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The association between health literacy and health services use in patients with type 2 diabetes in primary care

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ABSTRACT

Aims

Limited health literacy (HL) may result in a mismatch between patients' needs and the care provided, leading to inefficient use of health services. This study aimed to gain insight into HL and other patient characteristics associated with health services use. These insights can be used to improve person-centered care.

Methods

This cross-sectional study used multiple hierarchical regression analysis to investigate the association between HL and health services use in 352 primary care patients with type 2 diabetes mellitus (DM2).

Results

Patients with limited HL (30.4%) use more health services per year (median=18, IQR=10;26) than patients with sufficient HL (median=12, IQR=8;19) ($p<0.001$). After controlling for several patient characteristics, remaining factors associated with health services use were medication use, HbA1c, diabetes-related distress, and health status, explaining 37% of the variance. Medication use acted as a mediator between HL and health services use.

Conclusion

Limited HL in patients with DM2 is associated with increased health services use, mediated by medication use. This implies that healthcare providers also influence health services use through medication prescriptions. Their position enables them to detect limited HL and respond to it, leading to care that is more efficient and responsive to individual patient's needs.

INTRODUCTION

Type 2 diabetes mellitus (DM2) is one of the most prevalent chronic conditions worldwide, with an European prevalence of 8.9% in 2019 that is expected to rise to 10.3% in 2045 [1]. Long-term complications of DM2 are cardiovascular diseases, retinopathy, nephropathy, and neuropathy [2]. Treatment goals in DM2 are to prevent or delay complications and maintain good quality of life [3]. To achieve these goals, patients have to self-manage their DM2 [4,5]. Some patients, however, may not be able to self-manage their condition adequately due to a lack of knowledge or limited health literacy (HL), referred to as the capacity to obtain, process, and understand basic health information and services [6,7]. Limited HL is not always recognized by healthcare providers (HCPs). Patients may be unaware of their own lack of understanding or feel ashamed to mention this topic [8,9]. Furthermore, HCPs may overestimate patients' HL skills [10]. Consequently, patients' needs may remain hidden from HCPs, resulting in a mismatch between patients' needs and the care provided [11,12].

Prevalence of limited HL in the general population varies between European countries, with the lowest prevalence found in The Netherlands (28.7%) and the highest prevalence found in Bulgaria (62.1%) [13]. Limited HL is consistently associated with less knowledge of diabetes [14], which is also a mediator in the association between HL and glucose self-control [15]. Moreover, several studies showed associations between limited HL and poor health outcomes [16,17], including more health services use [18,19].

Previous studies have identified gaps in the knowledge about the impact of HL on health outcomes in diabetes care [14,20]. For example, while health services use may reflect the need for self-management support [21] or medical treatment [22], little is known about the effects of HL and several other patient characteristics on health services use by patients with DM2, either directly or through mediation.

More insight into the factors associated with health services use is needed to provide person-centered care in patients with DM. For example, a HCP who is aware of a patient's difficulties in understanding written information may use visual aids instead [23].

Therefore, the aim of the current study was to provide insight into the influence of HL and several patient characteristics on health services use in patients with DM2. Andersen's behavioral model of health services use [24,25] was used to guide this study. This model states that health services use is determined by environmental factors (societal factors and healthcare system) and patient characteristics, categorized as predisposing, enabling, and need factors (Fig.1). The following research questions were formulated:

1. What are the levels of HL in patients with DM2 in primary care?
2. What is the difference in health services use between patients with limited and sufficient HL?
3. What is the association between HL and health services use when controlled for several patient characteristics?

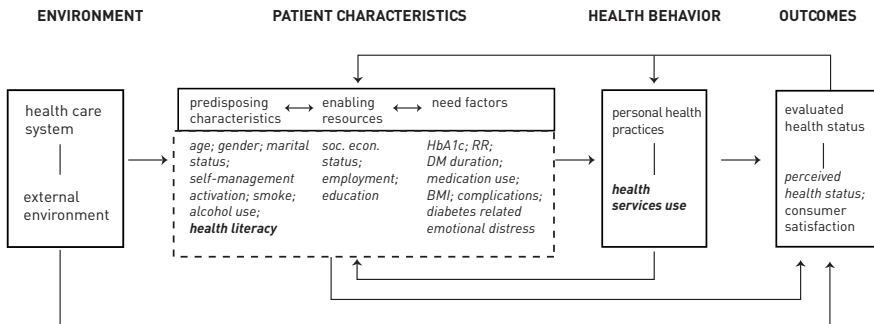


Figure 5.1 Andersen's behavioral model for health services use. Italics: several patient characteristics investigated for their direct or indirect influence on health services use. Bold: health literacy as the independent variable and health services use as the dependent variable.

METHODS

Study design

This cross-sectional study was conducted in 2 primary care centers in the Northeast region of The Netherlands. Data were collected between January 2020 and September 2020.

Setting

In Dutch primary care practices, primary care physicians, advanced nurse practitioners [26], physician assistants [27], practice nurses, and doctors' assistants can be employed to deliver general medical and chronic care, which is offered according to guidelines from the Dutch College of Primary Care Physicians [28]. In the Netherlands, disease management programs are developed to deliver chronic care [29]. The program for DM2 includes 4 monitoring visits per year, three with the practice nurse or doctors' assistant and 1 with the primary care physician. During these visits, DM2 related variables, such as weight, blood pressure, glucose, and cholesterol levels are monitored. Additionally, well-being, occurrence and prevention of complications, lifestyle issues, and adherence to medication are discussed.

Study population

The participating primary care centers served a total of approximately 16,500 patients, of whom 1,500 patients were diagnosed with DM2. To qualify for inclusion, patients had to be diagnosed with DM2 for at least 1 year, be aged 18 years or older, speak Dutch, and be able to give written informed consent for linking their medical and questionnaire data.

All patients with DM2 who visited the practice during the inclusion period were informed about the study by practice nurses. Patients interested in participating were

asked to answer 3 questions about HL [30]. Patients who scored low on these questions or were unsure whether they could complete all the questionnaires themselves were offered help from the practice nurse or interviewer (AW or a trained assistant). Patients who did not return their questionnaires within 2 weeks were reminded by phone once.

Primary outcome

The primary outcome variable and patient characteristics investigated in this study are presented according to Andersen's behavioral model [24,25] (**Figure 5.1**). Looking at the feedback loops in this model, perceived health status can be understood as an outcome as well as a determinant of health services use. In this study, perceived health status was used as a determinant of health services use.

Data on health services use were extracted from the patients' electronic health records and operationalized as the number of consultations with one of the HCPs, either at the practice, at home, or by telephone or email, during the past year and registered as insured care. Not included in this number were requests to make an appointment or to refill a prescription.

Factors associated with health services use and measurement instruments

The following patient characteristics were assessed by a general questionnaire: gender; age (in years); marital status (living alone or living with someone); socioeconomic status (by postal code); employment status (employed, un-employed, or retired); and education level divided into lower (none or primary school), medium (secondary school or vocational training), and higher (high school or university) education.

HL was assessed by the validated 3-item Dutch translation of the Set of Brief Screening Questionnaire [30]: 1. "How often do you need help from someone reading health-care materials?" 2. "How confident are you filling out medical forms by yourself?" 3. "How often do you have problems learning about your medical condition because of difficulty understanding written information?" The items could be answered on a 5-point Likert scale ranging from always (0) to never (4). Higher scores indicate better HL. In line with previous research [31], the sum scores (range 0 to 12) were dichotomized into limited HL (0 to 8) and sufficient HL (9 to 12).

Patient's self-management activation level, defined as the level of how well the patient is willing, able and feel ready to manage his or her chronic disease, was assessed using the validated Dutch translated 13-item Patient Activation Measure (PAM-13). This instrument assesses self-reported knowledge, skills, and confidence for self-management [32,33]. Items were scored on a 4-point Likert scale ranging from 'totally disagree' (1) to 'totally agree' (4) and a 'not applicable' option. The score is calculated according to the PAM's scoring table (Insignia Health, 2020). Four activation levels can be distinguished, including low (level 1 = score 0 - 47.0 and level 2 = score 47.1 - 55.1), moderate (level 3 = score 55.2 - 67.0), and high (level 4 = score 67.1 - 100). Higher levels indicate a more active role in self-management.

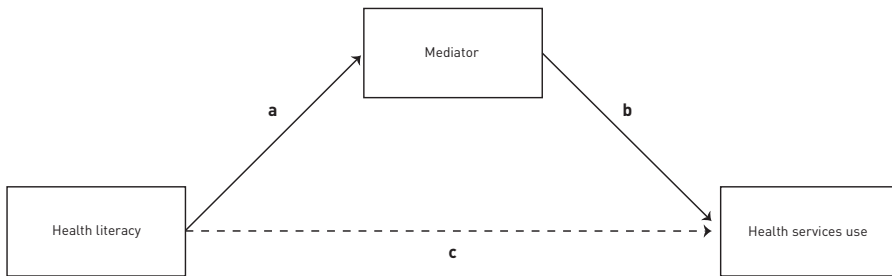


Figure 5.2 Path diagram for an indirect effect of the independent variable (health literacy) on the dependent variable (health services use) through a mediator.

Diabetes-related distress (DD) was assessed using the validated 5-item Problem Areas in Diabetes (PAID-5) questionnaire [34]. It contains items assessing fear, depressive symptoms, concerns about the future, and demands of living with diabetes. Items could be scored on a 5-point response scale ranging from 0 (no problems) to 4 (serious problems), with a score of ≥ 8 indicating DD.

Health status was assessed by the EuroQol-visual analogue scale (EQ-VAS) [35]. Scores range between 0 - 100, with higher scores representing better health status.

The following health-related factors were extracted from the patient's electronic health record: duration of DM2 in years; glycemic control assessed using glycated hemoglobin (HbA1c) in mmol/mol; Body Mass Index (BMI) in kg/m²; blood pressure (mmHg); type and number of diabetes complications reported as retinopathy, neuropathy, nephropathy, hypertension, and vascular diseases (yes/no); medication use (total number of medication prescriptions); type of DM medication (yes/ no); and receiving flu vaccination (yes/no).

Sample size

Looking at Andersen's model, the association between HL and health services use may be mediated by several factors (**Figure 5.2**). To detect any mediation effect, an a-path of 0.26 and a b-path of 0.14 were assumed. Therefore, a sample size of about 368 patients would be needed [36].

Statistical Analyses

Statistical analyses were performed using SPSS 23.0 software (SPSSinc.). Descriptive analyses were expressed as frequencies, percentages (%), means, standard deviations (SD), medians, confident intervals (CI), and interquartile ranges (p25; p75). Missing data were not imputed.

Univariate analyses were performed to explore associations. Because the distribution of data was skewed, associations were explored using non-parametric analyses (Spearman rank order correlations). Differences between groups were explored with a Mann-Whitney U test.

Hierarchical multiple regression was used to analyze the association between HL and health services use, after controlling for patient characteristics. First, factors associated with health services use ($p \leq 0.1$) were entered in the regression analysis. Next, factors with the highest p -values were removed manually step-by-step until all p -values in the model were ≤ 0.1 . Residuals were checked for a normal distribution.

The 4 steps to detect mediation were followed with health services use as an outcome variable, HL as a primary independent factor, and several other patient characteristics as possible mediators [36].

Ethical considerations

This study was approved by the local Medical Ethics Committee (METC no. 2019/688), declaring that the study did not fall under the scope of the Medical Research Involving Human Subjects Act. Informed consent was obtained from all participants.

RESULTS

Of a total of 615 invited patients, 352 participated in this study (response rate 57%). Nearly one-third ($n=107$, 30.4%) of the participants had limited HL (score < 9). Total health services use varied between 8.0 and 21.0 consultations, with a median score of 13.0 consultations per year (**Table 5.1**).

Patients with limited HL were significantly older ($p= 0.035$), reported lower health status ($p= 0.015$) and lower self-management activation scores ($p=0.004$), and used more medication ($p < 0.001$) than patients with sufficient HL (**Table 5.2**). Patients with limited HL made more use of health services per year (median=18, IQR=10;26) than patients with sufficient HL (median=12, IQR=8;19) ($p < 0.001$).

Medication use, HbA1c, DD and health status were significantly associated with health services use. Medication use was found to be the most important factor contributing to the explained variance of health services use throughout the models (**Table 5.3**). As demonstrated below, medication use mediated between HL and health service use (**Figure 5.2**, path a, b, c). Step 1 (path c): association of HL with health services use ($\beta = -0.881$, $p < 0.001$); Step 2 (path a): association of HL with medication use ($\beta = -0.527$, $p < 0.001$); Step 3 (path b): association of medication use with health services use ($\beta = 1.308$, $p < 0.001$); Step 4 (path c dashed line): association between HL and health services use after adding medication use to the model is no longer significant (β medication use = 1.275, $p < 0.001$ and β HL = -0.209, $p = 0.266$).

Table 5.1 Participants characteristics (n=352)

Characteristics (n valid observations)	n (%)
Predisposing factors*	
Gender (352) Male	193 (54.8)
Age (352) median (IQR)	71.0 (64.0;75.0)
Marital status (350) Living alone	112 (32.0)
Total health literacy score 0-12 (352) median (IQR)	10.0 (8.0;12.0)
Health literacy score < 9 (limited)	107 (30.4)
Self-management activation score 0-100 (352) median (IQR)	58.1 (51.0;72.5)
Level 1 (low level)	46 (13.1)
Level 2 (low level)	103 (29.3)
Level 3 (moderate level)	93 (26.4)
Level 4 (high level)	110 (31.3)
Alcohol use (299)	14 (4.7)
Current smoker (349)	50 (14.3)
Enabling factors*	
Deprived environment (352)	55 (15.6)
Employment status (349) Unemployed or retired	275 (78.8)
Education level (344) No or low education	138 (40.1)
Need factors*	
Duration DM2 in years (352) median (IQR)	9.0 (5.0;14.0)
HbA1c in mmol/mol (352) median (IQR)	53.0 (47.0;61.0)
BMI in kg/m ² (352) median (IQR)	30.1 (27.0;34.2)
Systolic bloodpressure in mmHg (352) median (IQR)	138.0 (128.0;146.0)
Number of complications (352) median (IQR)	1.0 (1.0;2.0)
Neuropathy	65 (18.5)
Nefropathy	71 (20.2)
Retinopathy	45 (12.8)
Hypertension	153 (43.5)
Heart vessel disease	152 (43.2)
Amount of medications (349) median (IQR)	7.0 (4.0;11.0)
Oral antidiabetic medication (352)	256 (72.7)
Insuline and/or GLP_1 (352)	69 (19.6)
PAID score 0-20 (351) median (IQR)	2.0 (0.0;5.0)
PAID score ≥ 8 (emotional distress)	49 (14.0)
Health status (352) score 0-100 median (IQR)	70.0 (65.0;80.0)
Outcome*	
Total health services use (352) median (IQR)	13.0 (8.0;21.0)

*Factors and Outcome ordered by the Andersen's behavior model of health services use (Figure 5.1) [24]. IQR: Inter Quartile Range (25th percentile; 75th percentile); DM2: type 2 diabetes; BMI: Body Mass Index; PAID: Problem Areas In Diabetes.

Table 5.2 Characteristics of participants with a limited and a sufficient health literacy (n= 352)

	Limited Health Literacy (n=107)	Sufficient Health Literacy (n=245)	
	Median (IQR)	Median (IQR)	p*
Age (years)	72.0 (65.0;77.0)	70.0 (62.0;75.0)	0.035
Health Status (0-100)	70.0 (60.0;80.0)	75.0 (70.0;80.0)	0.015
PAID score (0-20)	3.0 (0.0;6.0)	2.0 (0.0;5.0)	0.106
Self management activation score (0-100)	53.2(48.9;67.8)	58.1 (51.0;72.5)	0.004
Duration DM2 (years)	9.0 (4.0;16.0)	9.0 (5.0;14.0)	0.832
HbA1c (mmol/mol)	54.0 (47.0;64.0)	52.0 (47.0;60.0)	0.273
BMI (kg/m2)	30.8 (28.0;33.9)	29.9 (26.7;34.3)	0.257
Systolic bloodpressure (mmHg)	138.0 (130.0;146.0)	138.0 (126.0;146.0)	0.777
Number of complications	1.0 (1.0;2.0)	1.0 (1.0;2.0)	0.638
Amount of medication	9.0 (6.0;13.0)	6.0 (3.0;10.0)	<0.001
Health services use (year)	18.0 (10.0;26.0)	12.0 (8.0;19.0)	0.001

*Results from a Mann-Whitney U test. IQR: Inter Quartile Range (25th percentile; 75th percentile); PAID: Problem Areas In Diabetes; DM2: type 2 diabetes; BMI: Body Mass Index.

DISCUSSION

The results of this study show that HL is negatively associated with health services use, indicating that patients with limited HL used health services significantly more often than patients with sufficient HL. However, the strength of association between HL and health services use was reduced when controlling for several other patient characteristics. In terms of Andersen’s model, these characteristics can be termed health-related need factors. Medication use, HbA1c, DD, and health status were identified as factors explaining the variance. Medication use was found to have the strongest association with health services use and acted as a mediator in the association between HL and health services use.

The prevalence of limited HL found (30.4%) is in line with the prevalence in the general population in The Netherlands [13]. The sample was also assessed on self-management activation level, which is seen as an important aspect of HL [19]. Our

Table 5.3 Factors associated with health services use (n=352)

	Unstandardized Coefficients		95 % CI		p*	R ²
	B	Std. Error	Lower bound	Upper bound		
Model 1						0.142
Gender	1.97	1.19	-0.37	4.31	0.099	
Health Literacy	-0.60	0.21	-1.01	-0.18	0.005	
Health Status	-0.12	0.04	-0.21	-0.03	0.007	
PAID score	0.47	0.18	0.12	0.82	0.009	
HbA1c	0.10	0.05	-0.01	0.21	0.067	
Complications	1.31	0.58	0.18	2.44	0.023	
Constant	21.16	5.04	11.25	31.06	<0.001	
Model 2						0.369
Gender	0.63	1.04	-1.41	2.67	0.543	
Health Literacy	-0.11	0.19	-0.48	0.25	0.543	
Health Status	-0.07	0.04	-0.14	0.01	0.087	
PAID score	0.29	0.15	-0.01	0.60	0.058	
HbA1c	0.09	0.05	0.00	0.19	0.048	
Complications	-0.06	0.51	-1.07	0.95	0.905	
Medication use	1.19	0.11	0.97	1.40	< 0.001	
Constant	6.78	4.53	-2.12	15.68	0.135	

*Results from hierarchical multiple regression. CI = Confidence Interval, PAID = Problem Areas In Diabetes. R²= Explained variance.

Model 1: the contribution of factors in explaining the variance in health services use.

Model 2: Adding medication use to the model resulted in an increase of 0.23 in the explained variance in health services use. The impact of health literacy on health services use is no longer significant in model 2. Bold values reflect significant regression coefficients.

study confirms the association between HL and self-management activation level by showing a significant strong positive relationship. A substantial proportion (42.4%) of the sample had low self-management activation levels, slightly more than 37% as previously reported [19]. This finding can be explained by the older age, higher BMI, lower education level, and lower health status in patients with DM2 [37]. To perform adequate self-management, HL skills and at least a moderate level of self-management activation are necessary. Because treatment strategies are based on these skills [38], it is therefore important to be alerted to limited HL and to pay attention to the need for support in self-management [15]. In these cases, interventions that enhance health literacy are recommended [39].

Patients with limited HL used health services more often than patients with sufficient HL. The number of consultations in the sample of patients with DM2 varied from 8.0 – 21.0, with a median of 13.0 consultations per year. Compared with the median of 4.5 consultations per year of approximately 16,500 patients served by both centers, the number consultations per year of patients with DM2 is substantially higher. One explanation for this difference could be that the study participants are older than the total population of both centers. They are more likely to suffer from multimorbidity and require more medical care. Another explanation may be that protocol driven treatment goals are leading for the HCPs responsible for providing diabetes care, most often practice nurses and doctors' assistants [40]. Their focus on biomedical need factors such as the desired HbA1c, cholesterol, and blood pressure levels and their efforts to meet medical treatment goals have been reported previously [41]. Also, health status and DD contributed to health services use. This contribution is not surprising considering that psychosocial problems, including DD, appear to be common among patients with DM2. The influence of psychosocial problems on health outcomes, including glycemic control and health status, has been recognized previously [42].

In this study, medication use was found to have the strongest association with health services use and mediated between HL and health services use. Taking into account that limited HL is associated with poorer health outcomes [43], people with limited HL may need medical treatment more often compared with people with sufficient HL. Medical treatment may also lead to (more) follow-up visits to monitor effects of medication. This finding implies that HCPs also influence health services use due to their role as a prescriber. Given that patients with limited HL have difficulties understanding and complying with medical advice [43], they are highly dependent on comprehensible information provided by HCPs [44]. When HCPs are unaware of patients' limited HL, comprehensible information may not be provided. Consequently, a mismatch between provided care and patients' needs may occur due to HCPs' focus on treatment protocols on the one hand and patients' probably (unintentional) non-compliance on the other hand. Although no other studies could be found to confirm this particular finding, the pivotal role of HCPs in the context of HL has been noted previously [45].

To date, different instruments are available for measuring aspects of HL [46]. In comparison with other instruments [13], the Set of Brief Screening Questions was considered effective and easy to use for the purpose of this study [30]. Therefore, some caution is advised when comparing prevalence data of HL.

This study had some limitations. Patients may be unaware of their own lack of understanding or feel ashamed of their limited HL and therefore might have answered questions regarding HL too favorably. This effect may have led to an underestimation of the found prevalence of HL. Although no cause-and-effect relations could be inferred, the prevalence of limited HL found in this cross-sectional study emphasizes the importance of awareness of limited HL among HCPs. Their position, including the role as prescriber in the relationship between HL and health services use, enables them to detect limited HL. Their awareness can lead to care that is more efficient and responsive to the individual patient's needs.

Strength of this study was the appropriate sample size. Even though the sample was slightly smaller than initially intended, it was large enough to detect a mediation effect [36]. The results of this study may be generalizable to practices serving older patients with DM2 and limited HL and low social economic status. Furthermore, Andersen's behavioral model was useful for guiding this study and for providing more insight into several factors associated with health services use. This study demonstrated that health services use is not only influenced by patients' characteristics, but also by HCPs through medication prescription. Since HCPs are part of the healthcare system, Andersen's model may need to be adapted by connecting 'healthcare system' directly to 'health services use'. Future studies on HL should include the contribution of HCPs to health outcomes [47], for example, the extent to which HCPs are aware of limited HL and the effectiveness of interventions for improving HL. A qualitative research approach is recommended.

CONCLUSION

About one-third of patients with DM2 in this study had limited HL. They made more use of health services in primary care than patients with sufficient HL. This finding emphasizes the importance of being aware of patients' limited HL. After controlling for several patient characteristics, medication use had the strongest association with health services use and acted as a mediator in the association between HL and health services use. This implies that not only patient characteristics but also medication prescriptions by healthcare providers influence health services use. Their position, including the role as prescriber in the relationship between HL and health services use, enables them to detect limited HL and respond to it. This awareness can lead to care that is more efficient and responsive to the individual patient's needs.

REFERENCES

1. N.H. Cho, J.E. Shaw, S. Karuranga, Y. Huang, J.D. da Rocha Fernandes, A.W. Ohlogge, B. Malanda, IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045, *Diabetes Res. Clin. Pract.* 138 (2018) 271–281. <https://doi.org/10.1016/j.diabres.2018.02.023>.
2. World Health Organization (WHO), (2020). <https://www.who.int/news-room/factsheets/detail/diabetes>.
3. J.B. Buse, D.J. Wexler, A. Tsapas, P. Rossing, G. Mingrone, C. Mathieu, D.A. D'Alessio, M.J. Davies, 2019 update to: Management of hyperglycemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD), *Diabetes Care.* (2020). <https://doi.org/10.2337/dci19-0066>.
4. L.M. Thirsk, A.M. Clark, What is the “self” in chronic disease self-management?, *Int. J. Nurs. Stud.* (2014). <https://doi.org/10.1016/j.ijnurstu.2013.10.008>.
5. J. Barlow, C. Wright, J. Sheasby, A. Turner, J. Hainsworth, Self-management approaches for people with chronic conditions: A review, *Patient Educ. Couns.* (2002). [https://doi.org/10.1016/S0738-3991\(02\)00032-0](https://doi.org/10.1016/S0738-3991(02)00032-0).
6. N.D. Berkman, T.C. Davis, L. McCormack, Health literacy: What is it?, *J. Health Commun.* (2010). <https://doi.org/10.1080/10810730.2010.499985>.
7. K. Sørensen, S. Van den Broucke, J. Fullam, G. Doyle, J. Pelikan, Z. Slonska, H. Brand, Health literacy and public health: A systematic review and integration of definitions and models, *BMC Public Health.* (2012). <https://doi.org/10.1186/1471-2458-12-80>.
8. M.S. Wolf, M. V. Williams, R.M. Parker, N.S. Parikh, A.W. Nowlan, D.W. Baker, Patients' shame and attitudes toward discussing the results of literacy screening, *J. Health Commun.* (2007). <https://doi.org/10.1080/10810730701672173>.
9. K.G. Engel, M. Heisler, D.M. Smith, C.H. Robinson, J.H. Forman, P.A. Ubel, Patient Comprehension of Emergency Department Care and Instructions: Are Patients Aware of When They Do Not Understand?, *Ann. Emerg. Med.* (2009). <https://doi.org/10.1016/j.annemergmed.2008.05.016>.
10. P.A. Kelly, P. Haidet, Physician overestimation of patient literacy: A potential source of health care disparities, *Patient Educ. Couns.* (2007). <https://doi.org/10.1016/j.pec.2006.10.007>.
11. J. Trappenburg, N. Jonkman, T. Jaarsma, H. van Os-Medendorp, H. Kort, N. de Wit, A. Hoes, M. Schuurmans, Self-management: One size does not fit all, *Patient Educ. Couns.* 92 (2013) 134–137. <https://doi.org/10.1016/j.pec.2013.02.009>.
12. Monique Heijmans & Jany Rademakers, Gezondheidsvaardigheden en de mismatch tussen de patient en de zorgomgeving, Den Haag; The Netherlands, 2020. <https://oefenen.nl/kennisbank/leren-in-de-educatie/>.
13. K. Sørensen, J.M. Pelikan, F. Röthlin, K. Ganahl, Z. Slonska, G. Doyle, J. Fullam, B. Kondilis, D. Agrafiotis, E. Uiters, M. Falcon, M. Mensing, K. Tchamov, S. Van Den Broucke, Helmut Brand, Health literacy in Europe: Comparative results of the European health literacy survey (HLS-EU), *Eur. J. Public Health.* (2015). <https://doi.org/10.1093/eurpub/ckv043>.
14. F. Al Sayah, S.R. Majumdar, B. Williams, S. Robertson, J.A. Johnson, Health Literacy and Health Outcomes in Diabetes: A Systematic Review, *J. Gen. Intern. Med.* (2013). <https://doi.org/10.1007/s11606-012-2241-z>.
15. I. Van Der Heide, E. Uiters, J. Rademakers, J.N. Struijs, A.J. Schuit, C.A. Baan, Associations among health literacy, diabetes knowledge, and self-management behavior in adults with diabetes: Results of a Dutch cross-sectional study, *J. Health Commun.* (2014). <https://doi.org/10.1080/10810730.2014.936989>.
16. N.D. Berkman, S.L. Sheridan, K.E. Donahue, D.J. Halpern, K. Crotty, Low health literacy and health outcomes: An updated systematic review, *Ann. Intern. Med.* (2011). <https://doi.org/10.7326/0003-4819-155-2-201107190-00005>. 10

17. L. Marciano, A.L. Camerini, P.J. Schulz, The Role of Health Literacy in Diabetes Knowledge, Self-Care, and Glycemic Control: a Meta-analysis, *J. Gen. Intern. Med.* (2019) 1007–1017. <https://doi.org/10.1007/s11606-019-04832-y>.
18. J. Vandenbosch, S. Van den Broucke, S. Vancorenland, H. Avalosse, R. Verniest, M. Callens, Health literacy and the use of healthcare services in Belgium, *J. Epidemiol. Community Health.* (2016). <https://doi.org/10.1136/jech-2015-206910>.
19. J. Rademakers, M. Heijmans, Beyond reading and understanding: Health literacy as the capacity to act, *Int. J. Environ. Res. Public Health.* (2018). <https://doi.org/10.3390/ijerph15081676>.
20. R. Caruso, A. Magon, I. Baroni, F. Dellafiore, C. Arrigoni, F. Pittella, D. Ausili, Health literacy in type 2 diabetes patients: a systematic review of systematic reviews, *Acta Diabetol.* 55 (2018) 1–12. <https://doi.org/10.1007/s00592-017-1071-1>.
21. I. van der Heide, M. Heijmans, A.J. Schuit, E. Uiters, J. Rademakers, Functional, interactive and critical health literacy: Varying relationships with control over care and number of GP visits, *Patient Educ. Couns.* (2015). <https://doi.org/10.1016/j.pec.2015.04.006>.
22. F.D. Welzel, J. Stein, A. Hajek, H.H. König, S.G. Riedel-Heller, Frequent attenders in late life in primary care: A systematic review of European studies, *BMC Fam. Pract.* (2017). <https://doi.org/10.1186/s12875-017-0700-7>.
23. L. Hersh, B. Salzman, D. Snyderman, Health literacy in primary care practice, *Am. Fam. Physician.* (2015).
24. Ronald M. Andersen, Revisiting the Behavioral Model and Access to Medical Care: Does it Matter?, *J. Health Soc. Behav.* 36 (1995) 1–10.
25. B. Babitsch, D. Gohl, T. von Lengerke, Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998-2011., *Psychosoc. Med.* (2012). <https://doi.org/10.3205/psm000089>.
26. A. ter Maten-Speksnijder, M. Grypdonck, A. Pool, P. Meurs, A.L. van Staa, A literature review of the Dutch debate on the nurse practitioner role: Efficiency vs. professional development, *Int. Nurs. Rev.* 61 (2014) 44–54. <https://doi.org/10.1111/inr.12071>.
27. Q. van den Driesschen, D. Kuhns, M. Hoffmann, J. Parle, An update on the expansion of the physician assistant profession in Europe, *J. Am. Acad. Physician Assist.* (2016). <https://doi.org/10.1097/01.jaa.0000490122.80797.2e>.
28. Nederlands Huisartsen Genootschap (NHG), NHG-Standaard diabetes mellitus type 2 (version 5.3), (2018) 179. <https://richtlijnen.nhg.org/standaarden/diabetes-mellitustype-2>.
29. J. van Duivenboden, T. van Althuis, Huisarts, ketenzorg en ICT, Nederlands Huisartsen Genootschap, Utrecht, 2014. https://www.nhg.org/sites/default/files/content/nhg_uploads/nhg
30. L.D. Chew, K.A. Bradley, E.J. Boyko, Brief questions to identify patients with inadequate health literacy, *Fam. Med.* (2004).
31. B. Geboers, A.F. de Winter, S.L.W. Spoorenberg, K. Wynia, S.A. Reijneveld, The association between health literacy and self-management abilities in adults aged 75 and older, and its moderators, *Qual. Life Res.* 25 (2016) 2869–2877. <https://doi.org/10.1007/s11136-016-1298-2>.
32. J.H. Hibbard, E.R. Mahoney, J. Stockard, M. Tusler, Development and testing of a short form of the patient activation measure, *Health Serv. Res.* 40 (2005) 1918–1930. <https://doi.org/10.1111/j.1475-6773.2005.00438.x>.
33. J. Rademakers, H.T. Maindal, A. Steinsbekk, J. Gensichen, K. Brenk-Franz, M. Hendriks, Patient activation in Europe: an international comparison of psychometric properties and patients' scores on the short form Patient Activation Measure (PAM13), *BMC Health Serv. Res.* (2016). <https://doi.org/10.1186/s12913-016-1828-1>.
34. B.E. McGuire, T.G. Morrison, N. Hermanns, S. Skovlund, E. Eldrup, J. Gagliardino, A. Kokoszka, D. Matthews, M. Pibernik-Okanović, J. Rodríguez-Saldaña, M. De Wit, F.J. Snoek, Short-form measures of diabetes-related emotional distress: The Problem Areas in Diabetes Scale (PAID)-5 and PAID-1, *Diabetologia.* (2010). 11 <https://doi.org/10.1007/s00125-009-1559-5>.

35. The EuroQol Group., EuroQol - a new facility for the measurement of health-related quality of life, *Health Policy* (New York). (1990). [https://doi.org/10.1016/0168-8510\(90\)90421-9](https://doi.org/10.1016/0168-8510(90)90421-9).
36. M.S. Fritz, D.P. MacKinnon, Required sample size to detect the mediated effect, *Psychol. Sci.* (2007). <https://doi.org/10.1111/j.1467-9280.2007.01882.x>.
37. I. Bos-Touwen, M. Schuurmans, E.M. Monninkhof, Y. Korpershoek, L. SpruitBentvelzen, I. Ertugrul-van Der Graaf, N. De Wit, J. Trappenburg, Patient and disease characteristics associated with activation for self-management in patients with diabetes, chronic obstructive pulmonary disease, chronic heart failure and chronic renal disease: A cross-sectional survey study, *PLoS One.* (2015). <https://doi.org/10.1371/journal.pone.0126400>.
38. L.M. MacKey, C. Doody, E.L. Werner, B. Fullen, Self-management skills in chronic disease management: What role does health literacy have?, *Med. Decis. Mak.* 36 (2016) 741–759. <https://doi.org/10.1177/0272989X16638330>.
39. J. Brainard, Y. Loke, C. Salter, T. Koós, P. Csizmadia, A. Makai, B. Gács, M. Szepes, Healthy ageing in Europe: Prioritizing interventions to improve health literacy, *BMC Res. Notes.* (2016). <https://doi.org/10.1186/s13104-016-2056-9>.
40. L.J. Ubink-Veltmaat, H.J.G.G. Bilo, K.H. Groenier, R.O. Rischen, B. Meyboom-de Jong, Shared care with task delegation to nurses for type 2 diabetes: Prospective observational study, *Neth. J. Med.* 63 (2005) 103–110.
41. A.T. Wildeboer, H.A. Stallinga, P.F. Roodbol, Validation of the International Classification of Functioning, Disability and Health (ICF) core set for Diabetes Mellitus from nurses' perspective using the Delphi method, *Disabil. Rehabil.* (2020). <https://doi.org/10.1080/09638288.2020.1763485>.
42. N.E. Perrin, M.J. Davies, N. Robertson, F.J. Snoek, K. Khunti, The prevalence of diabetes-specific emotional distress in people with Type 2 diabetes: a systematic review and meta-analysis, *Diabet. Med.* (2017). <https://doi.org/10.1111/dme.13448>.
43. N.D. Berkman, S.L. Sheridan, K.E. Donahue, D.J. Halpern, A. Viera, K. Crotty, A. Holland, M. Brasure, K.N. Lohr, E. Harden, E. Tant, I. Wallace, M. Viswanathan, Health literacy interventions and outcomes: an updated systematic review, *Evid. Rep. Technol. Assess. (Full. Rep.)*. (2011).
44. C. Coleman, S. Kurtz-Rossi, J. McKinney, A. Pleasant, I. Rootman, L. Shohet, The Calgary charter on health literacy: Rationale and core principles for the development of health literacy curricula, *Cent. Lit. Québec.* (2008).
45. I. van der Heide, I. Poureslami, W. Mitic, J. Shum, I. Rootman, J.M. FitzGerald, Health literacy in chronic disease management: a matter of interaction, *J. Clin. Epidemiol.* 102 (2018) 134–138. <https://doi.org/10.1016/j.jclinepi.2018.05.010>.
46. T.H. Nguyen, M.K. Paasche-Orlow, L.A. McCormack, The State of the Science of Health Literacy Measurement, *Stud. Health Technol. Inform.* (2017). <https://doi.org/10.3233/978-1-61499-790-0-17>.
47. R.E. Rudd, The evolving concept of Health literacy: New directions for health literacy studies, *J. Commun. Healthc.* 8 (2015) 7–9. <https://doi.org/10.1179/1753806815Z.000000000105>

