulties in analysis and inferences. Thus, we decided to collapse the data into two main groups (4.0–5.9 and 6.0–6.5 years) based on the number of children in each group. The first group (i.e., 4–5.9



**FIGURE 1 |** Picture-based stroke literacy test, age-adjusted for young children.

**TABLE 1 |** Verbal explanations provided for each question of the test.

<b>Question 1:</b> What is happening when someone is having a stroke?	<b>Picture A:</b> One side of the face droops.	<b>Picture B:</b> They have gas.	<b>Picture C:</b> Their stomach hurts.	<b>Picture D:</b> They have fever.
<b>Question 2:</b> What is the appropriate course of act in case of a stroke?	<b>Picture A:</b> You should hire a taxi/take the bus and take the patient to the hospital.	<b>Picture B:</b> You should call the doctor.	<b>Picture C:</b> You should call 112.	<b>Picture D:</b> You should take the patient to bed.
<b>Question 3:</b> What happens to the face after a stroke?	<b>Picture A:</b> The face droops from both sides.	<b>Picture B:</b> The face droops from 1 side.	–	–
<b>Question 4:</b> What happens to the arm after a stroke?	<b>Picture A:</b> The arm is weak or numb.	<b>Picture B:</b> The arm is in plaster because it is broken.	–	–
<b>Question 5:</b> What happens to speech/ after a stroke?	<b>Picture A:</b> Everything is fine, they can even do math.	<b>Picture B:</b> Their speech is slurred or garbled.	–	–

years old) included 42 children whereas the second group (i.e., 6–6.5 years old) included 81 children.

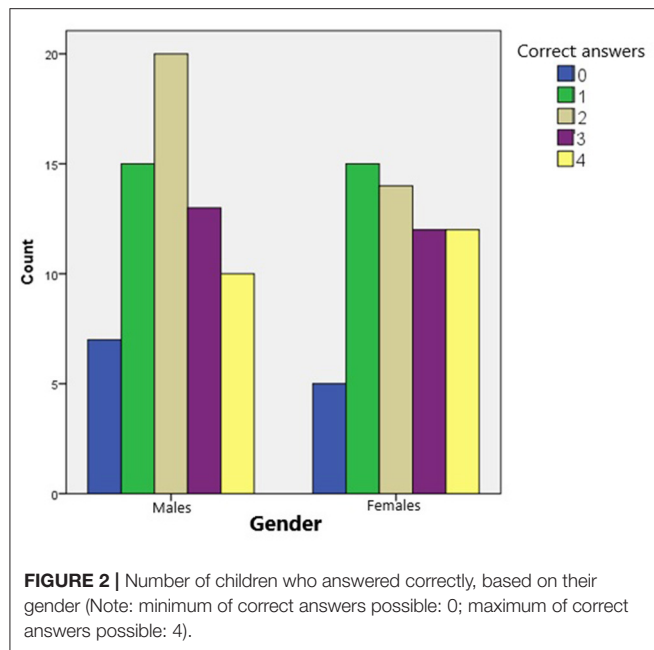
## RESULTS

The present study set out to answer two questions, both concerned with baseline knowledge of stroke symptomatology and stroke preparedness in young children. First, we aimed to explore the baseline knowledge that children of ages 4–6.5 years have. Second, to explore whether children can adequately state the actions needed for appropriate response in case of a stroke.

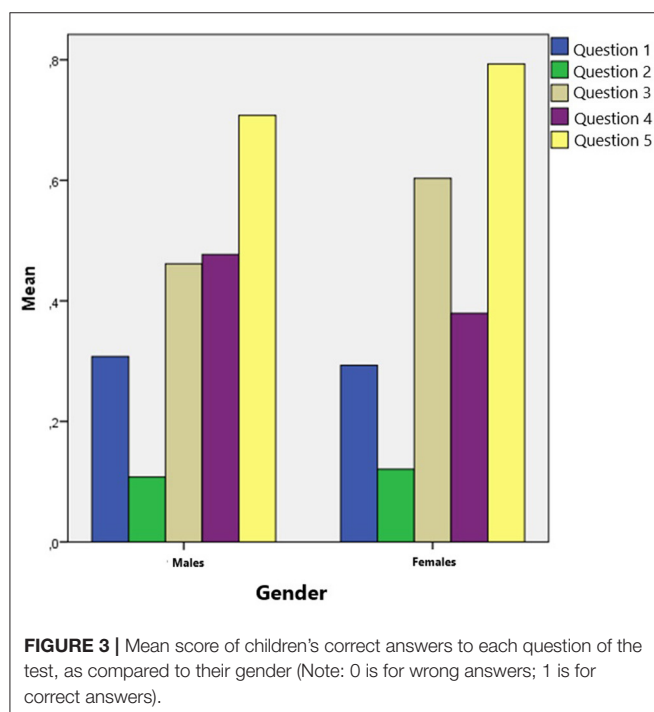
As illustrated in **Figure 2**, the number of correct answers in males appears as an approximately normal distribution. Most of the boys answered two questions correctly while the extreme cases (0 or 4 correct answers) representing the smallest portion of males. Most of the females' answers did not follow a normal distribution. None of the participants answered all questions correctly. However, both females and males scored better in the

questions regarding the stroke symptoms. As can be seen in **Figure 3**, females scored slightly better to the questions about stroke symptoms. Gender did not play a significant role in children's answer ( $t = 4.265, p = 0.571$ ).

Age did not play a significant role in children's answers ( $t = 0.467, p = 0.635$ ), as there were no significant differences in the percentage of correct answers depending on age. Children under 6 years old gave slightly more correct answers to questions regarding the stroke symptoms (**Figure 4**). Children under 6 years old answered correctly 43.2% of the questions while older than 6 years old answered correctly 40.95% of the questions (**Table 2**). Both groups of participants scored better in the questions regarding the stroke symptoms. The mean number of the correct answers given in regard to the stroke symptoms was almost the same depending on the two age groups. Children from the younger group answered questions 1 and 4 correctly while children from the older group answered questions 2, 3, and 5 correctly.

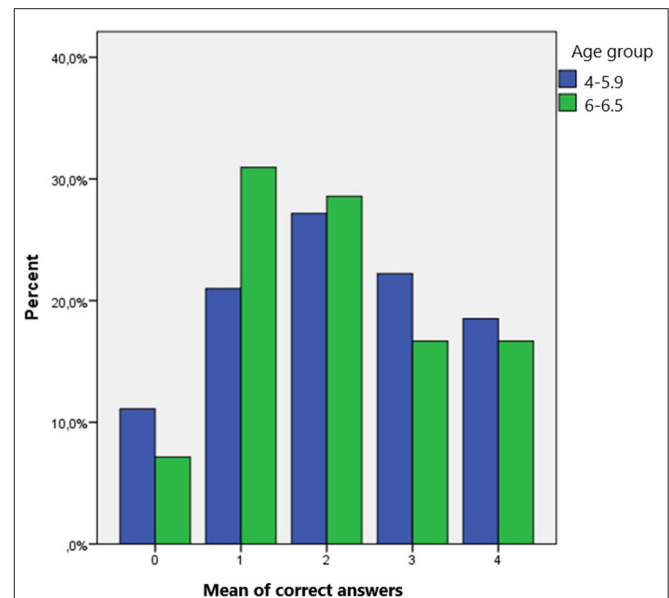


**FIGURE 2 |** Number of children who answered correctly, based on their gender (Note: minimum of correct answers possible: 0; maximum of correct answers possible: 4).



**FIGURE 3 |** Mean score of children's correct answers to each question of the test, as compared to their gender (Note: 0 is for wrong answers; 1 is for correct answers).

Preliminary analysis evaluating the questionnaire, indicated that 37 children (30.1%) could recognize a stroke (question 1); 13 children (10.6%) were able to answer the question regarding the appropriate course of action (question 2); 65 (52.8%) could spot a stroke by face (question 3); 53 children (43.1%) were able to answer the question regarding the arm symptom in a stroke (question 4); 92 children (74.8%) were able to answer the question regarding the speech in a stroke (question 5). Question 2 was the most difficult for the participants to answer correctly while Question 5 was the easiest for the participants to answer correctly.



**FIGURE 4 |** Mean score of correct answers given, based on children's age group.

**TABLE 2 |** The distribution of correct answers for each age group.

Group ages	N	% of correct answers	Standard deviation
4–5.9	81	43.2099	25.38834
6–6.5	42	40.9524	24.17513
Total	123	42.4390	24.90446

## DISCUSSION

Our prediction that children do not have sufficient baseline knowledge is in line with previous literature arguing that children lack of basic stroke literacy (16, 18). The majority of children in this work could not identify the appropriate course of action in case of a stroke and no child completed the test with a perfect score. Recent studies have shown that educational programs can have a positive impact, not only on children's stroke knowledge, but also on their extended families, since children can be leveraged as conduits and transfer stroke literacy to the family members (19–22). We show that young children are not aware enough of the stroke symptomatology and thus suggest more school-based interventions that will deliver stroke knowledge to children. The results revealed that children were able to recognize the stroke symptoms after the intervention, and maintained the knowledge gained for almost a month later.

Gaining such knowledge helps children build resiliency skills since they become prepared for an unfortunate event that may happen in a family. It is very beneficial for children to become acquainted with symptoms of disorders so that they normalize in their minds these events if or when they happen (23). It is commonly accepted, and experienced, that the majority of children adjust well to unfortunate events and inconveniences,

and thus, they can act as supportive units in the management of a stroke event involving a family member (24).

We summarize the major findings of this work by pointing out some limitations. First of all, sample size of young children was small. Nevertheless, we have tried to offer some speculations and can only hope that our investigation will stimulate further research on measuring baseline stroke knowledge for young children. In our interpretation of stroke knowledge questionnaires, the number of answers differed in questions 3, 4, and 5. The fact that questions regarding stroke symptoms had only two possible choices might be the reason why most children answered slightly better in questions 3, 4, and 5, which addressed face drooping, arm weakness and speaking trouble symptoms as stroke symptoms. The reason we chose this number of possible choices is justified by Alloway et al. (25) who suggest that the visuospatial working memory measures of young children demand parallel processing and storage of information, an association which gradually increases from the age 4–6 to older ages. Of course, more questions with the same number of possible answers per question could increase the test reliability.

The most interesting result in our questionnaire was that most of the participants struggled to find the correct answer to Question 2, concerning the appropriate way to act in case of a stroke. This is in accordance with the literature (26, 27) that points to the fact that young children generally do not know much about stroke. There are limited local campaigns or educational interventions to increase stroke knowledge as well as the appropriate emergency number in case of a stroke. What we hope to have achieved, even with the small sample tested here, is to have sparked educators and researchers' attention in encouraging people to further investigate stroke knowledge in young children and highlight the necessity of training emergency responses.

The present study focused on the baseline knowledge of children of stroke symptoms and immediate reaction to those on their behalf. One suggestion for future studies could be to extend

the investigation of young children's involvement or engagement with family members that suffer from a stroke in the long run. How do they react behaviorally and psychologically to these family members? Do they assist in their daily care? Do they become attached or remotized?

It is increasingly important that local state agencies will systematically offer such informative sessions with public and private schools so that knowledge is repeated in children's minds and thus mastered. Usually, such actions are conducted only in training for emergency situations but should be integrated in the school curriculum, as part of a national educational program.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Study approval was obtained from the Committee for Research Ethics of the University of Macedonia (Thessaloniki, Greece) (14/15.06.2020). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Addressing Health Literacy in Schools in Germany: Concept Analysis of the Mandatory Digital and Media Literacy School Curriculum

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It is generally agreed upon that the development of health literacy should be addressed from an early age onwards in order to empower children to develop their full health potential. Schools can be seen as an ideal venue for strengthening health literacy because they reach almost all school-aged children throughout their school years. The development of health literacy at a young age is a catalyst for healthy development throughout across the life span. Evidence shows that health and education are intertwined with favorable effects for health (e.g., health behavior, knowledge) and education outcomes (e.g., academic achievement). However, health literacy is often not sufficiently integrated into the school curriculum despite its importance to health and education. Integrating health literacy into schools is challenging, as both schools and teachers already face numerous educational requirements that may prevent them from addressing health in the classroom because they perceive it as an additional task. This is why taking a sensitive approach is important, adapted to the needs of schools and highlighting the benefits of health literacy. Installing health literacy in schools succeeds more easily if it can be linked to existing curricular requirements. In this context, curriculum and instruction on media literacy, information literacy, and digital literacy are most promising subjects to include health literacy because these concepts share many commonalities with health literacy and often are already part of the school curriculum. The aim of this article is to (1) analyze a mandatory curriculum on media literacy in the state of North-Rhine-Westphalia in Germany, (2) highlight its intersections with health literacy, and (3) show how it can be used to address health literacy. The state media literacy framework is based on the federal standards for “digital education” developed by the German Conference on Education Ministries und Cultural Affairs (KMK). As education policy and practice is decentralized with sixteen federal states in Germany, each of them has got their own media literacy framework, or they are currently developing it. This curriculum analysis may serve as a methodological blueprint for educationalists, teachers, and policy-maker elsewhere in order to include health literacy into existing curricula both health and non-health. It may help to integrate health literacy into schools when combined with existing curricula.

**Keywords:** health literacy, school, curriculum, school-aged children, Germany, media literacy

## INTRODUCTION

In a rather conservative approach to the concept, health literacy merely describes a person's ability to deal with his or her health-related functional literacy skills and navigate the health care system (1). However, the health literacy concept has evolved into a modern key competence of health promotion and prevention equally focusing on finding, understanding, and communicating health information, making critical judgments about health claims, and empowering individuals to make informed health decisions, practice healthier behaviors, and modifying the personal determinants of health (2, 3). In this context, many models and definitions appeared over the past decades for adults (4, 5) as well as for children and adolescents (6, 7). A common and often quoted definition of health literacy, also representing the main commonalities across available definitions, is the one presented by Sørensen et al. (4):

"Health literacy is linked to literacy and entails people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course".

The core of this definition focuses certain action areas related to competencies to deal with health information, namely (i) accessing, (ii) understanding, (iii) appraising, and (iv) applying. In this sense, health literacy can also be conceptualized as information literacy with regard to health topics (8, 9). New communication channels have emerged with increasing digitalization. This means that information is not only sought in analog form, but rather and especially in digital media such as social media (10). The concept of digital health literacy conveys this understanding of health literacy specifically to digital contexts and environments (11). Children and adolescents seek, adopt, and produce digital information on the internet partly also on social media (10). Thus, there is a close conceptual relationship between health literacy on the one hand and media, information, and digital literacy on the other (12–14). They essentially share the competencies to deal with (health) information. Hence, strengthening health literacy fits well with strengthening these literacies.

Emerging evidence suggests that fostering health literacy as early in life as possible is preferable since it is associated with better proximal and distal health and social outcomes (15–17). Focusing on early life helps children and adolescents to grow into health literate adults, who have learned and internalized the skills, competencies, knowledge, attitudes, and beliefs to handle health information on an individual level (18–21). This is why it is important that health literacy is embedded into a socioecological approach, encompassing behavioral and structural components (22). Schools have long been identified as strong venues for health promotion and health education (19, 23–25) since schools can reach almost all school-aged children regardless of their social, cultural, or economic background. This is particularly important because studies indicate a social gradient in the

incidence of low health literacy in children and adolescents (26–28). School-based interventions aiming at promoting health literacy can contribute to reduce health inequalities (20). Low health literacy in adolescence is associated with harmful and risky health behavior in adulthood and poorer health in general (20, 29). It is also relevant that students <sup>1</sup> develop skills to learn about (their own) health because much of the lexical knowledge will be insignificant when they are adults (24). In the Shanghai Declaration on promoting health in the 2030 Agenda for Sustainable Development (30), the World Health Organization (WHO) also calls for the early promotion of health literacy in the education system:

"Health literacy is founded on inclusive and equitable access to quality education and lifelong learning. It must be an integral part of the skills, and competencies developed over a lifetime, first and foremost through the school curriculum".

However, health literacy goes beyond an individualistic and behavioral approach and includes the structural and environmental levels (22, 31). In the context of education, health literacy can be addressed at the organizational level of schools in order to improve structural factors and lower barriers that hinder appropriate action on health literacy (20). Related to this, the health literacy of teachers, principals, and school staff is just as important as the health literacy of their students, especially because studies have shown that teachers' and principals' health literacy are associated with the implementation status of health promotion in schools (20, 32–34). In the best-case scenario, school-based interventions to promote health literacy should address both, the individual and organizational level as part of a holistic Health Promoting School (HPS) approach (20, 21). However, HPS is not available in all countries but similar concepts or whole of school approaches could be used as well to address and implement health literacy (20, 21).

Health literacy is known to be the outcome of health education at schools (1, 20). However, in Germany health education is not part of the mandatory school curriculum, which makes it difficult to address health literacy in school. Health, including health promotion and prevention, is often implemented in an unsystematic way, e.g., through school projects limited in time and scope (35). Often, health interventions introduced to the school context fail to be successfully incorporated into the curriculum and thus are not sustainable. One reason for this is rooted in teachers' and school professionals' perceived lack of fit between the subject matter of health and the core mandate of education, which in turn has to be understood as a key barrier in its own right, impeding uptake and sustainable implementation of health topics in schools (36). Another factor that hinders the uptake of health in schools is an overcrowded curriculum, missing time and professional resources, and, partly, the lack of competencies and knowledge of the school staff (18–20). Altogether, this makes it difficult to systematically address health in schools. It will need approaches that overcome these barriers, especially when aiming at strengthening health

<sup>1</sup>We use "student" to refer to all school-aged children.

literacy in schools. In the German federal state of North Rhine-Westphalia (NRW), like in most other German states, there are specific non-mandatory state programs to address school health promotion and education. In NRW, the state program 'health and education' includes the promotion of health literacy as one of the objectives to be accomplished by 2022 (37). By strengthening health literacy, it is supposed to improve overall health outcomes and educational opportunities of students in the long term. However, the state program is not mandatory, and many schools do not participate in the program, which is why health literacy has not been included systematically and across schools to the curriculum. For it to be included to the curriculum or classroom activities, it will be important to align health literacy with the core tasks and goals of schools. The health literacy learning activities must be easily adaptable to daily school routines without additional efforts for teachers and no need for additional resources for the schools (20, 21).

Since there is no mandatory health education in schools in Germany with health literacy as the desired outcome, different approaches and entry points are needed. In order to identify such entry points for health literacy within the school curriculum and possible intersections with the core school tasks and concepts, existing school curricula should be analyzed first. This way, subject areas, which can be easily linked with health literacy, can be identified. On the national level, a framework for digital education and digital literacy in schools (38) has been introduced recently, which consists six dimensions how to address 'education in a digital world' in schools. This framework has been adapted into the school media literacy framework on the state level. The new framework was designed as a cross cutting theme that can be used across subjects or other cross-sectional school topics and issues. The framework comprises digital literacy, media literacy, and information literacy, which share many similarities and commonalities with health literacy as highlighted earlier (9, 12, 13). Therefore, the new media literacy framework seems to be such an entry point and hence a promising opportunity for addressing health literacy in schools. Especially since (digital) media-related competencies are becoming more important as a result of increasing digitalization and the digital transformation of society (39, 40). In contrast to existing curricula, media literacy frameworks are still fairly new in Germany and will only become compulsory in summer 2021 (41), although there is a long tradition of media education and pedagogy in schools dating back to the 1990s.

The aim of this article is to discuss how health literacy could be introduced to schools, taking into consideration (1) that no additional efforts are required but (2) it would be integrated into existing teaching and learning frameworks. First, the German digital education framework and the new mandatory curriculum on media literacy of North-Rhine-Westphalia will be presented and the underlying concepts will be analyzed. Second, the intersections with health literacy will be highlighted. In addition, this approach to curriculum analysis can be seen as a methodological blueprint that can be easily adapted to educational systems of other countries so that they could integrate health literacy in their curricula without the need of any extra resources and in alignment with their educational goals.

## CONCEPT ANALYSIS OF NATIONAL PEDAGOGICAL FRAMEWORK

To assess state or federal school standards in Germany that share similarities and commonalities with health literacy, we have reviewed available documents of the education sector in online databases (both federal and state-level) as well as on the website of the KMK. We focused the concept analysis on:

1. identifying governmental frameworks and recommendations for topic-based or cross-cutting issues,
2. analyzing available concepts that provide possible interfaces to address health literacy.

In the available school curricula various subjects, topics, and competency frameworks were found to intersect with the core action areas addressed by health literacy. After analyzing the findings, the study team decided to use the national digital education and digital literacy framework and the state-level media literacy frameworks because they show the best fit to health literacy.

Through their recently introduced strategic concept 'Education in the Digital World' (In German: "Bildung in der digitalen Welt") (38), the KMK presented new national standards for addressing digital education and digital literacy in the school. This framework was developed in collaboration with all 16 German federal states and involved stakeholders from science, unions, associations, and different levels of administration and practice. Three strategies make up one federal act based upon three key documents: (i) The Education campaign for the digital knowledge society' ("Bildungsoffensive für die digitale Wissensgesellschaft" in German) (42), (ii) The 'Digital Pact Schools' ("DigitalPakt Schule" in German) (43) and (iii) The concept 'Education in the Digital World'. Together they also aim at preparing students, teachers, schools, and the whole education sector for the digital transformation of society and challenges associated with digital changes in all areas of life, including education. Part of the strategy is to establish a digital infrastructure in schools (including computers and internet access) and to create new training and education opportunities for in-service and pre-service teachers and educational staff. On the state-level, this new strategy includes a mandatory educational framework to foster digital literacy in schools, which will be implemented nation-wide, starting in 2021. Based on the digital literacy approach, the states have defined their own teaching and learning goals for promoting digital media skills in schools. Therefore, in the state-level education systems the national digital education and digital literacy framework is translated into a 'media literacy framework', and will also be a mandatory curriculum item in teacher training at University levels in all federal states, also starting in 2021.

The national framework outlines six action areas (also called 'competence areas') to ensure that all children have been taught media and digital skills in schools by 2026. These six areas of "Education in the Digital World" are briefly described below (Table 1).

**TABLE 1 |** Strategy and competence framework for digital education and literacy by the KMK (38).

Competence areas for digital education and digital literacy (38)		
1.	Searching, processing, storing	This includes searching and filtering sources and information in various digital environments, evaluating and assessing these information and sources, and storing and retrieving various information and data.
2.	Communicating and cooperating	This means interacting with the help of digital communication technologies, sharing data and information, working with different digital tools, knowing and adhering to rules of conduct and actively participating in society.
3.	Producing and presenting	Summarized by developing and producing, processing and integrating various contents and observing legal requirements.
4.	Protect and act safely	This comprises acting safely in the digital environment by considering risks and dangers, protecting personal data and privacy, protecting health by using digital technologies in a health-conscious way and protecting nature and the environment.
5.	Problem solving and acting	This encompasses solving technical problems, using digital tools as needed, identifying own deficits and searching for solutions, recognizing and formulating algorithms.
6.	Analyzing und reflecting	This contains the analysis and evaluation of media offers including the intentions and effects of information provision and the comprehensive understanding and reflection of media in the digital world, including the chances and advantages, but also the risks and disadvantages.

This concept is based on earlier life-skills and digital literacy approaches and defines the areas of competence in which students should learn digital and media skills at school and classroom levels. Like many school topics in Germany, this strategy is meant to be a cross-cutting issue that should be addressed across subjects and not only in specific school subjects such as math, science, or language. This framework represents both a guidance and action plan to further develop digital education in Germany.

Due to the federal states' sovereignty in Germany, each state is responsible for defining its own strategy for digital education. Many states have already adapted the strategy for education in the digital world and have embedded it in their own frameworks, which historically are often rooted in media education and media literacy (sometimes also called 'media pedagogy'). On the state level in North Rhine-Westphalia, the national model was adapted into the Media Literacy Framework ("Medienkompetenzrahmen NRW" in German) (41) using slightly modified titles and content for the dimensions compared to the original model (Table 2).

This framework is to be understood as rather generic and covers all areas relevant to educating students to become digitally literate. In Germany, educational efforts are meant to be inclusive and integrative. They not only focus on narrow skill areas but holistically address a concept in a broader sense, which is why it makes sense to think of health literacy holistically, too. Ideally, the students learn all necessary competencies, the relevant factual and practical knowledge etc. Then, health literacy can be linked to other relevant dimensions of the framework that go beyond the health literacy definition by Sørensen, et al. (4) presented earlier. If health literacy is understood (as part of) a process of developing this competencies rather than a cognitive concept to be transferred to the student, students will automatically learn more than just health-related information literacy skills while achieving the aims of the core health literacy action areas. They must learn techniques of media use, communication, problem-solving skills, and many more as outlined in Table 2. Therefore, embedding health literacy into this framework departs from the definition presented earlier as it interlinks health literacy

with various competence areas. In addition, it significantly contributes to a holistic conceptualization of health literacy as expected by the education sector. Doing so has several benefits, as the curriculum

- (1) addresses the core action areas of health literacy (the information literacy skills),
- (2) allows linking health literacy to the context of digital media and (communication) technology environments and associated requirements,
- (3) includes components to address social, emotional, ethical, and psychological development to support the learning of self-regulation, identity creation, and opinion forming in context of health literacy, and
- (4) permits the linking of necessary health literacy skills with other critical skills that are needed when aiming at finding, understanding, evaluating, and using information to promote health.

In the following we present the six core dimensions in more detail, including the 24 sub-dimensions of the framework, and adapt them to health literacy (Table 3). The model provides a curriculum and associated learning achievement goals across age-grades, including primary, secondary and upper-secondary students. While the dimensions are the same for all age groups, the age-adapted goals differ in their complexity and depth, increasing with age and children's cognitive and social development stages. For the purpose of our analysis, we will focus on the model itself rather than on specific age groups. The exemplary exercises in the third column are based on the learning and teaching examples given in the original framework. They are thought to demonstrate various possibilities and help to imagine how to operationalize and implement the promotion of health literacy in the school setting.

There are many entry points and intersections for addressing various actions connected to the handling of information and knowledge relevant to health and well-being. Especially the second dimension, "Informing and



**TABLE 2 |** Media literacy framework North-Rhine Westphalia, Germany (41).

Media literacy framework NRW (41)		
1.	Operating and applying	Describes the technical ability to use media sensibly and is the prerequisite for all active and passive media use.
2.	Informing and researching	Includes the sensible and targeted selection of sources as well as the critical evaluation and use of information.
3.	Communicating and cooperating	Accord to rules for secure and targeted communication and to use media responsibly for cooperation.
4.	Producing and presenting	To know about media design possibilities and to use them creatively in the planning and realization of a media product.
5.	Analyzing and reflecting	Is to be understood in two different ways: On the one hand, this competence comprises knowledge of the diversity of media, on the other hand, it amounts to the critical examination of media offers and one's own media behavior. The goal of reflection is to arrive at a self-determined and self-regulated use of media.
6.	Problem solving and modeling	Amounts to a basic informatics education as an elementary part of the educational system. In addition to strategies for problem solving, basic programming skills are taught and the influence of algorithms and the impact of process automation in the digital world are reflected.

researching” and its sub-dimensions 2.1, “Information seeking”, 2.2, “Analyzing information”, 2.3, “Evaluating information”, and 2.4, “Critical information review and use”, can function as interfaces to strengthen health literacy. Here, this understanding of health literacy can be applied seamlessly and there is no need to alter it in terms of the dimensional specifications.

To practice and strengthen health literacy and digital health literacy skills, other dimensions of the media literacy framework may be of use, too. When students search for various health information, e.g., on a smartphone, computer, or tablet, effectively, they “operate and apply” digital media (Dimension 1). In addition, group and tandem work, which is regularly practiced in schools, automatically addresses the third dimension, “Communicating and cooperating”, and also includes the social component which is important to health literacy. Dimension 4, “Producing and presenting”, is addressed when the search results need to be prepared for class presentations. Dimension 5, “Analyzing and reflecting” of media, is closely related to the health literacy action areas “critical thinking” and “appraisal of health information”. If students frequently search for health-related content on the internet, they will need the skills to reflect and analyze the content they access and distinguish accurate from false and misleading information. Dimension 6, “Problem solving and modeling”, is trained when students encounter digital problems during their research and have to solve them. This is also closely related to applying information. In the long run, they are trained in data literacy and in their understanding and use of algorithms to detect patterns in information flow and communication. This understanding can then be used to identify digital principles and use them consciously. The fifth and the sixth dimensions also share intersections with evaluating information and critical thinking about health claims. While the competencies and action areas presented here seem to go beyond the common health literacy concept, reviews on health literacy concepts and measurement tools for children and adolescents show that most of the competencies and action areas are in fact used in many of the available concepts and tools (7, 15, 44, 45).

## DISCUSSION ON THE PRACTICAL IMPLICATIONS

### Opportunities

Based on a socioecological understanding of health as presented by Whitehead and Dahlgren (46), there is a wide array of factors determining health development of students. The peril of addictive substance abuse (such as nicotine, cannabis, alcohol, or synthetic drugs), the influence of fitness trends and nutritional advice on social media, dealing with changes in the body, and being confronted with body ideals in print media and in the digital realm are important topics, affecting children and young people, and their peer groups. Many of these health-related topics are communicated on media channels, especially the internet and social media. Combining media and health skills would help students navigating these contents and environments. It would also equip them with the ability to critically evaluate online health messages and claims as well as their digital sources and suppliers. Educating and teaching students the competencies and facilitating the development of attitudes and beliefs in relation to media is necessary because today's generation grows up being socialized with social media as national (47, 48) and international studies (49) show. A German study from 2019 with 140 students from different types of schools in the 9th grade showed that their self-perceived skills to critically think about and deal with online sources and information tends to be overestimated compared to their actual performance (50). When selecting health information from a Google search, 19.2% tended to take a marketing website that advertises pharmacy products to be credible. In addition, 18.6% indicated that they never or rarely cross-check online information with other sources. The study also showed that students tended to take the number of followers as an indicator of the validity of information within a raffle on social media (50). Another German study revealed that adolescents frequently reported difficulties in searching for, evaluating, and assessing the personal relevance of digital health information (51). Despite growing up with digital and social media, it seems that adolescents are still inexperienced regarding the critical assessment and handling of digital health information and, above all, fail to make accurate judgments about health



**TABLE 3 |** Main dimensions and competence areas of the media literacy framework in North-Rhine Westphalia, Germany (41), and pertinent exemplary health literacy exercises.

Main dimension	Competence area	Exemplary exercises and learning goals regarding health literacy in class
1. Operating and applying	1.1 Media equipment (hardware)	Using a mobile phone and a tablet to search for health information.
	1.2 Digital tools	Using different tools or web-based applications (e.g., PowerPoint) to filter, summarize and creatively represent health information.
	1.3 Data organization	Securely storing, retrieving and accessing health information and data from multiple locations.
	1.4 Data protection and information security	Ensuring data protection, privacy and information security of online health information and storing data on a hardware.
2. Informing and researching	2.1 Information seeking	Defining a search topic, search strategies, and terms related to health needed to search for information.
	2.2 Analyzing information	Understanding, filtering, structuring, and preparing health information and being able to grasp and describe their meaning.
	2.3 Evaluating information	Critically evaluating the quality of health information and identifying strategies and intentions behind health information, sources, and information providers, and fact checking their reliability against other sources.
	2.4 Critical information review and use	Recognizing inappropriate health media content and estimate its legal base and the underlying social norms; knowing youth and consumer protection and using health-related support and assistance structures.
3. Communicating and cooperating	3.1 Communication and cooperation processes	Communicating and collaborating in groups of students through digital tools to share search health information results with the class.
	3.2 Communication and cooperation rules	Knowing and understanding the rules of (digital) health-related communication and using those when interacting with others.
	3.3 Communication and cooperation in the society	Creating health-related (digital) communication processes in the sense of participating in society and understanding ethical principles with regard to social norms and applying them on the internet.
	3.4 Cyber violence and cyber crime	Knowing the risks and effects of cyber violence and knowing how to deal with them when using the internet for health issues.
4. Producing and presenting	4.1 Media production and presentation	Planning, designing and presenting search results regarding health information, preparing them to share in class.
	4.2 Design tools	Knowing different design elements of media products, e.g., audio and video, radio plays, explanatory films or animation, and applying them in a reflective manner for presenting health information to others.
	4.3 Documentation of sources	Providing all sources of the health information and data used at the end of a PowerPoint presentation, which allows other to check the sources.
	4.4 Legal basis	Understanding and applying copyrights and rights of use when using images or illustrations during the creation and presentation of health-related content.
5. Analyzing and reflecting	5.1 Media analysis	Comparing a scientific article in a journal with a newspaper article in a daily magazine with respect to their health information.
	5.2 Opinion forming	Analyzing the spread of fitness and nutrition trends and commercial intentions on social networks (such as Instagram, YouTube, Twitter, TikTok) and understanding the power of and how influencers can form opinions as part of their job.
	5.3 Identity creation	Understanding how social networks disseminate health topics that can influence perceptions of reality and using this insight for their own identity building, e.g., through reflecting the difference between virtual and real world.
	5.4 Self-regulated media use	Being able to critically evaluate the effects of the media and to use them for health-related topics in a responsible manner.
6. Problem solving and modeling	6.1 Principles of the digital world	Comparing different search machines on the internet (e.g., DuckDuck, Google, Ecosia) and different hardware (e.g., mobile phone and tablet) and analyzing the results of the gathered health information.
	6.2 Recognizing algorithms	Recognizing how health information results and medicine advertising on the internet change when certain health keywords are searched for on commercial sites.
	6.3 Modeling and programming	Programming a bot with a construction-app so that they may be able to bypass algorithms on social media.
	6.4 Importance of algorithms	Analyzing the influence of algorithms on the digitized society and the effects of automation, e.g., when dealing with a research for health information.

claims and messages. These issues are important to address through health literacy in schools.

## Challenges

Consequently, several challenges have to be mentioned, and they have to be considered in present educational efforts and prospectively. Addressing health and health promotion, including health literacy, in the school setting requires professional knowledge about the health-related needs of a heterogeneous group of students with different cultural norms and social beliefs. Educator's health literacy is an enabling factor for the development of adequate students' health literacy, which is why teachers' and principals' health literacy should be equally strengthened in order to improve the quality of school health education (20, 21, 32). Teachers are required to be familiar with digital tools and teaching in, about, and by using virtual environments in order to motivate students to learn about and engage with health literacy. Accordingly, media skills and building up the confidence to use digital education tools in classroom should be part of the teacher training curriculum, not only at universities but also in practical trainings of pre-service teachers at schools. In-service teachers will need vocational training and education to become familiar with digital education and literacy teaching and learning to be able to pass on the knowledge, competencies, and values to their students, including various instructional and didactical methods.

In addition, materials, programs, and interventions must be available for teachers and schools to address health literacy. Presently, there are few teaching materials and their didactic implementation often is difficult. Therefore, interventions and didactic materials are much needed.

## CONCLUSION

To prepare and facilitate a better implementation of health literacy in schools, it is highly important to "speak the language" of education and understand the needs of teachers, schools, and the education sector (18). A most promising approach to include health literacy as a learning goal to schools is to identify entry points in existing school curricula and educational policies, which can be done by analyzing the national and/or local school curriculum and seek for concepts, topics and themes that share commonalities with health literacy. With the German strategic framework for digital education and the

associated media literacy frameworks on the state levels, we identified such entry points, which may exist in other countries as well. They provide a foundation for integrating health literacy and developing educational interventions to strengthen health literacy in school, and they can be interlinked with further cross-cutting topics such as health promotion, physical activity, or mental health. In addition, as this framework is also meant to be addressed in University curricula for teacher training and education, teachers would be able to use health literacy within a framework they are familiar with already. When using these frameworks for addressing health literacy, teachers would not have to make an extra effort. Analyzing existing curricula, identifying entry points, and adapting the frameworks accordingly could be a methodological blueprint for other countries to analyse their curricula and address health literacy through digital, media, and information literacy, other literacy frameworks or even whole new topics that allow to incorporate health literacy.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

TS, VK, KD, and OO wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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# Mental Health Literacy in Zurich: A First Measurement Attempt Using the General HLS-EU-Q47

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**Background:** Mental health literacy (MHL) promises to be an important factor for public health by enabling people to take responsibility for their own mental health. To date, there is no measurement tool that allows the assessment of a comprehensive understanding of MHL as part of health literacy (HL). Nonetheless, the widely used Health Literacy Survey European Questionnaire 47 (HLS-EU-Q47) includes items assessing at least some MHL-aspects in the context of HL. The present study aimed at investigating how these MHL-aspects are related to HL, health behavior and health outcome and how they differ between sociodemographic groups.

**Methods:** Data from the Health Literacy Survey Zurich 2018, collected by an adapted version of the HLS-EU-Q47, served to investigate these relationships.

**Results:** MHL-aspects were related to HL, health behavior and health outcome. Nearly half of all respondents (45%;  $N = 904$ ) showed low MHL levels, particularly those with higher age and higher financial deprivation.

**Conclusions:** Relations of MHL-aspects with HL, health behavior, and health outcome indicate their potential importance for future interventions in public health, addressing mental health and MHL. A specific MHL tool is needed to comprehensively investigate these relations, which could be developed by extending the present measurement approach.

**Keywords:** mental health literacy, health literacy, measurement tool, health behavior, health outcome

## INTRODUCTION

Mental health is an essential requirement for good health. Therefore, it is an integral vision of the World Health Organization (WHO) to achieve the highest possible standard of mental health and well-being for the entire population (1). Nowadays, mental health conditions cause one fifth of all years lived with disability worldwide (1), and have a significant impact on the quality of life of the affected individuals and their families (2). In Switzerland, 15% of the population report moderate to severe mental stress, while around three quarters of those with severe mental stress or depressive symptoms suffer from physical complaints as well (3). Considering that respondents of the Swiss Corona Stress Study (4) reported an increase of stress and depressive symptoms during the COVID-19 pandemic, the psychological burden of the Swiss population may even be higher.



Mental health literacy (MHL) promises to be an important resource to cope with this burden, as it may not only facilitate recognition of mental disorders and early help-seeking (5), but possibly also promote mental health (6).

MHL can be considered as an integral part of health literacy (HL), which itself can be understood as an individual's motivation, knowledge and ability to find, understand, and use health information to manage one's own health through informed decisions and corresponding health behavior (7). Hence, HL focuses on competencies in dealing with health information and exceeds aspects only linked to disease management. In fact, HL also includes the two dimensions disease prevention and health promotion that are important for both mental and general health. As the concept of HL is still discussed diversely (7, 8), also MHL has been explored with different definitions so far (9, 10). A common definition states that MHL includes the ability to recognize specific mental disorders, knowledge of risk factors, causes, self-treatments, availability of professional help, knowledge on how to seek mental health information as well as attitudes promoting recognition and appropriate help-seeking (11). Additionally, there have been discussions on an extended definition of MHL that does not only include knowledge and beliefs about mental disorders (12–14). Accordingly, Kutcher et al. (13) defined four main components of MHL: (1) understanding how to obtain and maintain positive mental health, (2) understanding mental disorders and their treatments, (3) decreasing stigma related to mental disorders, and (4) enhancing help-seeking efficacy, which means knowing when and where to seek help and developing competencies designed to improve one's mental healthcare and self-management capabilities. Including the understanding of how to obtain and maintain a good mental health in the definition of MHL is in line with the comprehensive concept of HL as well as the WHO's definition of mental health (15), i.e., mental health is more than the absence of mental health disorders.

The identification of specific sociodemographic groups reporting low MHL levels is important for the initiation of targeted interventions to strengthen their abilities to care for their own mental health. To identify whether people with a low level of MHL might also report needs concerning general health, it is also important to investigate their health behavior and health outcome. While many studies examined the relationship of HL and sociodemographic factors (16, 17), health behavior (16–19), and health outcome (16, 17, 20), so far only few studies examined these aspects in relation to MHL. These studies related MHL-aspects to sociodemographic characteristics such as age (21–23), gender (21–24), education (21–23), financial situation (23, 25), and rural residence (24, 26). Studies investigating MHL-aspects in the context of health behavior showed that stigma could be associated with more frequent alcohol and drug abuse (27), and low rates of help-seeking could be associated with higher rates of substance use disorders (28). In contrast, the few studies on MHL and health outcome showed that on the one hand higher

MHL levels were related to better (self-assessed) health (23, 29), and on the other hand, inadequate MHL levels were associated with increased odds for moderate to severe depression (30). In summary, so far studies on MHL used only few measures of health behavior and health outcome and merely focused on specific subpopulations. Additionally, these studies were based on different definitions of MHL and mostly omitted the aspect of positive mental health.

In addition, these studies investigated MHL with different measurement tools (10). However, to date, no specific instrument can be found which assesses the comprehensive spectrum of MHL as part of general HL. Moreover, most studies so far have related MHL only to specific sociodemographic characteristics or few aspects of health behavior and health outcome. Nonetheless, the widely used instrument to assess general HL—the so-called Health Literacy Survey European Questionnaire 47 (HLS-EU-Q47) (31)—includes at least some MHL-aspects in the context of HL. The HLS-EU-Q47 is usually applied to assess general HL including its specific abilities to access, understand, appraise and apply health information across the areas of healthcare, disease prevention and health promotion (16). Containing only few items that consider aspects of MHL, the questionnaire originally was not constructed to holistically assess MHL. However, it offers the opportunity to assess some MHL-aspects and their relation to HL, several sociodemographic characteristics and aspects of health behavior and health outcome. Therefore, the aim of the present study was to make a first attempt to examine MHL in the population of Zurich using this instrument and the MHL-aspects as well as their relation to general HL, health behavior, health outcome, and sociodemographic characteristics. For this purpose, recent data from a study on general HL of the population of the canton of Zurich—“Health Literacy Survey Zurich” (HLS-ZH-18) (32)—was used.

## MATERIALS AND METHODS

### Study Population

For the analysis, data of the population survey HLS-ZH-18 was used. Parts of the data have been analyzed and published in another context (32), other data has remained unpublished so far. The study population consisted of a total of 1,000 residents of the canton of Zurich (Switzerland) aged 18 years or older. Participants were interviewed between November and December 2018 using Computer Assisted Personal Interviews (CAPI) in German language. Data was collected by a third party (gfs.bern AG, research institute, Bern, Switzerland), which had also collected the data for the “Swiss Health Literacy Survey” (HLS-CH-15) (17). The present sample size was considered to be enough in order to conduct population- and subgroup analyses. Sampling error was 3.2. Sampling was conducted by a random selection of 100 cantonal sampling points and predefined quotas on site (age, gender). Communities with at least 1,000 residents built the basis for the sampling points. Larger communities had several sampling points (one for every 1,000 residents). The type of settlement was also taken into account when drawing the sampling points. A total of ten interviews per sampling point were conducted. Trained interviewers randomly interviewed

**Abbreviations:** HLS-CH-15, Swiss Health Literacy Survey; HLS-ZH-18, Health Literacy Survey Zurich.

**TABLE 1 |** MHL-associated items from the HLS-ZH-2018.

Item	On a scale from very easy to very difficult, how easy would you say it is to:
Q4*	"...find out where to get professional help when you are ill? (doctor, pharmacist, and psychologist)"
Q18	"...find information on how to manage mental health problems like stress or depression?"
Q33	"...find out about activities that are good for your mental well-being? (meditation, exercise, walking, Pilates etc.)"
Q40	"... how easy would you say it is to understand information on how to keep your mind healthy?"

\*Although Q4 can be related also to MHL, participants' answers to it may refer not only to help from a psychologist but also from a doctor or a pharmacist. This has to be considered when interpreting the data.

pedestrians, whereby interviewers were free to choose where they contacted the participants. The mean duration of the interview was 30.3 ( $\pm 6$ ) min. Participants were verbally informed about the goals, framework conditions and data protection measures before they gave their informed consent to participate in this study. All processes were in line with the legal and association requirements for the protection of data and personal rights (VSMS). A separate ethical approval for this study was not necessary.

## Questionnaire

The HLS-ZH-18 questionnaire was based on the national survey HLS-CH-15 (17), which in turn consisted of the 47 adapted HL items of the HLS-EU-Q47 (31). All of these self-assessment-instruments served to assess HL as well as health behavior, health outcome and sociodemographic characteristics.

## MHL-Associated Items

The HLS-EU-Q47 and the HLS-CH-15 questionnaire do not contain a specific MHL module so far. Therefore, in the present study (HLS-ZH-2018), four items related to mental health or MHL, respectively, could be identified and are referred to as "MHL-associated items." These four items (Q4, Q18, Q33, and Q40) built the focus of the present study (Table 1).

## MHL-Index, General HL-Index, and HL-Index

Out of the four MHL-associated items Q4, Q18, Q33, and Q40 an MHL-Index was built. As a second index, the general HL-Index (HL<sub>47</sub>) including all 47 HL items was built. The third index that was built was the HL-Index (HL<sub>43</sub>) and included 43 HL items, without the four MHL-associated items. All items were assessed with a Likert scale and numerical values were accordingly assigned ("very easy" = 4, "fairly easy" = 3, "fairly difficult" = 2, "very difficult" = 1). Based on these values, corresponding indices for each individual were built by calculating the mean and then applying the following formula, as recommended by the HLS-EU consortium (16, 33):

$$\text{Index} = (\text{mean} - 1) \times \frac{50}{3}$$

Accordingly, the indices were only calculated if a minimum respondent rate of 80% in all 47 HL items was achieved and all four MHL-associated items were rated as well. These criteria resulted in the inclusion of 904 participants. In a novel approach, the here calculated MHL-Index was interpreted like the standard general HL-Index (HL<sub>47</sub>), which means that 0–25 points were rated as "inadequate," >25–33 as "problematic," >33–42 points as "sufficient" and >42–50 points as "excellent" MHL or HL, respectively (16, 33).

For the multiple logistic regression analysis, the MHL-Index was also defined dichotomously, whereby the categories "excellent" and "sufficient" (>33–50 points) were summarized as "high MHL" and "problematic" and "inadequate" (0–33 points) were summarized as "low MHL".

Cronbach's alpha for all 47 items was 0.889, indicating a high level of internal consistency. For MHL-associated items Cronbach's alpha was 0.547.

## Sociodemographic Characteristics, Health Behavior, and Health Outcome

Sociodemographic characteristics as well as health behavior and health outcome were assessed with the same questions (except for minor changes) and scales as in the HLS-CH-15 (17). Included sociodemographic variables were age, gender, education, financial deprivation, and type of settlement. Included health behavior variables were smoking behavior, alcohol consumption and physical exercise frequency. Body-mass-index (BMI), self-assessed health status and presence of chronic disease were included as health outcome variables.

For the multiple logistic regression analysis, several variables had to be re-categorized: (1) educational levels that have been classified according to the International Standard Classification of Education (ISCED) (34) were divided into the three categories low (level 0–2), medium (level 3–4) and high (level 5–6) education; (2) alcohol consumption was categorized as excessive (very excessive, excessive) or non-excessive (moderate, low, no alcohol); (3) physical exercise frequency was categorized into weekly (each day to a few times a week) and less than weekly (a few times per month to not at all); and (4) self-assessed health status was categorized as bad (very bad, bad), medium or good (good, very good).

## Data Analysis and Statistics

Collected data were weighted according to the sociodemographic characteristics age/sex interlocked, type of settlement and highest level of education to account for the sample design, to adjust for respective sociodemographic characteristics and to increase representativity of the results. The Federal Statistical Office's statistics served as a reference for the weights (35, 36). Descriptive statistical analysis was used to characterize the sample, to analyze answer frequencies regarding MHL-associated items and to investigate MHL levels of the study population and their associations with HL<sub>47</sub>. Subgroup analysis with <50 respondents was—whenever possible—avoided. The interpretation of this analysis was almost impossible because of sampling errors of  $\pm 14$  percentage points. Hence, when smaller subgroups were identified, this was explicitly pointed out.

To investigate associations of MHL with HL<sub>47</sub>, HL<sub>43</sub>, and single HL items, spearman's rank correlation coefficients were calculated. In this context, HL<sub>43</sub> was used to investigate the association of MHL and HL—thus HL independent of the four MHL-associated items. To evaluate the significance and directions of the associations between MHL and health behavior, health outcome and sociodemographic characteristics, spearman's rank correlation coefficients were calculated. For all spearman's rank correlation coefficients, respective variable scales were defined in ascending order. In a second step, associations of MHL (dependent variable) with health behavior, health outcome and sociodemographic characteristics (independent variables) were assessed in a multiple logistic regression model. This step allowed the comparison of the odds ratio (OR) of different subgroups for having low MHL levels. Corresponding listwise exclusion led to a sample of 831 respondents in total. Assumptions for all conducted statistical tests were fulfilled. The response category “do not know” was interpreted as a missing value. Respective tests were two-sided and for multiple logistic regression 95% confidence intervals (CI) for OR were calculated.

Statistical analysis was conducted with the IBM SPSS v.26 software (IBM Corp. Armonk, NY, USA). For all statistical analyses, a value of  $p < 0.05$  was considered significant. Results are presented as mean  $\pm$  standard deviation (SD), percentage (%), spearman's rank correlation coefficient ( $r_s$ ),  $p$ -value, OR, and CI.

## RESULTS

### Characteristics of the Study Group

Overall, 904 participants were included in the analysis. Study participants were  $46.2 \pm 18.0$  years old. The youngest respondent was 18 and the oldest 88 years old. Sociodemographic characteristics of the included study population are presented in Table 2.

### MHL of the Population of Zurich

The average MHL of men and women in Zurich was inadequate ( $32.6 \pm 8.3$ ). Accordingly, nearly half of all respondents showed a problematic or inadequate MHL (Figure 1).

Most difficulties (37%) were reported with “...find information on how to manage mental health problems like stress or depression?” (Q18, Figure 2). Least difficulties (15%) were reported with “...find out where to get professional help when you are ill? (doctor, pharmacist, and psychologist)” (Q4, Figure 2).

### MHL and HL

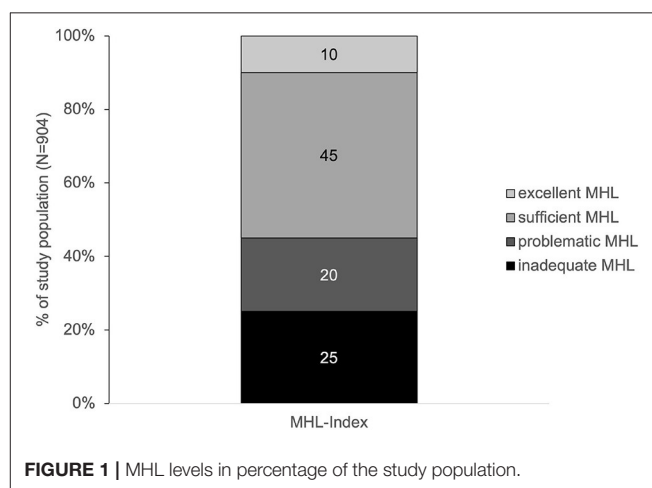
Ninety-one percent of the participants with inadequate MHL showed inadequate or problematic HL<sub>47</sub>. In contrast, 88% of the participants with excellent MHL showed sufficient or excellent HL<sub>47</sub> (Figure 3).

MHL significantly correlated to HL<sub>43</sub> ( $r_s = 0.563$ ,  $p < 0.001$ ). In addition, MHL showed the strongest correlations with the HL<sub>43</sub> items Q2, Q17, Q20, and Q32 (Table 3).

**TABLE 2 |** Sociodemographic characteristics of the included study population.

	Total (N = 904) % (n)
<b>Gender</b>	
Female	51% (456)
Male	49% (448)
<b>Age</b>	
18–39	37% (341)
40–64	42% (386)
65+	21% (177)
<b>Education</b>	
Low	20% (66)
Medium	43% (662)
High	37% (176)
<b>Type of settlement</b>	
Rural	5% (47)
Small/mid-sized city	16% (156)
Big city	80% (701)

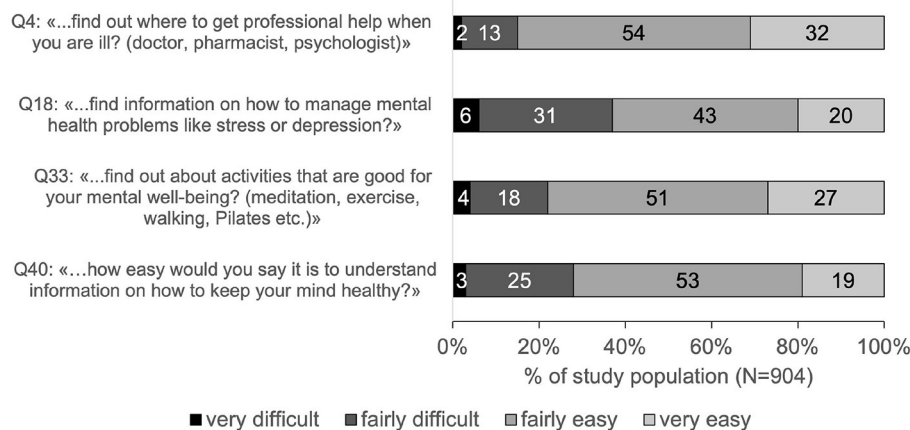
(n), unweighted number of cases; %, weighted percentage of a total of 904 respondents. Percentages are rounded mathematically and do not always add up to exactly 100%.



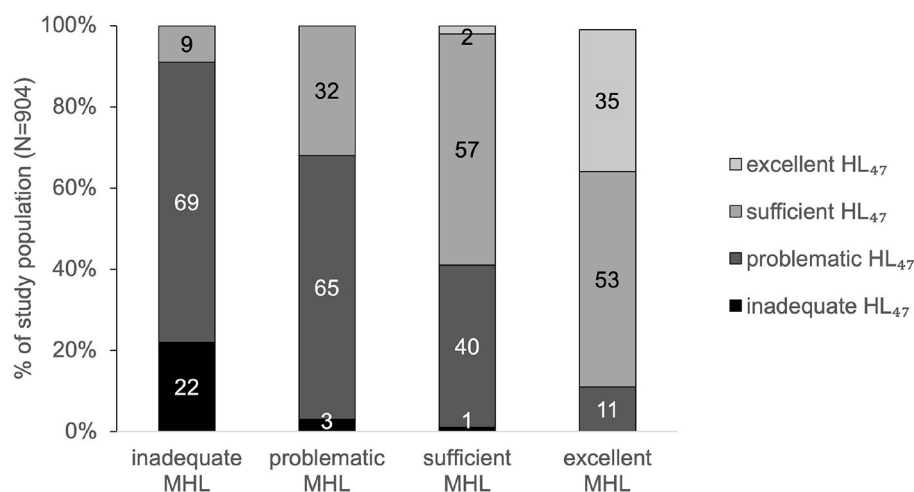
**FIGURE 1 |** MHL levels in percentage of the study population.

### MHL and Its Relations to Sociodemographic Characteristics, Health Behavior, and Health Outcome

Compared to general HL, MHL showed correlations with the same direction but lower strength with all sociodemographic characteristics, except for rural residence. Hence, MHL was positively correlated to education ( $r_s = 0.167$ ,  $p < 0.001$ ), and negatively correlated to age ( $r_s = -0.173$ ,  $p < 0.001$ ) as well as financial deprivation ( $r_s = -0.307$ ,  $p < 0.001$ ). No association was found between MHL and type of settlement ( $r_s = 0.012$ ,  $p = 0.688$ ). Significant effect sizes were found for age and financial deprivation (Table 4): Participants aged 65 years and older (OR = 2.542, 95% CI: 1.509–4.282) and those with high financial deprivation (OR = 2.314, 95% CI: 1.560–3.432) were more than



**FIGURE 2 |** Ratings of MHL-associated items in percentage of the study population. Percentages are rounded mathematically and do not always add up to exactly 100%.



**FIGURE 3 |** Association of MHL and HL<sub>47</sub>.

twice as likely to have low MHL than younger residents and participants with low financial deprivation.

In addition, and again compared to general HL, in the most cases MHL showed correlations of the same direction with health behavior and health outcome. Hence, MHL was positively correlated to physical exercise frequency ( $r_s = 0.254, p < 0.001$ ) and self-assessed health status ( $r_s = 0.263, p < 0.001$ ). In contrast, smoking behavior ( $r_s = -0.130, p < 0.001$ ), BMI ( $r_s = -0.066, p < 0.05$ ), and occurrence of chronic disease ( $r_s = -0.161, p < 0.001$ ) were negatively correlated with MHL. No association was found between MHL and alcohol consumption ( $r_s = 0.003, p = 0.910$ ). Significant effect sizes were found for physical exercise frequency, smoking behavior, and BMI (Table 4). Individuals who reported to be physically active less than once per week were more likely to have low MHL than their counterparts (OR = 2.214, 95% CI: 1.532–3.200). Smokers and overweight individuals

were more likely to have low MHL compared to non-smokers and individuals with normal weight.

## DISCUSSION

Nearly half of the study population reported low MHL: 20% showed problematic and 25% inadequate MHL. Thus, a substantial part of Zurich's population seems to have considerable difficulties with handling information on mental health. The main difficulty hereby concerned the access to information on how to cope with mental health problems. A similar result could be found in the Swiss national study HLS-CH-15 (17). Concerning MHL, also the Swiss population reported most difficulties in finding information on how to manage mental health problems like stress or depression (27% in HLS-CH-15 vs.



**TABLE 3 |** Analysis of the strongest correlations between MHL and single items of the HL<sub>47</sub>.

Item	Item description	$r_s^*$	p-value
Q2	"... find information on treatments of illnesses that concern you?"	0.387	<0.001
Q17	"... find information about how to manage unhealthy behavior such as smoking, low physical activity, and drinking too much?"	0.377	<0.001
Q20	"... find information on how to prevent or manage conditions like being overweight, high blood pressure, or high cholesterol?"	0.400	<0.001
Q32	"... find information on healthy activities such as exercise, healthy food and nutrition?"	0.404	<0.001

\*Spearman's rank correlation coefficient ( $r_s$ ).

37% in HLS-ZH-18). Considering these results, it seems crucial for the entire population to facilitate access to information on mental health. Knowing where to find information on coping strategies is a first step toward learning and applying such strategies to deal with mental health issues. This is even more important in respect of the increasing number of people with mental health problems (4) and other factors that could hinder help-seeking, like stigma for example (37) that seems to be still high in Switzerland (38). Furthermore, a lack of knowledge on strategies to deal with mental health problems has recently been detected in the younger Swiss population (39). This lack of knowledge could possibly also count for the general population. Thus, strengthening the access to information related to this knowledge seems to be of great necessity.

The present study population also showed difficulties in accessing and understanding information on the promotion and maintenance of their mental health. More than a fifth (22%) reported difficulties with finding information about activities that are good for their mental wellbeing (Q33) and more than a quarter (28%) reported difficulties with understanding information on how to keep their own mind healthy (Q40). Considering that during a pandemic like the COVID-19 pandemic, possibilities of mental health promoting activities, as for example meeting friends, or participating at community sports activities, might be restricted, it can be expected that finding appropriate mental health promoting activities might even be more difficult. In this context another recent Swiss survey concluded that there may not only be a lack of factual knowledge, but also concrete knowledge for action for mental health promotion (38). For example, only 46% of the respondents reported that they knew how to strengthen their mental health. Therefore, it seems to be important to not only offer alternative mental health promoting activities but also to make people aware of them, facilitate access to them, and increase the understanding of their importance. The current study as well as the Swiss national study on general HL showed that people report more difficulties with appraising and applying health information rather than with finding and understanding them.

Connecting this to the present findings, one might expect that if the assessment of MHL would have also included the two domains of appraising and applying information on mental health, MHL levels of the population might have even been lower and more problematic.

The results of this study indicate that MHL can be associated with general HL. Most of the respondents with inadequate MHL also showed inadequate or problematic general HL. This correlation was found to be true, irrespective of whether the four MHL-associated items were included into the model of HL (HL<sub>47</sub>) or not (HL<sub>43</sub>). This indicates that people with low MHL often not only seem to have difficulties with finding and understanding information on mental health, but also with handling health information in general. People with low MHL therefore possibly may need to be supported not only in their abilities to care for their mental health but in a more comprehensive manner, including their physical health. Furthermore, the relation between MHL and HL seems to support the understanding of MHL as an integral part of HL. This relationship between MHL and HL needs to be carefully treated, however, as the questionnaire did mainly focus on general HL and did not include a comprehensive conceptualization of MHL, but a rather limited number of MHL-associated items. Nonetheless, the present findings are in accordance with another study that also showed a substantial association between MHL and HL (22). In addition to the present approach, the referred study considered HL as a predictor of MHL. The authors pointed out that poor HL could be associated with greater prevalence of mental illness symptoms and a lower likelihood to seek professional help for these symptoms. In the present study, however, HL is not understood as an antecedent for MHL or vice versa, as for example the ability to handle information on general health does not necessarily influence the ability to handle information on mental health. It is rather hypothesized that personal, situational, societal, and environmental determinants that have an influence on HL (7), may also determine MHL.

The present study found older age, lower education, and higher financial deprivation to be associated with low MHL and low HL. Low MHL in older and lower educated in Switzerland were also found in another survey which stated that they report more pronounced difficulties in understanding information on mental disorders (38). Reasons for low HL in these subgroups may at least also partly be responsible for low MHL. In other words, the pronounced difficulties with higher age regarding dealing with general health information as well as accessing and understanding information on mental health may be explained by an age-dependent decline of cognitive abilities (40). Furthermore, health information is increasingly often available online. Accessing this information and assessing the quality of online health information seems to be a great challenge, especially for the elderly (41). Another factor that might affect the access and understanding of information on mental health in general, but especially at higher age, is stigma. Actually, stigma has been seen as a significant barrier to access care in case of mental disorders in elderly people (42), whereby especially Swiss people over 80 years seem to be affected by stigmatization (38). In this context, the WHO, the World Psychiatric Association and the

**TABLE 4 |** Associations of MHL and sociodemographic characteristics, health behavior, and health outcome.

Independent variable	Proportion <sup>a</sup> % (n)	OR	95% CI		p value <sup>b</sup>
			Lower	Upper	
Gender					
Female*	50% (414)	1	–	–	–
Male	50% (417)	0.939	0.677	1.303	0.709
Age					
18–39*	37% (307)	1	–	–	–
40–64	44% (368)	0.935	0.650	1.344	0.715
65+	19% (156)	2.542	1.509	4.282	0.000
Education					
Low*	7% (55)	1	–	–	–
Medium	73% (607)	1.353	0.853	2.144	0.199
High	20% (169)	1.636	0.999	2.679	0.050
Financial deprivation					
Low*	32% (268)	1	–	–	–
Middle	21% (173)	1.584	1.001	2.506	0.049
High	47% (390)	2.314	1.560	3.432	0.000
Type of settlement					
Big*	78% (647)	1	–	–	–
Small/medium-sized	17% (142)	0.446	0.287	0.695	0.000
Rural <sup>c</sup>	5% (42)	1.152	0.554	2.393	0.705
Smoking behavior					
Non-Smoker*	25% (205)	1	–	–	–
Ex-Smoker	23% (190)	0.956	0.598	1.527	0.850
Smoker	52% (436)	1.547	1.040	2.301	0.031
Alcohol consumption					
Non-excessive*	87% (720)	1	–	–	–
Excessive	13% (111)	0.643	0.400	1.031	0.067
Physical exercise frequency					
Weekly*	33% (274)	1	–	–	–
Less than weekly	67% (557)	2.214	1.532	3.200	0.000
BMI					
Normal weight*	65% (544)	1	–	–	–
Overweight	29% (242)	1.856	1.291	2.668	0.001
Obesity <sup>c</sup>	5% (45)	2.014	1.060	3.826	0.032
Health status					
Good*	77% (643)	1	–	–	–
Medium	18% (147)	1.115	0.652	1.905	0.691
Bad <sup>c</sup>	5% (41)	0.753	0.322	1.760	0.512
Chronic disease					
No*	75% (621)	1	–	–	–
Yes	25% (210)	0.790	0.476	1.310	0.360

<sup>a</sup>(n), number of cases per subgroup; %, percentage of a total of 831 included respondents.

<sup>b</sup>p-value for multiple logistic regression analysis with MHL as dependent variable [low vs. high MHL (=reference category)].

<sup>c</sup>Subgroup analysis with less than 50 respondents.

\*Reference categories for odds ratio analysis.

Sociodemographic characteristics are colored white, health behavior with light gray and health outcome with dark gray.

Percentages are rounded mathematically and do not always add up to exactly 100%.

Swiss Society for Public Health have emphasized the importance of destigmatization (42, 43). Assuming that stigmatization may have decreased (44), destigmatization is still ongoing, and awareness of mental health issues is rising, MHL could possibly

profit thereof in the future. Apart from the present results, weak depressive symptoms (45) as well as medium to high mental stress seem to increase with the years after retirement (46). This further indicates the great need to strengthen MHL levels of the

elderly. MHL of this population group could be strengthened by further decreasing stigma, increasing awareness of mental health issues as well as by facilitating and empowering them to access trustful and easy comprehensible (online) information on mental health.

Lack of awareness of mental health issues combined with stigma is also indicated in lower educated people (47–51), and may provide a possible explanation for their difficulties in accessing and understanding information on mental health. Respective subgroups showed higher levels of stigma (47), less knowledge (48), and poorer recognition of mental disorders (49–51). The need to improve MHL of low educated people seems to be especially important as they are more affected by mental stress (3, 52) and common mental disorders (53) than higher educated people. Besides low education, also high financial deprivation was associated with low MHL. This finding could be due to different reasons: Financially disadvantaged people may possibly less often use mental health services due to restricted access and financial reasons, and hence also be less aware of mental health issues. In addition, low financial capacities might also prevent them from participating in activities that could promote mental health.

Moreover, low HL was often found to be associated with poorer health behavior and outcome (16, 17, 20), whereas high HL was associated with more favorable health behavior and outcome (16–19). Therefore, it was hypothesized that low MHL (as part of HL) would be similarly associated with less favorable health behavior and worse health outcome. Accordingly, positive health behavior (reflected by higher physical exercise frequency and less smoking) and better health outcome (reflected by higher self-assessed health status, lower BMI, and fewer chronic diseases) were positively associated with MHL. One possible reason for the more unfavorable health behavior of individuals with low MHL could be their reported difficulty in finding information on changing an unhealthy or maintaining a healthy lifestyle (Q17, Q20, and Q32). Without or with less knowledge on health behavior and healthy lifestyle, it may be difficult and hardly possible to change one's behavior or maintain a healthy lifestyle. Nevertheless, knowledge on health behavior or on changing lifestyle does not automatically lead to healthier behavior. In this context, there are certainly other factors, for example motivational or situational factors that may influence MHL and health behavior. Moreover, less healthy lifestyle of participants with low MHL was also associated with poor health outcome, and worse health status as well as higher occurrence of chronic diseases were associated with lower MHL.

## Implications

Considering the present findings and the current substantial and increasing mental health burden, a measurement tool to assess and monitor MHL in a comprehensive approach is needed. The self-constructed MHL-Index of this study—based on the comprehensive model of HL—seems to be a promising first attempt. Additionally, although a correlation with general HL could be found, the present measure only included the domains finding and understanding of information on mental health issues. However, finding and understanding of such information without the ability of judging and applying it, is not sufficient to

take responsibility for one's own mental and general health. In agreement with Mansfield et al. (10), it is therefore recommended that future MHL measures assess the ability to find, understand, appraise and to apply information on mental health to being able to take care of one's own mental health. Finally, the definition and assessment of MHL should comprise all relevant dimensions, including management of mental disorders, prevention thereof and also promotion of mental health. Thus, it could be recommended to extend the current HLS-questionnaire with an optional module including items capturing MHL across all these outlined domains and dimensions. The approach of incorporating current MHL constructs and definitions into a more holistic model may pave the way for a more unified research direction of MHL and HL in the future.

In addition, and in consideration of the limited MHL model used in this study, some first implications for public health in Zurich and Switzerland may be formulated as well. It could be revealed that almost half of the respondents showed low MHL levels. These levels might even be lower considering the missing assessment of the two domains appraising and applying of information on mental health. Moreover, the need to strengthen MHL in the general population might even be more important in respect to the increasing numbers of people with mental health problems, poor knowledge on management of mental health problems and difficulties in coping with this lack of knowledge. MHL could be strengthened by facilitating the access to information on mental health and to information which especially address topics like coping strategies for mental health problems and mental health promotion. In this context, destigmatization campaigns might play an important role in strengthening MHL as well. Anti-stigma interventions at the workplace for example have shown to be a promising approach by improving employees' knowledge and supportive behavior toward people with mental-health problems (54). Another promising option could be the initiation of tailor-made interventions like mental health promotion campaigns for specific population groups. It seems to be crucial to increase their MHL and HL in order to strengthen their ability to care for their own mental and general health at the same time. In this context for example, Health Promotion Switzerland (55) has highlighted the importance of tailored community health education events on mental health and offers easy comprehensible health information for different target groups. Further initiations are however needed.

## Limitations

There are certain methodological weaknesses that need to be considered when interpreting the present findings. First, due to the limited number of MHL-associated items, the present MHL-Index cannot be considered as a valid measure of a comprehensive MHL concept. Second, all data were self-reported and thereby carry the risk of reporting bias and social desirability. Additionally, quota and inclusion criteria may have only partially allowed for an unbiased selection of participants, as interviewers were free to choose the location of recruitment. Third, the use of German language only might have excluded people less competent in this language and might have led to a selection

bias. Regarding data analysis, the transformation of ordinal and continuous into categorical data could have led to an exclusion of important information, despite the advantages of the multiple logistic regression as an adjusted analysis method. In addition, listwise exclusion led to reduced group sizes and might have affected the informative value, e.g., in the groups rural residence, poor self-rated health status or low education. Therefore, spearman rank's correlation has been valued higher, as results were independent of categorizations and based on more individuals. Moreover, more information could be considered by including ordinal and continuous data. For future approaches and when statistical assumptions can be fulfilled, it might be recommended to rather make use of a linear regression method, or to make sure to include enough respondents for each category. Also, Cronbach's alpha of the MHL-associated items was quite low. This had to be expected because the items were not self-generated or composed to measure a predefined construct, nor did the index contain a great number of items. However, the single MHL-associated items were created in a logical, systematic and structured development process (31) and gave important insights into MHL of the population of the canton of Zurich. Finally, regarding the aspect of mental health, the present survey assessed rather unspecific information on health behavior and health outcome. Therefore, future MHL surveys should capture such variables more specifically, for example by asking for specific mental diseases, drug consumption, and addictions.

## CONCLUSIONS

The present study gives first insights into several aspects of MHL among residents of the canton of Zurich using an adapted version of the commonly used health literacy survey HLS-EU-Q47. A substantial number of individuals reported difficulties in handling information on mental health, which in turn was associated with lower HL, less favorable health behavior and poorer health outcome. Therefore, especially in times of a pandemic and increasing mental health burden, it seems important to identify residents' MHL deficits. Based on these findings, they should be supported in their access, understanding, assessing and applying of information on mental health as well as their resilience to stress and other mental health issues and the promotion of their mental well-being. To capture MHL in a more comprehensive manner, the HLS-EU-Q47 could be extended by considering recent MHL constructs and definitions, and including all domains (finding, understanding, appraising, and applying information on mental health) and dimensions

(management of mental disorders, prevention thereof, and promotion of mental health).

## DATA AVAILABILITY STATEMENT

The datasets for this study are the property of the Careum Foundation and the Department of Health of the Canton of Zurich and can be received on reasoned request.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

MS, SD, and DN-F conceptualized this study, developed the research question, and were responsible for project administration. MS performed the data analysis and literature research. MS, SD, and RJ prepared the original draft of the article. DN provided critical review of the concept and the manuscript. All authors revised it critically, approved the final manuscript and agreed to be personally accountable for their own contribution to the article and to ensure the accuracy or integrity of any part of the work.

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# Recursive Path Model for Health Literacy: The Effect of Social Support and Geographical Residence

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**Background:** The public health relevance of health literacy is highlighted by the fact that its higher levels can improve health outcomes and reduce health inequities. In order to design effective interventions for improving health literacy, the relationship between health literacy and other factors such as sociodemographic variables, subjective health and social support must be understood.

**Objective:** Our aim was to test a socioecological model of the determinants of health literacy with a special focus on the effect of residence. Our study investigated geographical differences regarding the levels of health literacy and its determinants as this was not investigated before in European nationwide surveys.

**Methods:** Data was collected by a polling company in a sample ( $n = 1,200$ ) of the Hungarian adult population nationally representative by age, gender, and permanent residence in 2019 January. The questionnaire included items on sociodemographic data, subjective well-being, social support, and two health literacy scales. A recursive path model was used to outline the mediating effect of social support between sociodemographic variables and health literacy where both direct and indirect effects of the explanatory variables and multiple relationships among the variables were analyzed simultaneously. Multiple-group analysis was applied to the three pre-set categories of permanent residence (capital city, urban and rural).

**Results:** There was no statistically significant difference by residence regarding levels of health literacy. Social support and educational attainment were the most important determinants of health literacy after adjusting for the effect of other sociodemographic variables. However, the magnitude of effect of social support and educational attainment is different between types of settlements, the strongest being in rural areas.

**Conclusion:** Social support seems to mediate the effect of socioeconomic position on health literacy which could be taken into account when designing interventions to improve health literacy, especially in rural areas. Further studies would be needed especially in rural communities to see whether improvement of social support could be utilized in projects to increase the level of health literacy.

**Keywords:** health literacy, social support, socioeconomic position, permanent residence, recursive path model

## INTRODUCTION

An increasing number of articles reflects a growing scientific interest in health literacy (HL). According to one of the leading expert groups in the field, HL is “linked to literacy and entails people’s knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in every day life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course.” (1) A plethora of health literacy measures exist that can be grouped into two main categories: self-report (subjective) measures and performance-based (objective) tools (2). The level of HL is often dependent on the used measurement therefore it is important that researchers choose one which is aligned with the research question and has been validated in a similar target population. The public health relevance of health literacy is highlighted by the fact that its higher levels can improve health outcomes and reduce health inequities (3). In order to design effective interventions for improving HL, the relationship between HL and other factors such as sociodemographic variables, subjective health and social support must be understood.

According to the conceptual framework of the World Health Organization’s Commission on Social Determinants of Health socioeconomic position (SEP) has a main impact on equity in health (4). The most commonly used proxy indicators of SEP include income, education, occupation and gender. SEP has a major role in generating health inequities. Low SEP is associated with low level of HL of which education is the most important determinant. HL seems to be a mediating factor between SEP and health-related outcomes such as health status, quality of life, health behavior, and use of preventive services (5–7). If HL is a mediator between SEP and health status, it is potentially modifiable, and its improvement at the individual and population level can reduce health disparities (6).

Differences in levels of HL between rural and urban populations was assessed by a recent systematic review which found that urban populations tend to have higher levels of HL than rural ones. Rurality itself does not explain differences in HL, but SEP may play a role in it. This potentially can be explained by the fact that rurality in some cases can be treated as a proxy of low SEP depending on its definition (8).

There are studies suggesting that the correlation between SEP and health is partly genetically confounded (9–11). A recent twin cohort study revealed that both genetic and environmental factors can influence individual differences in educational attainment, though the effect of genetic factors seems to have decreased (12). However, a public health perspective requires focusing on determinants that are potentially modifiable at the population level. In line with the position of the World

Health Organization (4), namely that socio-economic position is dominantly determined by non-biological (social, economic, political) factors, our study aimed at uncovering the relation of such non-biological factors.

From the other side there is growing evidence that there is a need for greater inclusion of social cohesion (social capital, social support) in health literacy research. Based on previous results it seems that social cohesion plays an important role in HL, but the exact mechanism is still unknown (13).

HL was measured by two surveys in the Hungarian general population in 2015. One of them was implemented in one county in a sample of 302 people that was produced in two waves. First, convenience sampling was carried out followed by sampling to produce a sample representative by gender, age, and education (14, 15). This survey aimed at validating the Hungarian version of the Short-Test of Functional Health Literacy in Adults (S-TOFHLA) questionnaire and the Chew screening questions (16, 17). Results of this countywide survey showed that 86% of the participants had adequate level of HL measured by the S-TOFHLA questionnaire. Significant correlation between SEP (education level and income) and HL was found ( $p < 0.001$ ). A nationwide survey conducted by Koltai and Kun measured objective and subjective HL in a representative sample of 1,008 people (18, 19) using the European Health Literacy Survey Questionnaire 47 (HLS-EU-Q47) (20) and the Newest Vital Sign (NVS) tool (21). According to their results, 68% of the participants had adequate levels of objective HL measured by NVS (18). This is a particularly good result in European comparison considering that only the Netherlands had better result with 76% of the population at adequate levels of objective HL in the European Health Literacy Survey (HLS-EU) covering 8 countries. Overall, 55% of the European participants had an adequate level of objective HL in the HLS-EU survey (20). On the other hand, Hungarian results in terms of subjective HL measured by the HLS-EU-Q47 were unfavorable with 52% of the sample falling into the insufficient or problematic category compared to the European average of 47% (19).

Yet another pilot project (22) measured SEP, health status, knowledge about triage system and HL using the HLS-EU-Q47 (20) in one county (Baranya) of Hungary in 2019 with 141 respondents. Nearly half of the participants (46.1%) had limited HL levels. Significant correlation between the level of HL and education ( $p = 0.02$ ), training in a healthcare profession ( $p = 0.001$ ) and economic status ( $p = 0.035$ ) were found. Significant difference in HL was found between those with low and high educational level ( $p = 0.018$ ). In addition, a difference between the levels of HL in rural and urban population was revealed. Rural people were found to have a lower level of HL compared to people living in urban areas ( $p = 0.043$ ), but in that analysis, the impact of SEP was not controlled.

Our aims were (1) to investigate the hypothetical relationship between SEP and health literacy—measured simultaneal from a subjective and objective point of view—controlled for geographical residence and the mediation effect of social support; (2) to uncover geographical differences in the level of health literacy and its determinants as this was not investigated in European nationwide surveys before.

**Abbreviations:** BRIEF, Brief Health Literacy Screening Tool; CI, confidence interval; CFI, comparative fit index; CM, configural model; GFI, goodness-of-fit index; HL, health literacy; HLS-EU, European Health Literacy Survey; HLS-EU-Q47, European Health Literacy Survey Questionnaire 47; NVS, Newest Vital Sign; PCLOSE,  $p$  of close fit; RMSEA, root-mean-square error of approximation; SD, standard deviation; SEP, socioeconomic position; S-TOFHLA, Short-Test of Functional Health Literacy in Adults.



## MATERIALS AND METHODS

### Study Population and Data Collection

Data was collected by a polling company in a sample of the Hungarian adult population nationally representative by age, gender, and permanent residence in 2019 January.

The sample consisted of 1,200 persons aged 18 years or older. Four-stage random sampling was used in which 120 sampling points were selected proportionally by settlement size, then the starting points of the interviewers in each sampling unit were randomly selected. Ten households in each sampling unit were reached by a random route method, and one respondent was selected in each household by the Kish selection grid (23).

The paper-based questionnaire was administered by an interviewer. All interviewees were informed about the voluntary nature of participation and its conformation to the requirements of the national data protection act; none of them received incentive in any form. The company follows the professional and ethical guidelines specified in the ESOMAR Code of Conduct (24). Informed consent was obtained during data collection, and the appropriate ethical standards (according to the World Medical Association's Declaration of Helsinki) were followed as acknowledged by the Medical Research Council of the University of Debrecen (5315–2019).

### Domains of the Questionnaire

The questionnaire included items on demographic and socioeconomic data, subjective well-being, social support, and two newly adapted scales in order to measure subjective (Brief Health Literacy Screening Tool, BRIEF) and objective (NVS) health literacy. Items not referred separately were taken from the tool of the Hungarian version of the European Health Interview Survey of 2014 (25).

### Demographic and Socioeconomic Data

Age, gender, marital status (unmarried, married, divorced, widowed), type of the settlement of permanent residence (capital city, urban/city, rural/village), education (primary school or less, vocational, high school, college/university), employment status (active, inactive, retired, student; during the analysis these were dichotomized as active or student and inactive or retired), and subjective perception of family wealth (very bad, bad, average, good, very good) were registered.

### Self-Perceived Health

Perceived health was measured by a standard question by respondents assessing their health on a five-point Likert scale from very bad to very good.

### Social Support

Perceived social support was measured by the Oslo Social Support Scale from the European Health Interview Survey 2014. The scale contains three questions inquiring about the number of people the respondents can rely on in difficult life situations, how much concern other people show in what respondents are doing, and how easy it is for them to get practical help from neighbors. The sum score for these three items ranges between 3 and 14 with higher score indicating stronger support.

### Health Literacy

Health literacy was measured by a self-perceived (BRIEF) and an objective measure (NVS). The validated Hungarian versions of both scales were used (26). The NVS satisfied the criteria for internal consistency (Cronbach  $\alpha = 0.72$ ), while BRIEF questionnaire exhibited very good internal consistency (Cronbach  $\alpha = 0.87$ ) (26). Higher total scores reflect better health literacy at both scales (21, 27). The sum score for BRIEF ranges between 4 and 20, while this range is 0 to 6 for NVS.

### Data Analysis

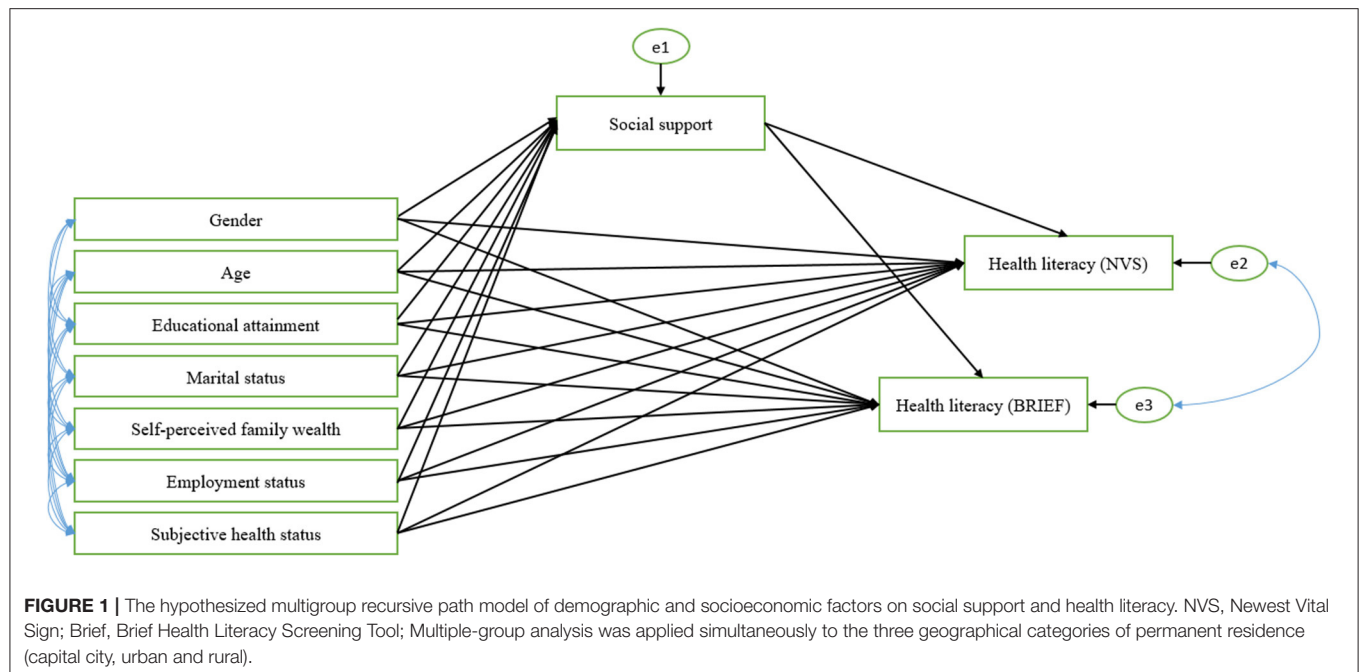
Only participants who provided information for all items were included in the analyses. Descriptive statistics were used to describe the respondents' sociodemographic characteristics. Equality of variances of the variables as well as possible outliers were checked before testing. The chi-square ( $\chi^2$ ) test was used for categorical variables and the Kruskal–Wallis test for continuous variables (with Bonferroni correction for multiple tests) as appropriate.

A recursive path model was built to outline the hypothetical relationship between SEP and health literacy controlled for geographical residence and the mediating effect of social support in accordance with the first aim of our study. Model specification was performed based on preliminary hypothesis, model fit and modification indices. Both direct and indirect effects of the explanatory variables and multiple relationships among the variables were analyzed simultaneously (full sample model, **Figure 1**). Assessment of model fit was based on multiple indicators such as the chi-square statistic ( $\chi^2$ ), comparative fit index (CFI), goodness-of-fit index (GFI), root-mean-square error of approximation (RMSEA), and  $p$  of close fit (PCLOSE). The model fit was considered good in case of non-significant ( $p > 0.05$ ) chi-square statistic, CFI  $> 0.95$ , and GFI above 0.95. RMSEA  $< 0.05$  demonstrates a “close fit” to the data, while  $p > 0.05$  for the PCLOSE test indicated that the model has a good fit to the data (28, 29).

Structural relationships of the path model were evaluated using direct ( $\beta_d$ ) and social support mediated indirect ( $\beta_i$ ) standardized path coefficients with the corresponding 95% confidence intervals (95% CI). Indirect effect (social support mediated effect) was analyzed only if all direct effects were significant. Equality of variances of the variables as well as possible outliers and multivariate normality according to Mahalanobis distances were checked before testing. Considering the multivariate non-normality, a bias-corrected (percentile method) bootstrapping procedure (1,000 bootstraps) was used to estimate model parameters.

Regarding the second aim of our study, a multiple-group analysis was applied to the three geographical categories of permanent residence (capital city, urban and rural). While testing for configural invariance, we focused on the extent to which path coefficients of the hypothesized model were similar across respondent's permanent residence. Analysis of the group invariance for the hypothesized model (CM: configural model) was performed by a method constraining two nested models (Model 1 in which all path coefficients were constrained equal, Model 2 where social support and education-related path





coefficients were constrained equal) to test sequentially for the equivalence of structural weights. Invariance was tested using the  $\chi^2$  statistical difference ( $\Delta\chi^2$ ) and the difference in CFI ( $\Delta\text{CFI}$ ). Invariance across groups was satisfied if the  $\Delta\chi^2$  value between models was not significant and if the  $\Delta\text{CFI}$  overstep the 0.01 threshold (30). Data were analyzed using SPSS 22.0 (IBM Corp, Armonk, NY, USA) and Amos (Version 26.0).

## RESULTS

### Main Characteristics of the Sample

1,200 respondents participated in the study. 93 respondents were excluded in the preliminary analysis due to missing data, providing a database of 1,107 records. Almost two-third of the respondents were female (61%), ~16% had primary school or less as the highest level of education, while the frequency of vocational or high school-educated participants was equal (36–36%). More than half of the respondents were married. Regarding self-perceived family wealth, 20, 56, and 24% of the participants characterized their status as bad, average, and good. Bad subjective health status was observed in 12% of the subjects, and ~56% of the respondents belonged to the active employment status category, or studied in an educational institute. The mean age of subjects was 53.62 (standard deviation, SD:  $\pm 15.91$ ) years. The mean score of NVS was 3.44 (SD:  $\pm 1.88$ ), 14.25 (SD:  $\pm 3.83$ ) for BRIEF, and 10.02 (SD:  $\pm 1.68$ ) for social support (Table 1).

Significant differences were found for educational attainment, self-perceived family wealth, marital status, age, and social support by permanent residence. However, there was no statistically significant difference by residence among categories of gender, subjective health status, employment status, or the means of NVS and BRIEF (Table 1).

### Analysis of the Recursive Path Model

The fit indices for the structural path model of the entire sample hypothesizing social support as the mediator of sociodemographic effects on health literacy indicated that data fit the model well: the  $\chi^2$  statistics and PCLOSE test were non-significant. The RMSEA (0.026), GFI (0.997) and CFI (0.996) were below their respective thresholds confirming the appropriateness of the model for our data. (A correlation matrix between all variables can be found in the **Supplementary Material**).

The full sample model indicated that education [ $\beta_d = 0.10$ ; (95%CI = 0.03; 0.16)], marital status (widowed) [ $\beta_d = -0.07$ ; (95%CI = -0.14; -0.008)], subjective health [ $\beta_d = 0.08$ ; (95%CI = 0.01; 0.16)] and social support [ $\beta_d = 0.11$ ; (95%CI = 0.04; 0.17)] exerted a significant standardized direct effect on NVS. The standardized path coefficients between education [ $\beta_d = 0.13$ ; (95%CI = 0.07; 0.20)], self-perceived family wealth [ $\beta_d = 0.11$ ; (95%CI = 0.05; 0.17)], social support [ $\beta_d = 0.10$ ; (95%CI = 0.05; 0.16)] and BRIEF were also significant (Table 2). Social support mediates the effect of self-perceived family wealth [ $\beta_i = 0.01$ ; (95%CI = 0.01; 0.02)] and subjective health [ $\beta_i = 0.03$ ; (95%CI = 0.01; 0.05)] on NVS. The full sample model also indicated an indirect link between self-perceived family wealth [ $\beta_i = 0.01$ ; (95%CI = 0.01; 0.02)], subjective health [ $\beta_i = 0.02$ ; (95%CI = 0.01; 0.04)] and BRIEF mediated by social support.

Table 3 presents the results of multiple-group path analysis across the type of residence of the respondents. All residential groups were analyzed simultaneously in the configural model to obtain efficient estimates where all path coefficients were freely estimated. In the subgroup of “capital city,” education was positively [ $\beta_d = 0.23$ ; (95%CI = 0.11; 0.38)], widowed marital status was negatively [ $\beta_d = -0.14$ ; 95%CI = (-0.28; -0.002)]

**TABLE 1** | Characteristics of the study population by place of residence.

	Residence			<i>p</i> *	Total sample ( <i>N</i> = 1107)
	Capital city ( <i>n</i> = 210)	Urban ( <i>n</i> = 584)	Rural ( <i>n</i> = 313)		
<b>Gender</b>					
Male	76 (36.19%)	233 (39.90%)	121 (38.66%)	0.638	430 (38.84%)
Female	134 (63.81%)	351 (60.10%)	192 (61.34%)		677 (61.16%)
<b>Educational attainment</b>					
Primary school or less	16 (7.62%)	75 (12.84%)	83 (26.52%)	<0.001	174 (15.72%)
Vocational school	42 (20.00%)	238 (40.75%)	115 (36.74%)		395 (35.68%)
High school	102 (48.57%)	208 (35.62%)	89 (28.43%)		399 (36.04%)
University/college	50 (23.81%)	63 (10.79%)	26 (8.31%)		139 (12.56%)
<b>Self-perceived family wealth</b>					
Bad/very bad	37 (17.62%)	108 (18.49%)	78 (24.92%)	0.003	223 (20.14%)
Average	122 (58.10%)	315 (53.94%)	183 (58.47%)		620 (56.01%)
Good/very good	51 (24.29%)	161 (27.57%)	52 (16.61%)		264 (23.85%)
<b>Marital status</b>					
Unmarried	35 (16.67%)	68 (11.64%)	41 (13.10%)	0.034	144 (13.01%)
Divorced	47 (22.38%)	95 (16.27%)	47 (15.02%)		189 (17.07%)
Widowed	34 (16.19%)	81 (13.87%)	51 (16.29%)		166 (15.00%)
Married	94 (44.76%)	340 (58.22%)	174 (55.59%)		608 (54.92%)
<b>Subjective health status</b>					
Bad/very bad	21 (10.00%)	61 (10.45%)	51 (16.29%)	0.051	133 (12.01%)
Fair	81 (38.57%)	189 (32.36%)	110 (35.14%)		380 (34.33%)
Good	89 (42.38%)	281 (48.12%)	132 (42.17%)		502 (45.35%)
Very good	19 (9.05%)	53 (9.08%)	20 (6.39%)		92 (8.31%)
<b>Employment status</b>					
Active or student	108 (51.43%)	336 (57.53%)	171 (54.63%)	0.289	615 (55.56%)
Inactive or retired	102 (48.57%)	248 (42.47%)	142 (45.37%)		492 (44.44%)
Age; mean (±SD)	56.84 (±16.89)	53.08 (±15.32)	52.47 (±16.08)	0.006**	53.62 (±15.91)
NVS; mean (±SD)	3.30 (±1.74)	3.41 (±1.89)	3.60 (±1.93)	0.135	3.44 (±1.88)
BRIEF; mean (±SD)	14.02 (±3.48)	14.36 (±3.86)	14.21 (±3.99)	0.314	14.25 (±3.83)
Social support; mean (±SD)	9.68 (±1.67)	10.04 (±1.60)	10.22 (±1.80)	0.001***	10.02 (±1.68)

SD, standard deviation, NVS, Newest Vital Sign, BRIEF, Brief Health Literacy Screening Tool. \*Chi-square for ratio associations, Kruskal–Wallis test for mean differences of independent-samples. \*\*Pairwise comparisons of residence with Bonferroni correction for multiple tests:  $p = 0.017$  (Capital city–Urban);  $p = 0.008$  (Capital city–Rural);  $p = 0.999$  (Urban–Rural). \*\*\*Pairwise comparisons of residence with Bonferroni correction for multiple tests:  $p = 0.052$  (Capital city–Urban);  $p = 0.001$  (Capital city–Rural);  $p = 0.168$  (Urban–Rural). Significant differences are marked in bold.

related to NVS. The standardized direct effect of education [ $\beta_d = 0.18$ ; (0.04; 0.31)], self-perceived family wealth [ $\beta_d = 0.14$ ; 95%CI = (0.004; 0.26)] and social support [ $\beta_d = 0.19$ ; 95%CI = (0.06; 0.31)] predicted the level of BRIEF. The social support-mediated standardized effect of gender and subjective health was [ $\beta_i = -0.03$ ; (95%CI =  $-0.07$ ;  $-0.01$ )] and [ $\beta_i = 0.08$ ; (95%CI = 0.03; 0.15)] on BRIEF, respectively.

In the “urban” subgroup, better subjective health [ $\beta_d = 0.13$ ; (95%CI = 0.03; 0.22)] and higher social support [ $\beta_d = 0.09$ ; (95%CI = 0.01; 0.18)] predicted higher NVS. Gender [ $\beta_d = 0.11$ ; (95%CI = 0.01; 0.19)], education [ $\beta_d = 0.09$ ; (95%CI = 0.01; 0.18)], and self-perceived family wealth [ $\beta_d = 0.12$ ; (95%CI = 0.04; 0.20)] exerted a standardized direct effect on BRIEF (Table 3). The standardized indirect effect of self-perceived family wealth and subjective health on NVS was [ $\beta_i = 0.01$ ; (95%CI = 0.001; 0.03)] and [ $\beta_i = 0.02$ ; (95%CI = 0.004; 0.05)].

In the “rural” subgroup, significant standardized direct effect of education [ $\beta_d = 0.12$ ; (95%CI = 0.02; 0.24)], unmarried

marital status [ $\beta_d = -0.13$ ; (95%CI =  $-0.25$ ;  $-0.01$ )], and social support [ $\beta_d = 0.19$ ; (95%CI = 0.08; 0.30)] was observed on NVS. Education [0.17; (95%CI = 0.07; 0.27)], employment status [ $\beta_d = -0.18$ ; (95%CI =  $-0.31$ ;  $-0.03$ )], divorced marital status [ $\beta_d = -0.13$ ; (95%CI =  $-0.24$ ;  $-0.02$ )], and social support [ $\beta_d = 0.21$ ; (95%CI = 0.10; 0.30)] had significant standardized direct effect on BRIEF (Table 3). Self-perceived family wealth [ $\beta_i = 0.03$ ; (95%CI = 0.01; 0.06)] and subjective health [ $\beta_i = 0.04$ ; (95%CI = 0.01; 0.09)] had indirect effect on NVS. Social support also mediated the effect of the association between self-perceived family wealth [ $\beta_i = 0.03$ ; (95%CI = 0.01; 0.07)], subjective health [ $\beta_i = 0.04$ ; (95%CI = 0.01; 0.08)] and BRIEF.

We also tested the hypothesis that the model which contains the two health literacy variables together was invariant across the respondent’s permanent residence. The unconstrained configural model (CM) provided good fit to the data, with  $\chi^2$  ( $p$ -value) = 0.139; CFI = 0.996; GFI = 0.994; and RMSEA = 0.016 (PCLOSE = 1.000). Model 1 (restricting all path coefficients to be equal) was compared against the configural model (which

**TABLE 2 |** Full sample: Estimated direct effects of demographic and socioeconomic factors on social support and health literacy as measured by the NVS and BRIEF questionnaires.

	Social support*	NVS*	BRIEF*
Male/Female	0.02 [−0.04; 0.08]	0.01 [−0.05; 0.07]	0.05 [−0.01; 0.11]
Age	0.05 [−0.03; 0.15]	0.01 [−0.08; 0.10]	0.02 [−0.06; 0.10]
Education	−0.01 [−0.07; 0.05]	<b>0.10 [0.03; 0.16]</b>	<b>0.13 [0.07; 0.20]</b>
Self-perceived family wealth	<b>0.11 [0.05; 0.18]</b>	0.004 [−0.07; 0.07]	<b>0.11 [0.05; 0.17]</b>
Inactive or retired/Active or student	0.01 [−0.07; 0.08]	−0.03 [−0.11; 0.05]	−0.06 [−0.14; 0.02]
Unmarried/Married	−0.04 [−0.10; 0.02]	−0.01 [−0.07; 0.06]	−0.03 [−0.10; 0.03]
Divorced/Married	−0.04 [−0.10; 0.01]	−0.03 [−0.09; 0.03]	−0.05 [−0.11; 0.02]
Widowed/Married	−0.04 [−0.12; 0.02]	<b>−0.07 [−0.14; −0.008]</b>	−0.03 [−0.10; 0.04]
Subjective health	<b>0.24 [0.16; 0.31]</b>	<b>0.08 [0.01; 0.16]</b>	0.06 [−0.01; 0.14]
Social support	–	<b>0.11 [0.04; 0.17]</b>	<b>0.10 [0.05; 0.16]</b>

Overall fit statistics of the model:  $\chi^2$  (df) = 17.650 (10);  $\chi^2$  (p-value) = 0.061; CFI = 0.996; RMSEA = 0.026; PCLOSE = 0.978; GFI = 0.997. Significant associations are marked in bold. \* $\beta_d$ , [95%CI]:  $\beta_d$ : standardized direct path coefficients; [95%CI]: 95% confidence interval obtained by bias-corrected percentile method of bootstrapping. NVS, Newest Vital Sign, BRIEF, Brief Health Literacy Screening Tool.

allowed all path coefficients to vary across groups), yielding  $\chi^2$ (df)<sub>Model(1)</sub> = 126.812 (88) and  $\Delta\chi^2$  (df) = 88.392 (58) with  $p$ -value = 0.006 and  $\Delta$ CFI = 0.015. Model 2 (constrained only social support and education-related path coefficients to be equal) was also not invariant by type of residence ( $\Delta\chi^2$  (df) = 22.554 (10),  $p$  < 0.013 and  $\Delta$ CFI = 0.017) (Table 4). Differences in the path coefficients impact the stability of the model across permanent residence, reflecting inconsistent estimates of the direct and indirect relationships among the studied groups.

## DISCUSSION

As per the first aim of our study, social support and educational attainment were shown to be the most important determinants of health literacy after adjusting for the effect of other SEP and demographic variables. Regarding the second aim, the magnitude of effect of social support and educational attainment was different between the three types of settlements, the strongest being in rural areas.

Education and social support were associated with both types of HL measurements but self-perceived family wealth was only related to self-evaluated HL (measured by BRIEF) while perceived health was only related to performance-based health literacy (measured by NVS). So determinants of performance-based and self-evaluated health literacy only partially overlapped in our study. Possible explanations for this difference can only be speculative. One potential explanation may be the nature of the instruments: perceived health is an excellent measure of objective health status that is why it has been widely used in health interview surveys (31). NVS as a performance-based tool is similar to perceived health inasmuch as both can be considered objective ways of assessing the underlying construct. In contrast, BRIEF as a measure of HL and self-perceived family wealth are rather more subjective approximations of their underlying constructs. Another explanation may be the difference in measurement

properties of the two tools. As for identifying inadequate HL, BRIEF demonstrated an AUROC curve of 0.79, while this was 0.88 for NVS (2, 21, 27). Furthermore, BRIEF contains items regarding the understanding of both written and verbal information, while NVS includes numeracy related items besides the understanding of written information. The two tools measure different aspects of health literacy therefore it is not unreasonable to assume that their determinants also differ.

Univariate analysis did not yield differences in the level of health literacy by type of permanent residence. This is in line with the result of the Hungarian eHealth literacy survey which similarly to ours did not find difference between urban and rural populations (32). However, path coefficients related to social support and education did not support cross-residential invariance meaning that geographical differences can be assumed in the determinants of health literacy. Potential explanations for this difference are probably manifold intriguing. One may be statistical: the simple fact that association (for instance in the case of education) was not proven in all strata does not necessarily mean lack of such an association. The statistical power of our study might not have been high enough to find it. The level of social support was highest in the rural strata, potentially the reason for the strong effect in that strata.

Our results are in line with the conclusion of the systematic review of Aljassim and Ostini (8) who found that differences in health literacy between urban and rural groups disappeared after controlling for SEP; that urban-rural differences mostly exist in developing countries, and in studies where HL was assessed from a specific (e.g., disease-related knowledge) point as opposed to a general point of view. This can be potentially explained by the observation that people from lower SEP tend to live or move to rural areas with lower costs of living which is supported by our data as well. Therefore, the association between rurality and health literacy should be considered an artifact if the analysis is not controlled for SEP.

**TABLE 3 |** Groups by geographical residence: Estimated direct effects of demographic and socioeconomic factors on social support and health literacy as measured by the NVS and BRIEF questionnaire.

		Social support*	NVS*	BRIEF*
Capital city	Male/Female	<b>−0.16 [−0.29; −0.01]</b>	0.05 [−0.04; 0.13]	0.08 [−0.04; 0.19]
	Age	0.22 [−0.04; 0.42]	−0.05 [−0.32; 0.22]	−0.01 [−0.24; 0.20]
	Education	−0.01 [−0.14; 0.12]	<b>0.23 [0.11; 0.38]</b>	<b>0.18 [0.04; 0.31]</b>
	Self-perceived family wealth	0.12 [−0.01; 0.25]	−0.03 [−0.18; 0.11]	<b>0.14 [0.004; 0.26]</b>
	Inactive or retired/Active or student	−0.01 [−0.21; 0.21]	0.05 [−0.19; 0.28]	0.06 [−0.16; 0.27]
	Unmarried/Married	0.04 [−0.11; 0.18]	0.00 [−0.17; 0.16]	−0.02 [−0.18; 0.12]
	Divorced/Married	0.03 [−0.11; 0.18]	−0.06 [−0.24; 0.07]	0.04 [−0.10; 0.18]
	Widowed/Married	−0.04 [−0.19; 0.11]	<b>−0.14 [−0.28; −0.002]</b>	−0.14 [−0.27; 0.03]
	Subjective health	<b>0.40 [0.23; 0.55]</b>	0.05 [−0.12; 0.22]	0.01 [−0.15; 0.18]
	Social support	–	−0.04 [−0.19; 0.11]	<b>0.19 [0.06; 0.31]</b>
Urban	Male/Female	0.05 [−0.04; 0.13]	0.03 [−0.05; 0.12]	<b>0.11 [0.01; 0.19]</b>
	Age	0.13 [0.00; 0.23]	0.01 [−0.11; 0.13]	0.03 [−0.09; 0.14]
	Education	0.02 [−0.06; 0.10]	0.06 [−0.03; 0.14]	<b>0.09 [0.01; 0.18]</b>
	Self-perceived family wealth	<b>0.10 [0.01; 0.18]</b>	0.02 [−0.07; 0.11]	<b>0.12 [0.04; 0.20]</b>
	Inactive or retired/Active or student	−0.05 [−0.13; 0.05]	−0.01 [−0.12; 0.09]	−0.04 [−0.14; 0.06]
	Unmarried/Married	−0.02 [−0.10; 0.07]	0.07 [−0.02; 0.16]	0.01 [−0.09; 0.11]
	Divorced/Married	−0.05 [−0.13; 0.04]	0.00 [−0.08; 0.08]	−0.04 [−0.12; 0.05]
	Widowed/Married	−0.02 [−0.12; 0.08]	−0.04 [−0.15; 0.05]	0.00 [−0.10; 0.10]
	Subjective health	<b>0.24 [0.13; 0.34]</b>	<b>0.13 [0.03; 0.22]</b>	0.06 [−0.06; 0.16]
	Social support	–	<b>0.09 [0.01; 0.18]</b>	−0.01 [−0.10; 0.08]
Rural	Male/Female	0.08 [−0.04; 0.19]	−0.04 [−0.16; 0.07]	0.00 [−0.11; 0.11]
	Age	−0.05 [−0.22; 0.12]	0.11 [−0.04; 0.25]	0.06 [−0.09; 0.21]
	Education	0.03 [−0.08; 0.14]	<b>0.12 [0.02; 0.24]</b>	<b>0.17 [0.07; 0.27]</b>
	Self-perceived family wealth	<b>0.14 [0.02; 0.25]</b>	−0.04 [−0.15; 0.08]	0.05 [−0.06; 0.17]
	Inactive or retired/Active or student	0.09 [−0.05; 0.25]	−0.12 [−0.25; 0.02]	<b>−0.18 [−0.31; −0.03]</b>
	Unmarried/Married	−0.08 [−0.21; 0.05]	<b>−0.13 [−0.25; −0.01]</b>	−0.08 [−0.21; 0.03]
	Divorced/Married	−0.04 [−0.15; 0.08]	−0.07 [−0.18; 0.05]	<b>−0.13 [−0.24; −0.02]</b>
	Widowed/Married	−0.10 [−0.21; 0.04]	−0.08 [−0.22; 0.06]	−0.01 [−0.16; 0.10]
	Subjective health	<b>0.19 [0.05; 0.33]</b>	0.08 [−0.05; 0.21]	0.13 [0.00; 0.27]
	Social support	–	<b>0.19 [0.08; 0.30]</b>	<b>0.21 [0.10; 0.30]</b>

Overall fit statistics of the model,  $\chi^2$  (df) = 38.420 (30);  $\chi^2$  (p-value) = 0.139; CFI = 0.996; RMSEA = 0.016; PCLOSE = 1.000; GFI = 0.994. Significant associations are marked in bold. \*  $\beta_{ij}$ , [95%CI];  $\beta_{ij}$ : standardized direct path coefficients; [95%CI]: 95% confidence interval obtained by bias-corrected percentile method of bootstrapping. NVS, Newest Vital Sign, BRIEF, Brief Health Literacy Screening Tool.

**TABLE 4 |** Goodness-of-fit statistics for tests of invariance analyses in multigroups by geographical residence.

Model description	Comparative model	$\chi^2$ (df)	$\Delta\chi^2$ (df)	Statistical significance*	CFI	$\Delta$ CFI
Configural model (CM); no equality constraints imposed	–	38.42 (30)	–	–	0.996	–
Model(1); All path coefficients constrained equal	CM vs. Model(1)	126.812 (88)	88.392 (58)	<b>p = 0.006</b>	0.981	0.015
Model(2); social support and education related path coefficients constrained equal	CM vs. Model(2)	60.973 (40)	22.554 (10)	<b>p = 0.013</b>	0.979	0.017

$\chi^2$  (df), model chi-squared statistic (model degrees of freedom);  $\Delta\chi^2$  (df), refers to difference in  $\chi^2$  values between models (df refers to difference in number of degrees of freedom between models); CFI, comparative fit index of the model;  $\Delta$ CFI, refers to difference in CFI values between models; \*chi-squared difference test. Significant differences are marked in bold.

The association between HL and health status was most frequently adjusted for social support (33–36) or HL as a mediator between social support and health was investigated (37), so comparisons with our results are limited. We found only

one publication with a research question similar to ours and its results do not contradict ours: social capital-related factors were associated with knowledge about Alzheimer's disease in older Korean Americans after controlling for SEP variables (38).



## Strengths and Limitations

Our study is limited by its cross-sectional design unable to reveal causality, and by most of the analyzed variables being ordinal which should be taken into account when evaluating the results. In the critical evaluation of the results it should be mentioned, that the statistical analysis did not take into account all possible confounding factors (e.g., intelligence, genetic factors) that may have contributed to the weak standardized coefficients. We used two measures to assess HL and one to assess social support which is a limitation in light of the wide selection of available tools for the assessment of both. Other measurement tools could and should also be tested. However, HL assessment tools can be grouped into two broad categories such as performance-based and self-evaluated measures, and one of each was used in the present study which can improve the generalizability of our results.

Our research fills a gap in knowledge regarding the potential differences in HL of rural and urban populations in Europe, and also contributes to understand whether the relationship between health literacy and its determinants differs between rural and urban populations.

## Conclusion

Our study calls attention to the importance of type of permanent residence as a geographical proxy of factors impacting on health literacy. Social support seems to be a mediator of the effect of SEP on health literacy which could be taken into account when designing interventions to improve health literacy, especially in rural areas. Further studies would be needed especially in rural communities to see whether improvement of social support could be utilized in projects to increase the level of health literacy. Community action groups, community sessions or clubs could be organized where the attainment of specific health-related goals would require learning along with strengthening community relations. Another option could be the employment of mediators who can actively participate in the education of community members while also supporting them and helping to improve interactions between individuals and the health system.

These recommendations are in line with a previously published health literacy intervention model (39) according to

which HL interventions should target—among others—the social context by activities which strengthen social support, empower individuals, and also involves workers of the health system.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

ÉB contribution to the conception of the work, supervision of data collection, interpretation of data, and drafting the article. FV data analysis, interpretation of data, visualization, and drafting the article. GM interpretation of data and drafting the article. KK contribution to the conception of the work, supervision, and critical revision of the article. All authors have read and agreed to the published version of the manuscript.

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# Education as a Predictor Factor for Knowledge of COVID-19 in Portugal

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**Introduction/Objective:** Pandemic of COVID-19 is a major public health problem. At the time of development of this study, no specific medication/vaccine for this disease was approved. Therefore, preventive measures were the main key to control this pandemic. Health literacy (HL) is the ability to obtain, understand and use the information to make free and informed decisions about the health of an individual and to promote community empowerment. Thus, the HL of COVID-19 is important for community empowerment and the adoption of preventive measures. This article aims to understand possible predictors of HL of COVID-19, functional domain.

**Material and Methods:** A cross-sectional study was designed, applying the Questionnaire of COVID-19 (previously designed and submitted to a preliminary pilot testing) through an online platform from April 23 to June 23, 2020. An Index of Health Knowledge of COVID-19 Questionnaire (IHK-COV19) was constructed. Associations between independent variables ("Gender," "Age," "Education," and "Risk Factor" for COVID-19 codified by ICPC-2) and HL were assessed using multivariate analyses (mixed effects models). The level of significance was set at  $p < 0.05$ .

**Results:** Our sample includes 864 subjects (median age, 44.33 years), mostly women ( $n = 619$ ; 71.76%), undergraduate ( $n = 392$ ; 45.37%) and with at least one risk factor for COVID-19 ( $n = 266$ ; 30.79%). Univariate and multivariate analyses demonstrated "Age" as a negative predictor of IHK-COV19 and "Education" and "Risk Factor" as positive predictors of IHK-COV19.

**Conclusions:** Health knowledge regarding COVID-19 is associated with the level of education. Future interventions should consider including HL mechanisms in interventions designed to improve communication.

**Keywords:** health literacy, COVID-19, education, community, communication, medical sciences

## INTRODUCTION

As reported already, COVID-19 is a disease caused by the strain SARS-CoV-2, which appeared in Wuhan, China, in December 2019, being declared as a pandemic in March 2020 (1). By now, about 116,166,652 people have been infected and 2,582,528 have died as a major consequence of this disease (2). During the first quarter of the year, several countries have declared a state of emergency, adopting and urging the adoption of preventive measures to avoid a greater dispersion of the disease (1).

COVID-19 is a disease whose clinical condition is mainly characterised by asymptomatic or mild respiratory symptoms; however, other symptoms may occur (1, 3–11). At the time of conduct of this study, no effective and/or approved antiretroviral treatment or vaccine targeting SARS-CoV-2 and the treatment is mainly symptomatic and organ support (5, 12). Thus, in this context, preventive measures such as correct handwashing, respiratory etiquette, disinfection of surfaces, social isolation and/or social distancing, and the use of masks presented themselves as preponderant measures to control this pandemic and to the individual and community protection (1, 3, 5). However, to be successful, the obligatoriness of these preventive measures requires a productive health literacy (HL) program, endowing the individuals of the ability to understand and how to follow these guidelines, and how to make decisions related to self and community health (13).

Health literacy is the ability of an individual to obtain, understand, and use the information to develop the skills to make free and informed decisions about the health of an individual and assuming an active role in preventive medicine and health policies, including the organisational and social context (14–16). Therefore, considering the actual public health problem, HL seems to have a preponderant impact through individual and community empowerment (17–19). Since there is a strong association between HL and several diseases, HL is obtaining increasing importance among the public health sector worldwide (20–23).

Health literacy is associated with three domains: primarily the functional domain, e.g., the basic skills for reading and writing health information; the interactive domain, which implies a comprehension of this information; the critical domain, which represents a more advanced stage of HL, representing the critical evaluation of health information and making informed and conscious decisions related to a self or community health (13).

Preceding, during, and after a pandemic, there are different psychological reactions arising from new necessary strategies, i.e., isolation and contact restrictions (13, 24). The consequent anxiety and, probably, fear led to a phenomenon known as “information epidemic” (infodemic)—the rapid production, spread, and amplification of information—scientifically reliable or unreliable—enhanced by an associated infodemic and its consumption (25). This phenomenon is related to higher levels of disinformation, misinformation, and malinformation, and also with two extreme attitudes: negative information bias (catastrophic thinking) and positive information bias (unrealistic optimism) (25). Moreover, the consumption of information about pandemics in Portugal was found to be associated with poor mental health indicators (25).

Therefore, COVID-19 HL can facilitate distinguishing between correct or incorrect information on COVID-19 and also empowering people to make informed and conscious decisions, and understanding and criticising the advocated political measures, being a necessary act for effective behaviour change (13, 17, 19, 25–28). Higher levels of HL usually mean higher probabilities to self-engage in health-promoting behaviours and, therefore, better health outcomes—individual and community (20, 21, 23, 29, 30).

Thus, it seemed imperative to understand and state the positive predictors of the functional COVID-19 domain of HL to establish a pattern and create HL promoting programs of COVID-19 and to act near those with lower HL.

Thereby, this study aims at understanding the predictors of HL of COVID-19—functional domain among a mainly rural district in Portugal, to promote prevention programs and provide scientific recommendations for the prevention of COVID-19/pandemics in the future.

## MATERIALS AND METHODS

### Questionnaire Development

The questions included in “COVID-19’s Questionnaire” were decided on by the authors of this article. The first author selected an extensive list of important topics to cover and the other three authors independently selected the topics to be included. The final decisions were made by consensus of the authors of this article. The pilot questionnaire was applied to a group of patients to verify its comprehension and adequacy, and also the average time required to answer the questions, and a preliminary study was conducted with a smaller sample (31). The final questionnaire was applied using an online platform and divulging it through social media.

### Translation

The approved and applied version of the Questionnaire of COVID-19 is written in Portuguese. There is not any validated translation of Questionnaire COVID-19.

### Subjects and Data Collection

This cross-sectional study was performed with a sample of 864 subjects, with age older or equal to 15 years who answered to Questionnaire of COVID-19, between April 23 and June 23, 2020. We collected the demographical and epidemiological data (age, gender, education level—graduate vs. undergraduate—and risk factor(s) for COVID-19 codified by International Classification of Primary Care, version 2). Free and informed consent was obtained at the beginning of the Questionnaire of COVID-19.

This study was submitted for approval and approved by the Direction of Department of Primary Health Care of Unidade Local de Saúde do Nordeste (Ethics Committee was informed about this study but regarding pandemics of COVID-19, this Committee did not have the opportunity to assemble and adjudge this study, transferring this responsibility to the Direction of Department of Primary Health Care of Unidade Local de Saúde do Nordeste), according to the Declaration of Helsinki of the World Medical Association. The confidentiality of the data was guaranteed and was only accessible by the main investigator and the respective authors.

### Construction of the Index of Health Knowledge of COVID-19 Questionnaire (IHK-COV19)

Using the Questionnaire of COVID-19, we have constructed an IHK-COV19. For the construction of this Index, for a correct answer we have assigned two points, for an answer of an



**TABLE 1** | Covariables of adult participants ( $n = 864$ ) residing in the district of Bragança, Portugal, April 23 to June 23, 2020.

Variables	Level/units	Absolute frequency ( $n$ )	Relative frequency (%)
Gender	Female	620	71.76
	Male	244	28.24
Education	Undergraduate	392	45.37
	Graduate	472	54.63
Risk factor	Non-risk factor	598	69.21
	Risk factor	266	30.79
Age, years (15; 100)	Mean	44.33	Standard deviation (s.d.)
			16.07

unknown concept (e.g., “I don’t know”) we have assigned 1 point, and for an incorrect answer/misconception we have assigned 0 points (because a person that states “I don’t know” can be compelled to search for information about the topic discussed while a person with an incorrect concept is someone with a higher probability of having closed boundaries in knowledge and acting according to this misconception) (32). For the questions with open answers (question 2, the symptoms of COVID-19 and question 4, the preventive measures to adopt), we adopt a system of “stated” vs. “unstated,” assigning 1 point for each symptom/preventive measure stated and 0 points for each symptom/preventive measure non-stated. The IHK-COV19 is the sum score according to the answers given by the participants.

## Statistical Analysis

All analyses were carried out using the statistical software package IBM SPSS® Statistics (standard version 22.0; SPSS, Chicago, Illinois, USA) and R: a language and environment for statistical computing (version 3.6.2; R Core Team, R Foundation for Statistical Computing, Vienna, Austria). An exploratory analysis was performed to demographically characterise our sample (age, gender, education, and risk factors for COVID-19) and for the answers given for each question of our questionnaire. IHK-COV19 was taken as a continuous variable. Mixed effects models (or generalised linear mixed effects models) were used to estimate the potential predictors of IHK-COV19, regarding the four independent variables such as age, gender, education, and risk factors for COVID-19. Univariate analyses were performed to determine the relationship between each Health Knowledge Questionnaire question. Multivariate analyses were performed to determine the relationship between each IHK-COV19 with “Age,” “Gender,” “Education,” and “Risk Factor” factors. Equation of the applied model:

$$IHK - COV19_i = \beta_0 + \beta_1 Age_i + \beta_2 Gender_i + \beta_3 Education_i + \beta_4 RiskFactor_{it} + u_i + \varepsilon_i$$

where  $i = 1, \dots, 864$ ,  $\varepsilon_i$  is the random error such that  $\varepsilon_i \sim N(0, \sigma^2)$ , general correlation matrix, with no additional structure;  $u_{1i}$  random effect and  $u_{1i} \sim N(0, d^2)$ .

The level of significance for all statistical tests was set at a  $p$ -value  $< 5\%$ , with a 95% CI. The confidentiality of the data

was guaranteed, only accessible by the main investigator and the respective authors.

## RESULTS

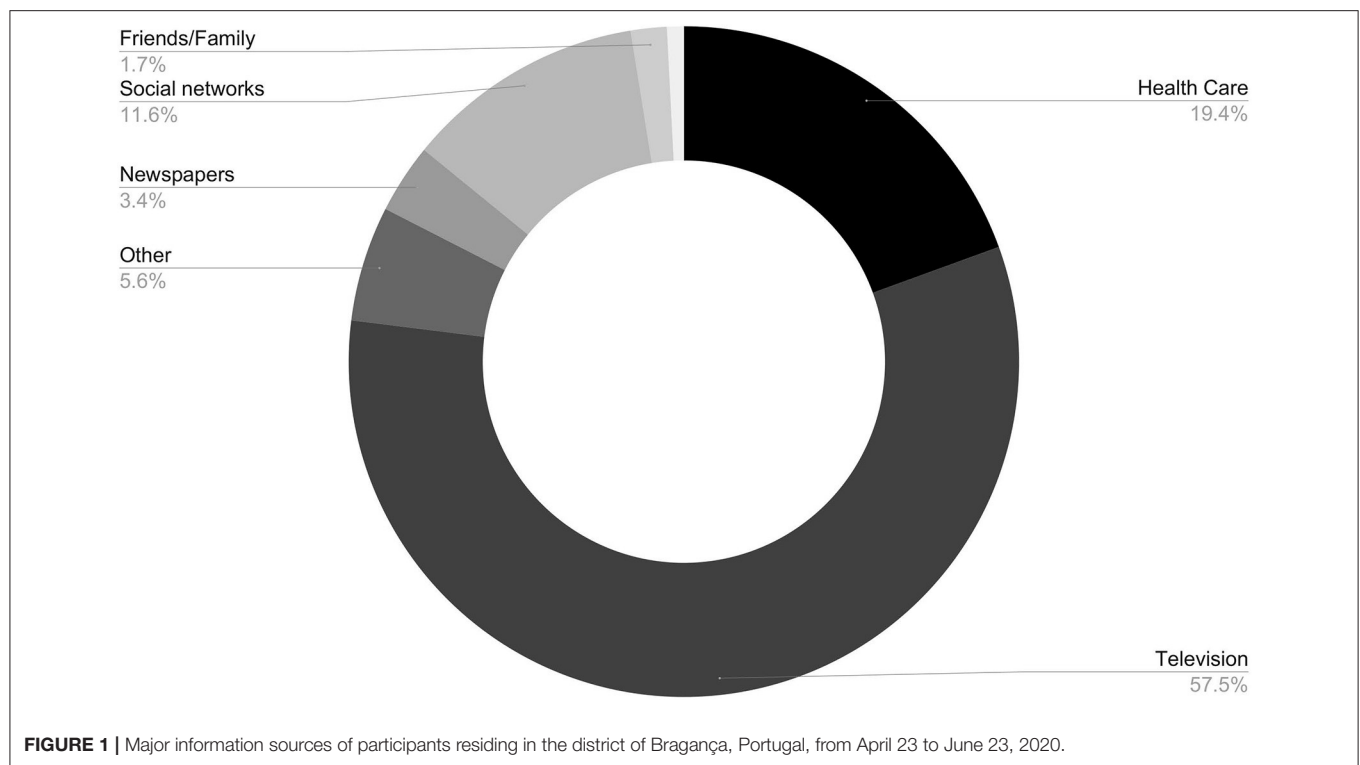
The total number of participants was 864. The average age was 44.33 years old ( $SD = 16.07$  years) and about 71.53% of the responders were women. Also, more than 50% of the individuals were graduates and 69.21% do not present a risk factor for COVID-19 (Table 1). The frequencies for each question that contributed to the IHK-COV19 are shown in Table 2. The major information sources of the participants are shown in Figure 1.

Based on the formulation of the models, the complete models were estimated: Estimates of fixed effects, SEs, test statistic values, and proof values. The Maximum Restricted Likelihood Method (REML) was used to adjust the different models. The analysis of residues is a useful tool for verifying the assumptions of the models regarding the AIC concentration variable. In the adjusted values vs. standardised residuals, adjusted values vs. observed values, and the QQ plot graph, we observed a pattern of homoscedasticity and few outliers. The graphical representation of the observed values and adjusted values shows that it is linearly available, and it is noticeable that there are few outliers. The representation of theoretical and empirical quantiles suggests that the residuals follow approximately a normal distribution.

Regarding each question individually, the covariables “Gender,” “Education,” and “Risk Factor” are significantly associated with the outcome. The IHK-COV19 is significantly associated with the covariable “Education,” “Age,” and “Risk factor” (Table 3); the graduated participants have the highest level of IHK-COV19 as compared with the undergraduate participants. Indeed, if an individual belongs to the Graduate Group, he has an increase of 8.2315071 in the IHK-COV19 than an ungraded one. Regarding the covariable, “Gender,” a male individual has an increase of 0.6675812 in having a higher IHK-COV19 compared with a female individual. If the individual belongs to the risk factor group, he has a decrease of 2.8946244 in IHK-COV19 than an individual belonging to the non-risk factor group (Table 3). Regarding the variable “Age,” mean age 44 years, for an increase of 1 year of age, the subject has an increase of 0.3257666 of a higher IHK-COV19.

**TABLE 2 |** Health Literacy Questionnaire [Index of Health Knowledge of COVID-19 Questionnaire (IHK-COV19)] scores of adult participants residing in the district of Bragança, Portugal, from April 23 to June 23, 2020.

Question	Levels	Absolute frequency (n)	Relative frequency (%)
1. Do you know which are the symptoms of COVID-19?	No	31	3.59
	Yes	833	96.41
2. What are they? "Fever"	Not stated	122	14.12
	Stated	742	85.88
2. What are they? "Cough"	Not stated	178	20.60
	Stated	686	79.4
2. What are they? "Dyspnea"	Not stated	176	20.37
	Stated	688	81.71
2. What are they? "Others"	Not stated	342	39.58
	Stated	522	60.42
3. Does COVID-19 have a cure?	No	177	20.49
	I don't know	293	33.91
	Yes	394	45.6
4. Which are the preventive measures to adopt face to the COVID-19 pandemic? "Social isolation"	Not stated	409	47.34
	Stated	455	52.66
4. Which are the preventive measures to adopt face to the COVID-19 pandemic? "Handwashing"	Not stated	357	41.32
	Stated	507	58.68
4. Which are the preventive measures to adopt face to the COVID-19 pandemic? "Respiratory Etiquette"	Not stated	767	88.77
	Stated	97	11.23
4. Which are the preventive measures to adopt face to the COVID-19 pandemic? "Other"	Not stated	220	25.46
	Stated	644	74.54
5. What are you supposed to do in case you have the symptoms of COVID-19?	Incorrect	90	33.91
	I don't know	12	20.49
	Correct	762	45.6
6. Which is the number of SNS 24?	Incorrect	246	28.47
	I don't know	91	10.53
	Correct	527	61
7. In social isolation, can you receive or visit family or friends at home?	Yes	36	4.17
	I don't know	13	1.05
	No	815	94.33
8. Does COVID-19 only affect the elderly?	Yes	28	3.24
	I don't know	4	0.46
	No	832	96.3
9. Does the use of gloves always prevent the infection by the new Coronavirus?	Yes	117	13.54
	I don't know	51	5.9
	No	696	80.56
10. Does the use of masks always prevent the infection by the new Coronavirus?	Yes	201	23.26
	I don't know	53	6.13
	No	610	70.6
11. Can children get sick with COVID-19?	No	829	95.95
	I don't know	20	2.31
	Yes	15	1.74
12. Can children transmit this disease?	No	803	92.94
	I don't know	48	5.56
	Yes	13	1.5



## DISCUSSION

According to the WHO, “health literacy implies the achievement of a level of knowledge, personal skills and confidence to take action to improve personal and community health by changing personal lifestyles and living conditions. [...] By improving people’s access to health information, and their capacity to use it effectively, health literacy is critical to empowerment” (14). Indeed, HL is a multilayered concept, and the ability to obtain, understand and use the information to make free and informed decisions about the health of an individual (31, 33). Besides, HL plays a major role in community empowerment: a higher degree of HL means an individual proactive in preventive individual and community medicine and in effectively advocating political leaders and policymakers (15, 34). This study uses an HL, functional domain assessment tool, with a multidimensional character, to explore potential positive or negative predictors of health knowledge regarding COVID-19. The IHK-COV19 is an index based on a questionnaire that allowed us to explore the additional HL needs, and the strengths were not assessed in previous studies on behaviour in a pandemic situation, by the time of the design of this study.

Our results demonstrate that the variable “Education” is a strong positive predictor for the IHK-COV19. This result indicates that individuals with lower degrees of education might have a greater need for improvement in HL.

In the literature, several studies advocate that a higher degree of education is a predictor of a higher level of HL. Indeed, Sørensen et al. in their work on European Health Literacy Survey

**TABLE 3 |** Associations between health literacy (HL), sociodemographic factors, identified in univariate and multivariate analyses, among adult participants residing in the Bragança district, Portugal, from April 23 to June 23, 2020.

	Value	Std. error	p-value
<b>Fix effects</b>			
Intercept	21.478	0.348	
Age	−0.041	0.007	<0.01
Gender	−0.689	0.216	0.182
Education	1.369	0.206	<0.01
Risk factor	−1.089	0.242	<0.01
<b>Random effects</b>			
d	0.994		
AIC	4274.192		
BIC	4307.483		
logLik	−2130.096		
R <sup>2</sup>	0.902		
R <sup>2</sup> <sub>adj</sub>	0.903		

(HLS-EU) reported low-level education as a predictor of low HL in its different strands (14, 22, 35). Furthermore, countless scientific articles report a low degree of education as a predictor of low HL and, therefore, a predictor of poor control of a chronic disease such as asthma, diabetes, and heart failure (34–38). Kyung Lee et al. advocate that this education-HL correlation may be a consequence of social factors: lower educational levels are usually correlated to lower socioeconomic status, which may influence an increased risk of cognitive impairment due

to poor nutritional intake, less access to healthcare services, social activity, interpersonal and community communication, with major social isolation (20).

Globally, men, older individuals, graduates, and individuals from the risk factor group have a better chance of having a higher IHK-COV19. Some of these findings are controversial with the literature and even with our previous study. This inconsistency might be a result of different cultural backgrounds such as educational inequalities and a potential divulgation bias (20, 35, 38–42). Another interesting study by van der Heide et al. endorses that stress or lack of concentration and motivation may affect the ability of people to understand and use health information (38). The fact that younger individuals belong to the proletariat may justify this difference regarding age.

Interestingly, Jin Lee et al., in their study, advocate that the higher the age, the more important is the role of educational level in acquiring HL (36). This finding may support the results in our study; the individuals that answered our questionnaire present a high median age, which may reinforce the role of education in the health knowledge outcome.

Even though there seems to be a strong positive correlation between the level of education and health knowledge, there are studies that plead the theory that educational level can be overcome by functional HL, because it is a process by which an individual acquires current health-related numeracy and literacy skills instead of unspecific skills obtained by formal education (38, 40). To prosecute this main objective, there are already some highlights in a recent scientific investigation. Indeed, we believe that this study reveals the importance of education and training, associating skills, and critical thinking (43). Besides establishing didactic education of healthcare professionals, it would be useful to adapt health information in a way it can be more easily accessed and understood, using some new methodologies to target the population, such as the use of short message service (33, 38, 43–45). Furthermore, the creation of training programs, along with a cohesive interrelation between healthcare professionals/social or health settings and population in general, would be a fruitful measure (34, 46, 47).

However, there are some limitations to this study. First, we did not categorise the “Education” in its different categories, i.e., <4 years of schooling; 4 years of schooling; 6 years of schooling; 9 years of schooling; 12 years of schooling; degree of bachelor; graduation; degree of master; doctorate, which may infer a bias. Thus, further research is needed to understand the outcome of HL among different levels of “Education” and to understand how to approach HL, improving it and reducing education-related disparities in health. Besides, another major limitation of the study is the fact that the study was conducted using a convenience sample from a specific district, therefore, it is not possible to extrapolate the results to the general population of Portugal.

Furthermore, in this study, we focused on education-related disparities in HL, but we did not assess the socioeconomic status of our participants or other social factors. Indeed, lower educational levels and socioeconomic status may influence a lower HL by an increased risk of cognitive impairment because of the poor nutritional intake and a higher predisposition to

social isolation (20, 48). Finally, even though we adopted the general precautions, avoided communication errors, used simple language, and conducted preliminary pilot testing, it is not evident that these measures translate the understanding of all individuals (30).

## CONCLUSIONS

In this study, we focused on understanding whether age, gender, education, and risk factors for COVID-19 have an important role in health knowledge regarding this pandemic. The results found that the level of “Education” is a strong positive predictor of health knowledge outcome; the higher the level of “Education,” the higher the health knowledge regarding COVID-19.

Future studies should consider the inclusion of the variable “Education” as it may have a positive impact in the functional domain of HL of several areas.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Direção dos Cuidados de Saúde Primários da Unidade Local de Saúde do Nordeste. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

JG wrote the first draught of the manuscript. CS, BA, and PM wrote sections of the article. All authors contributed to conception and design of the study, data collection and organisation of the database, statistical analysis and interpretation, manuscript revision, read, and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2021.680726/full#supplementary-material>



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# Middle-Aged and Older African Americans' Information Use During the COVID-19 Pandemic: An Interview Study

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African Americans in the United States have been disproportionately affected by the COVID-19 pandemic in infection and mortality rates. This study examined how middle-aged and older African American individuals accessed and evaluated the information about COVID-19. Semi-structured interviews with 20 individuals (age: 41–72) were conducted during the first stay-at-home advisory period in late March and early April 2020. The phronetic iterative approach was used for data analysis. We found that these individuals primarily relied on information scanning based on their routine media consumption to acquire information about COVID-19 and seldom actively searched for information outside of their regular media use. Individuals used several strategies to assess the quality of the information they received, including checking source credibility, comparing multiple sources, fact-checking, and praying. These findings could inform media and governmental agencies' future health communication efforts to disseminate information about the COVID-19 pandemic and future infectious disease outbreaks among the African American communities.

**Keywords:** COVID-19, African Americans, information use, interview, health disparities

## INTRODUCTION

The COVID-19 pandemic has disproportionately affected racial and ethnic minorities in the United States, especially African Americans<sup>1</sup>. According to the Centers for Disease Control and Prevention (the CDC), up to June of 2020, 21.8% of confirmed COVID-19 cases in the U.S. were African Americans, although this racial group only accounts for 13% of the U.S. population (1). The statistics provided by The Johns Hopkins University and American Community Survey suggested that the infection rate and the death rate for the predominantly black counties were 137.5/100,000 and 6.3/100,000, respectively (2). The infection rate in predominantly black counties was three times the rate in predominantly white counties. More importantly, the death rate in predominantly black counties was six-fold higher than that for predominantly white counties (3).

Several factors have contributed to the high morbidity and mortality rate among African American communities (3). African Americans are more likely to have pre-existing conditions, such as hypertension, diabetes, obesity, and cardiovascular disease (3).

<sup>1</sup> We used the term African Americans in this paper unless the term black/Black was used in the literature cited or used by interview participants.

In addition to comorbidity, African Americans have less access to quality healthcare (4). They are also more likely to live in less affluent neighborhoods with high housing density (3). Furthermore, African Americans are more likely to have jobs that do not allow social distancing or telecommuting.

Another important contributing factor to racial health disparity is health literacy. Individuals of racial and ethnic minority and lower socioeconomic groups are often burdened with low health literacy (5). Past research has shown that African Americans have more information insufficiency (i.e., the discrepancy between the information people desire and the information they have) (6) and are less likely to seek information about many health topics (7). How African Americans get information about COVID-19 might influence their risk perceptions and prevention behaviors. This study explores how middle-aged and older African Americans acquire and evaluate the information about COVID-19 during the outbreak's initial stage.

## LITERATURE REVIEW

Health literacy is “the degree to which individuals can obtain, process, and understand basic health information and services need to make appropriate health decisions” (8). Health literacy is more than general literacy in that it includes the ability of information seeking, critical information analysis, and decision making (9). According to the social ecological model of health literacy, health literacy is influenced by external factors in the physical and social environment such as individual, interpersonal, organizational, community, and policy factors (10). This model facilitates the understanding of disparity in health literacy.

During public health crises, individuals need the information to understand their risks and plan their behaviors. Several theoretical models explain the factors affecting how people acquire and process risk information. According to the Planned Risk Information Seeking Model (PRISM), individuals' information-seeking intentions and behaviors are influenced by cognitive factors (e.g., perceived risks, existing knowledge), affective factors (e.g., emotional response to threats), and subjective norms about information seeking (11). The Risk and Information Seeking and Processing Model (RISP) suggests that increased risk perceptions will trigger negative emotional responses, leading to an assessment of information needs and subsequent information seeking and processing (12). A meta-analysis of empirical studies using the RISP and PRISM models showed that current knowledge and subjective norms about information seeking are the two most important predictors of information seeking and systematic processing (13).

## Health Information Use During Public Health Crises

Individuals acquire health information through information-seeking and information scanning. Information seeking happens when individuals intentionally look for a certain kind of information (e.g., reading a newspaper article or searching

for a topic on the Internet). Information scanning occurs when individuals receive information during their routine media consumptions (e.g., watching TV, mobile phone push notifications) (14). Information seeking requires more effort than information scanning.

In health communication, information seeking includes proactive behaviors such as looking for information about an illness using search engines, asking for information during conversations with physicians, and reading articles about different health topics in newspapers or the Internet. Information scanning involves being exposed to health and illness information during one's routine media consumption, such as watching TV, listening to the radio, flipping through a magazine in a doctor's office, and looking at information pushed by social media apps. Health information scanning is likely to expose people to multiple sources of information, but health information seeking is more likely to change people's behaviors (15).

Health communication scholars have examined how people acquire information during public health crises such as outbreaks of infectious diseases. Van Velsen et al. (16) surveyed college students in the Netherlands about their information use during an *E. coli* outbreak in Europe. They found that college students were most likely to use and trust news websites and websites of newspapers, and they tended to distrust social media and used them less frequently for information related to the outbreak. Randle et al. (17) studied how residents of Ontario, Canada looked for information during the Zika virus outbreak using Google Trends and telemedicine service data and found that both Google search and telemedicine consulting peaked when the WHO declared Zika a Public Health Emergency of International Concern (PHEIC) in February and then dropped precipitously. The public's information-seeking remained low until a second smaller Peak occurred in August when CDC issued a travel advisory for pregnant women to Miami. Recently, in the context of the COVID-19 outbreak, Tang and Zou (18) examined the media consumption of residents of Hubei Province, which was the epicenter of the COVID-19 outbreak in China, and found that they predominantly relied on social media for health information and governmental sources were most trusted.

## Health Information Processing

Researchers have examined how people process health information. One of the prominent theoretical models used was the heuristic-systematic model. This model identifies two information processing modes: systematic and heuristic. Individuals engage in systematic processing when they try to understand and evaluate an argument by investigating the facts used and analyzing the internal logic of the argument. In contrast, if they process an argument through peripheral cues such as source credibility and membership, they are engaging in heuristic processing (19). Systematic processing is cognitively more demanding than heuristic processing. People's use of these different processing modes is motivated by the need for accuracy, the desire to form judgments consistent with one's prior beliefs and values, and the need to fulfill one's social goals (20).



The HSM has been used to study how people process health and risk communication. Griffin et al. (21) studied how people sought and processed health and environmental risk information and found that individuals were more likely to engage in systematic processing when they had strong attitudes toward the issue and high evaluation strength (the degree to which they agreed with an evaluation of the risk). Kahlor et al. (22) found that the perceived amount of information needed was positively related to systematic processing. In other words, when individuals believe there is a gap between what they know and what they need to know, they are more likely to think about the messages deeply. The HSM can also guide an exploration of how African American individuals seek and process the information related to the COVID-19 pandemic.

## African Americans' Health Information Use and Communication Disparity

In the United States, racial and ethnic minorities have experienced different health disparities. Health disparities have been attributed to differences in genetic vulnerability to illnesses, access to health resources, and living conditions (23). The unequal access to health information and difference in information-processing behaviors is another factor contributing to health disparity (24). For instance, Laz and Berenson (7) surveyed young women (16–24 years of age) and found that Black and Hispanic women were less likely to use the Internet for health information seeking than white women in general (7). However, Hovick et al. (6) conducted a phone survey of low-income African American and white women in the southern United States and found that while African American women had greater information insufficiency, they were more likely to engage with systematic processing than white women.

Besides information seeking and processing, differences in trust in information sources and channels across racial and ethnic groups have been noted in previous studies. For instance, Nguyen and Belgrave (25) found that minority groups, including African Americans, Asian Americans, and Hispanics, usually prioritized informal interpersonal communication within the community and religion-based organizations when choosing health information channels. A study based on the Health Information National Trends Survey (HINTS) data revealed that Black or African Americans were more likely to trust religious organizations and religious leaders than whites, and Hispanics have lower trust in health providers than whites (26). Oh et al.'s study (27) examined the same HINTS dataset and concluded that minority groups had more faith in radio and television than whites; meanwhile, Blacks or African Americans trust governmental institutions more than whites. At this moment, there is little research on how African Americans access COVID-19 related information and how they evaluate such information. It is within this context that we propose the following two research questions (RQs):

*RQ1: How do African American individuals seek and scan information during the COVID-19 outbreak?*

*RQ2: How do African American individuals evaluate the information about COVID-19 they receive?*

## METHODS

We designed a semi-structured interview study to explore how African American individuals acquire and evaluate information related to the COVID-19 pandemic and gain an in-depth understanding of the reasons they gave for their choices.

### Participants Recruitment

Convenience and snowball sampling was used. After the study was approved by the Institutional Review Board at the authors' institution, the second author reached out to her family and friends via social media, phone calls, and text messages to recruit potential participants. Those family and friends also referred other friends for the interviewer to contact and recruit. The inclusion criteria used initially were (1) must be African American, and (2) must live in the US at the time of data collection. We tried to achieve a balance of men and women in recruitment as well. Twenty-two participants completed the interview. After the completion of interviews, we found out that one participant was Caucasian and excluded the said participant from the study. In addition, we realized that among the remaining 21 African American participants, 20 of them were over 40 years old, and only one participant was in his early 20's. In this case, the younger participant became an outlier. Since individuals in different age groups were likely to have different media use habits, we made the decision to focus on middle-aged and older participants and excluded the younger participant from data analysis. In the end, 10 women and 10 men remained in the sample. The age of participants ranged from 41 to 72, with an average of 52. Participants were mostly well-educated (two with doctorates, six with master's degrees, three with bachelor's degrees, six with associate degrees or attended college/technical schools, and two graduated high school) and generally belonged to the middle class. In terms of geographic location, 15 were from a southern state, and the other five were from three different states in the United States. We gave each participant an alias to protect their identity (see **Table 1** for aliases and demographic information of participants).

### Data Collection

Semi-structured interviews were conducted. To answer RQ1, we asked questions such as "Which news source do you prefer when you want to get information during the COVID-19 pandemic," "why do you prefer it over others," "Do you use social media (if yes, how frequent) to get information during this period," "What kind of information do you find most useful." To answer RQ2, we asked questions such as "How will you judge if the information you get is credible." Additional questions were asked, but answers to these questions were not reported in this article. These questions were adapted based on Tang and Zou (18) and Zou and Tang (28).

The second author conducted all the interviews. She was an African American doctoral student and has personal connection to the community studied in this study. She also had extensive experience with conducting qualitative interviews. The connection between the interviewer and interviewees made the latter more at ease and more willing to tell their real thought

**TABLE 1** | Demographic Information of Participants.

	Alias	Sex	Age	Education
1	Ms. Antonio	F	48	Master's
2	Ms. Jay	F	51	Master's
3	Ms. Callie	F	50	Master's
4	Mr. Lindy	M	70	Some college, associate
5	Ms. Breesky	F	48	Ph.D.
6	Ms. Burrus	F	50	Master's
7	Ms. Tuckerton	F	42	Bachelor's
8	Ms. Aurora	F	45	Associate
9	Mr. Bass	M	52	Technical school
10	Ms. Delta	F	65	Ph.D.
11	Mr. Christy	M	72	Bachelor's
12	Mr. Brothers	M	47	Some college
13	Mr. MeHarry	M	60	Master's
14	Mr. Davenport	M	50	Some college
15	Mr. Antonio	M	52	Bachelor's
16	Ms. Booth	F	60	Some college
17	Mr. Phillips	M	42	High school
18	Ms. Aldine	F	41	Master's
19	Mr. Tony	M	49	Associates
20	Mr. Fontana	M	60	High school

and feelings. The interviews were conducted over the phone or Facetime since data collection was completed in late March and early April 2020 when the participants were under social distancing order. Interviews typically lasted between 15 and 40 min. We recorded all interviews with participants' permission and used Otter.ai Voice Notes to transcribe the recordings automatically. The second author listened to all the interviews and manually corrected the transcripts. In the end, 254 single-spaced pages of transcribed interviews were used in data analysis.

## Data Analysis

We used the phonetic iterative approach for data analysis. The phonetic iterative approach is a novel method of qualitative data analysis that allows researchers to identify themes and subthemes informed by existing theories and to discover new themes and subthemes in a manner consistent with the grounded theory building approach (29). First, open coding was conducted to identify recurring concepts based on theories of information seeking and scanning and the grounded theory building approach. Second, axial coding was undertaken to establish the relationship among different concepts (e.g., CNN was often trusted because it was considered factual). Negative case analysis was conducted on cases that did not fit into the general patterns of relationships. Negative case analysis is a method to ensure the validity of the interpretation of qualitative data by analyzing outlier data (30). For instance, while most of the participants stated that they primarily relied on cable news channels such as the CNN and MSNBC, a couple of participants mentioned they watched Fox News. We paid especial attention to these negative cases to see if the rationale of choosing Fox News was the same as the motivation in choosing more liberal cable

news channels. Conducting negative analysis allowed theoretical generalization based on the full range of data collected (30). Steps 1 and 2 described above were repeated in an iterative manner until we reached the themes and sub-themes based on our research questions. The first and third authors conducted the initial data analysis, and the second author confirmed the interpretation.

## RESULTS

### RQ1: Seeking and Scanning Information About COVID-19

Overall, our participants primarily relied on information scanning for COVID-19 related information, utilizing TV and social media. Some also engaged in information seeking by reading news websites, using search engines, etc.

#### Information Scanning

Information scanning was the primary mode through which our participants obtained information about COVID-19. Information scanning happened when individuals were exposed to COVID-19 related information during their regular media consumption without consciously looking for it. It included watching TV, using social media, and listening to one's family and friends.

#### TV

Our participants primarily relied on TV for COVID-19 related information. They often turned to cable news such as CNN, Fox News, and MSNBC for national coverage and local news channels operated by ABC, CBS, and NBC for information relevant to their cities and neighborhoods. Among cable news, CNN was by far the most used. Thirteen out of twenty participants mentioned they watched CNN for COVID-19 related information. Participants chose one cable news channel over others for several reasons. Some chose CNN because they believed that CNN was more neutral or more factual. For instance, Ms. Breesky (P5, 48) said, "they're kind of neutral [...] in my opinion. I know if you flip it to like other news stations, it may not. It may be a total opposite of what they're saying." Some participants chose a cable news channel because it was more aligned with their political beliefs. For instance, Mr. Christy (P11, 72) explained why he chose CNN over Fox News, saying, "I prefer CNN because they typically cater to the democratic public, rather than Fox news because they typically rely on the Republicans." Similarly, Ms. Aldine (P18, 41) preferred MSNBC because "I feel like my views line up with most [of the personalities] on MSNBC." Unlike CNN and MSNBC, Fox News was used to provide an alternative perspective.

In terms of local news stations, local TV channels operated by ABC, NBC, and CBS were all mentioned by our participants. In contrast to their rationale in choosing cable news, many of our participants reported that they watched local TV stations out of habit. For instance, Ms. Aldine (P20, 41) watched ABC13 for local news because "no real rhyme or reason. My grandmother was always watching Channel 13. Okay, it just kind of stuck with me, so I just prefer it. I mean, I like the reporters and everybody there." When asked why she used Channel 13, Ms. Burrus (P6,

50) said, "I wouldn't say a relationship with the media, but I guess I've developed [a relationship] with people (hosts) on the news media that I like, and I can trust." Occasionally, participants stated that they chose a particular local TV channel because of the quality of coverage.

### **Social Media**

While almost all participants heavily used television for information about the COVID-19 pandemic, their social media use was more varied. Some used social media extensively, checking them many times a day. For example, Mr. MeHarry (P13, 60) said he had been checking social media at least two or three times a day but had "slaked up" a little recently. He now checked social media once a day because the "information does repeat itself quite frequently now."

Seven participants explicitly stated that they did not use social media for COVID-19 related information, or they rarely used social media for such information. They offered several explanations for this decision. Some did not deem the news on social media to be credible. Ms. Antonio (P1, 48) explained, "you get a lot of opinions, and people copying and pasting from their other resources, and a lot of times it's just a lot of miscommunication, or the information may not be accurate." Others stated that they only used social media to stay connected to their family and friends. For instance, Ms. Booth (P16, 60) said, "I don't utilize social media for news. I use social media to, maybe, connect with a family member that's living in a different state just to see how they're doing."

Among those who used social media for COVID-19 related information, many mentioned that they primarily relied on push notifications. For example, Ms. Jay (P2, 51) said, "I use social media pretty much daily. And sometimes I may see things, news that [...] pop on one of the social media outlets that I'm looking at. I don't just seek to see what social media is saying about it, but while I'm on there, I generally see things going on via the newsfeed." Ms. Callie (P3, 50) made almost precisely the same comment. "I wouldn't say I'm going to social media just to look for that [information], but it pops up."

### **News Websites and Apps**

Several participants used news websites and news apps through their mobile phones. Some preferred to use news websites such as Yahoo News. Ms. Bass (P9, 52) explained, "Because sometimes I feel that Yahoo gives me more in-depth things that other sites don't. Sometimes I feel like they might go more in-depth than NPR." Some participants accessed their preferred TV channels through mobile phone apps. For instance, Ms. Booth (P16, 60) said, "I have my local news app on my phone. So, it'll come across the phone like a headline or breaking news. You know, or they'll say okay a live update, I can just push that and it'll bring me to what's taking place."

### **Family Members and Other Interpersonal Contacts**

Some participants reported that they relied on their family members and other interpersonal contacts for credible information about the COVID-19 pandemic. For instance, Ms. Antonio (P1, 48) said, "I really use my husband because,

um, he, you know works for this really big company, and he is staying on top of the news, and what's going on in the world and an economy is a big deal and a big part of his job. So he's always giving me great sources [...]. And so, I feel comfortable receiving it from him because of the industry that he's in."

### **Information Seeking**

Information seeking happened when individuals went out of their way to look for a piece of information. Some participants sought information by checking governmental websites. Some used search engines to look for specific information. However, in general, information seeking was limited among our participants.

### **Governmental Websites**

Governmental websites were used by a few participants to access credible information about the COVID-19 pandemic. When asked which news source he preferred when looking for information during the pandemic, the first response given by Mr. Fontana (P20, 60) was "dot gov. The government." He explained, "cause it speaks of accuracy. It speaks about what they have done, and you know they are behind, but it ain't falsification." Similarly, Ms. Aurora (P8, 45) preferred the CDC website because "it is assumed that they are experts getting out the pertinent information."

### **Search Engine**

Four participants reported that they used search engines such as Google and Yahoo when they wanted to find information about a specific topic. Having these search engines available increased our participants' confidence that they were capable of finding high-quality information about the pandemic. Mr. Tony (P19, 49) said, "I'm not moderately skilled. I'm very skilled. I know what I'm looking for. I can Google if I need to go look at the news, the local news channel and see what they're saying about COVID 19 today." However, even though search engines are readily available, some participants just did not feel the need to search for information. For instance, Mr. Lindy (P4, 70) said, "I am very confident in finding information, but I just didn't look any further."

## **RQ2: Information Evaluation**

RQ2 asked how African American individuals evaluated the information they received about COVID-19. A few participants mentioned they did not try to assess the quality of the information they received. When asked what she did to evaluate the information she received, Ms. Tuckerton (P7, 42) said, "I don't know for a fact. I just go with it and hope that it is accurate." However, most participants did use at least one of the several common strategies of information evaluation, including evaluating source credibility, comparing news from multiple sources, fact-checking through search engines, and appealing to a higher existence (praying).

### **Evaluating the Credibility of Information Source**

Source credibility was the most often used cue for individuals to judge the quality of the information they received, and it required the least effort. Almost all participants discussed sources that they perceived to be credible, including cable news, local TV



stations, trusted TV and radio hosts, and the government. Some participants also expressed that they relied on their trusted family members or contacts for information.

### Comparing News From Multiple Sources

Many participants reported comparing the news from multiple sources, and if they saw the same information from several sources, they considered it to be credible. Mr. Brothers (P12, 47) discussed how he processed the 5G conspiracy theory, saying, “Well, when I do the search, I look at three to four articles that they’re saying the same thing. I checked that off as being credible. But if I hear something and comprehend it. Not a lot of people are talking about it. An example is the 5G. So, I hear a lot of people, some people talking about the 5G had something to do with it, but not a lot of people talking about it or dismissing it. So, I just let that one slide.”

Sometimes, participants paid particular attention to news sources with different political leanings. For instance, Ms. Antonio (P1, 48) said, “You know what I do? I cross-reference. So, for instance, CNN tends to be a little more liberal. [...] A lot of times, they’re being a little biased about how the government is responding because maybe they’re not a fan of Trump. So, what I do, I’ll go back and forth. I’ll watch Fox. I’ll watch CNN. I try not to stay with just one particular side.”

### Fact-Checking Through Search Engines

Several participants reported fact-checking the information they received about COVID-19, especially information from social media. Mr. Christy (P11, 72) said, “But I typically do the research if it’s an interesting topic and I want to know more about the topic [...], then I will dig a bit further, and not necessarily on that platform, but through internet searches or through other outlets. To find out more about that particular topic, so I don’t know that the information they provide is credible. But I do dig a bit more to find out if the information is legitimate.”

### Praying

Religion was an important part of our participants’ coping strategies facing the COVID-19, and it was occasionally brought up as a way to ascertain the quality of the information participants received. Mr. Bass (P9, 52) stated that when he was not sure whether a piece of news was accurate or not, he would turn to his faith, saying, “That’s not always easy to know if it’s accurate or not, you know. You have to be honest with yourself because there are rumors out there [...]. So, you have to learn how to discern what’s going on. What is that, that’s why some of us are actually getting on our knees and praying every day and asking God for discernment of what we’re actually looking at and listening to make sure that whatever information we’re getting is accurate and precise.”

## DISCUSSION

Our study shows that middle-aged and older African American individuals often use credible sources for COVID-19 related information during the early months of the pandemic, even though they acquire such information primarily through

information scanning instead of information seeking. Like other groups, they typically evaluate the information they have through heuristic processing.

### Information Scanning Based on Media Consumption Routines

Interviews with middle-aged to older African American individuals showed that most of them acquired information about the COVID-19 pandemic through information scanning via their routine media consumption channels. Cable news, especially CNN and MSNBC, were frequently used either because they were more in line with our participants’ political beliefs or because they were considered to be more factual and unbiased. Our participants overwhelmingly relied on local television news stations operated by ABC, NBC, or CBS for COVID-19 updates and information in the local area. They typically chose local news stations out of their media consumption habit and usually did not go out of their way to use other sources. Surveys conducted in the UK showed that broadcast media consumption was positively correlated with health-protective behaviors (31). Our participants also reported using and trusting governmental sources such as the CDC and governmental websites. This is consistent with Oh et al. (27)’s analysis of HINTS data. A survey study on Black American’s trust in COVID information sources also shows that they are significantly more likely to trust the government and mainstream media than non-black Americans (32). We have reasons to believe that our participants have access to relatively high-quality information about the pandemic offered by traditional media channels, which is conducive to proper protection and prevention behaviors.

At the same time, Allington et al. (31) also found that social media use was positively correlated with belief in conspiracy theories. Furthermore, a survey conducted in China showed that spending more than 2 h daily on COVID-19 news via social media was associated with probable anxiety and depression (33). While some of our participants do use social media for health information related to the COVID-19 pandemic, many participants were cautious about the quality of the information they received through social media. This is in line with the finding of a similar study conducted in China, which finds that while young people almost exclusively rely on social media for COVID-19 related information, middle-aged and older adults primarily use traditional media, especially TV (18). Some participants intentionally chose to reduce their exposure to social media in order to keep a positive mindset. Consistent with the RISP and PRIP models, our participants reported a high level of perceived severity and susceptibility of the risk pushed them away from frequent information-seeking by triggering their negative emotions.

In general, middle-aged to older African American individuals in our sample seldom engaged in active information-seeking during the COVID-19 pandemic. Overall, they do not feel the need to seek information actively. By contrast, some participants preferred to consider praying as a primary coping strategy,



thus decreasing their motivation in taking the initiative to seek information.

## Evaluation of Information About COVID-19

In general, our participants appear to have limited motivation and capability in differentiating rumors. They primarily use heuristic processing to evaluate the credibility of the COVID-19 related information they receive by checking the sources' credibility and deciding if the information is carried in multiple channels. This echoes the findings of a similar study in China (28). Such strategies allow them to make quick decisions about the validity of a piece of information. These heuristic processing strategies will usually suffice for those African American individuals who primarily rely on cable news and local TV news for COVID-19 related information. However, they might be inadequate in helping people identify the misinformation and rumors about the COVID-19 that flood social media platforms. Only a few reportedly use fact-checking through search engines to validate the specific claims made in news articles or messages. Fact-checking could be an effective strategy that helps all participants evaluate COVID-19 related information from less authoritative sources.

## Unique Patterns of Social Media Uses

Unlike previous studies that suggest increased social media use for information seeking and exchanging among other demographic groups [e.g., (18)], our findings show that middle-aged and older African Americans are less likely to use social media for COVID-19 related information. Although most of them have social media accounts, they mainly consider social media as an important channel to communicate with family members instead of sources of pandemic-related information. Furthermore, most participants said they seldom posted or reposted any messages about COVID-19 during the pandemic. Instead, they sent private messages to their family and friends. According to the Uses and Gratification Theory, individuals' media choices are usually linked with their particular needs (34). Our study suggests that participants' social integrative needs become the main goal for social media use, compared to other needs (e.g., cognitive needs, tension-free needs, etc.).

## Practical Implications

Our study finds that middle-aged and older African American individuals overwhelmingly rely on cable news (CNN) and local television stations (ABC, CBS, and NBC) for COVID-19 related information, and they have high trust in these sources. This means that traditional TV channels are probably the most effective way to reach this particular demographic group in terms of risk communication about the COVID-19 pandemic and other

public health crises in the future. For the demographic group studied in the current study, knowledge deficiency is probably not a contributing factor to the disparity related to COVID-19. In particular, since religion plays an essential role in African American's coping with this health risk, health organizations could integrate faith-based content into health messages to attract this group's attention.

## LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Our participants were mostly middle-aged or older African American individuals with relatively higher education. Younger or less educated members of the African American community might have different patterns of information acquisition and evaluation. For instance, younger individuals may rely more on social media for information. Additional research is needed to understand these demographic groups and how they acquire and evaluate information about COVID-19. Secondly, our data collection occurred between late March and early April of 2020. It was a period when the country was on high alert while the number of infections was relatively low. Since individuals' information needs and information usage change significantly during different stages of a public health crisis (35), follow-up studies are needed to provide a comprehensive understanding of African-American individuals' media use for COVID-19 related information. Finally, a future survey study should examine the relationship between media use patterns, knowledge, and protective behaviors.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board, Texas A&M University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

LT and WZ conceptualize the study. FY collected data. LT wrote the manuscript. All authors contributed to data analysis.

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# Promoting Navigation Health Literacy at the Intersection of Schools and Communities. Development of the Game-Based Intervention Nebolus

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Emerging empirical evidence indicates a limited health literacy for a substantial proportion of children and adolescents. Although it is generally agreed upon promoting health literacy as early as possible in the lifespan, there is a lack of interventions addressing children and adolescents and their primary living environments. This article describes the development of Nebolus, a game-based intervention aiming to promote navigation health literacy at the intersection of schools and communities. Its intervention foundation lies in a socio-ecological understanding of health as well as in the Entertainment Education approach. Following an extensive literature search on health-related location-based games, a co-creation process was initiated that involved adolescents, community stakeholders, and design/IT professionals in all phases of the intervention development. The final Nebolus intervention includes three core activities: (1) a Nebolus rally app for adolescents aged 12 to 16 years, (2) an online planning tool allowing local health service providers/professionals to set up own Nebolus rallies, and (3) accompanying teaching material on health literacy in the school setting to be used before and after the Nebolus rallies. This article provides an overview of the intervention layout and discusses strengths and challenges of its development and implementation.

**Keywords:** navigational health literacy, location-based games (LBGs), adolescents, schools, communities

## INTRODUCTION

According to Sørensen et al. (1) health literacy can be understood as a modern concept including the individual ability to find, understand, appraise and apply health information to restore, maintain or promote health in everyday life. International surveys conducted in recent years (2, 3) as well as the high amount of health information especially during the Corona pandemic (4, 5), highlight the increasing importance of health literacy for public health research, policy and practice. Although numerous empirical findings on health literacy for adulthood are now available, research in childhood and adolescence is still in its infancy. While several instruments have been developed in recent years to assess health literacy in younger age groups (6, 7), they have not yet been widely

used. Recent findings from the Health Behavior in School-aged Children (HBSC) study revealed a medium or low health literacy for 80% of the respondents with the highest proportion found in Germany and Poland (both 87%) and lowest in Finland (62%) (8). In comparison, the proportion of adolescents with low health literacy in a cross-cultural comparative study varied by instruments between 23.7 and 45.5% (9). Furthermore, preliminary evidence on digital health literacy from Germany indicates that young people most often report difficulties in searching for and critically evaluating digital health information, at 42% each (10).

Health literacy has not only been linked with several proximal and distal health outcomes, but also with the use of healthcare services, the receipt of health screenings or adherence to non-medical and medical treatment (11–15). Given its high predictive power, it might be surprising that there is a lack of health literacy interventions for young people. In their review, Berkman et al. (16) examined the effects of health literacy interventions on health care service use and health outcomes. Most intervention studies included ( $n = 42$ ) focused on adult patients with only four interventions also including patients younger than 18 years. Another recent review focused on health literacy interventions in European countries and was able to identify only one intervention targeting children between 8 and 12 years (17). In terms of non-clinical health literacy interventions for adolescents, we are aware of only a few school-based interventions. McLucki et al. (18) report the effects of a Canadian high-school mental health literacy curriculum including six modules that are delivered by teachers in 10 to 12 h. Evaluation results revealed substantial improvements in mental health knowledge and attitudes. The German foundation “Gesundheitswissen” (19) developed another curriculum-based intervention called “Pausenlos Gesund” (engl: non-stop healthy). It aims at the promotion of general health literacy in secondary school children and contains seven overarching modules (e.g., Finding good information, How does our healthcare system work?), a knowledge-focused board game and an explain video. So far, no evaluation data on uptake by schools and effectiveness are available. The HealthLit4Kids program aims to improve the health literacy of the entire school community and includes four stages (needs assessment, discovery, action planning and evaluation) (20). These allow schools to develop a need-based action plan and to create and deliver classroom activities.

Against the background of the limited intervention basis, we developed a tailored-based universal health literacy intervention (called Nebolus) addressing adolescents at the intersection of schools and communities. The main intervention aim is to strengthen navigation health literacy of adolescents in their direct living environment (e.g., district, community). Specifically, this includes the ability to find, understand, assess and use information about and services provided by organizations or professionals in a person's vicinity. This article describes the intervention development including basic conceptual foundations and the methods used during the developmental process. Moreover, an overview of the intervention layout and the implementation strategy is given.

## CONCEPTUAL FOUNDATIONS OF THE INTERVENTION NEBOLUS

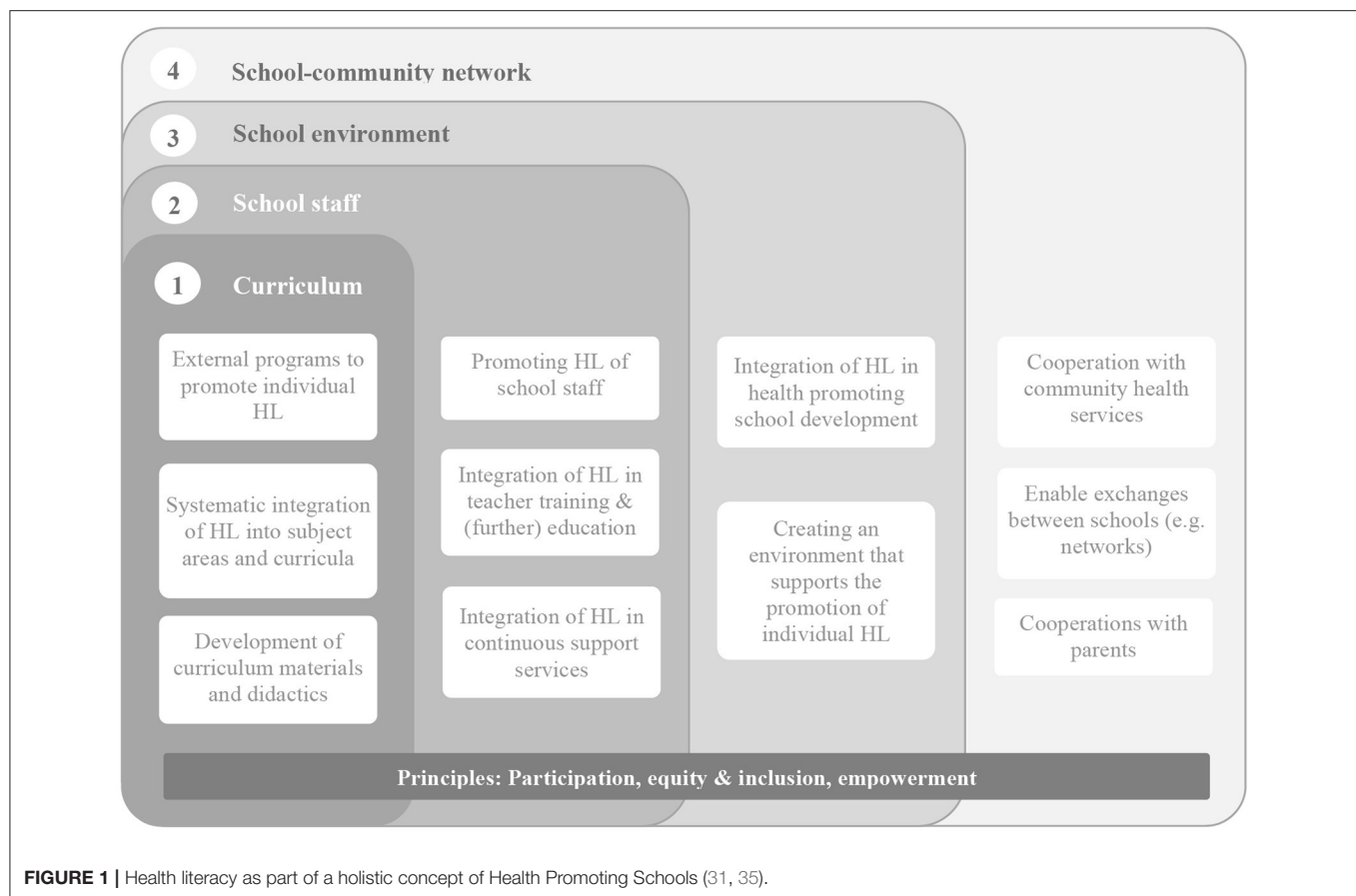
### Navigation Health Literacy

Problems in navigating through an increasingly complex health care system have been identified as a challenge for patient centered health literacy (21, 22). Based on a newly developed instrument [HL-NAV, (22)], most current results from a representative German population survey suggest that more than 80% have difficulties in navigating the health care information environment (23). Most navigation problems could be identified for understanding information about current health care reforms, in finding out what support options are available to help navigate the health care system or in finding information about the quality of health care providers and their services. Comparable to individual health literacy, navigation health literacy can also be understood as a relational concept with the health care environment and its structures contributing to individual capacities for orientation and navigation. Outside the health care system, navigation health literacy has not been sufficiently addressed so far. In universal prevention and health promotion, communities, districts and neighborhoods serve as the primary living environment for young people, with sport and youth clubs or counseling centers as prominent examples for non-clinical sub-settings (24). Findings on utilization of non-clinical health services among adolescents and their navigational barriers are scarce and have mostly focused on help-seeking in the area of mental health. Poor health literacy was identified as a major barrier to seek for professional support on mental health including lack of knowledge about help sources and the inability to recognize early signs of mental health problems (25–28). In their mixed-methods study, Wang et al. (29) identified knowledge barriers such as lack of knowledge about mental problems, support options and providers as disablers for school-based mental health help-seeking for Asian- and Latin-American adolescents. In turn, positive past-experiences with health services, the perception of supportive and understanding health service providers were found to be important in facilitating help-seeking (27, 30). Knowledge about the existence and availability of community health services, the ability to evaluate their quality and confidentiality, positive experiences with the providers, and the perception that these services promote or maintain one's own health can be seen as important determinants of utilization. Hence, based on the definition provided by Sørensen et al. (1), we understand navigation health literacy in the local context as the ability and motivation to find, understand, evaluate, and apply health-related information and services provided in or by organizations or professionals in a person's vicinity (e.g., city, district, neighborhood).

### Health Literacy as Part of Comprehensive School Health Promotion

Schools as community embedded systems have long been identified as an important avenue for health promotion and nowadays also for health literacy. First, as health knowledge and behavior are already established in the early phases of the life course, activities on health promotion and health





literacy should start as early as possible focusing on primary living environments such as schools. Second, health literacy is compatible to the education core mission of schools and share many commonalities with existing curricular requirement and programs (31, 32). Third, schools can also have an influence on health and health behavior through their structures, conditions and processes (33). Fourth, schools provide young people an inclusive and equitable access to education as a key determinant of health regardless of their socioeconomic, cultural or political background. This is especially important as empirical findings suggest, that health literacy follows a social gradient with higher frequencies for sufficient health literacy found for young people with higher family affluence (8). Compared to singular often pre-packed interventions that focus on individual behavior alone, holistic interventions that also address the physical and social environment and consider all members of the school and the wider school community are thought to have a higher potential for impact. In order to avoid competition and conceptual confusion for schools it has been suggested that novel approaches such as health literacy should be integrated in the holistic framework of the Health Promoting School (HPS) approach (34). **Figure 1** offers such an integrated perspective that is highly compatible with the HPS approach and its underlying values (e.g., participation, equity, inclusion). On a school class level, health literacy should be

addressed by subject-focused and cross-curricular programs and interventions [e.g., (18, 19)]. In light of the growing body of research on health literacy among teachers (36) and school administrators (37), the promotion of health literacy should also focus on school staff. This is important not least because educators have a critical role in teaching health literacy to pupils or act as important agents of organizational change. Following the concept of health literate organizations (38), a health literacy friendly school environment should be created (e.g., as part of the ongoing school development processes). Finally, as schools are first and foremost educational organizations, strong intersectoral collaborations with community-based health professionals and their services are needed to promote health literacy. This also includes cooperation with parents and exchange of knowledge and experiences between schools.

### Entertainment Education and Gamification as Innovative Intervention Approaches on Health Literacy

In light of study findings indicating a higher frequency of limited health literacy for those of lower socioeconomic status, the intervention focus should be on those vulnerable groups from which we know that are hard to reach. In particular, traditional forms of information provision and communication,

which are cognitive and rational, reach their limits when it comes to targeting groups with the greatest need for prevention (39). In the German discussion, the term “prevention dilemma” has been coined to emphasize the disproportionately high level of participation in traditional, often behavioral, prevention and health promotion interventions among low-risk target groups which increases the probability to widening the health inequality gap (40). From communication research the elaboration-likelihood model (ELM) can be used to explain differences in information processing (41, 42). When individuals show high motivation and (cognitive) ability to process information that are perceived as important, they will carefully examine the information and arguments which will result in more stable (health behavior) changes. In turn, individuals with low motivation and (cognitive) abilities are more likely to process information in a less effortful way by assessing simple social cues or heuristics (e.g., credibility of the statement, attractiveness of the communicator, length of a message). Compared to the “central route” health persuasive effects resulting from the “peripheral route” will be less likely to be stable. Chiang and Jackson (43) argue that individuals with high levels of health literacy are more likely to process (health) information in a cognitive careful way (central route), while those with limit health literacy tend to examine (health) information more often by peripheral cues and heuristics. The development of public health interventions should take into account the relationship between health literacy and information processing, i.e., there is a great need for interventions that go beyond the provision of information by also focusing on appeal and emotionality, both in terms of content and formal design. Entertainment Education (EE) is such a fruitful approach which can be defined as a communication strategy that uses popular media such as film, music or other new media to distribute prosocial (e.g., health-related) messages (44). Entertainment Education is usually characterized by an engaging story, that allows the audience to be absorbed into new worlds and appealing characters. Empirical evidence suggests small but significant effects of EE on health knowledge, attitudes, intentions, and behaviors (45). Compared to TV or radio serials, video or online games are a relatively new way to communicate health information and messages. While the term gamification refers to “use of game design elements in non-game contexts” [(46), p. 10] serious games are characterized to be intertwined with an educational approach by imparting knowledge or skills (47). A recent state-of-the-art review examined 1,743 health games released between 1983 and 2016 in 23 countries (48). Most frequently used game types were puzzle games, casual games or simulations and most games could be completed within 60 min. Findings regarding effectiveness were mixed with most promising results found for physical activity (especially through exergames), for dealing with chronic diseases (49, 50) or for psychotherapy (51).

## METHODS

Based on the background and theoretical foundation presented, the development of the Nebolus intervention was carried out

in two consecutive steps: (1) literature search on health-related location-based games, (2) participatory-based development of the intervention Nebolus.

## Literature Review on Location-Based Games for Health

As emphasized before, video or online games can be regarded as a promising intervention approach that delivers health-related messages in a low-threshold way by also focusing on peripheral cues and heuristics such as an immersive story, appealing characters and game mechanics. However, the evidence is heterogeneous, with some studies showing only small to zero effects of health related videogames (52). In addition to the relatively short duration of many game interventions, it might be problematic to assume that skills acquired in the virtual world can be easily transferred into real world action (39). Therefore, games that work at the interface between digital and analog worlds and enable real-world experiences through digital media could reduce this gap. Location-based games (LbG) are a relatively new game genre that became extremely prominent with the release of Pokémon Go in 2016. Most importantly, compared to classic videogames, location-based games operate in a physical environment such as public spaces (parks, neighborhoods). In a more general approach, Leorke [(53), p. 38] defines LbG as any game that “[...] incorporates the player’s physical location and/or actions in an outdoor or public space into the game via a networked interface.” Network interfaces refer to a digital device (e.g., smartphone) that allows to track the movement of the player in real-time using a Global Positioning System (GPS).

Against the background of the digital progress and the availability of location-based services (e.g., Google Maps, Mapbox), LbG’s are becoming increasingly interesting for public health. Therefore, the goal of the literature review was to provide an initial overview of the thematic issues, potential effects, and implementation experiences of health-related LbG’s among young people. To gain insight into the existing field of research an extensive literature search was conducted using Cochrane Library, EBSCOHost, EMBASE, ERIC, Medline PubMed and Web of Science Core Collection. In addition, a hand search of relevant journals was performed (e.g., Games for Health Journal, JMIR Serious Games, JMIR mHealth and uHealth). Eligibility criteria and search terms were defined using the PICO scheme (54): (1) Population: adolescents and young adults aged 13 to 29 years, (2) Intervention: all interventions using location-based games that addressed any determinant of health according to the socio-ecological model of health (55), (3) Comparators: in order to include a wide range of studies, no specific comparators were defined, (4) Outcome: next to proximal outcomes such as knowledge and attitudes, intermediate and distal outcomes (e.g., behavior, prevalence, morbidity) with reference to any determinant of health according to the social-ecological model of health (55) were considered. In addition, publication year (01/2010 to 09/2019), language (English or German), and study type (intervention studies, observational studies) were used as inclusion criteria. Following a stepwise selection process (title, abstract, full text) a total of 33 publications were included in the

analysis. More than half ( $n = 18$ ) were published in 2016 and 2017 with most coming from the U.S. ( $n = 14$ ). In terms of the topics addressed, LbG's with focus on health behavior such as physical activity predominates. Twenty-six of 33 publications included examined aspects of Pokémon Go. In their review and meta-analysis, Khamzina et al. (56) summarize the findings from 47 studies including more than 33,000 participants. Results indicate that Pokémon Go players engaged in less sedentary behavior and increased their daily physical activity by 1,446 steps on average. By contrast, aspects of mental health were examined much less frequently. Ronen et al. (57) report the results of a treasure hunt LbG played by first year university students during the orientation week in groups. Compared to a group of non-players, a higher psychological well-being (better sense of belonging, orientation, higher level of peer relations) was found for students who participated in the LbG. In addition to topics with a direct link to health, indirect links to or determinants of health were also examined by some studies (e.g., nature experience, connectedness with nature, perception of urban spaces). Overall, however, no explicit relation to health literacy and its subdimensions could be found in any of the included studies.

## Co-creation Using the Living Lab Approach

To allow that health literacy interventions are tailored to the needs of the target group, a co-creation design method was used. Despite different terms and understandings, co-creation refers to a process that systematically involves those for whom a health intervention is to be developed (58). Co-creation has its roots in participatory intervention design, that goes beyond lower levels of participation (often called as tokenism) such as information provision or singular consultation (59). We used the so-called Living Lab (LL) approach as one method of co-creation. According to the European Network of Living Labs, LL can be defined as a user-centered, open innovation ecosystem-based co-creation approach, aiming to integrate research and innovation processes in real life settings (60). The core elements of the LL include:

- User engagement, i.e., active participation of potential users at all phases of the process
- Multi-stakeholder participation, i.e., involvement of representatives of the public and private sector who are relevant for the innovation or product to be developed
- Co-creation, i.e., a process that substantially alters the role of users and stakeholders from subjects of research to equally contributors of the innovation
- Real-life setting, i.e., all co-creation activities take place in real-life environments (e.g., schools, communities) to better illuminate the context for which the innovation is being developed

Living Labs can be organized in three phases of innovation development: (a) understanding the current state and identifying needs of potential users (Exploitation), (b) developing a prototype (e.g., a minimal viable product) including feedback loops (Experimentation), and (c) evaluating the potential impact and added-value of the innovation (Evaluation). Living Labs

have been established in different fields of public health such as alcohol prevention (58) or primary health care (60, 61). In their recent integrative review, Kim et al. (62) could identify 15 studies reporting their LL experiences. The majority ( $n = 14$ ) were conducted in Europe with older adults as the main target group. While the topics addressed ranged widely (e.g., monitoring daily life, fall prevention), all LL applied a multi-method approach (e.g., by including quantitative and qualitative methods of data collection) and were embedded in a real-life setting.

The main users of the Nebolus intervention are adolescents aged 12 to 16 years, which were actively involved from the very beginning by the establishment of a youth council. Activities included several interactive workshops in which local providers of health services, barriers of utilization and potential strategies how to overcome these were discussed and a game story and potential types of game characters were developed (Table 1). Later stages of participation included various user-testing scenarios and feedback-loops. On the level of stakeholders, we established an advisory board consisting of local health promotion and prevention providers and professionals. Activities included regular meetings where key features and implementation strategies were discussed and developed. Next to public health experts, we worked very closely with IT professionals on the design as well as the technical development and implementation (including UX designer, web developer).

## RESULTS

### Objectives and Intended Outcomes of Nebolus

As described above, the Nebolus intervention aims to strengthen the navigation health literacy of adolescents aged 12 to 16 years in their direct living environment (community, district, neighborhood). This includes promoting the ability to (1) find information about local health service providers/professionals and their activities, (2) understand the services and activities provided by local health stakeholders and professionals, (3) evaluate the quality of local health service providers/professionals and their offerings, and (4) apply health information obtained through local health service providers and professionals. The secondary objective of the Nebolus intervention is to promote intersectoral collaboration of health service providers/professionals and to stimulate the development of a coordinated prevention strategy at the community level.

To achieve these objectives, the intervention Nebolus pursues three core activities: (1) Implementation of Nebolus rallies in the local community for adolescents, (2) Tailored-based development of Nebolus rallies by local health service providers/professionals and (3) Implementation of accompanying teaching material on health literacy in the school setting to be used before and after the Nebolus rallies (Table 2, intervention actions). According to outcome models, different types of proximal and distal outcomes can be distinguished, which build on each other and unfold gradually. When designing the intervention, we used the outcome model of health promotion (63) to derive proximal and distal

**TABLE 1** | Co-creation of Nebolus using the living lab approach.

Phase	Group involved	Activity
Exploitation	Adolescents	<ul style="list-style-type: none"> <li>• Creation of mental maps with local health providers and their services</li> <li>• Discussion of help seeking/health service usage and their barriers</li> <li>• Discussion of strategies how to overcome these barriers</li> </ul>
Experimentation	Adolescents	<ul style="list-style-type: none"> <li>• Development of a game story and types of game characters</li> <li>• First look and feel of the Nebolus app click prototype incl. feedback discussions</li> <li>• First MVP testing of the Nebolus app incl. feedback discussions</li> </ul>
	Health experts/stakeholders	<ul style="list-style-type: none"> <li>• Regular discussions of key features for planning a LbG and its local implementation</li> <li>• First look and feel of the Nebolus planning tool click prototype incl. feedback discussions</li> <li>• Development of a first case scenario for the implementation of Nebolus in various communities</li> </ul>
	UX Designer	<ul style="list-style-type: none"> <li>• Iterative development of mockups</li> <li>• Iterative development of design assets and a click prototypes for the Nebolus app and the Nebolus planning tool</li> </ul>
	IT Developer	<ul style="list-style-type: none"> <li>• Iterative development of the Nebolus app</li> <li>• Iterative development of the Nebolus planning tool</li> </ul>
Evaluation*	Adolescents	<ul style="list-style-type: none"> <li>• Experiences of using the Nebolus App</li> <li>• Effects of the Nebolus app on navigational HL, help seeking attitudes and the intention to use local health services</li> </ul>
	Health experts/stakeholders	<ul style="list-style-type: none"> <li>• Experiences of using the Nebolus planning tool</li> <li>• Experience of working with other local stakeholders to develop/implement a local LbG</li> </ul>

IT, information technology; MVP, minimal viable product; UX, user experience. \*In planning.

**TABLE 2** | Outcome model of the Nebolus intervention.

<b>Health and social outcomes</b>	<ul style="list-style-type: none"> <li>• Reduced maladaptive health behavior</li> <li>• Reduced prevalence of health problems</li> </ul>		
<b>Intermediate health outcomes</b>	<ul style="list-style-type: none"> <li>• Utilization behavior of local health promotion/prevention services</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinated local health promotion/prevention strategy</li> </ul>	
<b>Health promotion outcomes</b>	<ul style="list-style-type: none"> <li>• (navigational) health literacy</li> <li>• Attitudes towards local stakeholders/professionals, help seeking, and health service utilization</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of local networks</li> </ul>	
<b>Intervention actions</b>	Nebolus rally tailored to the needs and infrastructure of the community	Nebolus teaching material on health literacy for preparation and follow-up	Collaborative development of Nebolus rallies with community stakeholders/professionals

outcome assumptions based on the available evidence. As depicted in **Table 2**, we assume that Nebolus rallies and the accompanying teaching material lead to direct health promotion outcomes, which are improvements in (navigation) health literacy and positive attitudes toward local health service

providers/professionals and their offerings. With respect to the subdimensions of navigation health literacy, we expect Nebolus to strengthen, in particular, the ability to find and understand information about local health service providers/professionals and their offerings which can be seen as a prerequisite to make



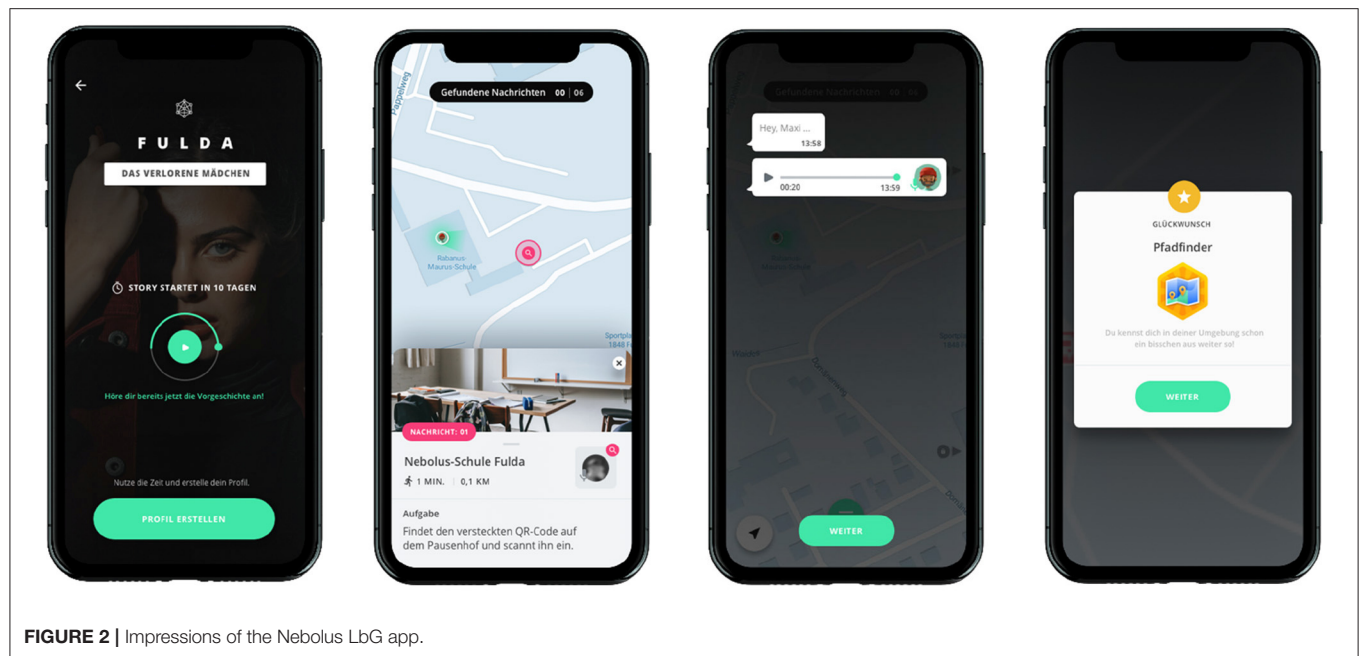


FIGURE 2 | Impressions of the Nebolus LbG app.

use of them when needed. Moreover, we expect improvements in attitudes toward help seeking and health service utilization. These effects are expected to favor intermediate outcomes such as utilization of local health promotion/prevention services. With increasing utilization, a decrease in the prevalence of unhealthy behaviors and health problems of adolescents is expected at the distal outcome level. As shown in the right column of **Table 2**, it is intended that Nebolus LbG rallies are developed by local health service providers/professionals based on their public health needs and community infrastructure. This should result in strengthening existing or establishing new local networks (direct health promotion outcomes) and the development of a coordinated local health promotion/prevention strategy (intermediate health outcomes).

## Nebolus Rallies for Adolescents

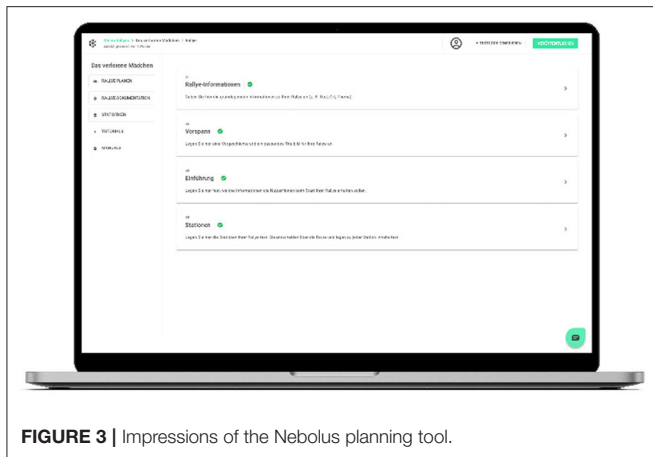
The core of the Nebolus intervention is an app-based rally that guides young people to various real-world locations (stations or levels) in their respective community (**Figure 2**). At each station, users meet local health stakeholders/professionals and get in contact with the staff and their health-related services in a low-threshold way. Following the Education Entertainment (EE) approach, each Nebolus rally is based on an engaging and immersive story that is tailored to the local needs and interests. Stories are fictional and can serve different genres (e.g., crime and mystery, fantasy). Each story is presented via voice messages from the perspective of a main character and a close friend or relative. Voice messages appear before each station (with tips on how to find the station) and after completing the station (relevance of the station from the main character's perspective). At each station, health service providers and professionals pick up the thread of the story and integrate into it their organization and health-related services. Once they have interacted with the local

stakeholder/professionals, users receive a QR code which unlocks further stations. To increase motivation, there are also so-called hidden places that only become visible on the map when the users are within a defined radius of this station. Moreover, various gamification mechanics are used. In addition to a sequence of levels (each station represents one level), a gender or cultural sensitive avatar representing the user in the game can be chosen and different badges can be earned depending on the progress (e.g., number of stations found, number of voice messages listened to). A progress bar graphically visualizes the progress of the rally (ratio of completed stations to the total number of stations).

Nebolus rallies are organized in groups of up to five users. This aims to reduce barriers to interaction with local health service providers and professionals as well as reduce the risk of exclusion of adolescents without access to digital media (smartphone).

## Tailored-Based Development of Nebolus Rallies by Local Stakeholders/Professionals

Nebolus is a universal health literacy intervention that can be tailored to any specific health topic and the local context of the community. To enable tailoring, a browser-based Nebolus planning tool has been developed that allows each local stakeholder/professional to develop an own Nebolus rally. It is intended that a local stakeholder (e.g., local health authority, sport and youth club or a school) will take responsibility and coordinate all activities to develop and implement the local Nebolus rally. This includes the recruitment of local health service providers/professionals, the establishment of a local working group with all participating stakeholders, the development of a fictional story and to set up the rally using the online planning tool. To support communities to



**FIGURE 3 |** Impressions of the Nebolus planning tool.

implement Nebolus on a local level a number of accompanying materials have been developed including checklists, a manual that helps to develop an own fictional story and characters, and a guide for local stakeholders to develop ideas for interaction with adolescents along the different dimensions of navigation health literacy. In addition, a YouTube channel was created, on which tutorials and explain videos will be made available successively. The Nebolus planning tool allows to set up a rally in four steps and does not require any specific IT related skills (**Figure 3**):

- Definition of basic properties for each rally, e.g., title of the rally, location, start and end date, main and secondary character
- Introduction into the rally that can be seen by the users before the start of the rally including e.g., a short description, a voice message presenting a background story
- Onboarding setup that can be seen by the users with the start of the rally (i.e., definition of several screens presenting the Nebolus rally and the tasks to be performed by the users)
- Creation of main and hidden stations including station name and description, address, text instructions for the users, and voice messages that appear before and after the station

For each Nebolus rally a unique rally-code will be created that needs to be entered in the Nebolus app by the users. This is to ensure that each rally is perceived as a unique event, without rallies from other communities being visible. However, each local rally will be documented as a case study on the Nebolus website ([www.nebolus.net](http://www.nebolus.net)) and will serve as inspiration for other communities to develop their own rallies. Each case study will include information about the health topic addressed and the target audience, the story-framework and characters developed and used, the number of stations and local health stakeholder/professional, and information on how the rally has been implemented.

## Nebolus Teaching Units

Cross-curricular teaching material can be used by teachers to introduce health literacy before and to reflect on experiences

and learning outcomes after the Nebolus rallies. Two preparatory lessons and two follow-up lessons are currently being developed, each with a duration of 45 min (i.e., 180 min in total). Each lesson includes background information for teachers, concrete learning objectives, a timetable, didactic instructions and accompanying material (e.g., worksheets).

The aim of the preparatory lessons is to introduce the concept of health literacy and to strengthen individual skills in the HL subdomains. The first lesson addresses the ability to search and find health information and includes group discussions about different information sources and their use as well as worksheets and group exercises about forms of information acquisition. The second lesson deals with the ability to critically reflect on and evaluate health information obtained through various sources. Specific focus will be given on digital health information and particularly on how to deal with information retrieved from social media.

In follow-up lessons, pupils are encouraged to develop a mental map of their local community that includes all local health stakeholders/professionals that were visited as part of the Nebolus LbG rally. This forms the basis for discussions within small groups and the class as a whole, for example, about the services offered by local health stakeholders/professionals and the experiences made with these by the fictional character of the Nebolus rally. In addition, barriers to utilization of these local health services (including the information that is provided by local stakeholders) and ways of overcoming them will be discussed.

## DISCUSSION AND CONCLUSION

As a result of increasing evidence, a German national action plan for health literacy was adopted under the auspices of the Minister of Health in 2018. It comprises a total of 15 recommendations across four suggested areas of action (64). Particular importance is attached to the education system, which, according to the recommendations, should be enabled to promote health literacy early in life. In addition, the action plan calls for community actions that provide residents with easy access to health information and strengthen their health literacy in collaboration with community stakeholders.

Due to a lack of interventions in childhood and adolescence, Nebolus aims to promote health literacy of adolescents aged 12 to 16 years at the intersection of schools and communities. It addresses two major recommendations of the German national health action plan and—through its focus on navigation health literacy—also provides references to two additional recommendations (#7: Facilitate navigation of the healthcare system, #8: Promote communication between health professionals and users). In addition, the Nebolus intervention allows for an explicit link to the Health Promoting School approach as it addresses the curriculum level and the school-community network. Through its focus on strengthening cooperation with community health services, Nebolus also contributes to intersectoral collaboration in school health promotion (65, 66).

Nebolus is characterized by several strengths: First, compared to traditional pre-packaged interventions, Nebolus provides an open intervention framework that can be adapted to the specific thematic and local needs. It therefore contributes to a shift from “one-size fits all” measures to targeting and tailoring health promotion and prevention (67, 68). Second, the development of the intervention is rooted in a co-creation process that involved youth, community stakeholders, and design/IT professionals from the very beginning. The iterative approach was intended to ensure that the needs of the youth and feasibilities of the local stakeholders were taken into account. Third, Nebolus explicitly addresses the relationship between health literacy and information processing. Based on the Entertainment Education approach, a low-threshold communication strategy including various gamification elements (e.g., story, avatars, level, badges) is applied. In contrast to informative/educative measures, health is addressed in a casual manner, which should lead to a higher motivation to participate, especially among those adolescents with limited health literacy.

Next to these strengths, several challenges need to be mentioned with regard to the intervention development and implementation: First, not all dimensions of the HPS framework (as depicted in **Figure 1**) are addressed by the Nebolus intervention. Given empirical findings indicating a low health literacy of educators and its association with mental health (36, 37), there is a need for promoting health literacy among school staff. Those activities should also focus on attitudes and teaching abilities as evidence from Taiwan could show that teacher’s health literacy teaching beliefs, their attitudes toward health literacy instruction, and their level of confidence in their ability to teach health served as predictors for health literacy teaching intentions (69). As Nebolus is an intervention with a comparatively short duration, it can serve as an entry point to other long-term activities. This requires linkage with existing interventions, that focus on health-literate school and/or community development (20, 70, 71). Second, the open character of Nebolus requires action to be taken at the community level to adapt the intervention to the local needs and structure. Although a number of supporting materials are provided for this adaptation process, it can be assumed that communities are at different stages of their health literacy development. Therefore, using proven approaches such as the Community Readiness Model, specific forms of support tailored to the stage of development are needed (35). To make it easier for community stakeholders to start using Nebolus, story-frameworks on various health topics including the characters are currently being

developed. These can be used by the community stakeholders and adapted to their own local needs. Finally, the current Corona pandemic poses a significant challenge to the implementation of Nebolus. In addition to the difficulty of adhering to infection control rules (e.g., sufficient distance when visiting local health services), school participation in Nebolus may currently be lower. Because of the learning gap, schools may tend to invest their time primarily in teaching core subjects, while health literacy receives little or no attention. Here it is important to emphasize that health literacy shares many communalities with existing curricular requirement (e.g., media literacy) and is not just an outcome but can also serve as a predictor for school achievement and school quality (32, 72).

In summary, Nebolus offers an innovative generic intervention framework that has the potential to strengthen (navigation) health literacy in adolescence. With the launch of the intervention, a number of studies are planned to evaluate the impact and the implementation process of Nebolus. The quantitative arm of the evaluation is planned as a cluster randomized trial, with schools within a given community serving as unit of randomization. Moreover, a qualitative evaluation arm includes interviews and focus groups with adolescents and local stakeholders/professionals about the experiences and facilitators and barriers during the implementation. In compliance with the Living Lab approach, active participation of all groups involved is planned during the evaluation.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## AUTHOR CONTRIBUTIONS

VK and EZ-H conducted the scoping review. KD wrote the first version of the manuscript. All authors contributed substantially to the intervention development and contributed to manuscript revision, read, and approved the submitted version.

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# Readability and Comprehension of Printed Patient Education Materials

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**Background:** Health literacy, a recently determined construct plays an important role in how individuals are able to manage their health. A useful approach for the assessment of health literacy is to measure the comprehension of available patient education materials (PEMs).

**Objective:** We aimed at assessing the usefulness of PEMS available in Hungarian by testing comprehension of selected PEMs in different groups of users.

**Methods:** Comprehension of patient education materials in the domain of healthcare was tested by selecting PEMs and creating questions based on their text in 3 dimensions of health literacy: understand, process/appraise, apply/use. Twenty questions were created that could be answered without pre-existing knowledge by reading the appropriate text taken from PEMs. Comprehension was examined in four groups: laypersons, non-professional healthcare workers, 1st year healthcare students, and 5th year medical students. Readability indices were calculated for the same texts to which questions were created.

**Results:** Laypersons answered <50% of the PEMs-based questions correctly. Non-professional healthcare workers performed better with 57% of right answers but significantly worse than healthcare students or medical students. Those with at least high school qualification (maturity exam) showed significantly higher comprehension compared to those with lower educational attainment. Persons in good or very good health also had significantly better comprehension than those in less favorable health. All readability indices showed that comprehension of the tested PEMs required at least 10 years of schooling or more. Therefore, these PEMS are difficult to understand for persons with less than high school level of education.

**Conclusion:** Rephrasing of the investigated patient educational materials would be recommended so that they better fit the educational attainment of the Hungarian population. Evaluation of the readability and comprehensibility of other PEMs also seems warranted.

**Keywords:** health literacy, comprehension, patient education, healthcare workers, readability index

## INTRODUCTION

According to an early definition of the term, health literacy is the degree to which individuals have the capacity to obtain, process and understand basic health information and services to make appropriate health decisions (1). A more recent definition of Sorensen and the HLS-EU Consortium (2) based on a systematic literature review proposed a more complex definition according to which health literacy “entails people’s knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course.” An integrated model, built on this wider definition identifies at least four dimensions of health literacy in three health domains: health care, disease prevention and health promotion.

Health literacy is assessed at the individual or population level using one or more of the large numbers of validated instruments (3, 4). International surveys found that sizable proportions of the populations in developed countries had less than sufficient levels of health literacy. For example, 36% of the adult US population had below-basic or basic level of health literacy in 2003 (5), and the proportion of persons with inadequate or problematic health literacy ranged from 28.7% in the Netherlands to 62.1% in Bulgaria in the European health literacy survey (HLS-EU) (6).

An obvious aim is to improve the level of health literacy. Until then, helping people comprehend health-related information can be achieved by creating easy-to-understand materials (7). One step in this process is to assess the comprehension and readability of existing written patient education materials (PEMs) (8, 9) since these are routinely used in health care and have been shown to improve self-management of various conditions (10, 11). In case of comprehension, understanding of relevant material by individuals is tested (12). Readability of a text is assessed by calculating various readability indices based on formulas that use the number of syllables or characters in a specific text. Indices reflect the difficulty of the vocabulary and sentences in written materials and can be assigned to a “grade level” to express the number of years of schooling which would be required to comprehend the given text.

The most frequently used readability indices are the Flesch-Kincaid Index (FKI), the Gunning-Fog Index (GFI), the Simple Measure of Gobbledygook (SMOG) (13, 14), and the Coleman-Liau index (CLI) (15). The former three are calculated using the number of syllables, words, and sentences in a text which are fed into a specific weighted formula to produce a total score in a range that corresponds to a particular US school level. The formula for calculating CLI uses the number of characters in a text instead of syllables. These readability indices are primarily used for English texts. However, the Flesch Reading Ease Test

from which the FKI index is calculated, the Gunning-Fog Index, and the Simple Measure of Gobbledygook were also tested and found useful in Hungarian texts (16). The CLI has also been used for languages other than English and can be used for comparing the readability of various texts in the same language, with higher numbers reflecting more difficult texts (17).

The suggested reading level for PEMs are grade 6–8. However, the readability scores of several existing PEMs seem to be significantly higher than that in the UK, Canada and Australia (18, 19).

Readability assessments according to various indices have been carried out on English PEMs for patients with chronic kidney disease (20), dermatological diseases (9), and PEMs available at the point of care (21). There were similar studies carried out on PEMs for patients at menopause (22), with congestive heart failure (23), as well as on PEMs for orthopedic or rheumatology patients (19, 24), also for patients undergoing hand surgery (25) and for various other common health conditions (26, 27).

A recent paper even addressed readability for patient education material on COVID-19 (28).

Our goal was to assess the usefulness of patient education materials by a two-pronged approach, investigating both comprehension and readability. PEMs used in the Hungarian health care system were collected in the most important areas of patient-doctor interactions: scheduling an appointment, giving consent, scheduling and side-effects of medication, side-effects of surgical procedure, dietary recommendations, finding health care services, health insurance-related and ethical guidelines. Comprehension of these texts was investigated by creating questions based on the texts. Readability of the same texts was assessed by calculating four indices (FKI, GFI, SMOG and LKI).

Comprehension of PEMs was assessed in laypersons and non-professional health workers of primary health care. These workers had no professional qualification and were employed as health mediators in a large-scale model programme that was designed to introduce group practices (so-called GP clusters) in the primary care system of Hungary. These group practices also offered previously unavailable preventive services such as health status assessment, lifestyle counseling, and community health promotion programmes in regions with sizable numbers of disadvantaged patients. Non-professional workers acted as facilitators between professional workers and the serviced population with the aim of easing communication, increasing access and uptake of health services, and aiding health promotion programmes (29). Patient education was not a specific task for health mediators but they were frequently asked to read and interpret PEMs by patients in the community, so comprehension of these texts was a salient question.

## MATERIALS AND METHODS

### Selection of Patient Education Materials

Considering the large number of PEMs used in the Hungarian health care, we decided to limit the study to those in the domain of health care as defined by Sorensen et al. (2). Of the four dimensions in this model, the first (“accessing/obtaining

**Abbreviations:** BRIEF, Brief Health Literacy Screening Tool; CLI, Coleman-Liau index; CPC, Competency in Patient Care; FKI, Flesch-Kincaid Index; GFI, Gunning-Fog Index; HLS-EU, European Health Literacy Survey; HLS-EU 47, European Health Literacy Survey Questionnaire 47; NVS, Newest Vital Sign; PEMs, patient education materials; SMOG, Simple Measure of Gobbledygook; S-TOFHLA, Short-Test of Functional Health Literacy in Adults.

**TABLE 1 |** Topics of the patient education materials selected for assessing comprehension.

Domain:	Dimensions of health literacy investigated in the present study		
	Understand information relevant to health	Process/appraise information relevant to health	Apply/use information relevant to health
Health care			
Issues	4. Consent form—analyzing complications 5. Insurance claim 6. Insurance claim 11. Obtaining imaging results 17. General prognosis of a chronic disease 18. Prognosis of chronic disease in a specific case	3. Potential of complication based on Consent form 8. Dietary recommendations 9. Laboratory results 10. Laboratory results 15. Organ donation law 19. Side effects of medication 20. Side effects of medication	1. Medication regimen 2. Medication regimen 7. Dietary recommendations 12. Opening hours of a pharmacy 13. Opening hours of a pharmacy 14. Medication regimen 16. Scheduling appointment for checkup
Number of questions	6	7	7

information relevant to health”) was omitted since this was not relevant in the present study. PEMs were selected that covered major issues of health care in the other three domains in which patients have to understand and process information and make decisions. Only patient education materials produced and distributed by the largest health care provider of the North-Eastern region of the country were selected since lay persons and patients in the target groups would most frequently receive these materials. Texts from PEMs were selected to cover the most important issues in each of the 3 dimensions as shown in **Table 1**.

## Creation of Questions for Testing Comprehension

Selected PEMs were reviewed and texts of no more than one paragraph with information describing conditions or situations relevant to issues in one of the 3 investigated dimensions (**Table 1**) were identified. Questions were formulated based on the text of PEMs so that all questions could be unequivocally answered—without pre-existing knowledge—by reading and comprehending the preceding text. Each question had one right answer and at least but no more than 3 potential other (wrong) answers (altogether 2, 3 or 4 answers) to choose from. Twenty questions were formulated in 12 topics from 12 PEMs. Pilot testing was carried out by health professionals with at least 5 years of work experience who found the texts and corresponding questions to be clear and answerable, not requiring adjustment. The created questionnaire is referred to as Competency in Patient Care (CPC).

## Sample and Data Collection for Testing Comprehension

Non-professional workers (health mediators) employed in the model programme were invited to participate ( $n = 35$ ). Lay participants of a community health promoting programme were also asked to participate ( $n = 130$ ). Data collection took place in May-June 2016. In order to compare the performance of lay persons and non-professional workers, 1st year students of physiotherapy and dietetics ( $n = 54$ ) and medical students in their final year of education ( $n = 29$ ) were invited to read the same texts and answer the same questions. Data collection in the latter two groups was carried out in December 2018-February 2019.

## Evaluation of the Test of Comprehension

The number of right answers was calculated for each respondent for all items. The proportion of right answers from all respondents was calculated for each item. The number of potential answers for each item varied between 2 and 4. This resulted in different probabilities of chance to find the right answer for each item which was taken into account by correction in the following way. The percent of correct responses for each question in each occupational group was divided by the probability of chance given the actual number of potential answers for each question. For example, if the right answer had to be chosen from 2 answers, the probability of finding it by chance was 50%; if the right answer had to be chosen from 4 answers, the random probability of finding the right one was 25%.

## Statistical Analysis

The proportion of right answers was calculated. The uncorrected proportion of right answers is shown in **Table 2**, and with correction (for the probability of choosing an answer randomly) in **Figure 1** where the “number of responses” means the total number of responses for each question from which the right answer had to be chosen. The proportion of right answers is corrected accordingly. Out of 20 questions, 5 questions had 2 potential answers, 3 questions had 3 potential answers, and 12 questions had 4 answers from which the one right answer had to be selected. Comparison of the proportion of right answers in the various groups was carried out by the Kruskal-Wallis test. Calculations were carried out in MS 365 Excel and Stata 16.1.

## Assessment of Readability

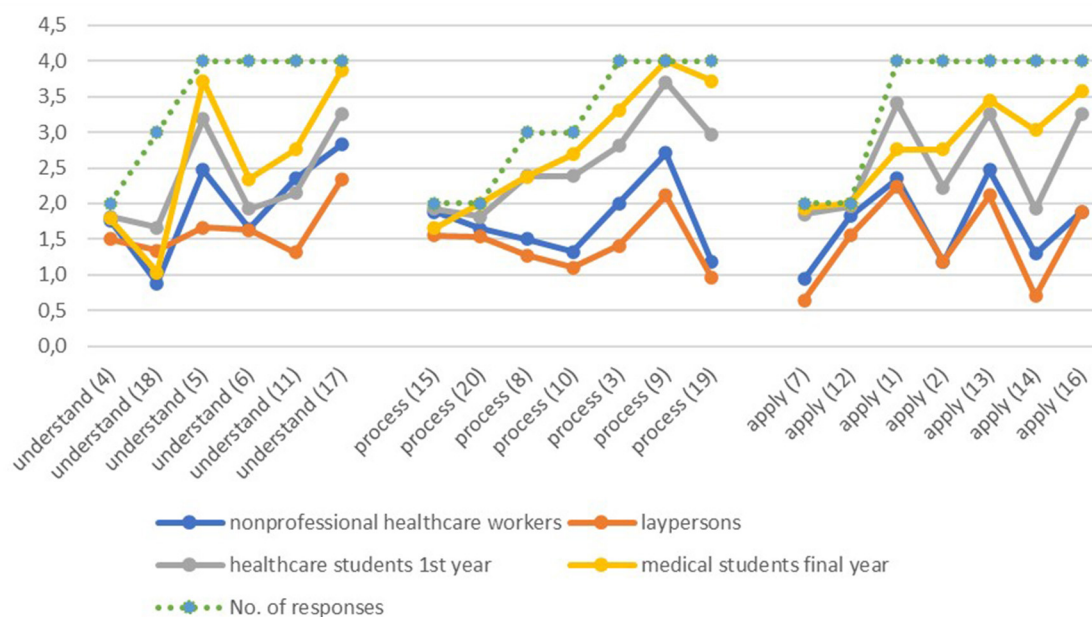
Four measures of readability were calculated for the total text of the test of comprehension. Three of those indices (Flesch Kincaid Index, Gunning-Fog Index, Simple Measure of Gobbledygook) are based on the number of syllables in a text; the fourth (Coleman-Liau index) is based on the number of characters.

To calculate the Flesch Reading Ease test, the total number of sentences, words and syllables were counted in the texts and fed into the Flesch formula to calculate the score as follows: Flesch Reading Ease score =  $206.835 - (1.015 \times \text{ASL}) - (84.6 \times \text{ASW})$  where ASL is the total word count divided by the total sentence count; ASW is the total syllable count divided by the total word count (30). Result of the Flesch Reading Ease Test



**TABLE 2 |** Features of the participants by occupational/study group.

	Non-professional health workers	Laypersons	Students of physiotherapy and dietetics	Medical students
N	34	125	54	29
Age (mean $\pm$ SD, years)	missing	37 years ( $\pm 14.91$ )	21 years ( $\pm 1.61$ )	24 years ( $\pm 1.11$ )
Sex (% males)	15	10	6	28
Highest level of education				
Primary % (N)	18 (6)	46 (57)	0	0
Secondary % (N)	82 (28)	47 (58)	0	0
In progress (university students) or completed tertiary % (N)	0	7 (9)	100 (54)	100 (29)
Marital status				
Single % (N)	12 (4)	27 (34)	100 (54)	100 (29)
Present partnership (married/cohabiting) % (N)	68 (23)	49 (61)	0	0
Former partnership (divorced/widowed) % (N)	20 (7)	24 (30)	0	0
Subjective health status				
Very good/good % (N)	53 (18)	49 (61)	85 (29)	69 (11)
Fair % (N)	41 (14)	40 (49)	15 (5)	31 (5)
Bad/very bad % (N)	6 (2)	11 (14)	0	0

**FIGURE 1 |** Distribution of the corrected proportion of right answers by dimensions of health literacy by occupational groups. Green dots show the total number of responses (2, 3, or 4) on each item.

can be converted to the Flesch-Kincaid Index which specifies the grade level of the text.

The Gunning-Fog Index is calculated as follows:  $0.4 \times [(total\ word\ count/total\ sentence\ count) + 100 \times (number\ of\ complex\ words\ (3\ or\ more\ syllables)/total\ word\ count)]$  (31, 32).

The SMOG Index was described by McLaughlin (33):  $3 + \sqrt{\text{complex words per 30 sentences}}$  (34).

The Coleman-Liau index has the following formula:  $CLI = 0.0588L - 0.296S - 15.8$  where L is the average number of letters per 100 words, S is the average number of sentences per 100 words (15).

A web-based tool was used to calculate all indices (35). This calculator analyzes the grade reading level of English text using a series of readability indices, including the ones listed above. The

**TABLE 3 |** Uncorrected proportion of right responses by item and occupational/study groups.

	Non-professional health workers	Lay-persons	Students of physiotherapy and dietetics	Medical students
Understand information (%)				
4. Potential complications of a surgical procedure based on the consent form	88.2	75.2	90.7	89.7
5. Insurance claim after mild accident	61.8	41.6	79.6	93.1
6. Insurance claim after severe accident	41.2	40.8	48.2	58.6
11. How to request imaging results	58.8	32.8	53.7	69.0
17. General prognosis of a chronic disease	70.6	58.4	81.5	96.6
18. Prognosis of chronic disease in a specific case	29.4	44.8	55.6	34.5
Process/appraise information (%)				
3. Identification of potential complications in a consent form	50.0	35.2	70.4	82.8
8. Calculation of dietary intake in diabetic diet	50.0	42.4	79.6	79.3
9. Identification of abnormal laboratory results	67.7	52.8	92.6	100
10. Impact of food consumption on laboratory results	44.1	36.8	79.6	89.7
15. Interpretation of the law on organ donation in a specific case	94.1	77.6	96.3	82.8
19. Identification of potential side effects of a specific medicine	29.4	24.0	74.1	93.1
20. Symptom as a potential side effect of a specific medicine	82.4	76.8	90.7	100
Apply/use information (%)				
1. Application of a specific medicine by age	58.8	56.0	85.2	69.0
2. Application of a specific medicine in children	29.4	29.6	55.6	69.0
7. Food choice in low-fat diet	47.1	32.0	92.6	96.6
12. Which pharmacy is open now	91.2	77.6	98.2	100
13. Which pharmacy will be open in a specific future timepoint	61.8	52.8	81.5	86.2
14. Can a specific medicine be halved	32.4	17.6	48.2	75.9
16. Choosing a date for checkup based on specific information	47.1	47.2	81.5	89.7

text was cleaned beforehand, that is, periods marking the end of each heading, sentence fragment, or sentence were removed.

## RESULTS

### Assessment of Comprehension

Two hundred and forty-eight participants returned the questionnaire of which 6 were excluded from evaluation because more than 50% of answers were left blank. Demographic features of the 242 respondents included in the study are shown in **Table 2**.

Without correction for the random choice of right answers, the mean comprehension of each item ranged between 33.47 and 86.78%. The mean proportions of right answers by item

and dimension are listed in each occupational category in **Table 3**. The overall proportion of right answers was significantly different by occupational groups: 56.7% among non-professional health workers, 47.6% in laypersons, 76.7% in students of physiotherapy and dietetics, and 82.7% among medical students ( $p < 0.01$ ).

We also analyzed the correct number of answers taking into account the varying number of potential responses (between 2 and 4) from which the correct answer had to be selected as described in Methods. This way the proportion of right answers was corrected by the probability of choosing an answer randomly: the proportion became lower in case of a higher number ( $>2$ ) of potential answers compared to when the right answer had to be selected only from 2 potential answers.

**TABLE 4 |** Comprehension in the subgroups by socio-demographic variables and subjective health.

	Per cent of all right answers	<i>p</i>
<b>By gender</b>		
Male ( <i>N</i> = 28)	58.93	0.820
Female ( <i>N</i> = 213)	59.86	
<b>By education</b>		
No maturity exam ( <i>N</i> = 102)	46.03	<0.001
Maturity exam ( <i>N</i> = 140)	69.50	
<b>By marital status</b>		
Single ( <i>N</i> = 121)	69.66	<0.001
Present partnership ( <i>N</i> = 84) (married or cohabiting)	48.27	
Former partnership ( <i>N</i> = 37) (divorced or widowed)	52.43	
<b>By occupation</b>		
Laypersons	47.60	<0.001
Non-professional health workers	56.76	
Students of physiotherapy and dietetics	76.76	
Medical students	82.76	
<b>By subjective health status</b>		
Good/very good ( <i>N</i> = 153)	64.54	<0.001
Fair/bad/very bad ( <i>N</i> = 89)	51.12	

The corrected proportions of right answers are shown by each item and occupational group in **Figure 1**. Green dots show the potential number of responses on each item. This corrected evaluation shows even more clearly the difference between the occupational groups. The figure also reveals questions which can be considered good or easy—the ones which most respondents answered correctly (4, 12, 15). The most difficult questions (6, 18) had a low proportion of correct answers even by medical and healthcare students. These related to the interpretation of insurance claim and organ donation law. Questions 5, 17, 10, 19, 16 had the highest differentiating power which were mostly correctly answered by healthcare and medical students, and mostly incorrectly by lay persons and non-professional health mediators.

We analyzed overall comprehension, that is, the proportion of right answers by gender, education, occupational group, and health status by the Kruskal-Wallis test as described in Methods. Results are summarized in **Table 4**. Except for gender, significantly different comprehension was found among subgroups of other variables. Those with at least maturity exam gave 23.5% more correct answers compared to those without ( $p < 0.001$ ); medical and healthcare students selected 27.6% more correct answers compared to laypersons and non-professional healthcare workers ( $p < 0.001$ ); and those in at least good subjective health gave 13.4% more right answers than those in adequate or worse health ( $p < 0.001$ ).

## Assessment of Readability in Comparison With Available Health Literacy Tools

Readability indices such as the FKI, CLI, SMOG and GFI were calculated for our test of comprehension (Competency in Patient

**TABLE 5 |** Comparison of readability scores of the assessed health literacy tools.

	CPC	NVS	S-TOFHLA	BRIEF	HLS-EU 47
FKI	10.6	10.6	12.7	12.4	12.7
Gunning-Fog	13.2	12.9	15.3	14.3	13.5
SMOG	9.8	9.5	11.6	10.3	9.9
CLI	12.0	11.0	8.0	11.6	19.0

Care, CPC), and also for the Hungarian versions of some widely used tests of health literacy. CPC was found to be at 12th grade level by the Coleman-Liau Index, at 11th grade level by FKI (10.6), at 10th grade level by the SMOG index (9.8), and at 13th grade by GFI (13.2 for GFI is defined as 'hard to read'). The readability indices of the widely used health literacy tools such as NVS, HLS-EU 47, BRIEF and S-TOFHLA were also calculated and compared to CPC. The readability indices of CPC are similar to the readability indices of validated health literacy tools, all requiring at least 10 years of education (**Table 5**).

## DISCUSSION

Our study tested the comprehension of patient education materials in various occupational groups, among them non-professional health workers who are supposed to help lay people access and use health care services and understand health-related information. Overall comprehension of the investigated PEMs among laypersons was around chance, that is, their comprehension was no different from selecting answers randomly, as opposed to answers based on the provided information. Comprehension among non-professional health workers was slightly better than chance and was considerably worse than that of students of medical and health care professions. Comprehension of the latter two groups was adequate. However, medical students in their final years performed way below expectations in terms of one issue, and their performance was only slightly better than chance in 3 more issues, all of them related to comprehension of insurance claims and ethical issues.

We also tested the readability of the same materials used for comprehension testing by calculating the most frequently used readability indices such as the Flesch-Kincaid Index (FKI), Gunning-Fog Index (GFI), Simple Measure of Gobbledygook (SMOG) as their usability was previously shown for Hungarian texts (16).

Both the test of comprehension and the readability indices suggest that the language of PEMs is not tailored properly to the wide range of potential users in the Hungarian population. Considering that 45.87% of the 15–74 year-old population had no high school diploma (no maturity exam), and 21.21% of the population had only primary education or less in 2018 according to the Hungarian Central Statistical Office (36), the investigated PEMs seem to be too difficult for those with no maturity exam.

Readability indices (FKI, GFI, SMOG) previously used for Hungarian texts were also calculated for the text of the test of comprehension, and their scores also suggest that the language of PEMs is certainly not tailored properly to the population with lower educational attainment than high school diploma. The CLI had a much wider range being way below (S-TOFHLA) or way above (HLS-EU 47) other indices of the same questionnaire so its interpretation requires caution.

Readability indices do not necessarily reflect whether a given material is effective since they only focus on individual words and sentences, and do not take into account the active role of the reader. Therefore, these indices do not measure comprehension, and indices for the same text may differ in their grade level assignment (27). However, since they can be used to measure any text for any purpose, they can be useful as a first approach to assess patient education materials and compare the grade level of different versions of the same material.

Our results are in concert with earlier findings of the American Medical Association according to which most health care materials are written at a 10th grade level or higher although most adults read between the eighth and ninth grade level (37).

Since increasing numbers of patients use an increasing number of digital educational resources, the creation of clear and effective PEMs is more important than ever. Guidelines have been available for the creation of easy-to-understand health messages and patient education materials for more than a decade (7, 38). Their general recommendation is to write as simply as possible without sacrificing content or distorting meaning. However, this seems to be a tall order as the readability assessment of a number of PEMs attest (21, 39, 40). The readability of PEMs aimed at patients with various conditions has been found to exceed that of recommended levels. Comprehension of topics involving legal matters such as insurance and medical ethics seem to be difficult even for medically qualified professionals as was shown by our questionnaire.

One of the limitations of our study is that it gives information about the readability of the selected PEMs based on text only. Charts, tables and images cannot be evaluated. Furthermore, the readability formulas were originally validated for English texts, though some of these scores were previously used with Hungarian texts (16).

Comprehension of the PEMs measured during our study does not provide in-depth information about health literacy though it can raise concerns regarding the required skills to understand, appraise and apply health information in healthcare, disease prevention and health promotion.

The strength of our study is its novelty to assess the readability of Hungarian PEMs and to reveal a gap between the recommended and the actual level of readability of such materials. Our findings underline the need for a review of patient education materials in use and evaluation of new materials before release along with the health literacy of patients who are supposed to use them. Difficulties or incomprehension of patient education materials is a grave problem since people cannot act upon information they do not comprehend. In optimal cases, patient education materials should not only be easy to comprehend but should also be

tailored to the specific characteristics of the intended target group (41).

## CONCLUSIONS

There seems to be a large discrepancy between the readability of the educational materials and the reading level of the general population. Considering that people with lower educational attainment are at higher risk for morbidity and mortality compared to those with higher levels of schooling, the previous group has been in a much greater need of clear health communication using plain language than the latter. More extensive research should be conducted to evaluate the readability and comprehensibility of available PEMs. In addition, rephrasing of existing education materials using simple language seems necessary, or even establishment of an organization responsible for editing such information materials as it is exemplified in Canada (42).

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Model Programme had been implemented in the framework of the Swiss Contribution Programme SH/8/1 that specified the indicators for evaluation. Indicators monitored in primary health care are specified in the Hungarian Health Care Act of 1997 (1997. évi CLIV. törvény az egészségügyről). The Programme was created on the basis of the Framework Agreement between Switzerland and Hungary (declared by 348/2007. (XII. 20.)) and signed on 20 December 2007. Ethical approval for data collection for research purposes in the Programme was issued by the Scientific and Research Ethics Committee of the Medical Research Council of Hungary (ETT-TUKEB) (16676-3/2016/EKU (0361-16)). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

PS collected PEMs, created the questionnaire for comprehension testing, collected data, performed statistical analysis, and drafted the manuscript. ÉB contributed to the creation of questionnaire, data collection, and drafting of the manuscript. KK designed the study, supervised creation of the questionnaire for comprehension testing, supervised statistical analysis, drafted the manuscript, and approved its final version. All authors have read and agreed to the published version of the manuscript.



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# Health Literacy Needs Among Unemployed Persons: Collating Evidence Through Triangulation of Interview and Scoping Review Data

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**Background:** Unemployed persons are at high risk for low health literacy. Most studies addressing health literacy of unemployed persons focus on risk factors for low health literacy or correlates of health literacy, but studies on needs of unemployed persons regarding health literacy are scarce. We aimed to obtain better understanding of health literacy needs of unemployed adults by triangulating the results from a scoping review on health literacy needs in unemployed adults and additional in-depth qualitative interviews.

**Methods:** Scoping review: We searched six databases up to January 2021 as well as gray literature for relevant studies following PRISMA-ScR guidelines. Titles, abstracts, and full texts were screened independently by two researchers. Qualitative study: Ten participants of a job-reintegration program in Germany were interviewed following a guideline covering topics including health issues of interest to the participants, their sources of health-related information and the barriers/facilitators they experience when accessing health services.

**Results:** Scoping review: After screening 2,966 titles and abstracts, 36 full texts were considered, and five articles fulfilled the inclusion criteria. Four focused on mental health literacy and outcomes, while the fifth assessed information-seeking practices. One additional report on health literacy was identified via the gray literature search. Awareness of one's condition was identified as a facilitator for mental health help-seeking, while fear of harmful effects of medication prevented help-seeking. Qualitative study: Participants were interested in and were generally well-informed about health topics such as nutrition and physical activity. The main challenge perceived was translating the knowledge into practice in daily life. GPs and the social services providers played an important role as a source of health information and advice. Regarding mental health, similar barriers, facilitators and needs were identified through triangulation of findings of the scoping review with those of the interviews.

**Conclusions:** There is need to address health literacy needs of long-term unemployed persons that go beyond mental health literacy. Public health interventions should not

only aim at improving health literacy scores, but also focus on how to help participants translate health literacy into practice. Population groups of interest should also be involved in all processes of designing interventions.

**Keywords:** health literacy [MeSH], needs assessment [MeSH], unemployed, scoping review, semi-structured interviews, participatory research

## INTRODUCTION

Health literacy is often defined as “the knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life throughout the course of life” (1). However, different definitions exist: While this definition centers on capacities of the individual in the decision-making process, others highlight the importance of the social environment for health literacy (2).

Nevertheless, the concept is evolving and continues to gain importance globally (3). It has been included in many policy programs such as the United States’ Healthy People 2030 initiative (2) or Germany’s National Action Plan Health Literacy (4). It has been suggested that persons with low health literacy suffer from poorer overall health (5) and find it more difficult to follow doctors’ instructions, or take medication as prescribed (6) compared to those with higher health literacy scores. They have also been reported to use hospital and out-patient services more and to use preventive measures less, thereby incurring more medical costs (7–9). Because health literacy affects many areas of life, it has been argued that differences in health literacy can cause or exacerbate health inequalities (10, 11). A large-scale European survey including 8,000 individuals from eight countries found more than a tenth of the whole sample (12.4%) to have inadequate health literacy (12). The proportion however varied between countries and ranged from 1.6% in the Netherlands to 26.9% in Bulgaria. The respective proportion for Germany was 11%, with a further 35% being observed to have problematic general health literacy.

One of the population groups with a particularly high risk for low health literacy is unemployed persons, particularly the long-term unemployed, who have been unemployed for at least 1 year. Being unemployed is associated with poorer health outcomes such as increased risk of heart disease, mental illness, and lower physical health (8, 13–15), which in turn can lead to long-term unemployment. Although the unemployment rate in the European Union (EU) has been steadily decreasing since 2013 (from 10.8% in 2013 to 6.7% in 2019), the proportion for 2019 corresponds to more than 14 million unemployed persons aged 15–74 years (16). Quite a high proportion of these (41.8%) were long-term unemployed, and the proportion of long-term unemployed persons among those aged 55–74 years was almost 58%. In Germany, 898 000 persons were long-term unemployed in October 2020, almost a third of those registered as being unemployed (17). Most were aged 45 years and older (53%), did not have a vocational qualification (58%) and were

male (56%). Slightly more than a quarter (26%) did not have German nationality.

While long-term unemployed persons have been shown to be at increased risk for poor health outcomes, the role health literacy plays in this regard and the respective needs of this population group are not clear. Survey data (8, 18, 19) suggest low levels of health literacy in this population. However, it is not clear whether members of this population group perceive themselves as having low health literacy, or indeed as having health information deficits or health literacy needs in general, as survey results are not necessarily communicated to or discussed with them. Further, findings of health literacy surveys do not automatically indicate the health topics that are relevant to those identified as having low health literacy scores. Health promotion activities involving unemployed persons have mainly focused on mental health and aimed to facilitate reintegration into the workforce (20). Exploring the subjectively perceived health literacy needs in these populations can serve as an entry point for participatory intervention development. Experts in the field have highlighted the importance of engaging directly with the members of the population group of interest when designing a health literacy intervention (3). The aim of this study was hence twofold: to systematically assess the current state of research with regards to health literacy needs of unemployed adults via a scoping review, and to empirically assess health literacy needs in a group of long-term unemployed adults via in-depth semi-structured qualitative interviews. Lastly, the findings of both approaches were integrated through triangulation.

## METHODS

This study was conducted within the framework of a larger study on health literacy in unemployed persons (FORESIGHT; funded by the German Ministry for Education and Research). Using a parallel approach, we conducted a scoping review to obtain an overview of health literacy needs of unemployed persons identified and/or addressed in previous studies and also conducted in-depth semi-structured interviews with long-term unemployed persons participating in workforce reintegration programs to assess their health literacy needs. In line with the parallel data analysis approach (21), the collection and analysis of the scoping review and interview data was done separately.

The study was approved by the Ethics Committee of the University of Bremen, Germany (reference number 2020-26). Participation in the interviews was voluntary and all participants provided informed written consent.



## Scoping Review

We conducted the scoping review in line with the PRISMA-ScR guidelines for scoping reviews (22). The respective protocol was registered at the Centre for Open Science (OSF) (23) and is also provided as **Supplementary Data (Supplementary File 1)**. Based on the PCC (Population, Concept and Context) criteria recommended for scoping reviews, we searched for primary studies with any designs that had been published in peer-reviewed journals or other sources (e.g., project reports, organizational reports, dissertations/theses). The studies had to have included persons officially registered as unemployed, looking for employment or participating in programs aimed at reintegration into the workforce, and assessed their health information needs, their health-related knowledge gaps, or components of health literacy that have been observed to be low in this population group. No date or language limitations were set at the search stage.

At the screening stage, non-primary studies such as literature reviews, editorials and conference abstracts were excluded from the scoping review, as were studies conducted in clinical settings or with clinical samples. Further, only studies published in English or German were included.

## Information Sources and Literature Search

The following databases were searched for potentially relevant publications from inception to January 2021: MEDLINE via OvidSP, CINAHL via EBSCO, PsycINFO via EBSCO, Social Sciences Citation Index (SSCI) via Clarivate, Sociological Abstracts via ProQuest, and Applied Social Sciences Index and Abstracts (ASSIA) via ProQuest. The search terms, developed iteratively by the research team including a professional librarian include descriptors of unemployment, such as “jobless” or “laid off”, combined with descriptors of health literacy, such as “health knowledge” or “health promotion”. The MEDLINE search strategy is provided as **Supplementary File 2**. The other search strategies can be provided by the first author upon request.

To identify gray literature relevant to this review, two team members (JK and ML) independently searched websites of relevant national and international public health institutions (e.g., Kooperationsverbund gesundheitliche Chancengleichheit (Germany), Public Health England and Centre for Diseases Control and Prevention). They compared their findings and discussed these with the larger team.

## Screening Process

Two authors, FSZ and HS, screened the titles and abstracts and then the full texts of the studies included into the next stage independently. Ensuing discrepancies were discussed by the two authors until consensus was reached.

## Data Items and Data Charting Process

A data charting form was developed *a priori* and the team calibrated, tested and refined the draft before two team members (HS and JK) charted the data independently. Discrepancies that arose were resolved through discussion. Data items that were charted included study characteristics such as first author,

year and type of publication, study design, definition of study population and sample size.

## Synthesis of Results

The study characteristics, health literacy-related needs reported, and the methods used to assess these were narratively summarized.

## Qualitative Interviews

The qualitative part of the study was conducted in line with the Consolidated Criteria for Reporting Qualitative Research recommendations (COREQ, **Supplementary File 3**) (24). The research team characteristics are presented in **Supplementary File 4**.

At study onset, the project was presented to participants of a workforce reintegration program run in Bremen, Germany, by a partner organization of the FORESIGHT project. The organization offers different services such as recycling centers and second-hand furniture shops, where long-term unemployed persons take part in workforce reintegration programs. On average, the organization has 100 program participants at any given time. The information session took place during normal operating times and was also attended by the organization's social worker. The workforce reintegration programs are run such that the participants attend on a regular basis, for example, 4–6 h every weekday. For the participants, participation in the programs hence constitutes ‘going to work’.

## Recruitment of Participants

Following the information session, the social worker, who was fully informed about the project from its conception, disseminated information about the study within the organization and invited program participants to take part in the interviews. No criteria were set for the recruitment of participants. For pragmatic reasons we decided on a sample of 10 persons. The interviews were conducted between January and February 2021. The interviewers (FSZ and HS) did not know any of the interviewees prior to the study.

## Interview Guide

In-depth semi-structured interviews were conducted using a guideline developed in consultation with the social worker at the partner organization (see **Supplementary File 5** for the original version and the English translation) and focused on themes such as the health topics of interest to the participants, the health services and sources of health information they use, and the barriers/facilitators they experience when accessing health services or health information.

The interviews were conducted at the partner organization, in a closed room in which only the interviewer and interviewee were present, and during normal operating hours. The interviewees were offered an incentive of 50 Euro for their participation and were interviewed once. Before the interviews, participants provided written informed consent. All interviews were conducted in German and were audio-recorded and later transcribed verbatim in the original language of the interviews. The duration of the interviews varied from 8 min to almost an

hour. Transcript segments required for this manuscript were translated into English by FSZ and ML and TB cross-checked the translations.

## Data Analysis

The interview transcripts were analyzed using thematic analysis via the freely available online program, QCAmap (25). The program foresees the compilation of questions to be addressed during the analysis. To this end, one of the authors (FSZ) initially compiled a list of such questions based on the interview guide. She then read through two of the interviews, using the list to code the respective segments and adding further questions where applicable. Thereafter, two coders (FSZ and ML) independently pilot coded two interviews each by assigning “categories” (codes) to the relevant interview segments inductively. The coders compared their results and addressed any disagreements that arose. They then used the developed category structure to code the rest of the interviews, again independently. Further questions and categories were added as deemed necessary (see **Supplementary File 6** for final list of questions used to analyze the data). After all interviews had been coded, the two coders went through all the interview transcripts, comparing their coding. They discussed any differences until consensus was reached. An example of the coding frame used to code one of the questions is provided as **Supplementary File 7**.

In a second step, the analysis questions and corresponding transcript segments were classified according to factors relating to different components of health literacy: finding health-related information, understanding, appraising and applying health-related information. Potential barriers as well as resources available to participants for each of the health literacy components were then identified based on the responses to the different analysis questions.

## RESULTS

### Scoping Review

From 2966 titles and abstracts of peer-reviewed articles that were screened, 36 were included in the full-text stage, and five were included in the final review. The main reasons for exclusion were (a) wrong study population (focus not on unemployed adults), (b) health literacy not assessed or reported and, (c) not primary data. Details are described in the PRISMA flow chart (**Figure 1**). The list of excluded full-texts is provided as **Supplementary File 8**.

Nine potential publications were identified through the gray literature search, seven of which were reports, one manual and one preprint manuscript. Only one of the reports was included in the review.

### Place of Study, Study Characteristics, and Outcomes Assessed

Two of the included peer-reviewed articles were based on studies conducted in Finland (26) and Portugal (27). The other three (28–30) and the report (31) were based on studies conducted in Germany. None of the studies identified included participants of a workforce-reintegration program.

A summary of the data extracted for each of the articles and the report is presented in **Table 1**. The full data is provided as **Supplementary File 9**. The study conducted in Finland investigated the relation between information seeking practices and coping strategies among 750 long-term unemployed persons, focusing on everyday life information and health information. Coping was assessed using abstracts from Folkman and Lazarus’ revised Ways of Coping questionnaire and use of information was assessed using open questions.

The study population for the Portugal study comprised 46 experts from various fields with professional experience in mental health, employment/temporary work and prevention of psychiatric disorders (27). The study applied the Delphi technique to reach expert consensus regarding essential intervention components for a program to promote mental health among unemployed people.

Two of the three articles from Germany (29, 30) were based on the same study population comprising unemployed persons with mental health problems who were recruited via unemployment agencies. One of the articles investigated the influence of mental health literacy (MHL) on help-seeking intentions and behaviors of the participants (29), while the other investigated predictors of help-seeking among the participants (30). The outcomes were assessed using the Depression Literacy Scale (DLS) (29, 30) and the Mental Health Knowledge Schedule (MAKS) and the Depression with Suicidal Thoughts Vignette (29). The third article from Germany assessed barriers and facilitators of help-seeking and service use among 15 unemployed persons using in-depth interviews (28).

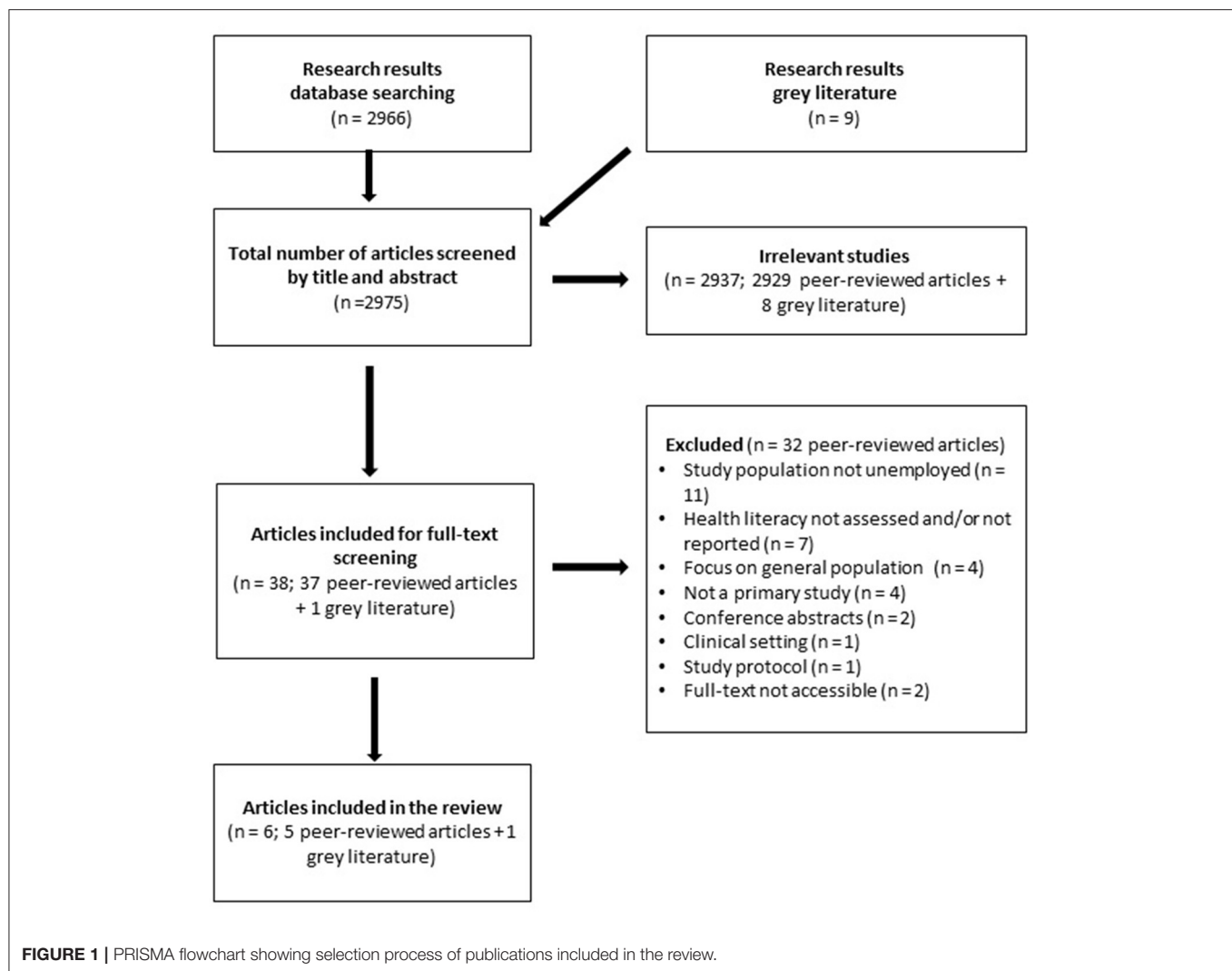
The report summarized results of an online survey to assess health literacy conducted among 4,764 members of the Barmer GEK health insurance company, 29.7% of whom were unemployed (31). Health literacy was measured using a self-developed questionnaire closely oriented to the professional self-efficacy scale.

### Summary of Findings of Studies Included in the Scoping Review

#### Information Seeking and Health Literacy Needs of Unemployed People

In the study by Perttilä and colleagues (26), the participants generally tended to seek information about health more often than about unemployment. In general, health-related information seeking was more prevalent among high and medium copers compared to low copers. Looking at coping strategies, health-information seeking was highest among high copers using a combination of emotion and problem-focused strategies compared to those using either emotion-focused or problem-focused strategies.

In the Barmer GEK survey (31), the average health literacy score among the unemployed was slightly higher than that for those employed. The data suggests that neither age nor gender differences explained this difference. The results of the survey indicate that expectations concerning success in staying healthy received the lowest score and may therefore be regarded as an area of need for an intervention.



## Mental Health Needs of Unemployed People

From the data synthesis, two major topics were identified regarding mental health needs of unemployed people, namely (a) potentially important intervention components for unemployed people and (b) facilitators and barriers of help-seeking among unemployed people with mental health problems.

The first topic was identified in the study by Santos and colleagues (27), with the participating psychologists and psychiatrists agreeing that the following aspects comprised important intervention components: promotion of MHL (mainly about anxiety, mood disorders and stigma about mental health), methods to challenge unemployment (as promotion of job searching skills through job interviewing training) as well as mental health promotion skills (self-regulation of emotions, effective communication training, awareness of skills and personal facets). Regarding the structure of the interventions, the experts recommended that these be conducted with small groups (up to 10 participants) and comprise more than 10 weekly 2-h sessions.

The studies conducted in Germany identified the second topic: barriers as well as facilitators of help-seeking among unemployed people with mental health problems. The barriers identified included: the fear of side effects of psychopharmacological treatment (rated as low MHL), ineffective psychiatric help, perceived discrimination by mental health care professionals, stigma in the social environment and general practitioners' (GPs) lack of interest in mental health problems. Facilitators of help-seeking identified were: gaining knowledge as motivation factor for treatment, awareness and acceptance of the illness, GP as facilitator and positive relationship between patient and therapist (28). Additionally, factors such as female gender, higher MHL, more depressive symptoms and more self-identification as having a mental illness significantly predicted increased help-seeking intentions (29).

## In-depth Semi-structured Interviews

Seven men and three women aged between 30 and 58 years took part in the interviews. Six of the interviewees were older than 50 years and three were younger than 40 years. Their duration

**TABLE 1 |** Characteristics and summary of findings of the five peer-reviewed and one gray literature source (31) included in the scoping review.

References, country	Study design/aims/outcomes	Participant characteristics	Health Literacy (HL) measurement/needs assessment	Findings
Perttälä et al. (26). Finland	<ul style="list-style-type: none"> <li>• Cross-sectional survey</li> <li>• <u>Aims:</u> Investigate information seeking practices and coping strategies of long-term unemployed via questionnaire; study link between coping functions and everyday life information seeking.</li> <li>• <u>Outcomes:</u> information seeking behavior, coping strategies for unemployment</li> </ul>	<ul style="list-style-type: none"> <li>• 750 long-term unemployed persons,</li> <li>• recruited via Ministry of labor</li> <li>• 73% &gt;54 years</li> </ul>	<ul style="list-style-type: none"> <li>• Participants asked how often they sought information about health on scale from 1 (try to avoid such information) to 6 (very often)</li> <li>• Questionnaires used to determine needs regarding information seeking relating to unemployment and health</li> </ul>	<ul style="list-style-type: none"> <li>• High mix-focused copers most active information seekers concerning both unemployment and health</li> <li>• Coping functions linked to information seeking practices of participants</li> <li>• High problem-focused copers significantly more active in information seeking than medium and low problem-focused copers</li> <li>• Mixed-focused copers most active regarding problem-specific information seeking</li> </ul>
Santos et al. (27). Portugal	<ul style="list-style-type: none"> <li>• Delphi technique (2 rounds)</li> <li>• <u>Aims:</u> Create expert consensus regarding how to develop and implement an intervention program for mental health promotion among unemployed people</li> <li>• <u>Outcomes:</u> Consensual items for mental health intervention for unemployed</li> </ul>	<ul style="list-style-type: none"> <li>• 46 experts (mental health; employment; temporary work; psychiatric disorders prevention)</li> <li>• recruited via snowball sampling</li> <li>• mean age: 48,17+-12.48 years</li> </ul>	<ul style="list-style-type: none"> <li>• Mental Health Literacy (MHL) defined as identifying signs and symptoms of depression, anxiety and stigma regarding mental health</li> <li>• Importance of contents and skills to be promoted by intervention rated via 5-point Likert scale (1 = totally disagree and 5 totally agree)</li> </ul>	<p>Important intervention components identified:</p> <ul style="list-style-type: none"> <li>• promotion of MHL (regarding anxiety, mood disorders and stigma)</li> <li>• methods to challenge unemployment (promotion of job searching skills through job-interviewing training)</li> <li>• mental health promotion skills (self-regulation of emotions, effective communication training, awareness of skills and personal facets)</li> <li>• preferred structure: small groups (up to 10 participants) on more than 10 weekly sessions (each 2 h)</li> </ul> <p><u>Main outcomes to be measured:</u></p> <ul style="list-style-type: none"> <li>• participants' satisfaction with intervention</li> <li>• indicators of mental health (as anxiety or general psychosocial functioning)</li> </ul>
Staiger et al. (28). Germany	<ul style="list-style-type: none"> <li>• Semi-structured interviews</li> <li>• <u>Aims:</u> Identify barriers to and facilitators of help-seeking and service use based on experiences of unemployed people with mental health problems</li> <li>• <u>Outcomes:</u> Experience with help-seeking and mental health service use with a focus on barriers and facilitators</li> </ul>	<ul style="list-style-type: none"> <li>• 15 (7 female / 8 male) unemployed persons with self-reported psychological distress</li> <li>• recruited via employment agencies and social organizations</li> <li>• aged 19-63 years (mean 48)</li> <li>• unemployed for 2 months to 15 years</li> </ul>	<ul style="list-style-type: none"> <li>• HL assessed as knowledge-related facilitators and barriers of service use, e.g. What do you know about mental health and its prevention? If you had a mental illness where would you seek help?</li> <li>• Experiences regarding stigma and discrimination, and needs concerning structures and conditions of health care also assessed</li> </ul>	<p><u>Main barriers of help-seeking:</u></p> <ul style="list-style-type: none"> <li>• fear of side effects of psychopharmacological treatment (low MHL)</li> <li>• ineffective psychiatric help</li> <li>• perceived discrimination by mental health care professionals</li> <li>• stigma in the social environment</li> <li>• GP's lack of interest in mental health problems</li> </ul> <p><u>Main Facilitators of help-seeking:</u></p> <ul style="list-style-type: none"> <li>• gaining knowledge as motivation factor for treatment</li> <li>• awareness and acceptance of illness</li> <li>• GP as facilitator and supporter</li> <li>• positive relationship between patient and therapist</li> </ul>

(Continued)



TABLE 1 | Continued

References, country	Study design/aims/outcomes	Participant characteristics	Health Literacy (HL) measurement/needs assessment	Findings
Waldmann et al. (29). Germany	<ul style="list-style-type: none"> <li>• Cross-sectional survey</li> <li>• <b>Aims:</b> Investigate the influence of MHL on help-seeking intentions and behaviors in unemployed people with mental health issues using questionnaire</li> <li>• <b>Outcomes:</b> MHL, depression-related knowledge and attitudes toward treatment and treatment options</li> </ul>	<ul style="list-style-type: none"> <li>• 301 unemployed persons with mental health problems (50.2% female)</li> <li>• mean age 43.7 years</li> <li>• recruited via employment agencies</li> <li>• average unemployment time 35.5 months</li> </ul>	<ul style="list-style-type: none"> <li>• MHL assessed using Mental Health Knowledge Schedule (MAKS), Depression Literacy Scale (DLS) and Depression with Suicidal Thoughts Vignette.</li> <li>• Help-seeking intentions and behaviors assessed using</li> <li>• General Help-Seeking Questionnaire (GHSQ)</li> </ul>	<ul style="list-style-type: none"> <li>• Higher MHL associated with increased help-seeking intentions and behaviors (from health professionals and from family and friends)</li> <li>• Age negatively associated with intentions to seek help from family and friends, while female gender positively associated</li> <li>• Having symptoms positively associated with seeking help from professionals but negatively associated with seeking help from family and friends.</li> </ul>
Wigand et al. (30). Germany	<ul style="list-style-type: none"> <li>• Longitudinal study</li> <li>• <b>Aims:</b> Assess predictors of help-seeking among unemployed people with mental health problems</li> <li>• <b>Outcomes:</b> Barriers and predictors of help-seeking, MHL, depressive symptoms, beginning of mental health treatment within 6 months after baseline survey</li> </ul>	<p><u>Baseline:</u></p> <ul style="list-style-type: none"> <li>• 301 unemployed persons with mental health problems (50.2% female)</li> <li>• mean age 43.7 years</li> <li>• recruited via employment agencies</li> <li>• average unemployment time 35.5 months</li> </ul> <p><u>Follow up:</u></p> <ul style="list-style-type: none"> <li>• 270 unemployed persons (50.7% female)</li> <li>• mean age 44 years</li> <li>• average unemployment time 36.4 months</li> </ul>	<ul style="list-style-type: none"> <li>• MHL assessed using the 8 treatment-related items of the 22-item DLS</li> <li>• Depressive symptoms were measured using the Patient Health Questionnaire</li> <li>• Frequency of symptoms assessed over the last 2 weeks (from 'not at all'/0 to 'nearly every day'/3): e.g., feeling tired or having little energy/interest/pleasure in doing things</li> </ul>	<ul style="list-style-type: none"> <li>• Following factors significantly predicted new help-seeking during follow-up period in different models:</li> <li>• female gender (Odds Ratio (OR): 1.82; 95% Confidence Interval (CI): 0.97-1.02)</li> <li>• more depressive symptoms (OR: 1.08, 95% CI: 1.02-1.14)</li> <li>• higher MHL (OR: 1.22; 95% CI: 1.03-1.46)</li> <li>• fewer non-stigma-related barriers (OR: 0.28; 95% CI: 0.12-0.63)</li> <li>• mental health service use at baseline (OR: 3.44; 95% CI: 1.57-7.57)</li> </ul>
Wieland and Hammes (31). Germany	<ul style="list-style-type: none"> <li>• Cross-sectional survey</li> <li>• <b>Aims:</b> Explore HL and the abilities of German citizens to cope with illnesses using online questionnaire (question part of a larger health report)</li> <li>• <b>Outcomes:</b> HL, psychological health type, health knowledge, health behavior</li> </ul>	<ul style="list-style-type: none"> <li>• 1417 unemployed people (from total of 4764 participants, all BARMER GEK health insurance company members)</li> <li>• mean age 61.3 years</li> <li>• 58.8% women</li> </ul>	<ul style="list-style-type: none"> <li>• HL determined via 10 different questions developed by Wieland &amp; Hammes (32). All questions ranked on a scale from 0 (it's not the case at all), to 4 (it's very often the case)</li> </ul>	<ul style="list-style-type: none"> <li>• unemployed had significantly higher HL compared to employed (2.61 vs. 2.53), but reported lower health status and health knowledge than employed persons</li> <li>• unemployed spent significantly more time weekly on health-related activities (2.84 vs. 2.47 h)</li> <li>• no difference observed between unemployed and employed persons regarding association between HL and health factors such as nutrition, physical activity, stress management and family/partnership, however, unemployed ascribed less relevance to the stated factors, except for physical activity. In particular stress management was accorded little relevance.</li> <li>• Participants with lower HL also spent less time on health-related activities</li> </ul>

of unemployment ranged from 5 to 19 years, and four of them had been unemployed for more than 15 years. All but one were native Germans.

The findings of the interviews are summarized hereafter according to the different health literacy aspects. The original versions of the quotes used are provided as **Supplementary File 10**.

### Finding Health-Related Information

The participants reported getting health-related information from various sources, including official health service providers such as the general physician, health insurance company and pharmacist, as well as digital and print media (**Table 2**). Seven of the ten participants also mentioned the social worker at the organization as a source of health information.

Nine out of 10 participants reported using the Internet as a source of health information, and five stated the Internet as their source of preference. Among those who preferred the Internet, the easy availability of information was the main reason given, especially in comparison to print media.

The participants generally reported searching the Internet for health information when requiring specific information. For instance, one participant reported how she had searched the Internet to try and understand more about colonoscopy after having been referred for the procedure. Another reported that his partner suffered from panic attacks and how information from the Internet had helped him realize that the condition does exist and also to understand it better. In general, digital media, together with the social worker at the “place of work”, health services, as well as family and friends were reported to facilitate access to health-related information (**Figure 2**).

The participants reported hardly any barriers related to finding health-related information. One participant reported not being able to find information about the origin of dairy food products on the packaging, while those who reported using health information from the Internet generally doubted the trustworthiness of the information. According to one participant:

*But the problem of the Internet is also; there I always have a but, because sometimes they also exaggerate. You read sometimes, for example: I have this, and I know how I feel, then I write that down there. The next person has the same, but describes it differently, because he feels differently. That's also the question: what to believe? (Interview 9, male, 39 years)*

The extent to which digital media was used as well as the purposes varied among the participants. For instance, one participant for whom nutrition and physical activity played a very important role followed advice from “influencers” on YouTube and Facebook.

*Well, to be honest, I admit that I watch a lot on the Internet and YouTube because of my wife. Because there is not only something about nutrition, but there are also all these people... influencers. Of course, you don't believe some of them because they want to sell their stuff, but I think some things are also true. They show you how to lose weight if you're overweight, what to eat, how many calories to eat and what not to eat. So I kind of take a lot from the Internet: YouTube, Instagram and Facebook. (Interview 9, male, 39 years)*

According to the participant, he however only “followed” people whose body image represented what he deemed to be physically fit.

*I look at these people more because of nutrition, to do sports. Because they explain to you that, if you want to train your abdominal muscles, for example, you first have to eat this and that, and train this for the exact goal. Or if you want to develop your chest muscles (...). Well, always these athletes, not only. ... I can't look at someone who looks like this [indicates an overweight person using arms] and explains to me about nutrition. Of course not. (Interview 9, male, 39 years)*

### Accessing Healthcare

All participants had health insurance coverage and hence did not have any formal difficulties accessing healthcare. Whereas some of the barriers mentioned pertained to individual participants, for example, medication co-payment, residential status and racism, aspects such as difficulties getting a timely appointment with a specialist, problems finding a therapist and the distance between the home and the physician's practice were mentioned by several participants.

When it comes to accessing healthcare, having a good relationship with one's doctor and having his/her support were generally reported to facilitate access to healthcare. A good relationship with the doctor was often linked with trust and feeling well-taken care of. In some cases, the doctor assisted with getting a timely appointment with a specialist.

The social worker at the “place of work” was also reported to facilitate access to healthcare, either by giving advice regarding where to go for help or assisting with the filling out of application forms for services required. One of the participants described this as follows:

*I mainly talk to Mrs. S [the social worker, for advice], because I think she is the one who also applies for [new orthopedic working shoes] or helps check what is possible. (Interview 6, female, 30 years)*

Referring to a time when she was not feeling well psychologically, the same participant went on to say:



*I talked to Mrs. S [the social worker] and tried to find [with her] a therapist again, because it would be better if I had one.*

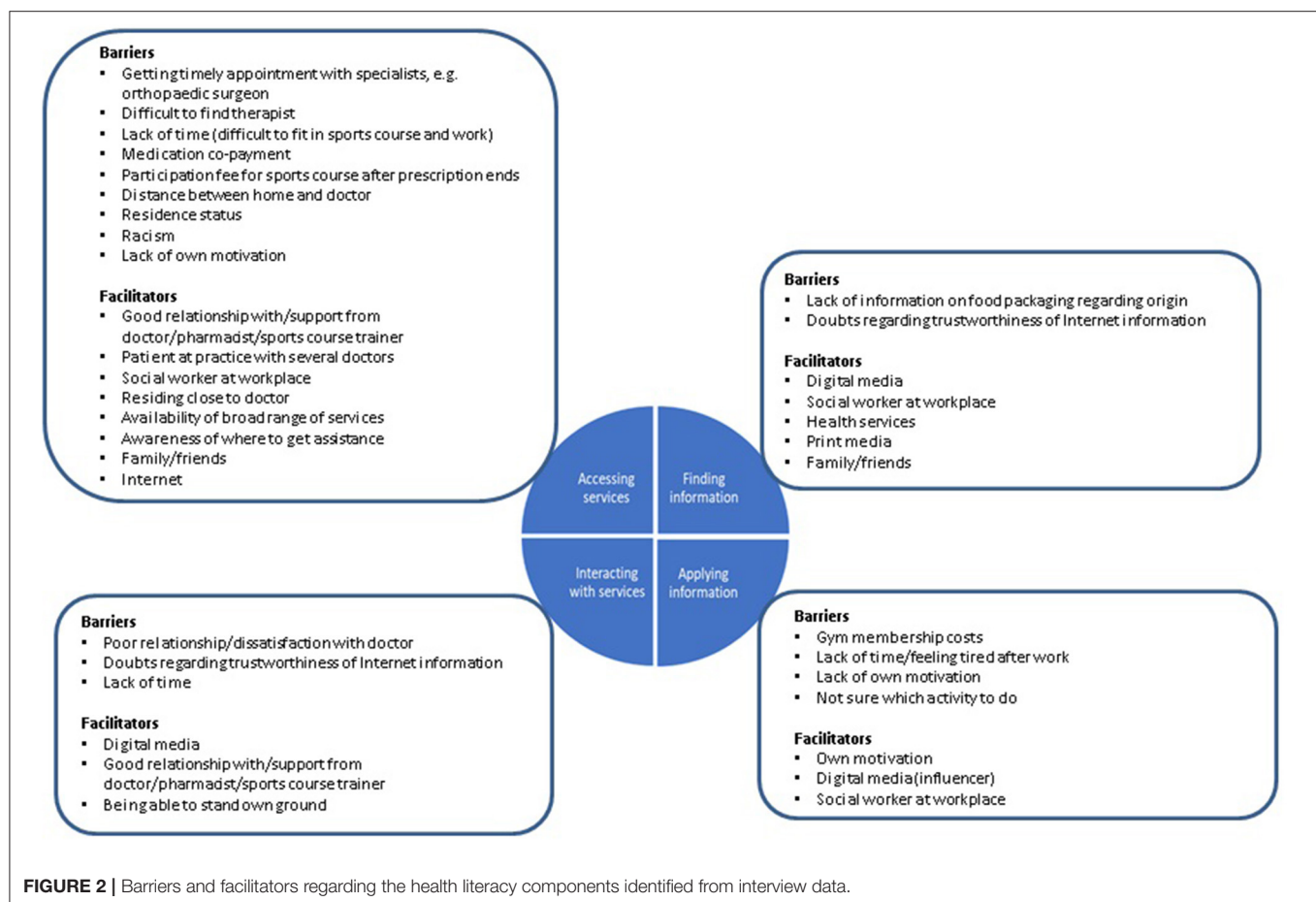
Other facilitators mentioned by the participants were the Internet, family and friends, as well as being a patient at a practice with more than one doctor (**Figure 2**). Examples of statements made by the participants regarding how the Internet facilitates access to health information are:

*Well, I guess the easiest way... because even with some doctors it's currently... is the Internet. I can say the Internet. Exactly. Although they are not doctors, but on the Internet, one really has a lot of information there. Whether one really believes it or not, but the information is there. (Interview 9, male, 39 years)*

**TABLE 2** | Sources of health information used as well as preferred by the qualitative interview participants.

	Internet/ digital media	Non-digital				
		Official health service provider	Workplace	Family and friends	TV/news/ magazines	Flyer, face-to-face
Interview 1						
Interview 2						
Interview 3						
Interview 4						
Interview 5						
Interview 6						
Interview 7						
Interview 8						
Interview 9						
Interview 10						

 Used sources of information.  
 Used and preferred sources of information.

**FIGURE 2** | Barriers and facilitators regarding the health literacy components identified from interview data.

### Use of /Interaction With Healthcare Services

A good relationship and support from the healthcare provider were not only reported to facilitate access to healthcare, but also use of services, respectively positive interaction with the healthcare provider (Figure 2). Participants with a good relationship to their healthcare provider generally reported being

satisfied with the interaction and services they received. While most of the participants referred to the doctor in this respect, one mentioned the pharmacist.

*I'd rather ask the doctor or the pharmacist. And that's also a decent man (The Pharmacist), he also takes a lot of time for the*

*people, that's good (...). Really, not just prescription, out, in, goodbye and... no, no, he still talks to the people. That's good. I think that is really cool. (Interview 1, male, 53 years)*

A further participant described how she had stopped attending a gymnastic course for her back because the trainer with whom she had a good relationship offered the course during her normal “working hours” and she could not get the time off. She had tried attending a course offered at a different time but did not feel as comfortable with the other trainer.

*The [aqua fitness] course with the trainer with whom I got along well was unfortunately during my “working hours”. That didn't work out so well with my working hours. (...)*

*I also once did the same course with another trainer (...), she was also quite friendly, that was also quite good, but somehow I didn't have the same connection to her (...), I somehow found it better with the other trainer. (Interview 6, female, 30 years)*

Dissatisfaction with the services received was mainly mentioned in relation to the participants feeling that the doctor was not paying them enough attention and was just dealing with them as if with numbers.

*At the doctor's (...) you go there, for example you can say “I have stomach ache today” and you get paracetamol. Tomorrow I go there and I say “I have a headache” and I get ibuprofen and paracetamol. They give you the same stuff, it's like that. Sometimes before I even go there I say, I'd rather go buy paracetamol. Because I know if I go, I'm going to get paracetamol. (Interview 9, male, 39 years)*

In most cases the dissatisfaction led to a change of doctors. One participant however reported how standing his own ground had helped him get the necessary treatment after consulting his doctor with longstanding throat pain.

*I was there 2 years ago, I had laryngitis. I knew that it was [not] a normal cough and he would prescribe me ACC Acute. I also told him that I don't need ACC and that it's been going on for a while. I can tell this is not normal. “Okay, then I'll give you a referral for the ENT specialist,” he said. And then I went and he said, yes, laryngitis and antibiotics. And I had told the doctor before “don't I need antibiotics or something?” (...) and he gave me ACC. (Interview 7, male, 52 years)*

Regarding preventive measures such as dental and medical check-ups, four of the 10 interviewees, all male, reported that they did not take part in any, not even the dental check-ups. The reasons given for not attending the latter were no time, childhood trauma and no need. The interviewee reporting no need said he had already lost almost all his teeth and was just waiting for one more to fall out, after which he would get dentures.

The other six interviewees reported at least going for dental check-ups, although one female interviewee did not do so annually, but rather now and again. All three female interviewees reported going for annual gynecological check-ups and two of them also went for general medical check-ups. Only one of the male interviewees reported participating in a further preventive

measure, namely, back training offered by the social worker at the work reintegration organization.

## Application of Health Information

The health information the interviewees mentioned in this regard mostly concerned nutrition and physical activity. Five of them specifically referred to the importance of both nutrition and physical activity, while a further three referred only to physical activity and one other only to nutrition. While some of the interviewees mentioned the social worker at the organization, digital media and personal motivation as facilitating factors (Figure 2), all of them reported difficulties when trying to put their knowledge into practice. A common barrier reported was time, respectively “work-related” difficulties, with some of the interviewees stating that their work was so physically demanding that they were too tired to prepare a healthy, balanced meal or do any physical activity after hours.

*During the week it's not so good, because in the evening I don't feel like cooking and here “at work” [in the canteen] there are hardly any vegetables. (Interview 7, male, 52 years)*

*I am exhausted [after “work”] because I also “work” physically. As already said, then there's something small to eat, not always healthy. When it has to be quick, it's a can [of food], but there is always an apple with it. (Interview 10, male, 54 years)*

The participant however also explained how he still tries to balance everything as follows:

*But I try somehow, as already said, to keep a well-balanced diet. The good thing here is that I have the exercise, so exercise and sports are actually always part of it, but I'm so busy here that during the weekend I somehow also... But I do have my quite good... quite well-balanced moments, where this eating, processing, the food, moving - without putting on weight - I'm diabetic. I am sometimes more or sometimes less disciplined. I know how it goes, I took part in a diabetic training course, I sometimes sin. But then again I have a day where I have to, I don't know, climb stairs a hundred times. I always try to balance things a bit and that works out quite well for me. (Interview 10, male, 54 years)*

Some interviewees also reported barriers specific to themselves, such as lack of own motivation:

*Well, theoretically everything is possible for me, but practically it is not so good. So, for example, at times I think I should actually be more physically active, but I don't do anything about it. That's the simple sentence... Well, because I do know, because I'm not 20 anymore and with 20 one simply didn't know certain things and now with over 50 one does know more and that's why, the problem is just the implementation. I can't really answer why. (Interview 5, female, 55 years)*

A similar personal barrier reported was feeling down:

*I've tried [to work] a little bit on nutrition itself, or I always try a bit not to eat too much sugar or too much fatty stuff, but when I really notice that I'm not feeling so good mentally at the moment,*



*then I eat whatever tastes good to me at that time. Be it the soggiest, greasiest burger or whatever.* (Interview 6, female, 30 years)

## Triangulation of Scoping Review and Qualitative Data

Throughout the interviews, most of the participants showed that they were quite knowledgeable about health topics such as nutrition and physical activity. The problem was rather putting the knowledge into practice. The main barrier mentioned in this regard was lack of motivation, particularly among those who lived alone. Several participants reported finding it difficult to find the energy to cook for themselves or do some physical activity alone.

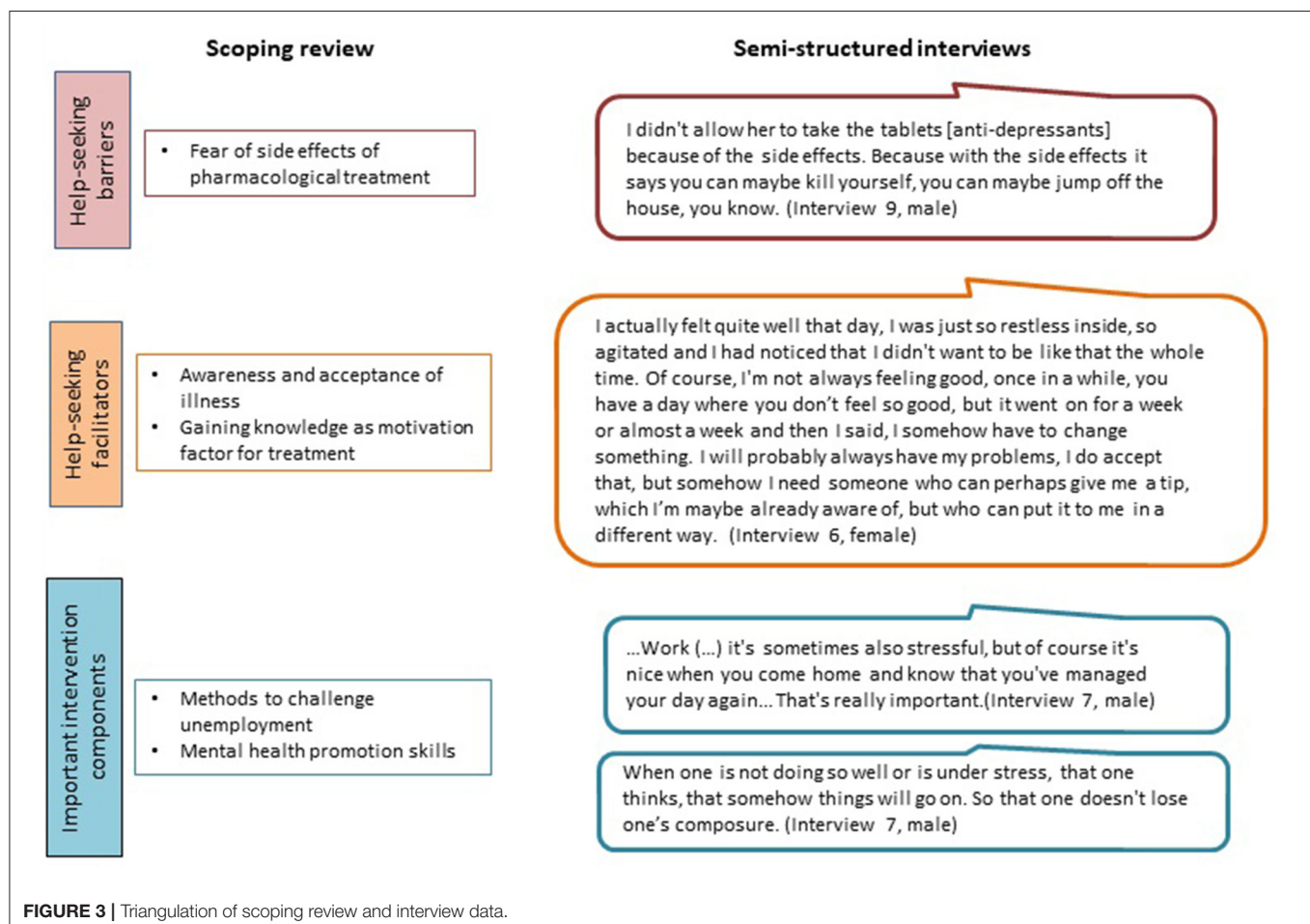
Although health was taken for granted by some participants, it was identified as one of the main sources of their quality of life. Regarding mental health, the results of the scoping review on some of the barriers and facilitators as well as intervention components identified as being important, resonated with some of the interview findings (Figure 3). This particularly concerned the fear regarding side-effects of antidepressants, the importance of being aware of one's condition and accepting it, and the significance of having a job, respectively something to do to help structure the day. The need for mental health promotion skills

was also identified during the interviews, with the participants mentioning active relaxation and avoiding stress as some of the topics of interest to them, in addition to nutrition and physical activity, among others.

Concerning facilitators of help-seeking when having mental health problems, health professionals such as the GP and therapist, and family and friends were identified as playing a role in both instances of the analysis.

## DISCUSSION

In this study, results from a scoping review and in-depth semi-structured interviews were triangulated to assess the health literacy needs of long-term unemployed persons. The triangulation process highlighted similarities between barriers and facilitating factors across these data sources. Although unemployment is generally associated with poor health and low health literacy (8, 13, 18, 19), our study participants were well-informed about health topics and relevant information sources, partly because of their own history of illnesses. Thus, finding and understanding health information was not a major issue among our participants. Rather, we identified applying health



information, i.e., developing or maintaining a healthy routine in everyday life, as the main problem.

While large parts of the general population probably face similar challenges regarding engaging in healthy lifestyles, the situation for long-term unemployed persons is compounded by various factors such as low economic resources and limited supportive social networks (33, 34). Our findings indicate that unemployed persons do not necessarily show low levels of health literacy, which is in line with the results of the report included in the scoping review, whereby unemployed persons on average had slightly higher health literacy scores compared to those employed (31). Recent results of a cross-sectional survey conducted in Austria also contradict the common assumption regarding employment and health literacy. In this study (35), the authors assessed general health literacy among adults residing in a disadvantaged district with high cultural and ethnic diversity as well as a considerably high unemployment rate, and compared it to adults residing in Vienna and to the general Austrian population. Health literacy was observed to be highest among participants from the disadvantaged district.

On the whole, most of the barriers and facilitators reported by our study participants concerning finding and applying health information, as well as accessing and interacting with services, correspond to those found in the population at large. As has been observed in other studies, having access to the Internet/digital media facilitated the finding of health-related information at the individual level (36–39), although some skepticism was also raised regarding the trustworthiness of online information.

## Practical Implications

This study was conducted as a first step in an intervention development process. There are several practical implications that can be derived from our analysis. While the identified literature mainly focused on mental health literacy, our study participants also highlighted healthy nutrition and physical activity as relevant topics. When designing intervention components, the main focus should be placed on applying health information in terms of developing healthy routines. The reintegration program seems to be a good place for promoting health literacy for a number of reasons. Firstly, the social worker at the organization appeared to be a relevant source of health information and may also provide cues to action to potential intervention participants. Further, intervention delivery at the organization would not only lower the threshold for taking part, the participants themselves could also be involved in the development and delivery of the intervention, for example as local champions for certain topics. Such participatory formats could also help to overcome motivational barriers and might increase participants' sense of having control over their own lives (6, 40, 41).

## Strengths and Limitations

The main strength of this study is the integration of findings from the literature and from qualitative interviews with long-term unemployed persons. Regarding the latter, taking an open approach, whereby study participants were asked for health topics of interest to them and then identifying their health literacy

needs from the interview data ensured that the perspective of the population group of interest was represented. The participatory approach further helped provide insight into barriers and facilitators as well as topics of interest to the study population that research has hardly focused on. A subsequent intervention development workshop with long-term unemployed persons will build on the insights gained, further supporting co-creation.

The fact that the interviews were conducted with participants of a workforce-reintegration program in Germany limits the generalizability of the findings to long-term unemployed persons in general, or in other countries, in particular those without workforce-reintegration programs. Our study population benefited from health-related activities offered as part of the reintegration program, which could have led to their relatively high levels of health literacy.

Another limitation is that all our participants were German-speaking. Long-term unemployed persons not able to speak or communicate sufficiently in German might face other difficulties dealing with health-related information or interacting with healthcare services.

The small number of articles identified by the scoping review limited the triangulation of the scoping review and qualitative data, especially as the identified literature mostly focused on mental health literacy. Further, the identified studies, including the gray literature, were all from Europe and did not include workforce-reintegration participants. This last aspect has possible implications regarding identification of barriers to application of health information. Our qualitative study identified barriers related to participating in the reintegration program, such as being tired or not having enough time, which were not identified by the scoping review. On the other hand, unemployed persons without access to reintegration programs may have more difficulties in finding and appraising health information. In addition, the three articles on mental health literacy with primary data were all from Germany, with two of them being based on the same study population. Nevertheless, as has already been discussed, our findings regarding barriers and facilitators are in line with the literature.

## CONCLUSION

Our results highlight a challenge to population-based health literacy interventions, that is, the need for interventions that not only aim to improve health literacy scores, but also help translate health literacy scores into practice. In countries where long-term unemployed persons are engaged in official job reintegration programs, the organizations running such programs can serve as low threshold intervention sites, with the unemployed themselves playing a central role in the design of the interventions.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the informed consent signed by the participants did not include their agreeing to their qualitative data being shared

publicly. Requests to access the datasets should be directed to Tilman Brand, brand@leibniz-bips.de.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee, University of Bremen (reference number 2020–26). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

BS, TB, and HZ conceptualized the study. HS, ML, JK, LC, and FS-Z were involved in the process of conducting the scoping review. FS-Z, TB, BS, HZ, ML, JK, and HS were involved in developing the qualitative study. FS-Z and HS conducted the interviews, which were coded and analyzed by FS-Z and ML, together with TB. FS-Z drafted the manuscript. All authors were involved in writing up the protocol of the scoping review, revised it critically, and approved the final version.

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.798797/full#supplementary-material>

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