Original Article

Health Literacy in Germany

Findings of a Representative Follow-up Survey

Doris Schaeffer, Eva-Maria Berens, Dominique Vogt, Svea Gille, Lennert Griese, Julia Klinger, Klaus Hurrelmann

Summary

Background: Studies have shown that the health literacy of the German population is low. The aim of this article is to analyze current developments in health literacy on the basis of recent data.

Methods: The Health Literacy Survey Germany 2 (HLS-GER 2) is a representative quantitative survey of the German-speaking resident population of Germany aged 18 and above. It was carried out in December 2019 and January 2020 by paper-assisted personal oral interview (PAPI). Data on health literacy and sociodemographic characteristics were acquired with an internationally coordinated questionnaire. The instrument for measuring general health literacy consisted of 47 questions that reflect an individual's ability to access, understand, appraise, and apply health-related information. The associations between general health literacy and sociodemographic factors were analyzed using bivariate and multivariate statistical tests.

Results: 58.8% of the participants had low health literacy, characterized by rating at least one-third of the questions as "difficult" or "very difficult." Many respondents stated that they had difficulties accessing (48.3%), understanding (47.7%), and applying (53.5%) information, and even more of them (74.7%) reported difficulties appraising information. The correlation coefficients reveal that health literacy is weakly associated with the following variables: age, sex, social status, literacy, level of education, financial deprivation, migration background, and the presence of one or more chronic diseases.

Conclusion: The findings of the HLS-GER 2 highlight the need for action in promoting health literacy in the healthcare system. As the explanation of variance is low, there are presumably other important determinants of health literacy that were not taken into account. Further studies should be performed to investigate societal conditions of supplying health information, for example, or social and personal characteristics.

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School of Public Health, Interdisciplinary Center for Health Literacy Research (ICHL), Bielefeld University, Bielefeld, Germany: Prof. Dr. phil. Doris Schaeffer, Dr. PH Eva-Maria Berens, Dr. PH Dominique Vogt, Svea Gille, MSc., Lennert Griese, MSc.

Institute of Sociology and Social Psychology (ISS), University of Cologne, Cologne, Germany:: Julia Klinger, MSc.

Hertie School – University of Governance, Berlin, Germany: Prof. Dr. rer. pol. Klaus Hurrelmann

Which competencies do people need to have today in order to cope with health problems and diseases—or, even better, to prevent these conditions and to deal with the information required to do this? For about ten years, this question has been discussed under the keyword "general health literacy". This refers to the ability of people to access, understand, appraise, and apply various types of health information in order to make judgments and take decisions in everyday life concerning coping with disease/health care, disease prevention and health promotion (1, 2).

Previous studies have shown that the health literacy of the German population is low (3–6). Follow-up surveys are needed to reveal the underlying factors responsible for this finding and to evaluate health literacy over time. Thus, six years after the first survey—the Health Literacy Survey Germany 1 (HLS-GER 1 [7])—, another health literacy survey—the Health Literacy Survey Germany 2 (HLS-GER 2)—was carried out, using advanced methods (8). So far, follow-up health literacy surveys have only been conducted in few countries. By repeating such surveys, trends in the changes can be identified which is increasingly important given the developments in the healthcare system and, above all, the dynamics in the field of information (9, 10). Since the first surveys on health literacy, digitalization has not only led to a surge in the number of information resources, but also to a vast expansion of the amount of health-related information available. At the same time, the amount of interest-driven, manipulated and false information has surged, as demonstrated by the current topic of COVID-19 (11). Along with this development, the so-called "infodemic" (12, 13), the requirements for dealing with health-related information and for the communication between doctors and patients have significantly increased.

The aim of this article is to analyze how health literacy has developed in the population in Germany, with a special focus on the challenges associated with the processing of information.

The questions are:

- What is the current status of health literacy?
- What are the challenges associated with information processing?
- What demographic and socioeconomic factors influence health literacy and the various steps of information processing?

Methods

This study is based on a representative quantitative survey of 2151 persons of the German-speaking resident population of Germany aged 18 and above *(Table 1)*.

The survey was carried out in December 2019 and January 2020, using the paper-assisted personal oral interview (PAPI) method. The study's design and methods build on the HLS-GER 1. The study is part of the Health Literacy Survey 2019 (HLS19) of the Action Network on Measuring Population and Organizational Health Literacy (M-POHL) of the World Health Organization Europe, which is currently being conducted in 17 countries (14).

Health literacy measurement is based on the European Health Literacy Survey Questionnaire with 47 questions (HLS-EU-Q47), which was revised and refined for the new survey (8). With this instrument (HLS19-Q47-DE), a person's self-assessed difficulties accessing, understanding, appraising, and applying health-related information was measured, using various information tasks.

In their responses to each of the 47 questions, the respondents could choose between the options "very easy", "easy", "difficult" and "very difficult". From their answers, score values were calculated. For the descriptive reporting of health literacy, the scores were categorized in four levels:

- Excellent (>83.3–100)
- Sufficient (>66.6–83.3)
- Problematic (>50–66.6)
- Inadequate (0–50).

Combined, the levels "problematic" and "inadequate" were referred to as "low health literacy". In addition, several sociodemographic data were obtained. The International Standard Classification of Education 2011 (ISCED-11) was used to determine the level of education. Social status was assessed based on the perceived position in society, using the image of a ladder with ten rungs. Financial deprivation was determined based on three questions, addressing perceived difficulties in paying for medications, medical treatments, and monthly bills. Migration background was defined as own or parental birth outside Germany. Chronic disease was identified by asking whether one or more chronic diseases (health problems persisting for more than six months) were present. Literacy skills were determined using an objective test, the Newest Vital Sign (NVS) (15).

Detailed information is provided in the *eMethods* section.

Results

Health literacy

Overall, 58.8% of the respondents (*Table 2*) had low health literacy (8). Significant differences were found between the various steps of information processing. For example, about half of the respondents had a low health literacy in terms of assessing (48.3%), understanding (47.7%) and applying information (53.5%). When it comes to appraising information, a particularly large proportion of the respondents (74.7%) have low health literacy (*Table 2*).

Determinants of health literacy

Health literacy is correlated with social status ($r = 0.172–0.243$, $p<0.001$), level of education ($r = 0.123–0.243$, $p<0.001$), financial deprivation ($r = –0.156$ to $–0.213$, $p<0.001$), and literacy ($r = 0.115–0.238$, $p<0.001$) (*Table 3*). Health literacy increases with higher social status and level of education as well as a higher level of literacy; it decreases with increasing financial deprivation.

Old age (76 years and older) is also associated with lower health literacy (general health literacy compared to 30–45-year-olds: $r = 0.239$, $p<0.001$; *eTable 1*).

Looking at the correlation between health literacy and chronic disease, it can be seen that especially the presence of multiple chronic diseases is associated with low health literacy (general health literacy: $r = –0.1$, $p<0.001$) (*Table 3, eTable 2*).

The broad multivariate analysis (*eTable 3*) confirmed these effects. Social status, literacy and financial deprivation are related to health literacy, both overall and in each of the four steps after adjustment for other variables in the model; however, the strength of the effects is sometimes weak and shows wide variation. The higher the social status ($\beta = 0.08–0.129$, $p<0.005$), the higher the health literacy ($\beta = 0.081–0.162$, $p<0.001$) and the lower the financial deprivation ($\beta = −0.088$ to $−0.109$, $p<0.001$), the better the health literacy. Likewise, the level of education is related to health literacy in each of the steps, except for the application of information, ($\beta = 0.078–0.134$, $p<0.001$): Health literacy increases with increasing level of education. Age is related to health literacy in that it affects how well respondents access ($p = 0.042$) and appraise information ($p = 0.009$). Older persons report more difficulties with these steps (*eTable3*). In the presence of multiple chronic diseases, age is only negatively related to health literacy in the information application step ($B = −6.309$, $p<0.001$). The same applies to migration background ($B = −2.962$, $p = 0.039$).

Discussion

The HLS-GER 2 carried out another representative survey of health literacy of the population in Germany, as often called for (10, 14). The results show that, with 58.8%, health literacy had declined compared to previous surveys (*eTable 4*). Comparability with earlier studies is limited because some of them used different methodologies and different questionnaire versions. Yet, it is evident that over the course of the last few years, the proportion of the population with a low level of health literacy has tended to increase. Thus, promotion of health literacy continues to be an important task of society and here the medical community has an important role to play.

It also became apparent that appraising information is particularly challenging. While this dimension already stood out in previous national (3, 5, 6, 7) and international (4, 16, 17) studies as the most difficult step in dealing with information, the gap to the other steps (accessing, understanding and applying) has significantly increased in the meantime. Current COVID-19-related studies have also shown that appraising information is the most challenging step (11).

This development is likely to be largely attributable to the expansion of health-related information and especially misinformation and interest-driven information which has increased to such an extent and at such a pace that internationally the term "information obesity" (18) has been adopted. Furthermore, information is often limited to mere factual information and it is left to the recipients to appraise it and apply it to their personal circumstances. Both can be overwhelming and unsettling; in addition, it impedes the application of information, which causes difficulties more often than in the past. In promoting health literacy, these increased demands on information processing should be given more intense attention in the future. The aim should be to ensure that information can be adequately received and used so that the variety of information does not abruptly turn into information aversion or produces other undesirable effects. This can, for example, be done by improving the quality of written information, but also by ensuring that physicians spend more time on communication and information dissemination and explain health-related content in detail and in an actionable form. Appropriate framework conditions should be created for this purpose.

Our analysis has once again underlined the importance of social determinants in processing health-related information: Low social status, low educational attainment, financial deprivation, and low literacy correlate with low health literacy. It should be noted, however, that the methods used in this study do not allow for conclusions about causality (17, 19, 20). Especially deprived population groups cannot or only with difficulty cope with the increased requirements for accessing, understanding, appraising, and applying information (3, 8, 21). Consequently, this, and the elimination of social inequality in general, continue to require considerable attention—and this is true for promoting health literacy as well. Furthermore, this also applies to everyday clinical practice, especially since doctors are still the most important source of information (22, 23) and they are often consulted when it cannot be determined how high the quality and reliability of information disseminated by the media is, especially of digital information. Here, trustworthy, easy-to-understand information with as few as possible technical terms, the use of conversational techniques, such as Teach-Back (*Box*), and sufficient time for communication and explanation are crucial.

TABLE 1

Characteristics of the HLS-GER 2 sample (n = 2151)*

Variable	M	SD	Min–Max
Age (in years)	50.82	18.47	18–92
Sex		%	n
Male		49.1	1056
Female		50.6	1089
No data		0.3	6
Level of education		%	n
Low (ISCED 0–2)		11.1	238
Intermediate (ISCED 3–4)		58.7	1263
High (ISCED 5–8)		28.2	607
No data		2.1	44
Migration background		%	n
No migration background		85.5	1838
Migration background		13.8	397
No data		0.7	15
Social status		%	n
Low (scores 1–4)		18.7	402
Intermediate (scores 5–7)		63.4	1364
High (scores 8–10)		15.1	325
No data		2.8	60
Chronic disease		%	n
No		47.7	1026
Yes, one		15.2	327
Yes, multiple		35.3	759
No data		1.8	39
Literacy		%	n
Highly likely to be limited (scores 0–1)		5.7	124
Potentially limited (scores 2–3)		18.7	403
Adequate (scores 4–6)		70.8	1522
No data		4.8	102
Financial deprivation		%	n
No difficulties reported		74.6	1583
One difficulty reported		10.6	228
Two difficulties reported		6.5	141
Three difficulties reported		10.2	219
No data		9.7	208

*Sample weighted: The population structure of the 2018 German Microcensus was considered with regard to sex, age, population density, federal state, and (higher) education.
HLS-GER 2, Health Literacy Survey Germany 2; ISCED, International Standard Classification of Education; Max, maximum; Min, minimum; M, mean; SD, standard deviation

TABLE 2

Descriptive statistics of general health literacy and stratified by steps of information processing

	HL overall		Access		Understand		Appraise		Apply	
M (SD)	61.81	(20.47)*	63.71	(23.32)	67.35	(23.49)	51.26	(26.86)	65.43	(21.59)
(Min-Max) n	(0–100)	2 150	(0–100)	2 141	(0–100)	2 149	(0–100)	2 146	(0–100)	2 142
Level of HL	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Inadequate	28.4	611	26.4	567	22.6	486	54.5	1172	23.3	501
Problematic	30.4	653	21.9	472	25.1	539	20.3	436	30.2	649
Sufficient	26.5	570	28.1	605	27.4	589	13.6	292	28.0	602
Excellent	14.7	315	23.1	497	24.9	535	11.4	246	18.1	390
No data	0.0	1	0.5	10	0.1	2	0.2	5	0.4	9

*Sample weighted: The population structure of the 2018 German Microcensus was considered with regard to sex, age, population density, federal state, and education.
HL, health literacy; Max, maximum; Min, minimum; M, mean; SD, standard deviation.

In addition, our study provides new, more detailed insights into the relevance of the various determinants of health literacy. For instance, previously chronic disease was generally considered to be an indicator of low health literacy (4, 7, 24). The new data now show that it is primarily the presence of multiple chronic diseases which is associated with low health literacy. Especially with the growing complexity of disease processes as the result of multimorbidity, the challenges of dealing with health-related information are also growing. This is true specifically for the application of information. It also has an impact on daily clinical practice, as it highlights the importance of discussing in detail with patients which measures should be taken as the result of (factual) information. This is of particular importance for patients with multiple chronic diseases, especially since they are often confronted with diverse and sometimes conflicting information which does not adequately take the interactions between their conditions or symptoms into consideration, making it difficult to assess how relevant the information is for practical application.

Similarly, this study provides new insights into the association between age and health literacy. In previous studies, old age was usually summarized as a general age of 65 years or older, an approach which does not do justice to the differentiation of the old-age stage of life (25, 26). Our new data allow an age-differentiated approach and confirm the assumption that low health literacy poses a challenge primarily to those aged 76 and older. In this age group, the risk of chronic diseases and multimorbidity also increases, making health literacy a top priority. This, and the difficulties in accessing and appraising information, which are particularly noticeable in this stage of life, should be considered more intensely when health literacy is being promoted. This can be accomplished, for instance, through target group-specific promotional activities and guidance on where to find and how to identify reliable information, e.g. by reference to www.gesundheitsinformation.de.

But even younger people are facing considerable difficulties when it comes to dealing with health-related information. This may be attributable to the fact that, due to their age, they have only been confronted with comparatively few health problems and related information so far. Thus, these results underscore the relevance of tailoring information and information strategies to the target age group.

The finding of this study that migration background is not generally associated with low health literacy—data from earlier studies pointed to such an association—also warrants discussion (27, 28). For this subgroup too, a more differentiated approach is required, as new data show that health literacy is particularly influenced by personal migration experiences and limited German language skills (29).

Summarizing, it becomes clear how important differentiated, in-depth analyses of health literacy and the various steps of information processing as well as associated factors are. This aspect has not been addressed adequately in previous studies. Our analysis helps to fill this gap in the research, thus making a valuable contribution not only in terms of new knowledge, but also in terms of promoting health literacy in everyday clinical practice.

Limitations

For a few years now, there have internationally been calls for follow-up measurements of health literacy to enable insights into trends; however, such surveys have rarely been carried out so far—here, the HLS-GER 2 Germany is an exception. The same applies to the (further) development of measuring instruments; HLS19 has also addressed this aspect (8). However, health literacy was primarily measured based on the self-assessed difficulty in dealing with health-related information. Although this approach has now been widely adopted in Europe and Asia, explanatory power

TABLE 3

Spearman's correlation between health literacy indices and covariables

	HL overall	Access	Understand	Appraise	Apply
Sex	0.041*	−0.002	0.037	0.062**	0.019
Age	−0.073**	−0.098**	−0.124**	0.017	−0.068**
Social status	0.239**	0.243**	0.220**	0.172**	0.196**
Literacy	0.201**	0.190**	0.238**	0.145**	0.115**
Level of education	0.231**	0.243**	0.258**	0.167**	0.123**
Financial deprivation	−0.213**	−0.202**	−0.202**	−0.156**	−0.182**
Migration background	−0.045*	−0.038	−0.031	−0.014	−0.055**
Multiple chronic diseases	−0.100**	−0.105**	−0.088**	−0.033	−0.147**
One chronic disease	0.020	0.027	0.017	0.015	0.017

This table shows the relationships between sociodemographic characteristics of the respondents and their health literacy. Based on the unweighted sample, the statistical relationships were calculated using Spearmen's correlation coefficient. Correlation coefficients can take values from −-1 to 1, expressing the direction and strength of the relationship between the variables. As can be seen, the coefficients are quite low which means that the correlations are only weak.

Specifically, the following correlations were found:
- Sex (1 = male, 2 = female). The positive values mean that women have almost consistently higher health literacy scores than men. Access to health-related information is the only deviation from this.
- Age (in years) The almost consistently negative values mean that health literacy decreases with increasing age. The only deviation from this is in the appraise step.
- Social status (self-assessed position in society; 1 = low to 10 = high): The positive values mean that with increasing self-assessed social status, health literacy also increases.
- Level of education (ISCED-11: 0 [primary school not finished] to 8 [doctorate]): The positive values mean that with increasing level of education, health literacy also increases.
- Financial deprivation (0–3 reported difficulties with paying for medicines, medical treatment and monthly bills): The negative values mean that with increasing difficulties with paying for medicines, medical examinations and monthly bills, health literacy decreases.
- Migration background (0 = no, 1 = yes): The negative values mean that persons with migration background have lower health literacy.
- One or more chronic diseases (dummy variable; reference group: no chronic disease): The negative values mean that persons with multiple chronic diseases have lower health literacy compared to persons without or with only one chronic disease.

HL, health literacy; ISCED-11, 2011 International Standard Classification of Education; * p<0.05; ** p<0.01

is restricted. Therefore, the self-assessment tool was complemented by the NVS test to also measure functional literacy (15). By using the two instruments in combination, it was possible to achieve a comprehensive view of health literacy in the population in Germany.

Other limiting factors include that the survey was conducted in German and that the number of respondents with migration background was not particularly high (n = 397, 13.8%) and analyzed combined in two categories (migration background: yes or no). This may explain why almost no differences in relation to migration background were found. Thus, there is a need for separate, migration-specific studies (31).

Overall, the included variables explain approximately 6% to 13% of the variance. With regard to appraising and applying health-related information, the considered variables contributed the least to explaining health literacy variance; the coefficient of determination R^2 was the lowest for these two steps. Thus, only small effects were identified. This suggests that important determinants of health literacy, such as social conditions that shape the information available, or social and additional personal characteristics (e.g. social support), have not yet been analyzed in this paper. The results of further data analyses planned as part of this study therefore remain to be seen.

Conclusion

The findings of this study highlight the need for action in promoting health literacy which exists both on a socio-political level and in the healthcare system. In fact, health literacy has long been a key skill that is considered essential to cope with disease, regain and maintain health, but also to deal with the infodemic, as it is highlighted in the National Action Plan Health Literacy in Germany (Nationaler Aktionsplan Gesundheitskompetenz) (33) and several documents of the World Health Organization (12, 13). While this is a task for society as a whole, in which actors from all areas of society should be involved, the healthcare professions, and especially the medical profession, play a particularly important role. Doctors remain the population's main point of contact for questions regarding health (information) (22, 23). This makes it all the more important that they intensify their commitment to this task and, in doing so, help to improve health literacy in Germany. Because if the healthcare professions and institutions do not get more involved in this, then: "[...] the market will respond as an advisor" (34) and there is an increased risk of incorrect and misinformation being spread.

BOX

Teach-back method

The teach-back method is a simple and effective interviewing technique in which „teach back" is used to verify whether patients have understood, remembered and can recall the information provided. This is how the method works: The person who has been provided with the information is asked to state this information in their own words. The aim is not to simply repeat what has been said, but to ensure that the content of the information has really been understood and retained. If not everything was understood, the advisor repeats the process. The internet platform teachbacktraining.org provides a quick introduction to the method.

Conflict of interest statement
The authors declare that no conflict of interest exists.

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Corresponding author
Prof. Dr. phil. Doris Schaeffer
Universität Bielefeld
Interdisziplinäres Zentrum für Gesundheitskompetenzforschung
Universitätsstraße 25
33615 Bielefeld
Germany
doris.schaeffer@uni-bielefeld.de

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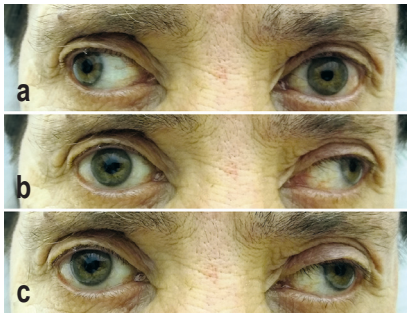
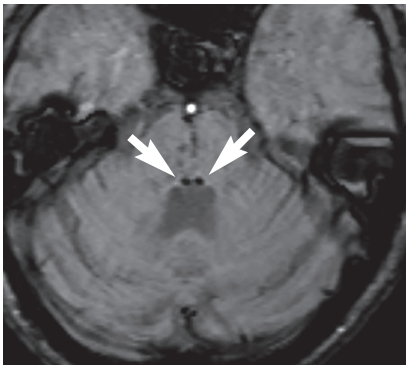
► **Supplementary material**

eMethods, eTables:
www.aerzteblatt-international.de/m2021.0310

CLINICAL SNAPSHOT

WEBINO Syndrome Caused by Bilateral Pontine Microhemorrhages





A 55-year-old man presented with acute-onset double vision. His blood pressure was 210/100 mmHg. Clinical signs included bilateral internuclear opthalmoplegia (INO) with adduction deficit of the left eye in right gaze *(Figure 1a)*, adduction deficit of the right eye in left gaze *(Figure 1b)*, and large-angle exotropia in primary gaze *(Figure 1c)*. 3T MRI revealed two symmetrical microhemorrhages (arrow) in the dorsal pons. These ran along the right and left medial longitudinal fasciculi *(Figure 2)* and had probably been caused by hypertension. We began targeted treatment to reduce blood pressure to below 140/90 mmHg. Bilateral INO together with exotropia of both eyes in primary gaze is known as WEBINO (wall-eyed binocular internuclear ophthalmoplegia) syndrome. This is an eye movement disorder caused by damage to both medial longitudinal fasciculi in the brain stem (pons or mesencephalon), usually due to inflammation or ischemia. Bilateral microhemorrhages in the pons have not previously been described as a cause of WEBINO syndrome. The patient's disordered eye movement improved over time; consequent unstable gait persisted.

Stephan Petrik, Dr. med. Johann Lambeck, Prof. Dr. med. Jürgen Bardutzky
Klinik für Neurologie und Neurophysiologie, Universitätsklinikum Freiburg
stephan.petrik@uniklinik-freiburg.de

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Supplementary material to:

Health Literacy in Germany

Findings of a Representative Follow-up Survey

by Doris Schaeffer, Eva-Maria Berens, Dominique Vogt, Svea Gille, Lennert Griese, Julia Klinger, and Klaus Hurrelmann

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eMETHODS

Additional information about the HLS-GER-2 study (8)

The first and second Health Literacy Survey Germany (HLS-GER 1 and HLS-GER 2) adopted the conceptual model described by Sørensen et al. (2012) (2) which was developed for the European Health Literacy Survey (HLS-EU). In this model, health literacy is based on literacy and includes the knowledge, motivation and competences to deal with health-related information in three domains:

- Coping with disease/healthcare
- Disease prevention
- Health promotion.

The investigation into how health-related information is dealt with looks at four steps of information processing: accessing, understanding, appraising, and applying/using health-related information to maintain one's health.

The conceptual model developed by Sørensen et al. illustrates that health literacy is associated with a number of determinants and health consequences. These include demographic and socioeconomic factors, but also situational factors, which in turn are closely related to societal and environmental factors. This is reflected in the term „relational character" which is used to describe this conceptual model.

As before in the HLS-GER 1 conducted in 2014, health literacy was measured using the European Health Literacy Survey Questionnaire with 47 questions (HLS-EU-Q47); in the HLS-GER 2, however, a refined version of the questionnaire was used (see Schaeffer et al. 2021 [7]). The questionnaire HLS-EU-Q47, which is now widely used internationally, measures the self-assessed problems of a person to deal with 47 concrete, health-related information task and requirements and looks at the competences accessing, understanding, appraising, and applying health-related information in the domains coping with disease and healthcare, disease prevention, and health promotion.

As specified in the international comparative study for the calculation of the health literacy indices, first the responses were dichotomized ("easy" and "very easy" combined), then added up and scaled to 100. Thus, the index specifies the percentage of the items which were answered as "easy" or "very easy". A requirement for calculating an index was that at least 80% of the items belonging to the (sub) index had to be answered. Based on the health literacy indices, subsequently four levels of competence are defined. The absolute cut-offs for creating the various levels are set at one-half, two-third and five-sixths of the index. With a Cronbach's alpha of 0.92, the instrument has good internal consistency.

The study is based on a representative quantitative cross-sectional survey of the German-speaking resident population of Germany aged 18 and above. The survey was carried out using paper-assisted personal oral interviews (PAPI). For the data collection part of the HLS-GER 2 conducted from December 2019 to January 2020, the Allensbach Institute for Public Opinion Research (Institut für Demoskopie Allensbach)

contacted altogether 3985 persons with the help of 558 interviewers according to the quota targets. Of the persons contacted, 1232 persons declined to participate in the survey. A further 591 interviews were not conducted because the quota targets had already been met. All interviews that were started were completed, so a total of 2162 interviews were conducted. After adjustments (exclusion of interviews in which less than 80% of the core questions were answered as well as interviews with unusually monotonous response behavior or unusual similarity of the interviews of a specific interviewer), 2151 interviews were included in the analyses. The response rate was 63.4%. The mean interview duration was 65 minutes.

In order to ensure that the data were representative and to compensate for any bias resulting from differences in willingness to participate in specific population groups, factorial weighting was applied to the sample structure, in addition to the quota targets, and the sample structure was then adjusted to the official statistics for the Microcensus 2018.

Analysis

The SPSS 27.0 software package was used for all analyses. The sample description, the prevalence rates of the various health literacy levels and scores as well as the individual steps of information processing are reported. In addition, Spearman's correlation analyses and multivariate linear regression models for general health literacy as well as the various steps of information processing were calculated. The dependent variable was the respective health literacy score. The independent variables were the mentioned sociodemographic determinants with a significant association in at least one of the information processing steps in the bivariate analyses.

Here, the strength of the effect should also be taken into account. According to Cohen (1992), values of $r = 0.10$ represent a weak effect, of $r = 0.30$ a moderate effect and $r = 0.50$ a large effect.

eTABLE 1

Descriptive statics of health literacy (score) overall and for each information processing step, stratified by age group

	HL overall	Access	Understand	Appraise	Apply
Age	**M (SD) N**	**M (SD) N**	**M (SD) N**	**M (SD) N**	**M (SD) N**
18–29 years	61.04 (20.26) 361	63.48 (22.46) 358	67.53 (23.80) 361	47.46 (26.90) 361	66.63 (20.91) 360
30–45 years	64.38 (19.48) 493	67.56 (21.03) 490	71.00 (22.03) 493	52.44 (27.04) 492	66.80 (21.28) 492
46–64 years	63.60 (19.68) 685	65.38 (22.82) 683	69.75 (22.58) 684	53.61 (26.17) 683	66.17 (21.01) 682
65–75 years	60.89 (20.86) 341	61.99 (23.88) 338	63.83 (23.74) 340	52.54 (26.30) 339	65.45 (22.35) 339
≥ 76 years	54.24 (22.70) 252	53.98 (26.55) 252	57.86 (24.88) 252	46.62 (28.51) 252	59.21 (22.98) 250
p value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

p values describe the significances of the comparisons of means (analysis of variance, ANOVA). The scores indicate the percentage of the questions which were answered as "easy" or "very easy". The higher the score, the higher the health literacy. Scores up to 66.6 indicate low health literacy; scores > 66.6 indicate high health literacy. HL, health literacy; M, mean; N, number; SD, standard deviation

eTABLE 2

Descriptive statics of health literacy (score) overall and for each information processing step, stratified by presence of chronic diseases

	HL overall	Access	Understand	Appraise	Apply
Presence of chronic diseases	**M (SD) N**	**M (SD) N**	**M (SD) N**	**M (SD) N**	**M (SD) N**
No chronic disease	64.44 (19.92) 1 010	66.68 (21.98) 1 006	69.84 (23.50) 1 009	52.91 (26.94) 1 008	68.90 (20.59) 1 008
One chronic disease	63.47 (19.88) 334	65.55 (23.46) 330	69.20 (21.77) 334	52.91 (27.09) 334	66.79 (21.08) 333
Multiple chronic diseases	59.52 (20.65) 772	61.32 (23.63) 769	65.14 (23.52) 771	50.45 (26.14) 769	61.45 (22.07) 768
p value	<0.001	<0.001	<0.001	0.212	<0.001

p values describe the significances of the comparisons of means (analysis of variance, ANOVA). The scores indicate the percentage of the questions which were answered as "easy" or "very easy". The higher the score, the higher the health literacy. Scores up to 66.6 indicate low health literacy; scores > 66.6 indicate high health literacy. HL, health literacy; M, mean; N, number; SD, standard deviation

eTABLE 3

Determinants of health literacy overall and by steps of information processing—results of multivariate linear regressions

	B	[95% CI]	β	p
General health literacy				
Constant	35.815	[27.101; 44.530]		<0.001
Sex	2.387	[0.649; 4.124]		**0.007**
Age	0.299	[0.002; 0.596]	0.270	**0.048**
Age²	−0.004	[−0.007; −0.001]	−0.340	**0.013**
Literacy	1.612	[1.048; 2.175]	0.132	**<0.001**
Level of education	1.160	[0.609; 1.712]	0.103	**<0.001**
Social status	1.486	[0.808; 2.164]	0.118	**<0.001**
Financial deprivation	−2.175	[−3.185; −1.164]	−0.109	**<0.001**
Migration background	−1.534	[−4.096; 1.028]		0.240
Multiple chronic diseases	−1.960	[−4.104; 0.184]		0.073
One chronic disease	0.801	[−1.746; 3.348]		0.537
Adjusted R^2	0.115			
Access				
Constant	36.138	[26.254; 46.022]		**<0.001**
Sex	0.776	[−1.191; 2.743]		0.439
Age	0.349	[0.012; 0.685]	0.278	**0.042**
Age²	−0.005	[−0.008; −0.001]	−0.386	**0.005**
Literacy	1.752	[1.114; 2.390]	0.127	**<0.001**
Level of education	1.501	[0.876; 2.126]	0.118	**<0.001**
Social status	1.837	[1.069; 2.605]	0.129	**<0.001**
Financial deprivation	−1.982	[−3.128; −0.837]	−0.088	**0.001**
Migration background	−2.310	[−5.217; 0.597]		0.119
Multiple chronic diseases	−0.769	[−3.196; 1.657]		0.534
One chronic disease	1.688	[−1.203; 4.578]		0.252
Adjusted R^2	0.119			
Understand				
Constant	39.759	[29.758; 49.760]		**<0.001**
Sex	3.102	[1.106; 5.099]		**0.002**
Age	0.200	[−0.141; 0.542]	0.157	0.249
Age²	−0.004	[−0.007; 0.000]	−0.283	**0.038**
Literacy	2.277	[1.630; 2.924]	0.162	**<0.001**
Level of education	1.741	[1.107; 2.375]	0.134	**<0.001**
Social status	1.302	[0.524; 2.080]	0.090	**0.001**
Financial deprivation	−2.241	[−3.402; −1.081]	−0.097	**<0.001**
Migration background	−2.015	[−4.964; 0.935]		0.180
Multiple chronic diseases	0.369	[−2.095; 2.832]		0.769
One chronic disease	2.062	[−0.864; 4.988]		0.167
Adjusted R^2	0.126			
Appraise				
Constant	14.759	[2.632; 26.886]		**0.017**
Sex	4.452	[2.032; 6.873]		**<0.001**
Age	0.555	[0.141; 0.969]	0.372	**0.009**

Age²	−0.005	[−0.009; −0.001]	−0.359	**0.011**
Literacy	1.387	[0.602; 2.173]	0.084	**0.001**
Level of education	1.178	[0.408; 1.947]	0.078	**0.003**
Social status	1.357	[0.414; 2.301]	0.080	**0.005**
Financial deprivation	−2.374	[−3.780; −0.967]	−0.088	**0.001**
Migration background	0.833	[−2.740; 4.406]		0.647
Multiple chronic diseases	−1.699	[−4.687; 1.289]		0.265
One chronic disease	0.797	[−2.749; 4.343]		0.659
Adjusted R^2	0.057			
Apply				
Constant	56.563	[49.813; 63.314]		**<0.001**
Sex	1.171	[−0.733; 3.076]		0.228
Age	−0.026	[−0.087; 0.035]	−0.022	0.409
Age²	*			
Literacy	1.056	[0.440; 1.671]	0.081	**0.001**
Level of education	0.095	[−0.503; 0.693]	0.008	0.756
Social status	1.428	[0.688; 2.169]	0.106	**<0.001**
Financial deprivation	−2.315	[−3.422; −1.208]	−0.108	**<0.001**
Migration background	−2.962	[−5.773; −0.151]		**0.039**
Multiple chronic diseases	−6.309	[−8.659; −3.958]		**<0.001**
One chronic disease	−1.285	[−4.072; 1.502]		0.366
Adjusted R^2	0.076			

B, unstandardized coefficient; β, standardized coefficient; values in bold: p<0.05.
95% CI, 95% confidence interval

Sex: 1 = male, 2 = female; age: in years, age²: included as a squared term because of the increase in health literacy until middle age with subsequent decrease (*eTable 1*), literacy: 0–6 correct responses in the Newest Vital Sign (NVS) test; level of education (ISCED-11: 0 [primary school not finished] to 8 [doctorate]); social status (self-assessed position in society): 1 = low to 10 = high; financial deprivation: 0–3 reported difficulties with paying for medicines, medical treatment and monthly bills; migration background 0 = no migration background, 1 = migration background; chronic disease: dummy variable, reference group: no chronic disease; adjusted R^2: The higher the value, the better the model fits the data.

*No squared term was included because of the rather linear relationship here (*eTable 1*).

This table shows the adjusted relationships between sociodemographic characteristics of the respondents and their health literacy. For this, the individual health literacy scores (see *Methods* section), which can assume values between 0 and 100, were used as dependent variables in multivariate linear regressions. The unstandardized coefficients indicate the estimate of the average change in the score value that occurs with the corresponding values of the respective variables. The correlation with the remaining independent variables of the model is kept constant—in this case specifically at the value 0. The results are based on the unweighted sample. Real data are used; however, the results themselves are estimates and thus will be described below in the subjunctive. In each case, the assumption is that all other factors remain the same ("ceteris paribus").

Legend: From the regression analysis for general health literacy, it can be read (analog for the other models):
- Sex: Women would, on average, have a score 2.387 points higher than men.
- Age: Due to the addition of the squared age term, the interpretation is somewhat more complex, because both coefficients have to be summed up. The positive value of the normal age variable indicates that health literacy increases with increasing age (0.299 score points per year; in the example at 50 years: [0.299 × 50] 14.95 points). The negative B coefficient of the squared age term confirms the assumed inverted U-shaped relationship *(eTable 1)* between age and health literacy: While health literacy initially increases with age, it subsequently decreases with advancing age.
- Literacy: For each correctly answered question, the health literacy value would be higher by 1.612 points.
- Level of education: With each level of higher educational attainment, the health literacy value would be higher by 1.160 points.
- Social status: With each additional level of self-assessed social status, the health literacy value would be higher by 1.486 points.
- Financial deprivation: Any further payment difficulty would be associated with a 2.175 points lower health literacy value.
- Migration background: Among persons with migration background, the health literacy value would be lower by 1.534 points. However, the p value indicates that this difference may only occur by chance in the analysis.
- Chronic diseases: Compared to persons without chronic disease, persons with multiple chronic diseases would have a 1.96 points lower health literacy value and persons with one chronic disease a 0.801 points higher health literacy value. However, the p value indicates that this difference may only occur by chance in the analysis.
- The adjusted R^2 is 0.115, which means that 11.5% of the variance of the total health literacy score can be explained by means of the independent variables included in the model. As this is a rather low percentage, it indicates that there are diverse other determinants of health literacy which were not included in this study.

eTABLE 4

Population-based studies on health literacy

Study	Time of measurement	Subject	Proportion of low health literacy
HLS-GER 1	July/August 2014	Representative study to establish the health literacy of the population in Germany N = 2000 (aged 15 and above)	54.3%
HLS-GER 1'	August/September 2020	Establishing the health literacy of the population in Germany over time N = 504 (aged 18 and above) Direct comparison with HLS-GER 1	64.2%
HLS-GER 2	December 2019/ January 2020	Extended representative study on health literacy of the population in Germany N = 2000 (aged 18 and above) Advanced methods	58.8%
HLS-GER 2'	September/October 2020	Additional survey to HLS-GER 2: Health literacy during the corona pandemic and trend analysis N = 500 (aged 18 and above) Direct comparison with HLS-GER 2	55.9%

Direct comparison HLS-GER 1 vs. HLS-GER 1' (2014/2020) (22). This comparison shows that health literacy in the population in Germany has deteriorated. Since this comparison is based on the same survey and analysis methods, it provides the most reliable evidence of the deterioration.
HLS-GER 2 with the added survey HLS-GER 2' (both from 2020; conducted before and during the corona pandemic using advanced survey and analysis methods) (7). Even with the advanced methods, HLS-GER 2 still indicates that health literacy continues to deteriorate. A direct comparison of the results of the HLS-GER 2 versus HLS-GER 2' shows that health literacy has slightly improved during the corona pandemic (7).
HLS-GER, Health Literacy Survey Germany