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PHARMACOEPIDEMIOLOGY AND PRESCRIPTION

# The impact of health literacy on beliefs about medication in a Dutch medication-using population

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## Abstract

**Purpose** Medication beliefs are likely contingent on aspects of health literacy: knowledge, motivation, and competences to access, understand, appraise, and apply health information. An association between medication beliefs and health literacy is expected as they both influence self-management. The aim of this study was to examine the association between health literacy and the beliefs about overuse and harmful effects of medication and to examine modifying effects of age, gender, and number of medications on this association.

**Methods** The data were collected using the online "Medication panel" of the Dutch Institute for Rational Use of Medicine. A linear regression model was used to examine the association between health literacy and beliefs about medication and the modifying effects of age, gender, and number of medications on this association.

**Results** Respondents with a lower level of health literacy had more concerns about overuse ($\beta$ adj.= -.174, $p$<.001) and harmful ($\beta$ adj.= -.189, $p$<.001) effects of medication. This study found no modifying effects.

**Conclusions** A lower health literacy level is associated with more concerns about the overuse and harmful effects of medication. The results of this study suggest that extra attention should be given to persons with low health literacy level by healthcare professionals, to decrease their concerns about overuse and harmful effects, and improve adherence to self-management behavior.

**Keywords** Beliefs about medication · Health literacy · Adherence · Gender · Age · Number of medications

## Introduction

Over the last decade, an increased focus has been placed upon patients' ability to self-manage their health and to organize their care. Health literacy plays an important role in this development [1, 2]. Low health literacy is associated with poorer health outcomes and poorer use of health care services [3]. Most of the existing research focuses on a functional definition of health literacy (the ability to read and write), but a more comprehensive perspective on health literacy is needed as an important prerequisite in order to take up a pro-active role in one's own health [1, 4–10]. Health literacy is "linked to literacy and encompasses people's knowledge, motivation and competences to access, understand, appraise, and apply health

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information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course." [11]. This definition addresses a broader range of competences compared to functional health literacy, including communication and social skills and the ability to apply health information which are essential for an active patient role in shared decision making and self-management.

Medication beliefs are cognitive representations of treatment, for example, whether persons believe that taking their medication is necessary or whether they are concerned about the side effects of medication. These medication beliefs are likely contingent on aspects of health literacy: knowledge, motivation, and competences to access, understand, appraise, and apply health information. Medication beliefs have been shown to be associated with medication adherence, which is a crucial component of effective self-management behaviors. An association between medication beliefs and health literacy is therefore to be expected as they both influence self-management [12–16].

Previous studies have examined the relation between health literacy and beliefs about medication. These studies were focused on the functional health literacy in populations with a specific illness (asthma, COPD, and diabetes type 2) or pregnancy [12, 17–19]. These studies showed that lower health literacy levels were associated with stronger beliefs in necessity, harm, and overuse of medication [18–21].

### Aim of the study

The primary aim of the current study was to examine the association between health literacy and beliefs about overuse and harmful effects of medication. This study focuses on health literacy that addresses a broad range of competences and includes persons using medication, regardless of type of disease. The secondary aim of the study was to examine the modifying effects of age, gender, and number of medications on the association between health literacy and beliefs about overuse and harmful effects of medication.

## Methods

### Study design and study population

Data were derived from the online "Medication panel" of the Dutch Institute for Rational Use of Medicine, Utrecht, the Netherlands. This panel was founded in 2016 to map opinions of medication users about different themes concerning pharmaceutical and pharmacotherapeutical care. There was a 2-step self-selection process. First, people who visited the website www.meldpuntmedicijnen.nl to share their experiences with medication could register to participate in the panel via a button on the website. Second, all registered members received an invitation for the study by e-mail, with background information about the study and a survey-link. Informed consent was obtained from all individual participants included in the study. The panel members were not incentivized to respond. The mean age of the panel members was 60 years. 69% of the panel members were female, and 93% of the panel members were taking medication. The educational level of the panel members can be classified as high (40%), intermediate (53%), and low (7%). For the current study, an online questionnaire was sent to all 2,157 panel members in February of 2018, with the inclusion criterion that they use medication. All members received an invitation for the study by e-mail, with background information about the study and a survey-link.

### Measurements

The survey was divided into 3 parts: respondents' characteristics, a health literacy questionnaire (Health literacy survey (16-item) (HLS-EU-Q16)), and a questionnaire to measure beliefs about medication (beliefs about medicines questionnaire (BMQ-general)) [22, 23]. The questionnaires were in Dutch.

#### Respondents' characteristics

The respondents' characteristics section consisted of background questions on age, gender, number of medications, education level, and illnesses. Education level was classified based on the highest level of education accomplished: low (primary school or preparatory vocational training), intermediate (intermediate or advanced general education or intermediate vocational training), and high (high vocational education or university).

#### Health literacy

The validated HLS-EU-Q16 in Dutch was used for measuring health literacy [22]. This HLS-EU-Q16 measures health literacy in terms of the three domains (healthcare, disease prevention, and health promotion) that concern people's health and are expressed in terms of accessing, understanding, appraising, and applying information to manage disease, risks, and health. Additional information about the HLS-EU-Q16 is given in Online Resource 1. Respondents with a score <9 were categorized as having "inadequate" health literacy, respondents with a score 9–12 were categorized as having "problematic" health literacy, and respondents with a score >12 were categorized as having "sufficient" health literacy [22, 24].

### Beliefs about medication

Medication beliefs were measured with the BMQ. The BMQ consists of two parts, a specific part and a general part. The BMQ-specific assesses whether a person believes that taking their medication is necessary or whether they are concerned about side effects regarding medication they take themselves. The BMQ-general assesses whether a person believes that taking medication in general is harmful and that medication is overused by doctors. In this study, the BMQ-general was used with its 2 subscales of 4 items each. The "overuse" subscale addresses the concept of over-prescription of medication by doctors who place too much trust in them (e.g., "Doctors place too much trust in medication"). The "harm" subscale assesses beliefs about how harmful medications are (e.g., "Medications do more harm than good"). Each item was measured on five-point Likert-type scales with strongly disagree to strongly agree as the response options. The scoring method is the total subscale; scores range from 4 to 20. Higher scores indicate stronger concerns about overuse and harm. The BMQ and its Dutch translation have been validated in studies that involved patients with various chronic diseases [23, 25, 26].

### Data analysis

Cronbach's Alpha was used to determine the internal consistency of the HLS-EU-Q16, BMQ-overuse, and the BMQ-harm scores. Linear regression was used to assess the association between the independent variable HLS-EU-Q16 and the dependent variables BMQ-overuse and BMQ-harm. To test whether age, gender, and number of medications were confounding factors, they were added to the linear regression model with a change of more than 10% in the adjusted β indicating confounding. To assess whether age, gender, and number of medications were effect modifiers, HLS-EU-Q16, age, gender, and number of medications were standardized and interaction terms between HLS-EU-Q16 and the possible effect modifiers age, gender, and number medications were calculated and added to the linear regression. The distribution of the data, including skewness and kurtosis, was examined. Statistical significance level was set at 0.05. All data analyses were conducted using IBM SPSS Statistics version 24.

## Results

### Respondents' characteristics

A total of 777 (36%) of the 2,157 panel members returned the questionnaire, 195 questionnaires were incomplete, and these questionnaires were excluded from analysis. After exclusion, 582 completed questionnaires remained. 43 of the panel members who returned a complete questionnaire indicated that they did not use medication and were excluded, so the data of 539 respondents were analyzed.

Table 1 lists the characteristics of the respondents. Most were female (69%), and the mean age was 64 (± 11.4) years old. The youngest participant was 18 years old, and the oldest was 92 years old. The mean number of medications used concomitantly was 4.00 (± 2.32), the frequency of medication intake was 2.50 (± 1.43) per day, and 29% did not report an illness. Overall, 62% of respondents had a sufficient health literacy level, 25% had a problematic health literacy level, and 13% had an inadequate health literacy level (Table 2). Table 2 also shows the mean score of BMQ-overuse and BMQ-harm for the inadequate, problematic, and sufficient health literacy levels.

### Health literacy and beliefs about medication

The internal consistency of the BMQ and HLS-EU-Q16 was good, .84 and .90, respectively (Cronbach's alpha). For each statement in the BMQ and HLS-EU-Q16, Cronbach's alpha decreased if a statement was removed. The mean score of BMQ-overuse was 11.94 (SD=3.44), which was normally distributed with acceptable skewness (-0.06) and kurtosis (−0.52). The mean score of BMQ-harm was 9.89 (SD=3.12), which was normally distributed with acceptable skewness (0.42) and kurtosis (−0.08). Table 2 shows that people with a lower level of health literacy had a higher score on the BMQ-overuse and BMQ-harm. This implies that people with a lower level of health literacy had more concerns about overuse and harmful effects of medication compared to people with a higher level of health literacy. To examine this association, a linear regression was performed (Table 3). Linear regression shows that respondents with a lower level of health literacy had more concerns about overuse and harmful effects of medication. Confounder analysis showed that age, gender, and number of medications did not change the adjusted βs of health literacy more than 10% for both BMQ-overuse and BMQ-harm, so were not considered confounders. Table 3 shows that adding the interaction terms health literacy and gender, health literacy and age and health literacy and number of medications were not significantly associated with BMQ-overuse and BMQ-harm and, thus, showed no modifying effect.

## Discussion

The results of this study showed that respondents with a lower level of health literacy had more concerns about overuse and harmful effects of medication. This is in line with previous research on the association between functional health literacy and beliefs about medication and health literacy [13]. This study found that age, gender, and number of medications

**Table 1** Respondents' characteristics

| | | *n* (%) or mean (SD) *n*=539 |
|---|---|---|
| Gender | Male | 168 (31%) |
| | Female | 371 (69%) |
| Age in years | Average | 64 (11.4) |
| | ≤ 60 | 185 (34%) |
| | > 60 ≤ 70 | 199 (37%) |
| | > 70 | 155 (29%) |
| Number of medications | Average | 4.00 (2.32) |
| | < 3 | 218 (31%) |
| | ≥ 3 | 321 (69%) |
| Education | Low | 32 (6%) |
| | Intermediate | 264 (49%) |
| | High | 243 (45%) |
| Self-reported illness* | Cardiovascular | 223 (41%) |
| | Asthma/COPD | 97 (18%) |
| | Mental health | 88 (16%) |
| | Rheumatism | 83 (15%) |
| | Diabetes | 77 (14%) |
| | Stomach/bowel | 71 (13%) |
| | Parkinson | 25 (5%) |
| | Psoriasis | 24 (4%) |
| | Epilepsy | 18 (3%) |
| | Glaucoma | 14 (3%) |
| | Human immunodeficiency virus | 2 (1%) |

*More than 1 answer possible per subject

had no modifying effect on the association between health literacy and beliefs about medication. This is in line with a previous study in an obstetric population; this study also did not find an effect of the number of medications on the domains BMQ-overuse and BMQ-harm [19]. This study is one of the first studies that examine the association between health literacy and the BMQ-overuse and BMQ-harm in multiple illnesses. Future research should examine the association between health literacy and the BMQ-overuse and BMQ-harm in specific patient populations, to gain more insight into possible differences in associations between those populations.

**Table 2** BMQ-scores per level of health literacy

| Health literacy level | *n* | BMQ-overuse Mean (SD) | BMQ-harm Mean (SD) |
|---|---|---|---|
| Sufficient | 336 | 11,68 (3,33) | 9,57 (3,01) |
| Problematic | 133 | 11,85 (3,55) | 10,02 (3,10) |
| Inadequate | 70 | 13,56 (3,41) | 11,27 (3,08) |
| Overall | 539 | 11,94 (3,44) | 9,89 (3,12) |

This study showed that people with difficulties in knowledge, motivation, and competences to access, understand, appraise, and apply health information in order to make judgments have more concerns about overuse and harmful effects of medication. These concerns may negatively influence

**Table 3** Linear regression model of the association between beliefs about medication and health literacy and the modifying effect of age, number of medications on the association

| | *β* adj. | *p* value |
|---|---|---|
| BMQ-overuse | | |
| Health literacy | -.174 | < .001 |
| Health literacy and gender[a] | .011 | .801 |
| Health literacy and age[a] | .068 | .110 |
| Health literacy and number of medications[a] | .006 | .881 |
| BMQ-harm | | |
| Health literacy | -.189 | < .001 |
| Health literacy and gender[a] | -.020 | .644 |
| Health literacy and age[a] | .023 | .594 |
| Health literacy and number of medications[a] | .013 | .767 |

*Significant at $p < 0.05$; [a] Interaction term between two variables

decisions in self-management, disease prevention, and health promotion. Therefore, extra attention should be given to persons with a low health literacy level using medication by healthcare professionals. A healthcare professional could help those persons voice their concerns and where possible resolve concerns. A number of tools have been developed for healthcare professionals to recognize health literacy levels, e.g., the RALPH interview guide (Recognizing and Addressing Limited Pharmaceutical literacy)[27, 28]. Such tools can be helpful in recognizing persons with low health literacy and to anticipate the health literacy level in communication. Moreover, future research is needed to explore how to enhance understanding of the necessity of taking medication and allay concerns to shift from emphasis on concerns to necessity.

Besides health literacy that influences beliefs about medication, other factors that might influence beliefs about medication are cognitive illness perception and emotional responses to the disease [14–16]. These cognitive illness perceptions consist of five domains according to the self-regulatory model: illness perceptions as identity, timeline, cause, consequences, and control [29]. These cognitive illness perceptions activate behavioral actions, for example, medication adherence. All these five factors might influence the beliefs about medication and should be investigated in future research.

A limitation of this study was that the study population was drawn from an online panel in a two-step selection process. Respondents must already have a degree of digital skills to register for participating in the panel on the website and be subsequently motivated to share their experiences. The findings of our study might only be representative of relatively motivated, digitally skilled medication users. In the Netherlands, the level of health literacy is inadequate in 9.5% of the overall population, problematic for 26.9%, and sufficient for 63.6% [27]. The data of this study showed similar percentages (13% inadequate, 25% problematic, and 62% sufficient). We expected that the level of health literacy of the panel members would be better compared to the Dutch population, because the digital panel members were motivated to participate and were required to read and use digital skills. To increase the generalizability of the results, there is a need to repeat this study in a larger group of patients with low levels of health literacy.

In this study, we did not measure medication adherence, therefore, the results of this study do not show whether low levels of health literacy lead to improved or decreased levels of medication adherence. Measuring adherence, health literacy, and beliefs about medication could give more insights on the factors that influence the beliefs about medication. Future research should gain more insights into these associations, so interventions can be developed, which decrease patients' concerns about overuse and harmful effects of medication and increase medication adherence.

## Conclusion

In conclusion, this study showed that there is an association between health literacy and beliefs about medication. A lower health literacy level is associated with more concerns about the overuse and harmful effects of medication. The results of this study suggest that extra attention should be given to persons with low health literacy levels, to decrease their concerns about overuse and harmful effects and improve adherence to self-management behavior.

**Author contribution** Boudewijn Visscher: conceptualization, methodology, formal analysis, investigation, data curation, writing—original draft, visualization, and project administration. Bas Steunenberg: conceptualization, methodology, writing—review and editing, and supervision. Hanneke Zwikker: resources, data curation, and writing—review and editing. Jany Rademakers: conceptualization, methodology, writing—review and editing, and supervision. Rob Heerdink: conceptualization, methodology, writing—review and editing, and supervision.

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**Data availability** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

**Code availability** Not applicable.

## Declarations

**Ethics approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of the University of Applied Sciences Utrecht (reference number 9400020192).

**Consent to participate** Informed consent was obtained from all individual participants included in the study.

**Consent for publication** Not applicable.

**Conflict of interest** The authors declare no conflict of interest.

## References

1. Rademakers J, Heijmans M (2018) Beyond reading and understanding: health literacy as the capacity to act. Int J Environ Res Public Health 15(8):1676
2. Papadakos JK, Hasan SM, Barnsley J, Berta W, Fazelzad R, Papadakos CJ, Giuliani ME, Howell D (2018) Health literacy and cancer self-management behaviors: a scoping review. Cancer 124(21):4202–4210
3. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K (2011) Low health literacy and health outcomes: an updated systematic review. Ann Intern Med 155(2):97–107

4. Visscher BB, Steunenberg B, Heijmans M, Hofstede JM, Devillé W, van der Heide I, Rademakers J (2018) Evidence on the effectiveness of health literacy interventions in the EU: a systematic review. BMC Public Health 18(1):1414–1417
5. Berkman ND, Sheridan SL, Donahue KE et al (2011) Health literacy interventions and outcomes: an updated systematic review. Evid Rep Technol Assess 199:1–941
6. Dennis S, Williams A, Taggart J, Newall A, Denney-Wilson E, Zwar N, Shortus T, Harris MF (2012) Which providers can bridge the health literacy gap in lifestyle risk factor modification education: a systematic review and narrative synthesis. BMC Fam Pract 13:44
7. Barry MM, D'Eath M, Sixsmith J (2013) Interventions for improving population health literacy: insights from a rapid review of the evidence. J Health Commun 18(12):1507–1522
8. Zhang NJ, Terry A, McHorney CA (2014) Impact of health literacy on medication adherence: a systematic review and meta-analysis. Ann. Pharmacother 48(6):741–751
9. Miller TA (2016) Health literacy and adherence to medical treatment in chronic and acute illness: a meta-analysis. Patient Educ Couns 99(7):1079–1086
10. Ostini R, Kairuz T (2014) Investigating the association between health literacy and non-adherence. Int J Clin Phar 36(1):36–44
11. Sorensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z et al (2012) Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health 12:80
12. Kale MS, Federman AD, Krauskopf K, Wolf M, O'Conor R, Martynenko M, Leventhal H, Wisnivesky JP (2015) The association of health literacy with illness and medication beliefs among patients with chronic obstructive pulmonary disease. PLoS One 10(4):e0123937
13. Shiyanbola OO, Unni E, Huang YM, Lanier C (2018) The association of health literacy with illness perceptions, medication beliefs, and medication adherence among individuals with type 2 diabetes. Res Social Adm Pharm 14(9):824–830
14. Menckeberg TT, Bouvy ML, Bracke M, Kaptein AA, Leufkens HG, Raaijmakers JAM, Horne R (2008) Beliefs about medicines predict refill adherence to inhaled corticosteroids. J Psychosom Res 64(1):47–54
15. Kaptein AA, Klok T, Moss-Morris R, Brand PLP (2010) Illness perceptions: impact on self- management and control in asthma. Curr Opin Allergy Clin Immunol 10(3):194–199
16. Halm EA, Mora P, Leventhal H (2006) No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. Chest. 129(3):573–580
17. Shiyanbola OO, Nelson J (2011) Illness perceptions, beliefs in medicine and medication non-adherence among South Dakota minority women with diabetes: a pilot study. S D J Med 64(10):365–368
18. Federman AD, Wolf M, Sofianou A, Wilson EAH, Martynenko M, Halm EA, Leventhal H, Wisnivesky JP (2013) The association of health literacy with illness and medication beliefs among older adults with asthma. Patient Educ Couns 92(2):273–278
19. Duggan L, McCarthy S, Curtis LM, Wolf MS, Noone C, Higgins JR, O'Shea S, Sahm LJ (2014) Associations between health literacy and beliefs about medicines in an Irish obstetric population. J Health Commun 19(Suppl 2):106–114
20. Clyne B, Cooper JA, Boland F, Hughes CM, Fahey T, Smith SM, OPTI-SCRIPT study team (2017) Beliefs about prescribed medication among older patients with polypharmacy: a mixed methods study in primary care. Br J Gen Pract 67(660):e507–e518
21. Phatak HM, Thomas J 3rd (2006) Relationships between beliefs about medications and nonadherence to prescribed chronic medications. Ann Pharmacother 40(10):1737–1742
22. Sorensen K, Van den Broucke S, Pelikan JM et al (2013) Measuring health literacy in populations: illuminating the design and development process of the European health literacy survey questionnaire (HLS-EU-Q). BMC Public Health 13:948
23. Horne R, Weinman J, Hankins M (1997) The beliefs about medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. Psychol Health 14(1):1–24
24. Vandenbosch J, Van den Broucke S, Vancorenland S et al (2016) Health literacy and the use of healthcare services in Belgium. J Epidemiol Community Health 70(10):1032–1038
25. Horne R, Weinman J (1999) Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. J Psychosom Res 47(6):555–567
26. Theunissen NC, de Ridder DT, Bensing JM et al (2003) Manipulation of patient-provider interaction: discussing illness representations or action plans concerning adherence. Patient Educ Couns 51(3):247–258
27. Heijmans M, Brabers A, Rademakers J (2018) Health literacy in Nederland. NIVEL [Dutch], Utrecht
28. Vervloet M, van Dijk L, Rademakers JJDJM, Bouvy ML, de Smet PAGM, Philbert D, Koster ES (2018) Recognizing and addressing limited pharmaceutical literacy: development of the RALPH interview guide. Res Social Adm Pharm 14(9):805–811
29. Leventhal H, Brissette I, Leventhal EA (2003) The common-sense model of self-regulation of health and illness. In: Cameron LD, Leventhal H (eds) The Self-Regulation of Health and Illness Behaviour. Routledge, London, pp 42–65