

RESEARCH

Open Access



Association between multiple chronic conditions and insufficient health literacy: cross-sectional evidence from a population-based sample of older adults living in Switzerland

Maud Wieczorek^{1*}, Clément Meier^{2,3,4}, Sarah Vilpert^{3,4}, Robert Reinecke⁴, Carmen Borrat-Besson⁴, Jürgen Maurer^{1,3} and Matthias Kliegel^{1,5}

Abstract

Background Health literacy is the ability to find, understand, assess, and apply health information. Individuals suffering from multiple chronic conditions have complex healthcare needs that may challenge their health literacy skills. This study aimed to investigate the relationship between multimorbidity, the number of chronic conditions, and health literacy levels in a sample of adults aged 58+ in Switzerland.

Methods We used data from 1,615 respondents to a paper-and-pencil questionnaire administered as part of wave 8 (2019/2020) of the Survey of Health, Ageing and Retirement in Europe (SHARE) in Switzerland. Health literacy was measured using the short version of the European Health Literacy Survey questionnaire. The final score ranged from 0 to 16 and was categorised into three health literacy levels: inadequate (0–8), problematic (9–12), and sufficient (13–16). The number of chronic conditions was self-reported based on a pre-defined list. Associations were examined using multivariable ordinary least squares and ordered probit regression models, controlling for key socio-demographic characteristics.

Results Overall, 63.5% of respondents reported having at least one chronic condition. Respondents who reported one, two, and three or more chronic conditions were more likely to have lower health literacy scores compared to respondents who did not report any chronic condition ($p<0.05$, $p<0.01$, and $p<0.001$, respectively). Suffering from two and three or more chronic conditions (vs. no chronic condition) was significantly associated with a higher likelihood of having inadequate or problematic health literacy levels (both p -values <0.01).

Conclusions Our findings suggest a need to improve health literacy in older adults suffering from chronic conditions. Improved health literacy could constitute a promising lever to empower individuals to better self-manage their health to ultimately reduce the double burden of chronic diseases and insufficient health literacy in this vulnerable population.

Keywords Health literacy, Chronic conditions, Multimorbidity, Older adults

*Correspondence:

Maud Wieczorek

maud.wieczorek@unil.ch

Full list of author information is available at the end of the article



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

Background

Chronic conditions and multimorbidity cause many challenges in aging populations [1, 2]. At the biological level, aging results from the accumulation of molecular and cellular damages over time [3], which lead to gradual decreases in physical and mental abilities and an increased susceptibility to chronic diseases [4, 5]. In addition to age, chronic diseases have other shared risk factors, including smoking, alcohol consumption, and increased body mass index [6]. Complications of one initial disease can cause other chronic diseases, ultimately leading to multimorbidity [7, 8]. Multimorbidity is associated with subjective cognitive impairment [9], functional decline [10], altered health-related quality of life [11], and an increased risk of mortality [12] in older adults. Besides being a personal burden, chronic conditions represent a complex, long-term challenge for healthcare systems and healthcare providers [13, 14]. The resulting need for novel approaches to manage these conditions more effectively has placed the challenge of good health literacy among the top priorities in public health and policy research [15].

Health literacy is defined as the degree to which individuals have the capacity to find, understand, assess, and apply health information [16]. Recently, the World Health Organization and scientific journal editors called for action to enhance health literacy and identify its correlates, specifically among older adults and other vulnerable groups, including individuals with chronic conditions [17–19]. So far, low health literacy levels have been linked to unfavourable health behaviours and other adverse outcomes, including poorer adherence to physical activity guidelines [20] and medication treatment [21], and an increased number of doctor visits [22] and hospitalizations [23]. Therefore, health literacy constitutes an important determinant of health and healthcare use, especially in the context of chronic conditions and their related complex care needs. Having sufficient health literacy levels is key for individuals to comprehensively manage their chronic conditions daily, to make more autonomous and informed decisions regarding healthcare, and to navigate the healthcare system [24].

Previous cross-sectional studies reported that individuals with chronic conditions or multimorbidity tended to have lower levels of health literacy than individuals with one or no chronic condition [25–29]. Specific difficulties concerned the understanding health information, active engagement with healthcare providers [26] and low levels of critical health literacy (i.e. skills for critically analyzing and reflecting on information or advice received) [29]. This emerging literature currently suffers from three major limitations. First, most of the existing studies included only a limited number of chronic conditions

in their assessments. Second, many studies did not specifically focus on older adults, which are specifically vulnerable to (multiple) chronic conditions. Finally, very few studies examined the association between the absolute number of chronic conditions and health literacy levels in older age [26]. The current study set out to address those limitations and aimed to investigate the relationship between multimorbidity, the number of chronic conditions, and health literacy levels in a population-based sample of adults aged 58 years and older living in Switzerland.

Methods

Study design and participants

We used data from the Survey of Health, Ageing, and Retirement in Europe (SHARE). SHARE is a multidisciplinary and longitudinal population-based survey of older adults aged 50 and older across 28 European countries and Israel [30]. Individuals who are incarcerated, hospitalized or out of the country during the entire survey period as well as persons who are unable to speak the country's language(s) or who have moved to an unknown address are excluded from the survey [30]. At each biennial wave, internationally harmonized computer-assisted personal interviewing was used to collect data on health, socioeconomic status, social, family networks, and other life circumstances. In addition, participants were invited to complete a country-specific paper-and-pencil questionnaire.

The present study used data collected during the eighth wave of SHARE Switzerland, from October 2019 to March 2020 [31]. In total, 2,005 older adults living in Switzerland and their partners participated in the face-to-face interviews, and 94% of them ($n=1,891$) also completed a self-administered country-specific questionnaire, which contained an assessment of respondents' health literacy. At the time of sampling, SHARE Switzerland was designed to be nationally representative of community-dwellers aged 50 and over and their partners. To maintain the representativeness of the sample, periodic refreshments have been performed. Since the last refreshment of the Swiss sample took place in 2011, survey participants aged 50 to 58 in 2019/2020 could only enter SHARE as partners of target respondents such that those survey participants were therefore not representative of the general population aged 50-58. For this reason, the present study only included respondents, or their partners, aged 58 years and over in 2019/2020. After excluding 114 respondents who did not complete the paper-and-pencil questionnaire, 28 respondents younger than 58 years old, and 248 respondents with one or more missing answers on the outcome, exposure variables, or

covariates, the final analytical sample consisted of 1,615 individuals.

Outcomes

The Switzerland-specific paper-and-pencil questionnaire assessed health literacy through the short version of the European Health Literacy Survey questionnaire (HLS-EU-Q16) [32]. This questionnaire consists of 16 items related to concrete health-relevant tasks or situations that respondents rate using a four-point Likert scale ranging from “very easy”, “fairly easy”, “fairly difficult”, to “very difficult”. As described by Pelikan et al., each item was dichotomized, with a value of “0” for the categories “fairly difficult” and “very difficult” and a value of “1” for “very easy” and “fairly easy” [33]. If the overall number of item non-response did not exceed two, missing item values were replaced by 0 [34]. The health literacy total score was calculated by summing the values of each item only for respondents who answered at least 14 items and ranges from 0 to 16. Three categories of health literacy levels were derived from the total score: inadequate health literacy levels (0–8), problematic health literacy levels (9–12), and sufficient health literacy levels (13–16) [33]. Additionally, as health literacy is a multidimensional construct, seven subindices related to three domains (coping with disease/healthcare, disease prevention, health promotion) and four stages of literacy concerning health information processing (accessing health information, understanding health information, processing health information, applying health information) were derived from the scale (Appendix 1). Following an approach suggested by Sørensen et al. [35], the health literacy total score and the seven subindices were standardized to harmonized metrics from 0 to 50 to ease the interpretation and comparison of the results.

Exposures

The number of chronic diseases and multimorbidity, defined as the coexistence of two or more chronic conditions [36], were the main exposures. Information on diseases and chronic conditions were self-reported. Participants were handed a show card with a list of specific chronic conditions and asked: “Has a doctor ever told you that you had / Do you currently have any of the conditions on this card? With this, we mean that a doctor has told you that you have this condition and that you are either being treated for or bothered by this condition” [31]. The card had 17 conditions and diseases: 1. Heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure, 2. High blood pressure or hypertension, 3. High blood cholesterol, 4. Stroke or cerebral vascular disease, 5. Diabetes or high blood sugar, 6. Chronic

lung disease such as chronic bronchitis or emphysema, 7. Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers, 8. Stomach or duodenal ulcer, peptic ulcer, 9. Parkinson’s disease, 10. Cataracts, 11. Hip fracture, 12. Other fractures, 13. Alzheimer’s disease, dementia, organic brain syndrome, senility, or any other serious memory impairment, 14. Other affective or emotional disorders, including anxiety, nervous or psychiatric problems, 15. Rheumatoid Arthritis, 16. Osteoarthritis, or other rheumatism, 17. Chronic kidney disease. The respondents could additionally specify other conditions not mentioned on the list. Any other declared chronic disease was included in the chronic disease count as well.

Covariates

The key covariates considered in the present study were common socio-demographic variables, including sex (men, women) and age group (58–64 years, 65–74 years, 75+ years). Education levels were grouped into three categories based on the International Standard Classification of Education (ISCED) of 2017 (low, medium, high) [37]. The binary variable for partnership status (has a partner, has no partner) considered all types of partnership. The subjective financial situation of respondents was assessed based on the question: “Is your household able to make ends meet?”. Response categories were recoded as “easily”, “fairly easily” and “with difficulty”. The variable related to respondents’ living area was dichotomized (urban, rural). The language used to answer the questionnaire (German, French, Italian) was used as a proxy for regional/cultural differences.

Statistical analysis

The cross-sectional weights available in the SHARE dataset were used to calibrate the sample and obtain estimates representative of the target population [31, 38]. The characteristics of the analytical sample were described using unweighted number counts and weighted proportion estimation with corresponding 95% confidence intervals (CI). Consistent with this approach, the distribution of the health literacy levels by exposure variable was examined using weighted proportions and 95% CI. Chi-square tests were used to assess the bivariate associations between the exposure variables and the three categories of health literacy levels. The partial associations between multimorbidity, the number of chronic conditions, and health literacy were examined separately using unweighted ordinary least squares (OLS) regression models (with health literacy total score as outcome) and multivariable ordered probit model (with the three categories of health literacy levels as outcome). The multivariable models thereby accounted for potential

confounders including sex, age groups, education levels, partnership status, subjective financial situation, living area, and Swiss linguistic regions. Results were reported as average partial effects along with corresponding standard errors (SE). Additionally, the partial associations between the exposure variables and the standardized health literacy score and its seven subindices were explored using separate unweighted OLS regression models. Since both respondents and their partners could be part of the SHARE study, the possibility of unobserved dependencies between two observations was accounted for in the multivariable models by clustering the estimated standard errors at the household level. Statistical analyses were conducted using STATA/SE 17.0 (STATA Corporation, College Station, TX). Two-sided p -values < 0.05 were considered statistically significant.

Results

Main characteristics of the analytical sample

Table 1 presents the weighted characteristics of the 1,615 respondents included in the analytical sample. The mean age was 67.5 years (SE: 0.44), half of the respondents were 58–64 years (49.6%), and 51.5% were male. Most of the respondents had a medium education level (63.4%), had a partner (70.9%), lived in the German-speaking part of Switzerland (70.6%), and reported that they could make ends meet easily (56.9%) or fairly easily (30.2%). Their living area was mainly rural (58.3%).

Overall, 93 (5.8%) and 29 (1.8%) respondents had one and two missing HLS-EU-Q16 items, respectively. The respective weighted prevalence of problematic and inadequate health literacy levels was 6.6% and 24.6%. Regarding the exposure variables of interest, almost one third (32.8%) of the respondents suffered from multimorbidity. The count of chronic conditions ranged from 0 (36.5%) to 8 (1.0%). For sample size considerations, respondents who reported suffering from three or more chronic conditions ($n=302$, weighted %: 15.0%) were grouped in one extreme exposure category (3+).

Weighted distribution of health literacy levels by exposure variable

Figure 1 shows the weighted distribution of health literacy levels, stratified by the two exposure variables. The weighted prevalence of problematic and inadequate health literacy levels was significantly higher among respondents with multimorbidity compared to their counterparts without multimorbidity ($p<0.001$). Similarly, the distribution of the three health literacy levels was significantly different according to the number of reported chronic conditions, with a higher prevalence of problematic and inadequate health literacy levels among

respondents with one or multiple chronic conditions ($p<0.001$).

Multimorbidity, number of chronic conditions, and health literacy

Table 2 describes the partial associations between multimorbidity, the number of chronic conditions, and health literacy from adjusted multivariable models. When controlling for key socio-demographic variables, respondents who suffered from multimorbidity were more likely to have lower health literacy scores than their counterparts without multimorbidity ($p<0.01$). Further, respondents who reported one, two, and three or more chronic conditions were more increasingly likely to have lower health literacy total scores compared to respondents who did not report any chronic disease ($p<0.05$, $p<0.01$, and $p<0.001$, respectively). Similarly, prevalence of multimorbidity and suffering from two and three or more chronic conditions (vs. 0) were associated with a higher likelihood of having inadequate or problematic health literacy levels (all p -values <0.01) holding other characteristics fixed.

Multimorbidity, number of chronic conditions, and health literacy subindices

Average partial associations between multimorbidity, the number of chronic conditions, and health literacy subindices are presented in Table 3. Compared to individuals without multimorbidity, respondents who suffered from multimorbidity were more likely to have lower health literacy scores in the health care and health promotion domains ($p<0.05$ and $p<0.01$, respectively). Also, multimorbidity was associated with lower scores in three of the four stages of literacy concerning information processing, i.e., accessing, understanding, and processing health information (all p -values <0.05). Similarly, respondents who reported two and three or more chronic conditions were more likely to have lower health literacy scores concerning most of the three health domains (disease prevention and health promotion) and four stages of literacy concerning health information processing, compared to respondents who did not report any chronic condition.

Discussion

Using a population-based sample of adults aged 58 and older living in Switzerland, we investigated the relationship between multimorbidity, the number of chronic conditions, and health literacy levels. Multivariable analyses showed that multimorbidity was significantly associated with a higher likelihood of having lower health literacy total scores as well as a higher likelihood of having problematic or inadequate health literacy levels holding other characteristics fixed. Similarly, we observed

Table 1 Main characteristics of the analytical sample, adults aged 58+, SHARE Switzerland, 2019/2020, (n=1,615)

		Unweighted	Weighted	
	n	%	95% CI	
Socio-demographic variables				
Sex	Men	761	51.5	47.3, 55.7
	Women	854	48.5	44.3, 52.7
Age groups	58-64 years	397	49.6	44.6, 54.6
	65-74 years	668	27.2	24.2, 30.5
	75+ years	550	23.1	20.4, 26.0
Education levels	Low	287	15.9	13.1, 19.3
	Medium	1010	63.4	58.8, 67.7
	High	318	20.7	17.0, 24.9
Partnership status	Has a partner	1208	70.9	66.4, 75.0
	No partner	407	29.1	25.0, 33.6
Make ends meet	Easily	892	56.9	52.3, 61.4
	Fairly easily	513	30.2	26.3, 34.5
	With difficulty	210	12.8	10.1, 16.2
Swiss linguistic regions	German	1145	70.6	65.9, 75.0
	French	412	26.4	22.2, 31.2
	Italian	58	3.0	2.0, 4.3
Living area	Urban	739	41.7	37.1, 46.5
	Rural	876	58.3	53.5, 62.9
Outcomes				
Health literacy levels	Sufficient	1113	68.8	64.9, 73.1
	Problematic	374	24.6	20.5, 29.1
	Inadequate	128	6.6	4.9, 8.9
Exposure variables				
Multimorbidity	No	976	67.2	63.0, 71.2
	Yes	639	32.8	28.8, 37.0
Number of chronic conditions	0	471	36.5	31.6, 41.7
	1	505	30.7	26.6, 35.2
	2	337	17.8	15.0, 20.8
	3	160	7.9	6.1, 10.2
	4	88	3.8	3.0, 4.8
	5	31	1.4	0.9, 2.0
	6	10	0.4	0.2, 0.8
	7	11	0.5	0.2, 0.9
	8	2	1.0	0.2, 4.9

C/ Confidence intervals

generally lower levels of health literacy in respondents with more chronic conditions. We further explored associations using the seven health literacy subindices as outcomes, which indicated similar significance and direction of associations overall. Other social, regional, and health determinants of health literacy in the same study population are presented elsewhere [34].

Our findings on the cross-sectional relationship between multimorbidity, the number of chronic conditions and health literacy for older adults in the Swiss

general population appear to align with current knowledge, even if inter-study differences in terms of mean age of the study populations, definitions of multimorbidity or chronic conditions, scales used to assess health literacy skills, and the conduct of multivariable analyses somewhat limit direct comparisons across studies. Garcia-Codina et al. reported that having a self-perceived chronic disorder (yes vs. no) was significantly associated with increased odds of having an inadequate or problematic level of health literacy in respondents with a mean

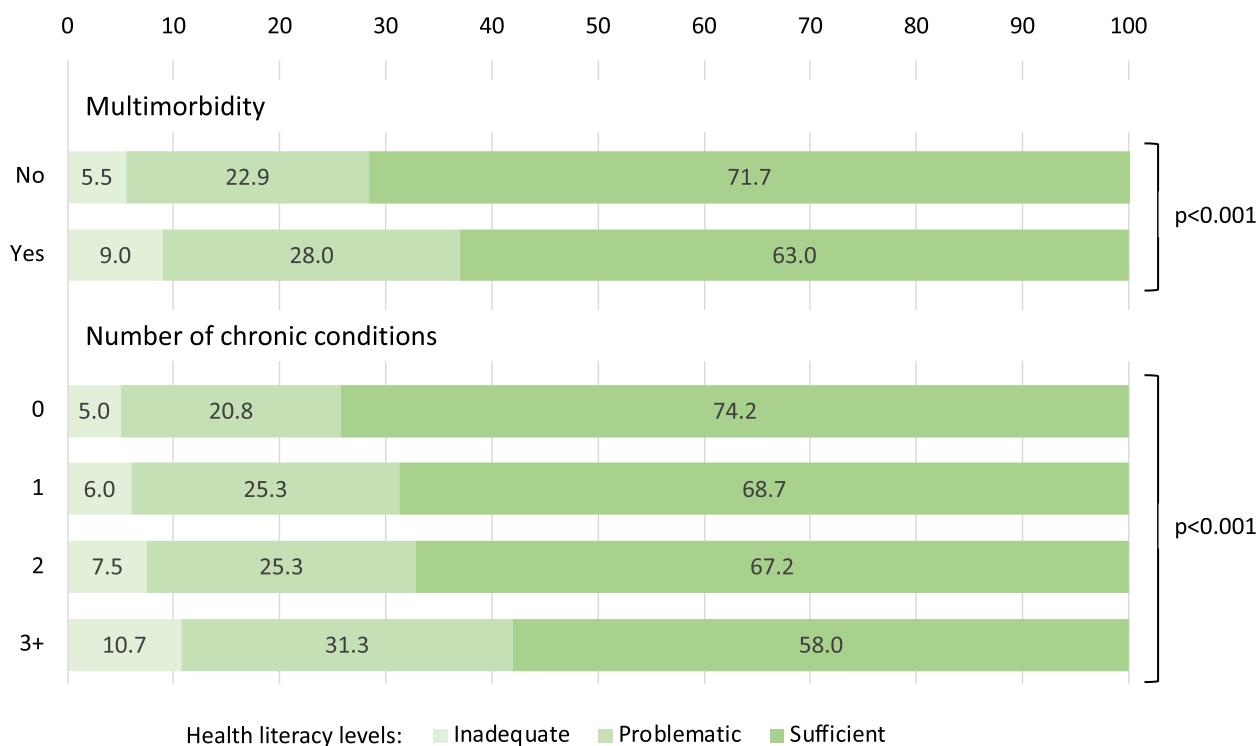


Fig. 1 Weighted distribution of health literacy levels in the analytical sample by exposure variable, adults aged 58+, SHARE Switzerland, 2019/2020, n=1,615

Table 2 Partial associations between multimorbidity, number of chronic conditions and health literacy levels, adults aged 58+, SHARE Switzerland, 2019/2020, n=1,615

	Health literacy levels		
	Health literacy score	Problematic vs Sufficient	Inadequate vs Sufficient
Multimorbidity (vs no multimorbidity)	-0.48** (0.16)	0.04** (0.01)	0.03** (0.01)
Number of chronic conditions			
1 (vs 0)	-0.42* (0.18)	0.04 (0.02)	0.02 (0.01)
2 (vs 0)	-0.56** (0.21)	0.05** (0.02)	0.03** (0.01)
3+ (vs 0)	-0.88*** (0.25)	0.07** (0.02)	0.04** (0.01)

The table shows average partial effects and standard errors in parentheses from separate models for multimorbidity and the number of chronic conditions

The ordinary least squares regression and ordered probit regression models control for sex, age partnership status, linguistic region, education levels, subjective financial situation and living area

Concerning the interpretation of the average partial effects, the estimate for multimorbidity in the ordered probit regression, for instance, means that individuals with multimorbidity had a 4-percentage point higher probability of problematic health literacy, compared to individuals without multimorbidity

Statistical significance: *p < 0.05, **p < 0.01, ***p < 0.001

age of 46 years [27]. In another study among Finnish adults aged 75 and older, the number of self-reported physician-diagnosed chronic conditions was significantly negatively correlated with health literacy levels [28].

In addition to the use of a more detailed categorization of the number of chronic conditions, one of the original aspects of our study lies in the use of the three health domains and four stages of literacy concerning information processing to get a more holistic picture of individuals' health literacy and its association with (multiple) chronic conditions. So far, few studies have specifically focused on different dimensions of the health literacy construct in the context of multimorbidity and chronic conditions in later life. Heijmans et al. reported that respondents who suffered from multimorbidity were more likely to have lower mean levels of functional health literacy (basic level of reading and writing skills to obtain, understand and use factual information), communicative health literacy (advanced skills that allow a person to extract information, derive meaning from different sources of communication, and apply new information to changing circumstances) and critical health literacy (more advanced skills for critically analyzing and reflecting on information or advice received and using the information to exert greater control over life events and situations), compared to individuals with no or only

Table 3 Partial associations between multimorbidity, the number of chronic conditions and standardized health literacy subindices, adults aged 58+, SHARE Switzerland, 2019/2020, n=1,615

	Health literacy score	Health care	Disease prevention	Health promotion	Access health information	Understand health information	Process health information	Apply health information
Multimorbidity (vs no multimorbidity)	-0.98* (0.48)	-0.93* (0.42)	-0.64 (0.47)	-1.63** (0.50)	-1.27* (0.49)	-0.89* (0.40)	-1.25* (0.53)	-0.68 (0.47)
Number of chronic conditions								
1 (vs 0)	-0.98* (0.48)	-0.39 (0.49)	-1.08 (0.56)	-1.91** (0.59)	-0.95 (0.58)	-0.72 (0.47)	-1.35* (0.63)	-1.19* (0.57)
2 (vs 0)	-1.28* (0.54)	-1.06 (0.54)	-0.88 (0.64)	-2.17** (0.68)	-1.40* (0.63)	-1.06* (0.54)	-1.68* (0.72)	-1.16 (0.65)
3+ (vs 0)	-1.85** (0.60)	-1.23 (0.64)	-1.62* (0.68)	-3.23*** (0.73)	-2.23** (0.74)	-1.53* (0.61)	-2.33** (0.78)	-1.50* (0.70)

The table shows average partial effects and standard errors in parentheses from separate models for multimorbidity and the number of chronic conditions

The ordinary least squares regression models control for sex, age, partnership status, linguistic region, education levels, subjective financial situation and living area

Statistical significance: * p < 0.05, ** p < 0.01, *** p < 0.001

one chronic condition [29]. In another study, Pedersen et al. found that individuals with more than one physical condition had significantly higher odds of having difficulties specifically in understanding health information and actively engaging with healthcare providers than individuals with only one physical condition [26]. Further, Schaeffer et al. reported that the presence of multiple chronic diseases (more than one health problem persisting for more than six months) was significantly associated with lower health literacy scores only for the “applying health information” stage [25].

We highlight that, independently of key socio-demographic characteristics, older individuals with multiple chronic conditions had lower levels of health literacy in most domains and concerning most information processing stages. Our population-based study, thereby, provides new and more detailed insights on the relationship between health literacy and chronic disease as a major determinant of vulnerability in health. Although our cross-sectional design does not allow us to draw conclusions in terms of causality, our results consistently showed that tasks or situations related to health promotion were particularly challenging for individuals with multimorbidity and for individuals with one, two, and three or more chronic conditions, placing these more vulnerable individuals at particularly high risk for poor disease (self-)management. Conceptually, the health promotion domain includes the ability to stay up-to-date concerning one's health condition, understand health information and derive meaning from it, interpret and evaluate health information, and make informed decisions on health determinants in the social and physical environment [33]. These aspects can have important implications for the target population since major risk

factors for the progression of chronic diseases and transition to multimorbidity are generally modifiable. Notably, evidence suggests that lifestyle factors such as smoking, alcohol consumption, physical activity, sedentary lifestyle, and unhealthy diet play an important role in the progression of the most common and deadly chronic diseases [39–42]. Specifically, it has been shown that a healthy lifestyle, including regular physical activity, a healthy diet, no smoking and no or moderate alcohol consumption, was significantly associated with a gain in life years in individuals with multimorbidity [43, 44], suggesting that lifestyle and related prevention behaviours are likely to have a considerable health impact at the individual and population levels. Moreover, previous studies have reported a positive association between health literacy and uptake of at least one health-promoting behaviour in individuals with chronic conditions [45–47], confirming that health literacy is an important factor in the context of disease prevention and control. A growing literature in the developing field of health literacy continues to demonstrate the effectiveness of interventions regarding behaviours that can ultimately decrease disease burden [48, 49]. However, two recently published systematic literature reviews highlighted that the proportion of studies reporting on interventions aimed at improving health literacy in chronic conditions remains low, despite a rapid increase in the number of publications on this health determinant [50, 51]. Since health literacy is a multifaceted and complex issue, a global approach may be necessary to effectively tackle its many challenges. The recent launch of the World Health Organization European Action Network on Health Literacy for Prevention and Control of Noncommunicable Diseases to promote the development of national strategies on health

literacy will further support the scaling up of health literacy interventions to improve the implementation of chronic disease prevention and control [52].

While the findings of the present study indicate a clear need to improve health literacy in older adults suffering from one or multiple chronic conditions, several publications called for a wider conceptualization of health literacy, taking into account the complexity of healthcare systems and the availability of understandable health information [15, 19]. An updated definition that acknowledges health literacy as contextual and resulting from several interactions between individuals and the healthcare system has recently been proposed. This definition suggests a conceptual framework where health literacy initiatives are to be multidisciplinary and shared among the diverse stakeholders who influence health behaviours and outcomes [53]. This framework would be particularly relevant for individuals suffering from several chronic conditions since the complexity of their care needs can challenge their health literacy skills. Indeed, health literacy abilities are not always easily transferable to tasks required for effective care of multiple chronic diseases, as understanding co-existent conditions necessitates more advanced health literacy skills, such as in-depth knowledge of pathophysiology or pharmacology. Also, individuals with multiple chronic conditions are sometimes confronted with diverse and potentially conflicting information, multiple treatments, and recommendations from several healthcare providers in diverse settings [54, 55]. Health literacy development should, therefore, be seen as a combined effort between healthcare users and healthcare professionals rather than an individual effort [15, 56]. In this context, measuring health literacy in hospital or primary care settings could be a key lever to personalizing health information and disease management in daily clinical practice. Recent publications developed and validated brief scales to rapidly detect inadequate health literacy in order to better tailor communication to healthcare users' skills and needs [57–59]. As communication and information exchange constitute a central part of disease management, continued efforts should also be made to support the learning of communication skills throughout the career of health professionals [60]. Additionally, new technologies, such as patient decision support systems linked to electronic health records, may be promising levers for healthcare professionals to provide relevant, individualised health information to healthcare users with multiple chronic conditions [61]. Finally, several systematic reviews and meta-analyses demonstrated the effectiveness of strategies incorporating therapeutic education through different formats such as information handouts, audiovisual offerings, online resources, or building individuals' skills to encourage shared decision

making, improve treatment adherence and mental health outcomes, and empower individuals to better self-manage their health [48, 62].

Although our study contributes valuable insight into the topic, some limitations need consideration. While the study used data from a population-based survey with a high response rate along with population weights to account for differences in selection probabilities and response rates, we cannot exclude the existence of potential residual selection biases. Subpopulations with increased risk of low health literacy, such as the oldest-old adults or individuals with severe health and/or cognitive problems may be underrepresented among the SHARE respondents. In addition, individuals with limited national language skills are not eligible to participate in the Swiss component of the SHARE survey. Furthermore, as the ability to complete a survey can be seen as a health literacy competence, it may be possible that individuals with low health literacy were reluctant to respond to the questionnaire. Therefore, the potential selection biases in this study are likely to have resulted in an overestimation of the health literacy skills of the sample, making the estimates of the observed associations conservative. In addition, the consideration of 17 medically diagnosed diseases in the measurement of chronic conditions does not fully preclude potential bias due to self-reporting. Moreover, although we used a validated and internationally recognized instrument to measure health literacy and its seven related subindices to account for the multidimensional nature of the construct, we cannot rule out that exposure to and need for healthcare and information about health would affect self-reported measures of health literacy. Indeed, individuals who are in good health and have little need for health care may think that they can easily understand oral and written health information, may be unaware of potential difficulties if they actually needed such information and therefore may overestimate their health literacy levels. Also, since we did not adjust for multiple comparison testing, the results when using the standardized health literacy subindices as outcomes should be interpreted with caution. In addition, our study's cross-sectional design did not allow us to assess whether the co-existence of chronic conditions and their association with insufficient health literacy levels change over time; hence, this question remains to be investigated in future studies. Finally, our study exclusively used subjective measures of health literacy. While subjective measures of health literacy like the HLS-EU-Q16 are well-established, commonly used in the literature [63] and likely to be important drivers of health outcomes in part due to their close link with self-efficacy concerning health-related literacy tasks

[64], it would nonetheless be interesting to further test the consistency of our findings using performance-based (objective) measures of health literacy such as the Test of Functional Health Literacy in Adults (TOF-HLA) [65] or the Newest Vital Sign [66].

Conclusion

The present study's findings indicate a clear need to improve health literacy in older adults suffering from one or multiple chronic conditions. Improved health literacy could constitute a promising lever to empower individuals to better self-manage their health. Implementing health literacy screening in clinical care could allow for a tailoring and personalization of health information and patient-provider communication, including therapeutic education, with the ultimate goal of reducing the impact of insufficient health literacy on individuals' health, functional status, and healthcare use in this vulnerable population.

Abbreviations

CI	Confidence Intervals
HLS-EU-Q16	16-item European Health Literacy Survey Questionnaire
ISCED	International Standard Classification of Education
OLS	Ordinary Least Squares
SE	Standard Errors
SHARE	Survey of Health, Ageing, and Retirement in Europe

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-023-15136-6>.

Additional file 1.

Acknowledgements

Not applicable

Authors' contributions

MW and CM designed the study. MW conducted the analysis and drafted the article in collaboration with CM. All authors discussed the interpretation of findings and provided critical revision of the article for important intellectual content. The authors read and approved the final manuscript.

Funding

The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE; CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASHISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782, SHARE-COVID19: GA N°101015924) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/0135, VS 2018/0285, VS 2019/0332, and VS 2020/0313. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see <https://share-eric.eu/infrastructure/funding>). We acknowledge support from the Swiss National Centre of Competence in Research LIVES—Overcoming

vulnerability: life course perspectives, funded by the Swiss National Science Foundation (grant number: 51NF40-185901).

Availability of data and materials

The datasets generated and/or analysed during the current study are available to the scientific community upon submitting a data request application to the SHARE study (<https://share-eric.eu/data/become-a-user>). Additional materials can be received upon request on: maud.wieczorek@unil.ch.

Declarations

Ethics approval and consent to participate

All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from all individual participants included in the study. The ethics committee of the canton of Vaud, Switzerland, approved this study in March 2014 (approval number 66/14).

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Author details

¹Swiss National Centre of Competence in Research LIVES - Overcoming vulnerability: Life course perspectives, University of Lausanne, Building Géopolis, CH-1015, Lausanne and Geneva, Switzerland. ²Faculty of Biology and Medicine (FBM), University of Lausanne, Lausanne, Switzerland. ³Faculty of Business and Economics (HEC), University of Lausanne, Lausanne, Switzerland. ⁴Swiss Centre of Expertise in the Social Sciences (FORS), University of Lausanne, Lausanne, Switzerland. ⁵Centre for the Interdisciplinary Study of Gerontology and Vulnerability, University of Geneva, Geneva, Switzerland.

Received: 20 September 2022 Accepted: 24 January 2023

Published online: 06 February 2023

References

1. Fabbri E, Zoli M, Gonzalez-Freire M, Salive ME, Studenski SA, Ferrucci L. Aging and Multimorbidity: New Tasks, Priorities, and Frontiers for Integrated Gerontological and Clinical Research. *J Am Med Dir Assoc.* 2015;16(8):640–7.
2. Salisbury C, Johnson L, Purdy S, Valderas JM, Montgomery AA. Epidemiology and impact of multimorbidity in primary care: a retrospective cohort study. *Br J Gen Pract.* 2011;61(582):e12–21.
3. Khan SS, Singer BD, Vaughan DE. Molecular and physiological manifestations and measurement of aging in humans. *Aging Cell.* 2017;16(4):624–33.
4. Hou Y, Dan X, Babbar M, Wei Y, Hasselbalch SG, Croteau DL, et al. Aging as a risk factor for neurodegenerative disease. *Nat Rev Neurol.* 2019;15(10):565–81.
5. Kryston TB, Georgiev AB, Pissis P, Georgakilas AG. Role of oxidative stress and DNA damage in human carcinogenesis. *Mutat Res.* 2011;711(1–2):193–201.
6. Ng R, Sutradhar R, Yao Z, Wodchis WP, Rosella LC. Smoking, drinking, diet and physical activity-modifiable lifestyle risk factors and their associations with age to first chronic disease. *Int J Epidemiol.* 2020;49(1):113–30.
7. Johnston MC, Crilly M, Black C, Prescott GJ, Mercer SW. Defining and measuring multimorbidity: a systematic review of systematic reviews. *Eur J Public Health.* 2019;29(1):182–9.
8. Catalá-López F, Alonso-Arroyo A, Page MJ, Hutton B, Tabarés-Seisdedos R, Aleixandre-Benavent R. Mapping of global scientific research in comorbidity and multimorbidity: A cross-sectional analysis. *PLoS One.* 2018;13(1):e0189091.
9. Caracciolo B, Gatz M, Xu W, Marengoni A, Pedersen NL, Fratiglioni L. Relationship of subjective cognitive impairment and cognitive impairment no dementia to chronic disease and multimorbidity in a nation-wide twin study. *J Alzheimers Dis.* 2013;36(2):275–84.

10. St John PD, Tyas SL, Menec V, Tate R, Griffith L. Multimorbidity predicts functional decline in community-dwelling older adults: Prospective cohort study. *Can Fam Physician*. 2019;65(2):e56–63 (PMID: 30765370; PMCID: PMC6515497).
11. Gu J, Chao J, Chen W, Xu H, Zhang R, He T, et al. Multimorbidity and health-related quality of life among the community-dwelling elderly: A longitudinal study. *Arch Gerontol Geriatr*. 2018;74:133–40.
12. Nunes BP, Flores TR, Mielke GI, Thumé E, Facchini LA. Multimorbidity and mortality in older adults: A systematic review and meta-analysis. *Arch Gerontol Geriatr*. 2016;67:130–8.
13. Vandenberghe D, Albrecht J. The financial burden of non-communicable diseases in the European Union: a systematic review. *European Journal of Public Health*. 2020;30(4):833–9.
14. Goryakin Y, Thiébaut SP, Cortaredona S, Lerouge MA, Cecchini M, Feigl AB, et al. Assessing the future medical cost burden for the European health systems under alternative exposure-to-risks scenarios. *PLOS ONE*. 2020;15(9):e0238565.
15. van der Heide I, Poureslami I, Mitic W, Shum J, Rootman I, Fitzgerald JM. Health literacy in chronic disease management: a matter of interaction. *J Clin Epidemiol*. 2018;102:134–8.
16. Santana S, Brach C, Harris L, Ochiai E, Blakey C, Bevington F, et al. Updating Health Literacy for Healthy People 2030: Defining Its Importance for a New Decade in Public Health. *J Public Health Manag Pract*. 2021;27(Suppl 6):S258–s64.
17. Regional Committee for Europe, 69th session. Sixty-ninth Regional Committee for Europe: Copenhagen, 16–19 September 2019: draft WHO European roadmap for implementation of health literacy initiatives through the life course. World Health Organization. Regional Office for Europe, 2019. <https://apps.who.int/iris/handle/10665/339362>.
18. World Health Organization. Shanghai declaration on promoting health in the 2030 Agenda for Sustainable Development. *Health Promot Int*. 2017;32(1):7–8.
19. Lander J, Dierks M-L, Hawkins M. Health Literacy Development among People with Chronic Diseases: Advancing the State of the Art and Learning from International Practices. *Int J Environ Res Public Health*. 2022;19(12):7315.
20. Geboers B, de Winter AF, Lutten KA, Jansen CJ, Reijneveld SA. The association of health literacy with physical activity and nutritional behavior in older adults, and its social cognitive mediators. *J Health Commun*. 2014;19(Suppl 2):61–76.
21. Easton P, Entwistle VA, Williams B. Health in the “hidden population” of people with low literacy. A systematic review of the literature. *BMC Public Health*. 2010;10:459.
22. Berens EM, Vogt D, Messer M, Hurrelmann K, Schaeffer D. Health literacy among different age groups in Germany: results of a cross-sectional survey. *BMC Public Health*. 2016;16(1):1151.
23. Cho YI, Lee SY, Arozullah AM, Crittenden KS. Effects of health literacy on health status and health service utilization amongst the elderly. *Soc Sci Med*. 2008;66(8):1809–16.
24. Poureslami I, Nimmon L, Rootman I, Fitzgerald MJ. Priorities for Action Recommendations from an international roundtable on health literacy and chronic disease management. *Health Promot Int*. 2017;32(4):743–54.
25. Schaeffer D, Berens E-M, Vogt D, Gille S, Griesse L, Klinger J, et al. Health Literacy in Germany: Findings of a Representative Follow-up Survey. *Dtsch Arztebl International*. 2021;118(43):723–9.
26. Pedersen SE, Aaby A, Friis K, Maidental HT. Multimorbidity and health literacy: A population-based survey among 28,627 Danish adults. *Scand J Public Health*. 2021. [published online ahead of print, 2021 Oct 12].
27. Garcia-Codina O, Juvinyà-Canal D, Amil-Bujan P, Bertran-Noguer C, González-Mestre MA, Masachs-Fatjo E, et al. Determinants of health literacy in the general population: results of the Catalan health survey. *BMC Public Health*. 2019;19(1):1122.
28. Eronen J, Paakkari L, Portegijs E, Saajanaho M, Rantanen T. Assessment of health literacy among older Finns. *Aging Clin Exp Res*. 2019;31(4):549–56.
29. Heijmans M, Waverijn G, Rademakers J, van der Vaart R, Rijken M. Functional, communicative and critical health literacy of chronic disease patients and their importance for self-management. *Patient Educ Couns*. 2015;98(1):41–8.
30. Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbacher J, Malter F, et al. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol*. 2013;42(4):992–1001.
31. Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 8. Release version: 8.0.0. SHARE-ERIC. Data set. <https://doi.org/10.6103/SHARE.w8.100>
32. Okan O, Bauer U, Levin-Zamir D, Pinheiro P, Sørensen K. International Handbook of Health Literacy: Research, practice and policy across the lifespan. Policy Press; 2019. <https://library.oapen.org/handle/20.500.12657/24879>.
33. Pelikan J, Ganahl K, Van den Broucke S, Sorensen K. Measuring health literacy in Europe: Introducing the European Health Literacy Survey Questionnaire (HLS-EU-Q). 2019. <https://dial.uclouvain.be/pr/boreal/object/boreal:219963>.
34. Meier C, Vilpert S, Borrat-Besson C, Jox RJ, Maurer J. Health literacy among older adults in Switzerland: cross-sectional evidence from a nationally representative population-based observational study. *Swiss Medical Weekly*. 2022;152(1314):w30158.
35. Sørensen K, Pelikan JM, Röthlin F, Ganahl K, Slonska Z, Doyle G, et al. Health literacy in Europe: comparative results of the European health literacy survey (HLS-EU). *Eur J Public Health*. 2015;25(6):1053–8.
36. World Health Organization. Multimorbidity. Geneva: World Health Organization; 2016. <https://apps.who.int/iris/handle/10665/252275>.
37. International Standard Classification of Education. ISCED 1997. In: Hoffmeyer-Zlotnik JHP, Wolf C, editors. Advances in Cross-National Comparison: A European Working Book for Demographic and Socio-Economic Variables. Boston, MA: Springer, US; 2003. p. 195–220.
38. The Survey of Health, Ageing and Retirement in Europe (SHARE): Release Guide 8.0.0. 2022. https://share-eric.eu/fileadmin/user_upload/Release_Guides/Sshare_release_guide_8-0-0.pdf.
39. Huston P. A Sedentary and Unhealthy Lifestyle Fuels Chronic Disease Progression by Changing Interstitial Cell Behaviour: A Network Analysis. *Frontiers Physiol*. 2022;13:904107.
40. Baska A, Kurpas D, Kenkre J, Vidal-Alaball J, Petrazzoli F, Dolan M, et al. Social Prescribing and Lifestyle Medicine-A Remedy to Chronic Health Problems? *Int J Environ Res Public Health*. 2021;18(19):10096.
41. Sagner M, Katz D, Egger G, Lianov L, Schulz KH, Braman M, et al. Lifestyle medicine potential for reversing a world of chronic disease epidemics: from cell to community. *Intl J Clin Pract*. 2014;68(11):1289–92.
42. Freisling H, Viallon V, Lennon H, Bagnardi V, Ricci C, Butterworth AS, et al. Lifestyle factors and risk of multimorbidity of cancer and cardiometabolic diseases: a multinational cohort study. *BMC Med*. 2020;18(1):5.
43. Chudasama YV, Khunti K, Gillies CL, Dhalwani NN, Davies MJ, Yates T, et al. Healthy lifestyle and life expectancy in people with multimorbidity in the UK Biobank: A longitudinal cohort study. *PLoS Med*. 2020;17(9):e1003332.
44. Cheng X, Ouyang F, Ma T, Luo Y, Yin J, Li J, et al. Association of Healthy Lifestyle and Life Expectancy in Patients With Cardiometabolic Multimorbidity: A Prospective Cohort Study of UK Biobank. *Front Cardiovasc Med*. 2022;9:83019.
45. Aaby A, Friis K, Christensen B, Rowlands G, Maidental HT. Health literacy is associated with health behaviour and self-reported health: A large population-based study in individuals with cardiovascular disease. *Eur J Prev Cardiol*. 2017;24(17):1880–8.
46. Friis K, Vind BD, Simmonds RK, Maidental HT. The Relationship between Health Literacy and Health Behaviour in People with Diabetes: A Danish Population-Based Study. *J Diabetes Res*. 2016;2016:7823130.
47. Neter E, Brainin E. Association between health literacy, eHealth literacy, and health outcomes among patients with long-term conditions: A systematic review. *Eur Psychol*. 2019;24(1):68.
48. Miller TA. Health literacy and adherence to medical treatment in chronic and acute illness: A meta-analysis. *Patient Educ Couns*. 2016;99(7):1079–86.
49. Uemura K, Yamada M, Okamoto H. The Effectiveness of an Active Learning Program in Promoting a Healthy Lifestyle among Older Adults with Low Health Literacy: A Randomized Controlled Trial. *Gerontology*. 2021;67(1):25–35.
50. Larsen MH, Mengshoel AM, Andersen MH, Borge CR, Ahlsen B, Dahl KG, et al. “A bit of everything”: Health literacy interventions in chronic conditions - a systematic review. *Patient Educ Couns*. 2022;105(10):2999–3016.
51. Campbell ZC, Dawson JK, Kirkendall SM, McCaffery KJ, Jansen J, Campbell KL, et al. Interventions for improving health literacy in

- people with chronic kidney disease. Cochrane Database of Syst Rev. 2022;12:CD012026.
52. World Health Organization, Regional Office for Europe, Drapkina O, da Graça Freitas M, Mikkelsen B, Breda J, Salakhov E, et al. The for Prevention and Control of Noncommunicable Diseases. Public health panorama. 2019;5(2–3):197–200.
 53. Pleasant A, R. E. Rudd, C. O'Leary, M. K. Paasche-Orlow, M. P. Allen, W. Alvarado-Little, L. Myers, K. Parson, and S. Rosen. Considerations for a New Definition of Health Literacy. NAM Perspectives. Discussion paper. National Academy of Medicine, Washington, DC; 2016.
 54. van der Aa MJ, van den Broeke JR, Stronks K, Plochg T. Patients with multimorbidity and their experiences with the healthcare process: a scoping review. *J Comorb.* 2017;7(1):11–21.
 55. Aggarwal P, Woolford SJ, Patel HP. Multi-Morbidity and Polypharmacy in Older People: Challenges and Opportunities for Clinical Practice. *Geriatrics (Basel).* 2020;5(4):85.
 56. Brach C, Harris LM. Healthy People 2030 Health Literacy Definition Tells Organizations: Make Information and Services Easy to Find, Understand, and Use. *J Gen Intern Med.* 2021;36(4):1084–5.
 57. Perrin A, Siqueira do Prado L, Duché A, Schott AM, Dima AL, Haesebaert J. Using the Brief Health Literacy Screen in Chronic Care in French Hospital Settings: Content Validity of Patient and Healthcare Professional Reports. *Int J Environ Res Public Health.* 2020;18(1):96.
 58. Chouinard M-C, Lambert M, Lavoie M, Lambert SD, Hudon É, Dumont-Samson O, et al. Measuring Health Literacy in Primary Healthcare: Adaptation and Validation of a French-Language Version of the Brief Health Literacy Screening among Patients with Chronic Conditions Seen in Primary Care. *Int J Environ Res Public Health.* 2022;19(13):7669.
 59. Leung AYM, Yu EYT, Luk JKH, Chau PH, Levin-Zamir D, Leung ISH, et al. Rapid Estimate of Inadequate Health Literacy (REIHL): development and validation of a practitioner-friendly health literacy screening tool for older adults. *Hong Kong Med J.* 2020;26(5):404–12.
 60. Hill SJ, Sofra TA. How could health information be improved? Recommended actions from the Victorian Consultation on Health Literacy. *Aust Health Rev.* 2018;42(2):134–9.
 61. Beeler PE, Bates DW, Hug BL. Clinical decision support systems. *Swiss Med Wkly.* 2014;144:w14073.
 62. Downie S, Shnaigat M, Hosseinzadeh H. Effectiveness of health literacy-and patient activation-targeted interventions on chronic disease self-management outcomes in outpatient settings: a systematic review. *Aust J Prim Health.* 2022;28(2):83–96.
 63. Nguyen TH, Paasche-Orlow MK, McCormack LA. The State of the Science of Health Literacy Measurement. *Stud Health Technol Inform.* 2017;240:17–33.
 64. Berens E-M, Pelikan JM, Schaeffer D. The effect of self-efficacy on health literacy in the German population. *Health Promot Int.* 2022;37(1):daab085.
 65. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. *J Gen Intern Med.* 1995;10(10):537–41.
 66. Weiss BD, Mays MZ, Martz W, Castro KM, DeWalt DA, Pignone MP, et al. Quick assessment of literacy in primary care: the newest vital sign. *Ann Fam Med.* 2005;3(6):514–22.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

