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The impact of health literacy: associations with disease activity and medication prescription in patients with rheumatoid arthritis

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Abstract

Objective: The aim of this study was to explore the longitudinal associations between health literacy profiles and disease activity and medication prescription in patients with RA.

Methods: Patients with RA who previously completed the Health Literacy Questionnaire (HLQ) and were assigned 1 of 10 distinct health literacy profiles based on cluster analysis were further aggregated into three groups: 'several health literacy limitations', 'some health literacy limitations' and 'good health literacy'. Linear mixed modelling (LMM) was used to analyse the association between health literacy groups and disease activity over the course of 1 year. Chi-squared tests and logistic regression analyses were used to compare medication prescriptions between the groups.

Results: A total of 108 patients with RA were included. LMM showed a significant effect of health literacy group on disease activity over time ($P = 0.010$). Patients with 'good health literacy' had significantly lower disease activity over time [28-joint DAS with ESR (DAS28-ESR) = 2.4] than patients with 'several health literacy limitations' (DAS28-ESR = 3.1), independent of age, gender and education level. Patients with 'good health literacy' were most often prescribed a biologic DMARD (50%), whereas patients with 'some health literacy limitations' more commonly received a conventional synthetic DMARD only [72.7%; odds ratio (OR) 4.24], and patients with 'several health literacy limitations' were more often prescribed prednisolone (52.4%; OR 3.56).

Conclusion: Significant differences in longitudinal disease activity and medication prescription were observed between groups with different health literacy levels. These results stress the importance of insights into the role of health literacy in treatment and outcomes in patients with RA.

Keywords: health literacy, health inequalities, disease activity, medication prescription, RA

Rheumatology key messages

- Patients with RA experiencing health literacy limitations have higher disease activity and are prescribed more prednisolone.
- Patients with 'good health literacy' have lower disease activity and are most often prescribed a biologic DMARD.
- This study underscores the importance of insights into health literacy in patients with rheumatoid arthritis.

Introduction

Patients' health literacy is increasingly recognized as a critical determinant of health [1]. Health literacy comprises 'the combination of personal competencies and situational resources needed for individuals to access, understand, appraise and use information and services to make decisions about health, which includes the capacity to communicate, assert and act upon these decisions' [2].

The importance of health literacy has been demonstrated in multiple studies across diverse patient populations, linking 'limited' health literacy with problems seeking preventive care [3], delayed diagnosis of chronic illnesses [4], low adherence to treatment [5] and poorer health outcomes [4]. Health literacy follows a social gradient, with difficulties most often (but not exclusively) observed in societal groups in vulnerable positions, including older adults [6], ethnic minorities [3] and socio-economically disadvantaged populations [6, 7]. In the Netherlands, 'limited' health literacy is estimated to affect about a quarter of the general adult population [8].

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This study focuses on patients with RA. Previous studies on RA and health literacy specifically described a worse functional status [9] and reluctance to change prescriptions in patients with 'limited' health literacy [10]. Nevertheless, research in this field is still limited and predominantly focused on unidimensional definitions of health literacy, primarily targeting patients' levels of functional health literacy [11]. Further studies into the role of health literacy in the treatment and outcomes of patients with RA, particularly using multidimensional tools, are warranted.

We expand upon previous research by Bakker *et al.* [12], who identified 10 distinct health literacy profiles of patients with rheumatic diseases. These profiles categorized patients based on their health literacy strengths and weaknesses, thereby unveiling clusters of patients who might benefit from specific types of support. The profiles indicating more limitations were associated with lower self-rated health, but the clinical relevance of the identified profiles needs further substantiation, as associations with disease activity trajectories and medication prescription have yet to be explored.

To gain more insight into the predictive role of health literacy profiles on treatment and treatment outcomes in patients with RA, the aim of this study was to explore the longitudinal associations between health literacy profiles, disease activity and medication prescription in patients with RA.

Patients and methods

Study design

We conducted a single-centre, retrospective cohort study among patients with RA at Medisch Spectrum Twente (MST) Hospital (Enschede, The Netherlands) who had previously completed the Health Literacy Questionnaire (HLQ [13, 14]) between February and May 2019 [12]. Up to 1 year of follow-up data were obtained from patients' electronic health records.

Patients and patient selection

The original study by Bakker *et al.* [12] included 895 adult patients with gout, SpA or RA from three different hospitals in the Netherlands, representing diverse socio-economic backgrounds. From this pre-existing dataset, 307 patients were being treated at MST Enschede, of which 122 were diagnosed with RA. For the current study, we included those with available DASs and medication prescription data in their patient records, resulting in a final sample of 108 patients.

The included patients had previously been assigned to 1 of 10 possible health literacy profiles, ranging from patients who could manage their health and healthcare with minimal difficulty (group 1) to patients who experienced several limitations (group 10). A more elaborate description of health literacy profiles and demographic characteristics can be found in the original article [12]. For the current study, the 10 profiles were further aggregated based on similarities in profile characteristics. The resulting three groups were labelled; 'several health literacy limitations' (profiles 6–10), 'some health literacy limitations' (profiles 2, 4 and 5) and 'good health literacy' (profiles 1 and 3).

Data collection and dataset formation

We retrieved up to 1 year of follow-up data on disease activity and medication prescription from patients' electronic health records. The date at which the patient completed the HLQ was taken as the baseline for the current study. Disease activity was assessed using routinely collected 28-joint DASs with ESR (DAS28-ESR) scores. The DAS28-ESR score comprises the tender joint count (TJC), swollen joint count (SJC), a patient's indication of their global assessment of health (between 0–10) and ESR. A DAS28-ESR score >5.1 implies active disease, <3.2 implies low disease activity and <2.6 implies remission. We retrieved follow-up DAS28-ESR scores collected 6 and 12 months after baseline. These time points were based on routine rheumatological care appointments. A range of ± 4 months per time point was used to minimize missing data. Information on medication prescription [prednisolone yes/no, conventional synthetic DMARDs (csDMARDs) yes/no, biologic DMARDs (bDMARDs) yes/no] and medication changes (switching type or all-out stopping of medication) was retrieved over a period of 12 months after baseline.

Statistical analysis

Differences between the three health literacy groups at baseline were tested using one-way analysis of variance (ANOVA), or where appropriate Kruskal–Wallis tests, for continuous data and chi-squared tests for categorical data.

We used linear mixed modelling (LMM) with restricted maximum likelihood estimation to analyse the association between health literacy groups and DAS28-ESR scores over time, using the health literacy group, time and their interaction term as fixed effects with the 'good health literacy' group as the reference category and gender and age as random effects. A first-order autoregressive (AR1) covariance structure was selected for the repeated covariance structure, because it was the best-fitting pattern of covariance matrices, based on Akaike's information criterion (AIC) and Schwartz's Bayesian information criterion (BIC) values. Least significant difference was used for post hoc contrast analysis. A sensitivity analysis was performed to observe the effect of education (as a fixed effect) on the association of health literacy and DAS28-ESR. Because no changes in the type of medication prescribed were observed over time, we used chi-squared tests to compare the health literacy groups at baseline. For medication variables with significant differences, we performed logistic regression models with medication prescription (yes/no) as the dependent variable and health literacy group as the independent variable, adjusted for gender, age and education.

Missing data ranged from 0 to 16 patients for DAS28-ESR scores at the different time points, which were left missing. No medication prescription data were missing. All statistical analyses were performed using SPSS Statistics version 27 (IBM, Armonk, NY, USA). A two-sided *P*-value of 0.05 was considered statistically significant for all tests.

Ethics

This study complies with the Declaration of Helsinki. All patients treated at MST have given their written informed consent for use of their routinely collected data in patient files for (pseudo-anonymised) research purposes and have previously provided informed consent for collection of health literacy data in the original study [12]. No additional data were collected. Therefore, renewed ethical review was not necessary, in accordance with Dutch regulations. The relevant Dutch law {Medical Research Involving Human Subjects Act [Wet medisch-wetenschappelijk onderzoek met mensen

(WMO)]} requires only certain research to be reviewed. Research is subject to the WMO if it concerns medical scientific research and participants are subject to procedures or are required to follow rules of behaviour [Article 1.1 b. Available from: https://wetten.overheid.nl/BWBR0009408/2022-01-31 (in Dutch)]. An explanation of this law in English can be found on the website of the Central Committee on Research Involving Human Subjects (CCMO, the committee created in Dutch law to administer the operation of the law; https://english.ccmo.nl/investigators/legal-framework-for-medical-scientific-research/your-research-is-it-subject-to-the-wmo-or-not). Analyses of pseudo-anonymised routinely collected patient data (accessed with written informed consent of the patient) and secondary analyses of previously collected research data (as undertaken in this study) are not within the meaning of medical scientific research, nor do they place the participants under a particular process or behaviour change. Therefore the research undertaken here did not require further review under Dutch law. The original study by Bakker *et al.* [12] was reviewed by the Medical Ethics Review Committee at Maastricht University Medical Center (2018-0327) and the locally responsible committee at MST (KH18-23).

Results

A total of 108 patients with RA were included in the study and assigned to the 'several health literacy limitations' ($n = 21$), 'some health literacy limitations' ($n = 33$) or 'good health literacy' ($n = 54$) group.

Baseline characteristics

The mean age at baseline was 66.0 ± 12.7 years and 62.0% were female. Persons belonging to the group with 'several health literacy limitations' were older on average, more frequently female and comprised more persons with lower education levels compared with the other two groups. Moreover, patients with 'good health literacy' on average had lower DASs (DAS28-ESR) at baseline. More than half of the participating patients had a positive RF (57%) and/or anti-CCP (54%). The majority of patients used a csDMARD (56%) and/or bDMARD (18%). Table 1 shows the baseline characteristics per health literacy group.

Longitudinal analyses of disease activity

Fig. 1 displays the trajectories of mean DAS28-ESR scores over 12 months for the three health literacy groups. LMM showed a significant main effect of health literacy group on DAS28-ESR scores over time ($P = 0.010$; Table 2, main model). Post hoc contrast analysis showed that patients with 'good health literacy' had significantly lower DASs than patients with 'several health literacy limitations' ($P = 0.019$) or 'some health literacy limitations' ($P = 0.009$). The difference between the two groups with health literacy limitations was not significant.

In addition, DAS28-ESR scores changed significantly over time ($P = 0.007$) in the total sample, owing to significantly lower scores at the 6-month follow-up. There was no significant interaction between group and time ($P = 0.541$), indicating that the changes over time were not different between health literacy groups. Sensitivity analysis (Table 2) showed that controlling for education had no significant impact on the association between health literacy group and DAS28-ESR scores.

Analyses of medication prescription

No changes in prescriptions occurred during the study period, so we present medication prescription data at baseline. Fifty percent of patients in the 'good health literacy' group were prescribed a bDMARD, compared with 18.2% and 38.1% in the 'some health literacy limitations' [adjusted odds ratio (OR) 0.22 (95% CI 0.08, 0.65)] and 'several health literacy limitations' [adjusted OR 0.81 (95% CI 0.27, 2.47), not significant] groups, respectively. Patients with 'some health literacy limitations' were prescribed a csDMARD significantly more often [72.7%; OR 4.24 (95% CI 1.57, 11.51)] than patients with 'good health literacy' (38.9%). Patients with 'several health literacy limitations' were prescribed prednisolone significantly more often [52.4%; OR 3.56 (95% CI 1.13, 11.15) compared with 'good health literacy'] than patients with 'some health literacy limitations' (21.2%) or 'good health literacy' (22.2%). Tables 1 and 3 display all data on medication prescriptions.

Discussion

The aim of this study was to explore the longitudinal associations between health literacy profiles and disease activity as well as medication prescription in patients with RA. We found differences between the health literacy groups for both disease activity and medication prescription over the course of a year.

DASs were consistently higher over time in patients with more health literacy needs. In sensitivity analysis, this relationship proved independent of patients' education level. Previous cross-sectional studies on the relationship between health literacy and disease activity in patients with RA yielded mixed results. Hirsh *et al.* [15] did not find an association of disease activity with health literacy (as measured with three different unidimensional measures of health literacy, primarily targeting Nutbeam's first level of functional health literacy [11]). They attributed this lack of association to the variable nature of DAS28 scores and a relatively small sample size ($n = 110$). In contrast, a larger study by Swearingen *et al.* [16] was consistent with our findings, linking higher disease activity to worse scores on the Rapid Estimate of Adult Literacy in Medicine (REALM; measuring functional health literacy) and Health Education Literacy of Patients (HELP; measuring comprehension, applying medical information and communicative competence) questionnaires. Our study complements these findings by establishing a link between DAS28-ESR scores and health literacy as measured with a comprehensive multidimensional tool, which considers Nutbeam's levels of interactive and critical health literacy, in addition to functional health literacy [11]. The underlying mechanism for this association remains unknown, but explanatory factors are most likely multifaceted. Examples include the (in-)adequacy of the history taking by the physician and the relay of information by the patient, the difficulty with appraisal of severity of the experienced symptoms by physician and patient and the lack of reliability and validity of subjective (components of) outcome measures used to determine disease activity in people with 'limited' health literacy [17]. For this last challenge, it may be necessary to simplify measurement tools [17, 18] and provide patients with additional guidance and support [17]. In addition, adherence to treatment could play a role in the relationship between health literacy and DASs.

Table 1. Patient characteristics at baseline by health literacy group ($N = 108$)

Characteristics	Good health literacy ($n = 54$)	Some health literacy limitations ($n = 33$)	Several health literacy limitations ($n = 21$)	*P*-value
Demographics				
Female, *n* (%)	35 (64.8)	17 (51.5)	15 (71.4)	0.284[d]
Age, mean (S.D.), years	65.1 (12.5)	65.0 (12.5)	69.5 (13.3)	0.542[e]
Education level, *n* (%)				0.059[d]
High education	16 (29.6)	7 (21.2)	4 (19)	
Medium education	13 (24.1)	7 (21.2)	0 0	
Low education	25 (46.3)	19 (57.6)	17 (81)	
Clinical characteristics				
Anti-CCP positive, *n* (%)[a]	25 (51.0)	14 (51.9)	11 (64.7)	0.604[d]
RF positive, *n* (%)[b]	31 (58.5)	17 (54.8)	11 (57.9)	0.946[d]
ESR, median (IQR)	10.0 (21.0)	15.0 (19.0)	12.0 (27.0)	0.687[f]
TJC, median (IQR)	0 (0–2)	0 (0–1)	0.5 (0–5)	0.268[f]
SJC, median (IQR)	0 (0–1)	1 (0–3)	1 (0–3)	**0.010**[f]
Disease activity				
Remission (<2.6), *n* (%)	35 (64.8)	15 (45.5)	7 (33.3)	**0.030**[d]
DAS28-ESR, mean (S.D.)	2.4 (1.1)	2.9 (1.2)	3.1 (1.5)	**0.042**[e]
Medication prescription, *n* (%)				
Any DMARD	48 (88.9)	30 (90.9)	20 (95.2)	0.695[d]
Both csDMARD and bDMARD	15 (27.8)	4 (12.1)	4 (19.0)	0.215[d]
csDMARD only[c]	21 (38.9)	24 (72.7)	12 (57.1)	**0.008**[d]
bDMARD only[c]	12 (22.2)	2 (6.1)	4 (19.0)	0.138[d]
Any csDMARD	36 (66.7)	28 (84.8)	16 (76.2)	0.166[d]
Any bDMARD	27 (50.0)	6 (18.2)	8 (38.1)	**0.012**[d]
Prednisolone	12 (22.2)	7 (21.21)	11 (52.4)	**0.019**[d]

[a] Anti-CCP was available for 93 patients.
[b] RF was available for 103 patients.
[c] Refers to a single type of DMARD but could still be prescribed with other medication such as prednisolone.
[d] Chi-squared test.
[e] One-way ANOVA.
[f] Kruskal–Wallis test.
IQR: interquartile range. Bold values indicate $P < 0.05$.

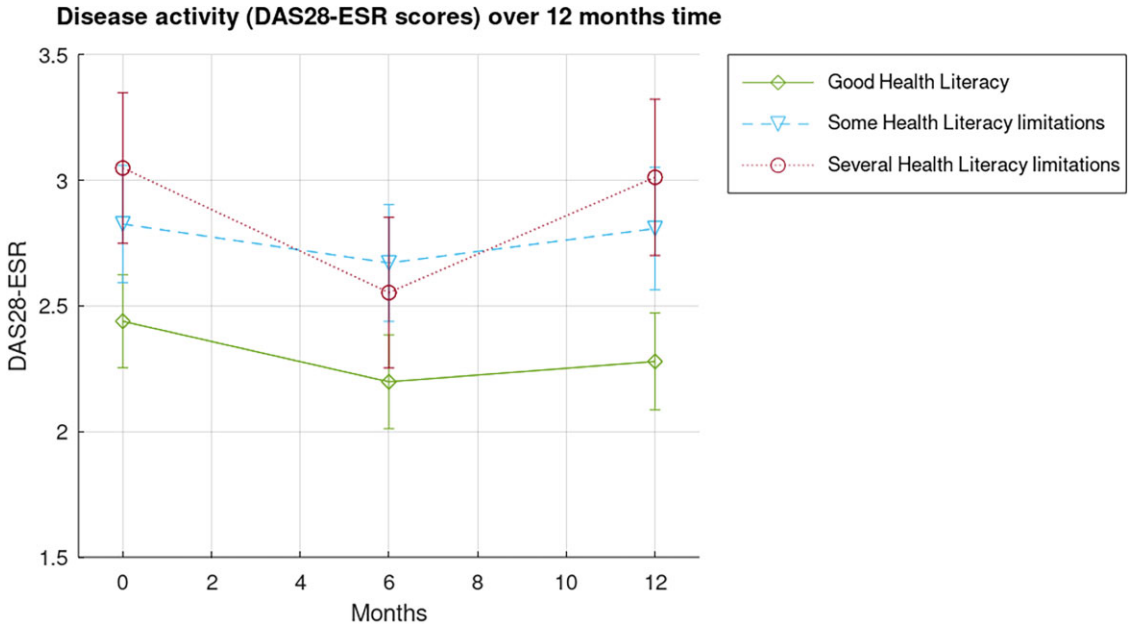

Figure 1. DAS28-ESR per health literacy group over 12 months

Adherence in itself is dependent on a multitude of factors, of which understanding the necessity is key. Several studies have indeed explicated the relationship between 'limited' health literacy and the lack of medication adherence, resulting in reduced disease control and higher disease activity levels [19].

Medication prescriptions also differed between the health literacy groups. Most remarkably, we found that patients with 'several health literacy limitations' were prescribed prednisolone more often. No previous studies have reported on this phenomenon. Prednisolone was recommended by the

Table 2. Factors associated with DAS28-ESR scores.

Factors	Main model				Sensitivity analysis			
	β	SE	95% CI	*P*-value	β	SE	95% CI	*P*-value
Health literacy group				**0.010**				**0.011**
Good health literacy	ref	ref	ref	ref	ref	ref	ref	ref
Some health literacy limitations	0.617	0.265	0.096, 1.140	**0.021**	0.597	0.262	0.080, 1.114	**0.024**
Several health literacy limitations	0.765	0.309	0.155, 1.375	**0.014**	0.797	0.313	0.180, 1.413	**0.012**
Time				**0.007**				**0.008**
Baseline	0.155	0.184	−0.208, 0.518	0.400	0.159	0.184	−0.203, 0.521	0.387
6-month follow-up	−0.082	0.151	−0.381, 0.216	0.587	−0.075	0.152	−0.374, 0.224	0.622
12-month follow-up	ref	ref	ref	ref	ref	ref	ref	ref
Time*health literacy group				0.541				0.537
Education								**0.046**
High education					ref	ref	ref	ref
Medium education					0.661	0.274	0.119, 1.203	**0.017**
Low education					0.412	0.221	−0.027, 0.851	0.065

Results are from linear mixed models ($N = 108$). Dependent variable: DAS28-ESR scores; random effects: gender, age. Displayed are adjusted coefficients from multivariable models.
Bold values indicate $P < 0.05$.
ref: reference group.

Table 3. ORs for medication prescription.

Factors	Any bDMARD		csDMARD only		Prednisolone	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Health literacy group						
Good health literacy	ref	ref	ref	ref	ref	ref
Some health literacy limitations	0.22 (0.08, 0.65)	**0.006**	4.24 (1.57, 11.51)	**0.004**	0.99 (0.34, 2.92)	0.989
Several health literacy limitations	0.81 (0.27, 2.47)	0.717	1.58 (0.53, 4.75)	0.412	3.56 (1.13, 11.15)	**0.029**
Education						
High education	ref	ref	ref	ref	ref	ref
Medium education	1.69 (0.47, 6.03)	0.420	0.44 (0.12, 1.60)	0.212	1.85 (0.43, 7.97)	0.410
Low education	0.75 (0.26, 2.17)	0.599	1.21 (0.43, 3.40)	0.720	1.67 (0.51, 5.50)	0.401
Female gender	1.63 (0.67, 3.94)	0.283	0.54 (0.23, 1.27)	0.158	1.60 (0.62, 4.18)	0.334
Age	0.98 (0.94, 1.01)	0.178	1.02 (0.99, 1.06)	0.179	1.02 (0.98, 1.06)	0.372

Results are from multivariable logistic regression models ($n = 108$). Dependent variable: medication prescription, defined for each column.
Bold values indicate $P < 0.05$.
ref: reference group.

American College of Rheumatology in 2015 to treat disease flare-ups and relieve swelling and pain [20]. In our practice, prednisolone is mainly used in the initial remission induction treatment of RA and as bridging therapy when switching between different DMARDs. The difference in prednisolone prescriptions suggests RA is not sufficiently under control in these patients, leading to prednisolone initially being prescribed as a practical short-term solution but continued as a long-term maintenance dose. Patients with more health literacy needs may also ask for prednisolone more often because they may not be as able to anticipate the adverse effects in the long-term.

Additionally, we found significantly more bDMARD prescriptions in the 'good health literacy' group. In the 'some health literacy limitations' group, this was likely to be compensated by prescription of csDMARDs only, while the 'several health literacy limitations' group, as stated before, received more prednisolone. This finding could be partly explained by the reluctance of patients to switch to bDMARDs [10]. The causes of this reluctance are multifactorial, but likely includes patients' concerns about new medication and overall satisfaction with their current treatment regimen (even if disease activity levels indicate a medication switch is required) [21]. Furthermore, a previous study in the USA showed that patients in socio-economically disadvantaged positions (as associated with 'limited' health literacy) were often not informed about or prescribed bDMARDs, albeit primarily due to high patient costs [22]. Nonetheless, a study conducted in Norway (where financial barriers are absent) also hypothesized that health literacy may play a role as a barrier to bDMARD prescription in patients of older age and with lower education levels [23]. The present study further establishes this prescription divide in a health system where financial barriers generally play only a small role, as all medication discussed here is covered under mandatory basic health insurance in the Netherlands. Of note, patients with 'good health literacy' were prescribed the most bDMARDs (Table 1), but differences were only significant compared with the 'some health literacy limitations' group (Table 3).

Due to the relatively small size of the groups with health literacy limitations, we should be careful in drawing strong conclusions from comparisons between the two, as they may also be due to chance, and further research is needed to confirm our findings. Nevertheless, different attitudes of healthcare professionals and patients towards decision making between the groups [23] or higher disease activity in the 'several health literacy limitations' group might have prompted the prescription of prednisolone and earlier initiation of bDMARDs.

Further (qualitative) research into the roles and attitudes of patients and rheumatologists in treatment decisions for bDMARDs in relation to health literacy is warranted.

Our findings may raise questions about what could be done to level the playing field through health literacy. While health literacy is seen as a modifiable determinant of health, improving individuals' health literacy is difficult in a clinical setting, where time with a patient is limited. Rather, we should identify how our services can better respond to the health literacy limitations of our patients. Ongoing research based on the study by Bakker *et al.* [12] currently focuses on what so-called health literacy actions could be implemented in rheumatology care. The project follows the OPtimizing HEalth LIteracy and Access (OPHELIA) process [24], a methodology endorsed by the World Health Organization, which generates solutions to health literacy challenges in diverse (medical) settings all over the world [25]. Examples of health literacy solutions include using the Conversational Health Literacy Assessment Tool (CHAT) to identify a patient's specific challenges [26], developing understandable and actionable information materials (e.g. by using plain language or illustrations [27]) and offering patients additional guidance and support (e.g. by discussing questions and treatment decisions with a rheumatology nurse).

Another initiative that could potentially address the health literacy divide in rheumatology is the 'universal precautions' approach [28]. This approach assumes that every patient is at risk of reduced access to and outcomes of care due to 'limited' health literacy. A rheumatology-specific toolkit that can help organizations in providing care that connects with patients of all health literacy levels is publicly available [29]. Applying this approach can lead to increased adherence of rheumatology-related medications [30]. No matter which approach is taken, we should look beyond one-size-fits-all solutions: health literacy needs are context-specific and therefore solutions need tailoring to the local context as well.

A strength of this article is the use of a multidimensional approach to health literacy. This study is the first to explore associations of health literacy with disease activity and medication prescription in patients with RA using the HLQ, a multidimensional tool for health literacy. Additionally, the use of patients' data from routine visits (without additional lab tests or measurements) provides a true-to-life representation of RA treatment and outcomes. Nevertheless, there are some limitations to consider. First, due to the relatively small sample size, we aggregated the 10 health literacy profiles to three health literacy groups for comparison. Variation of the effect of different health literacy profiles within these three groups on disease activity or medication prescription may exist, but a bigger sample size would be required for such analyses. Second, due to the single-centre study design, the population was rather homogeneous, with all patients included being from the Twente region in The Netherlands. This limited the socio-economic diversity, thereby hindering broader generalization of the results. Previous research in the field of health literacy showed a distinct connection between ethnicity and the level of health literacy [3], so a more diverse sample may yield different results. Last, this study only assessed medication prescription and did not look into adherence. Medication adherence in patients with 'limited' health literacy is a widely researched topic and there is general consensus about an existing negative association between the two [5, 19]. Studying medication prescription and adherence patterns in tandem could provide more insight into the reasons behind higher DAS28-ESR and prednisolone use.

In conclusion, in a population of patients with RA, we found that patients with 'several health literacy limitations' had higher DASs over time, even when adjusted for education level, and used prednisolone significantly more often than patients with higher health literacy levels. Patients with 'good health literacy' were most often prescribed a bDMARD. These results support the clinical relevance of the previously identified health literacy profiles and provide more insights into the role of health literacy in the treatment and outcomes of patients with RA. This study suggests that better recognition of and attention to patients' health literacy needs by health professionals is necessary for more optimal disease management and patient understanding.

Data availability

The data underlying this article will be shared upon reasonable request to the corresponding author. The data cannot be shared publicly, as they contain information that could compromise the privacy of research participants. They did not consent to have their data shared.

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