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Health literacy and the use of healthcare services in Belgium

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ABSTRACT

Background Most of the existing studies demonstrating the relationships between health literacy and health service use have been conducted outside Europe and cannot be generalised to European healthcare systems. Moreover, the majority of studies measure healthcare use via self-reports. This study investigated whether health literacy is related to the use of health services measured objectively via patient records in a European country.

Methods 9617 members of a Belgian health insurance fund (59% females, ages 18–88 years, mean age 55.8 years) completed an online questionnaire including the 16-item European Health Literacy Survey Questionnaire (HLS-EU-Q) and agreed to have their responses linked to the insurance fund's health service use records. A two-part model approach was used to assess the association between health literacy and the use of healthcare services and the costs related, adjusting for personal and behavioural characteristics.

Results Low health literacy is associated with more admissions to 1-day clinics, general practitioner (GP) home consultations, psychiatrist consultations and ambulance transports, and with longer stays in general hospitals. Associations with psychiatric hospitalisations and specialist consultations are also found but are not significant when correction for multiple comparisons is applied. In contrast, health literacy is not significantly related to the number of GP consultations, admissions to 1-day surgical clinics or emergency consultations. The relationship between health literacy and medication use is inconsistent.

Conclusion The results partly confirm that low health literacy is associated with greater use of healthcare services, and especially of more specialised services. Improving the health literacy of the population can be an effective strategy to promote a more (cost)-effective use of the healthcare services and thus contribute to population health.

Health literacy is increasingly recognised as a concept of critical importance for public health. Introduced in the 1970s,[1] it refers to a person's knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgements and take decisions concerning health. In modern society, these competences are necessary, as the healthcare systems become more complex and people often have to make decisions with regard to diseases, prevention and health promotion.[2 3] As such, health literacy is considered a major determinant of a person's health and a factor that contributes to health inequalities.[4 5] However, attaining a sufficient level of health literacy is not just a problem of a small minority, as the proportion of individuals with low health literacy in the general population is considerable. Population data from the USA indicated that nearly half of the American adult population may have difficulties acting on health information.[6] In Europe, the European Health Literacy Survey revealed that 12% of the Europeans have inadequate, and 35% limited, health literacy.[7] A recent study in Belgium showed similar results, with around 40% of the Belgians having limited or insufficient health literacy.[8]

The importance of health literacy for public health is supported by a growing number of studies indicating that people with low health literacy are more likely to have poorer health status and higher mortality rates.[9–11] These effects of low health literacy on health outcomes are indirect, and involve intermediate factors such as self-care, health-risk behaviours, participation in preventive services and treatment adherence.[12 13] Indeed, several studies have shown that individuals with low health literacy are less likely to participate in cancer screening or other preventive services, and more likely to show health damaging behaviours such as smoking, regular drinking and lack of physical exercise, as well as poorer medication adherence and self-care management.[9 14–20] They are also reported to make greater use of healthcare services (eg, more consultations, hospitalisations and emergency care use).[9 21 22]

However, most existing studies demonstrating the relationship between health literacy and the use of healthcare services have been carried out in the USA or Asia. As such, these findings may not be generalised to European countries, which have different healthcare systems. In Belgium, for instance, all citizens must pay mandatory social security contributions[i] and register with a health insurance fund[ii] (mutuelle/mutualiteit). Patients must pay for each consultation, medical treatment or procedure

[i]The calculation and payment of the social security contributions depends on the person's status. For salaried workers, contributions are paid by both employers and employees to social security services. These contributions serve to finance the different areas of social security, including the mandatory health insurance.
[ii]The main goal of health insurance funds in Belgium is to provide healthcare reimbursements and indemnities in case of incapacity for working (also called the mandatory health insurance). Health insurance funds act as intermediaries between their members and the National Institute for Sickness and Invalidity Insurance (INAMI/RIVIZ), which distributes the financial resources between the different health insurance funds.

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they receive, and then obtain a partial or full reimbursement from their health insurance fund in accordance with a nationally established fee schedule (called the nomenclature), which specifies the contractual fee and reimbursement rate of each service. In addition, the majority of studies that have investigated the impact of health literacy on healthcare use have used self-reported measures that focused on a limited period of time (eg, treatment history during the past year).[10 22] While this approach is understandable for reasons of methodological feasibility, it introduces an important self-report bias and does not provide a representative and accurate view of the individuals' use of healthcare services over a longer period of time. As such, it would be preferable to link health literacy to more objective measures of healthcare use over an extended period of time.

Given the link between low health literacy and greater use of healthcare services, one would expect health literacy to also have an impact on the cost of healthcare. Surprisingly, however, this impact is less well established, with only two recent systematic reviews showing inconsistent evidence of a relationship between low health literacy and increased expenses.[9 23] However, as with the evidence regarding the link between health literacy and the use of healthcare services, most of the studies included in these reviews were carried out in the USA, and the few studies that have assessed the relationship between health literacy and healthcare costs in Europe focused on specific patient groups like diabetics.[24]

The present study aims to investigate whether the use of healthcare services and the costs related to healthcare use, measured via patient records over an extended period of time, vary as a function of health literacy in the Belgian population.

METHOD

Participants and procedure

The study took place within the framework of a larger study on emotions and health among the Belgian population.[25] For that study, a stratified sample of 200 000 adults drawn from the database of the largest health insurance fund in Belgium (ie, the Mutualité Chrétienne–Christelijke Mutualiteit; MC-CM) was contacted by email and invited to complete an online survey. The sample was stratified for gender, age, socioeconomic status and province to be as representative as possible of the Belgian population. Of this sample, 16 999 participants (11.76%) completed the survey and agreed to have their survey data linked to the healthcare consumption records of the MC-CM. Among this sample, 9617 participants who were members of the MC-CM during the entire period under study (2001–2012) were considered for this study. The characteristics of this sample (M_{age}=55.78 years, age range=18–88 years) are summarised in table 1. Compared to the general population of Belgium, women, older persons and Dutch speakers are over-represented in the sample, with 58.9% women (vs 50.9% in the general population), 76.6% Dutch speakers (vs 60% in the general population) and 28% persons older than 65 years (compared to 17% in the general population).

Measures

Health literacy

Health literacy was assessed with the 16-item version of the European Health Literacy Survey Questionnaire (HLS-EU-Q16[26]). This questionnaire is a short version of the questionnaire used in the HLS-EU-Q47,3, based on Rasch modelling (1-parametric dichotomous model) and item selection on content and face validity (item relevance). While it does not allow one to calculate scores for the subdimensions of health literacy as identified in the full questionnaire, it is a good approximation of the full 47-item version, with a high correlation (r=0.82) between the HLS-EU-Q16 and the general health literacy score of the HLS-EU-Q47, and a 75.8% concurrent classification of respondents as having insufficient, limited and sufficient health literacy. Items are typically formulated as questions (eg, "How easy would you say it is to find information on treatments of illnesses that concern you?", "How easy would you say it is to understand your doctor's of pharmacist's instruction on how to take a prescribed medicine?") to be rated on a four-point Likert scale ranging from 'very easy' to 'very difficult'. Overall health literacy scores were computed by coding a response of 'very easy' or 'easy' as 1, and of 'difficult' or 'very difficult' as 0, and summing the answers, yielding a score between 0 and 16. A score of 0 to 8 is considered as indicating insufficient health literacy, a score between 9 and 12 as limited health literacy, and a score of 13 or more as sufficient health literacy.

Healthcare use and costs

With the participants' consent, their responses on the questionnaire were linked to their healthcare utilisation and expenses records kept by the MC-CM over the past 11 years (2001–2012). Healthcare use variables included the number of days of hospitalisations in general and psychiatric hospitals, the number of admissions to 1 day and surgical clinics, the number of doctor visits (general practitioner (GP), specialist practitioner and psychiatrist), the number of GP home visits, and the use of emergency care (number of transports by ambulance[iii] and emergency room (ER) visits). Medicine consumption was measured by the defined daily dose (DDD), which refers to the average maintenance dose of drug per day. Costs (in euros) related to these healthcare use variables were obtained from the nationally established fee schedule (negotiated yearly or biennially between representatives of the health insurance funds and of the healthcare professionals) that the health insurance funds have to apply to reimburse patients. Although these costs are not the total healthcare expenditure, it is an exact and accurate estimation of the health insurance fund's expenditure related to their members' use of healthcare services.

Health behaviours

Since the effects of health literacy on the use of healthcare services may be in part explained by health behaviours,[12] several health behaviours were used as covariates in the analyses. Health behaviour was measured by 10 items of the Belgian Health Interview Survey,[27] rated on a three-point Likert-scale ('hardly ever' to 'nearly always'). Four items referred to dietary habits (eg, "I avoid eating too much sugar", "I avoid eating too much salt by cooking with a limited quantity of salt and by avoiding adding salt during dinner"), giving an internal consistency (Cronbach α) of 0.65. Physical activity was assessed via three items (eg, "I do sport (eg, running, swimming, aerobic, etc) for 15 to 30 min at least three times a week"), giving a Cronbach α of 0.60. Alcohol and tobacco use were both assessed by a single item ("I drink at least two glasses of alcoholic beverages per day" and "I smoke more than 2 cigarettes a day").

Statistical analyses

Descriptive statistics and χ^2 tests were performed to examine the characteristics of the sample and the relationship between health literacy and sociodemographic variables (table 1).

[iii]In case of emergency, via the European emergency number 112.

Table 1 Participant characteristics by health literacy level

Characteristics	Total sample (N=9617) N (%)	Insufficient HL (N=1111) N (%)	Limited HL (N=2847) N (%)	Sufficient HL (N=5629) N (%)	χ^2	p Value
Gender						
Female	5487 (58.9)	602 (56.4)	1536 (55.9)	3329 (60.8)	20.61	<0.001
Male	3836 (41.1)	465 (43.6)	1211 (44.1)	2150 (39.2)		
Missing	294 (3.1)	44 (4)	100 (3.5)	150 (2.7)		
Age (mean years±SD)	55.78±13.17; range 18–88	55.29±13.90	56.48±13.28	55.57±12.98	45.68	<0.001
18–24	125 (1.3)	28 (2.6)	40 (1.4)	56 (1)		
25–34	779 (8.2)	84 (7.7)	216 (7.7)	477 (8.6)		
35–44	1015 (10.7)	133 (12.1)	297 (10.6)	583 (10.5)		
45–54	1759 (18.5)	205 (18.7)	477 (17)	1070 (19.2)		
55–64	3166 (33.3)	337 (30.7)	921 (32.7)	1901 (34)		
65–74	2220 (23.3)	257 (23.4)	698 (24.8)	1256 (22.5)		
75+	452 (4.7)	54 (4.9)	164 (5.8)	232 (4.2)		
Missing	101 (1.1)	13 (1.1)	34 (1.2)	54 (0.9)		
Education						
Primary school	458 (4.8)	88 (8)	156 (5.5)	210 (3.7)	210.49	<0.001
Junior high school	1588 (16.6)	263 (23.8)	505 (17.9)	815 (14.5)		
High school	2866 (30)	375 (34)	918 (32.5)	1563 (28)		
College	2971 (31.1)	251 (22.7)	807 (28.6)	1906 (34)		
University (master's)	1464 (15.3)	119 (10.8)	391 (13.9)	951 (17)		
Post-graduate (Ph.D)	213 (2.2)	8 (0.7)	46 (1.6)	158 (2.8)		
Missing	57 (0.6)	7 (0.6)	24 (0.8)	26 (0.4)		
Language						
French	2248 (23.4)	353 (31.8)	813 (28.5)	1079 (19.2)	141.84	<0.001
Dutch	7369 (76.6)	758 (68.2)	2034 (71.5)	4550 (80.8)		

Data related to HL level were missing for 30 participants (0.3%) who did not complete the whole HLS-EU questionnaire.
HLS-EU, European Health Literacy Survey Questionnaire.

Then a two-part model was used to model the relationship of health literacy on the healthcare use and cost variables.[28–31] This approach was chosen to overcome the non-normal distribution and positive skewness of the healthcare use and cost variables. Since the data did not meet the assumptions of normality, linearity of relationship and homogeneity of variances, methods such as ordinarily least squares (OLS) regression analysis were not suitable, and common transformations to overcome the skewness of the distribution, such as square-root or natural log, are not applicable when the data exhibit many zero values, representing respondents who did not use certain healthcare services.[28 32] As an alternative, we used a zero-inflated regression analysis, which addresses the concentration of zero values by distinguishing healthcare users from non-users (ie, individuals with a count of zero). This approach requires to first perform a logistic regression to predict the probability of use or no use of services (zero vs not zero values) or of having healthcare costs or no costs, followed by a regression analysis to assess the level of utilisation among users (values higher than zero). For the latter, regression analyses based on the negative binomial model (for healthcare use) and γ distribution (for healthcare costs) were performed to predict the level of healthcare use and costs among the users. The negative binomial model is an extension of the Poisson model, which is considered appropriate for count and rate data that have discrete and integer positive values such as healthcare utilisation.[28 29] However, since the Poisson model assumes the equality of the mean and distribution variance—which is rarely the case—the negative binomial model, which accounts for over-dispersion (ie, when the variance is larger than the mean), was considered as more suitable. This model has been used in several studies that investigated healthcare utilisation.[33 34] On the other hand, models based on γ distribution have been recommended to analyse costs data and have been used in several studies that investigated healthcare costs.[30–32] In both parts of the model, healthcare use and costs were predicted as a function of health literacy, with the category of 'sufficient HL' as the reference group, while controlling for age, sex, education level, body mass index (BMI) and health behaviours (diet habits, physical activity, alcohol consumption and smoking habits). All analyses were performed on IMB SPSS Statistics (V.23).

Ethical considerations

This study was approved by the Internal Ethical Committee, and a collaboration agreement mentioning the obligations of the stakeholders and the security guidelines was written and approved by the legal department and by the President of the health insurance fund (MC-CM). Before participating in the survey, participants received a full explanation of the purpose of the study, their rights as participants, and the anonymity and confidentiality of the data collected. At the end of the questionnaire, participants were asked to give their consent to link the survey data to the healthcare consumption records of the MC-CM.

RESULTS

Health literacy and sociodemographic variables

χ^2 Tests showed that health literacy was significantly related to sex, age, educational attainment and language regime (table 1). The proportions of females, Dutch speakers and individuals with high education level are higher within the sufficient HL group compared to the insufficient and limited HL groups.

Regarding age, the proportion of individuals aged 18–24 and 35–44 years is higher within the insufficient HL group, whereas the proportion of individuals aged 25–34, 45–54 and 55–64 years is higher within the sufficient HL group compared to the other HL groups. Moreover, the proportion of older individuals aged 65–74 and 75 years and over is higher within the limited HL group compared to the insufficient and sufficient HL groups.

Health literacy, use of healthcare services and healthcare costs

Table 2 shows the results of the regression analyses for the variables related to healthcare use. Table 3 shows the results for healthcare cost variables. Both tables provide the regression coefficients for the first part (ie, logistic regressions predicting the probability of the use of healthcare services) and second part of the model (ie, regressions predicting the level of utilisation among those who had used healthcare services). For easy interpretation, the logistic regression coefficients were transformed to ORs, which refer to the odds of using healthcare services and having healthcare-related costs in the groups with limited and insufficient HL compared to the group with sufficient HL as the reference. For the regression analyses among healthcare users, the β-coefficients are difficult to interpret because the negative binomial and γ distributions are non-linear and reflect changes in the units of a transformed dependent variable such as the natural logarithm. Therefore, the coefficients were exponentiated (e^{β}) and transformed to incidence rate ratios (IRRs), which refer to the effect of a one-unit change in the predictive variable on the dependent variable. For the present analyses, they reflect the predicted multiplicative effect of the health literacy categories on healthcare use and costs compared to the reference category (in this case, sufficient health literacy) while holding other variables constant. For instance, among healthcare users, an IRR of 1.35 for days of hospitalisation in the group of respondents with insufficient HL indicates that individuals in this category have 1.35 times as many days of hospitalisations in general hospital than respondents with sufficient HL (ie, the reference group).

The results of the logistic regression indicate that individuals with insufficient HL have significantly greater odds of having psychiatric consultations (OR=1.36, p<0.001) and of being transported by ambulance (OR=1.67, p<0.001) than individuals with sufficient HL. The odds of being admitted to a psychiatric hospital are 1.50 greater for individuals with insufficient HL compared to those with sufficient HL (p=0.03), although this result is no longer significant when applying a correction for multiple comparisons. The odds of using other healthcare services are not significantly different for respondents in the limited and insufficient HL groups compared to the sufficient HL group. The results regarding medication use and the related costs are inconsistent and counterintuitive, with lower odds of taking medication and of having higher costs related to medication use for people with limited health literacy (OR=0.32, p=0.024), but not for those with insufficient health literacy.

Table 2 Regression coefficients of health literacy predicting healthcare use using a two-part model

		Logistic regression (users/non-users)				Regression for users†			
Use of healthcare services	**Predictive variable**	**β**	**SE**	**χ^2**	**OR**	**β**	**SE**	**χ^2**	**IRR**
Hospitalisations									
Days in hospital (GH)	Limited HL	−0.03	0.04	0.63	0.96	0.11	0.03	11.42**	1.11
	Insufficient HL	0.04	0.07	0.34	1.04	0.30	0.04	43.07***	1.35
Days in hospital (PH)	Limited HL	0.21	0.15	1.86	1.23	0.09	0.15	0.40	1.10
	Insufficient HL	0.40	0.18	4.73*	1.50	0.39	0.18	4.78*	1.49
Admissions in ODC	Limited HL	0.05	0.04	1.10	1.05	0.06	0.03	3.09‡	1.07
	Insufficient HL	−0.09	0.07	1.80	0.91	0.35	0.05	39.84***	1.41
Admissions in ODSC	Limited HL	−0.05	0.05	1.22	0.94	0.00	0.05	0.00	1
	Insufficient HL	−0.00	0.07	0.00	0.99	0.00	0.07	0.00	1
Doctor consultations									
GP	Limited HL	−0.03	0.26	0.01	0.96	0.01	0.02	0.38	1.01
	Insufficient HL	0.15	0.44	0.13	1.17	−0.01	0.03	0.07	0.99
SP	Limited HL	0.00	0.25	0.00	1.00	0.02	0.02	0.57	1.02
	Insufficient HL	−0.28	0.32	0.78	0.75	0.07	0.03	4.14*	1.07
Home visits (GP)	Limited HL	0.03	0.05	0.40	1.03	0.15	0.03	25.58***	1.16
	Insufficient HL	0.10	0.08	1.65	1.11	0.32	0.04	60.49***	1.38
Psychiatrist	Limited HL	0.12	0.06	3.66‡	1.13	0.09	0.06	2.41	1.09
	Insufficient HL	0.30	0.09	12.27***	1.36	0.28	0.08	12.23***	1.33
Emergency care									
Transport by ambulance	Limited HL	0.04	0.12	0.01	1.04	0.00	0.16	0.00	1.00
	Insufficient HL	0.51	0.14	12.62***	1.67	0.13	0.19	0.46	1.14
ER visits	Limited HL	0.05	0.13	0.17	1.06	−0.15	0.18	0.70	0.85
	Insufficient HL	0.12	0.18	0.45	1.13	−0.25	0.25	0.96	0.78
Medication									
Medication use	Limited HL	−1.11	0.49	5.06*	0.32	0.024	0.02	0.99	1.02
	Insufficient HL	−0.56	0.81	0.48	0.57	0.037	0.03	1.06	1.03

All the regressions included the covariates sex, age, education level, body mass index and health behaviours (diet habits, physical activity, smoking habits and alcohol consumption). Sufficient HL is the reference group.
*p<0.05, **p<0.01, ***p<0.001.
†Negative binomial regression with log link was used.
‡Significant at p<0.10.
ER, emergency room; GH, general hospital; GP, general practitioner; HL, health literacy; IRR, incidence rate ratio defined as e^{β}, where β is the regression coefficient; OD, OR defined as e^{β}, where β is the regression coefficient; ODC, one-day clinic; ODSC, one-day surgical clinic; PH, psychiatric hospital; SP, specialist practitioner.

Table 3 Regression coefficients of health literacy predicting healthcare costs using a two-part model

Costs related to the use of healthcare services	Predictive variable	Logistic regression (users/non-users) β	SE	χ^2	OR	Regression for users† β	SE	χ^2	IRR
Costs of hospitalisations									
GH	Limited HL	−0.04	0.05	0.35	0.96	0.08	0.03	6.49*	1.08
	Insufficient HL	0.04	0.07	0.75	1.04	0.17	0.04	13.76***	1.18
PH	Limited HL	0.16	0.18	0.81	1.18	0.50	0.26	3.58‡	1.65
	Insufficient HL	0.35	0.23	2.37	1.42	0.89	0.31	7.90**	2.44
ODC	Limited HL	0.05	0.04	1.10	1.05	0.02	0.04	0.32	1.02
	Insufficient HL	−0.09	0.06	1.80	0.91	−0.17	0.06	6.50*	0.84
ODSC	Limited HL	−0.05	0.05	1.18	0.94	0.03	0.02	1.27	1.03
	Insufficient HL	−0.01	0.07	0.16	0.99	0.03	0.04	0.66	1.03
Costs of doctor consultations									
GP	Limited HL	−0.03	0.26	0.16	0.96	0.01	0.01	0.68	1.01
	Insufficient HL	0.16	0.44	0.13	1.17	−0.01	0.02	0.13	0.99
SP	Limited HL	0.02	0.25	0.01	1.02	.03	.02	2.59	1.03
	Insufficient HL	−0.27	0.32	0.69	0.76	0.09	0.03	10.16**	1.10
GP	Limited HL	0.03	0.05	0.43	1.03	0.14	0.03	17.52***	1.15
	Insufficient HL	0.11	0.08	1.81	1.11	0.39	0.04	63.38***	1.47
Psychiatrist	Limited HL	0.12	0.06	3.59‡	1.13	0.09	0.08	1.44	1.10
	Insufficient HL	0.31	0.09	12.46***	1.36	0.28	0.11	6.57*	1.33
Costs of medication use									
	Limited HL	−1.12	0.49	5.06*	0.32	0.08	0.02	11.28**	1.08
	Insufficient HL	−0.56	0.81	0.48	0.57	−0.18	0.03	22.84***	0.83

All the regressions included the covariates sex, age, education level, body mass index and health behaviours (diet habits, physical activity, smoking habits and alcohol consumption). Sufficient HL is the reference group.
*p<0.05, **p<0.01, ***p<0.001.
†Regression based on γ distribution with log link was used.
‡Significant at p<0.10.
GH, general hospital; GP, general practitioner; HL, health literacy; IRR, incidence rate ratio defined as e^{β}, where β is the regression coefficient; OD, OR defined as e^{β}, where β is the regression coefficient; ODC, one-day clinic; ODSC, one-day surgical clinic; PH, psychiatric hospital; SP, specialist practitioner.

The results from the second part of the two-part model, which looks at the level of healthcare use and costs among users, show that for individuals who are admitted to general hospitals, the number of days spent in hospital are significantly higher for people with limited (IRR=1.11, p=0.001) and insufficient HL (IRR=1.35, p<0.001) than for those with sufficient HL (table 2). Similarly, the costs related to the stays in general hospitals are higher for people with limited (IRR=1.08, p=0.011) and insufficient HL (IRR=1.18, p<0.001) than for those with sufficient HL. Likewise, for those who are admitted to a psychiatric hospital, the number of days spent in the hospital and the costs related to these hospitalisations are significantly higher in the insufficient HL group (IRR=1.49, p=0.029; and IRR=2.44, p=0.005, respectively). Similar patterns are found for admissions to 1 day clinics, with insufficiently health literate persons having 1.41 times (p<0.001) more admissions than those with sufficient HL. In contrast, the costs related to admissions to 1 day clinics are lower for individuals with insufficient HL (IRR=0.84, p=0.011). Among individuals who had at least one home consultation by the GP, those with limited and insufficient HL have more visits (IRR=1.16, p<0.001; and IRR=1.38, p<0.001, respectively) than those with sufficient HL, which translates into higher costs (IRR=1.15, p<0.001; and IRR=1.47, p<0.001, respectively). Among individuals who had at least one consultation with a specialist practitioner, those with insufficient HL have more consultations (IRR=1.07, p=0.042) and greater related costs (IRR=1.10, p=0.001) than those with sufficient HL. Similar patterns are found for psychiatric consultations, with individuals with insufficient HL having 1.33 times more consultations (p<0.001) than those with sufficient HL, and 1.33 times higher costs related to these consultations (p=0.01). In contrast, among healthcare users, health literacy does not significantly predict admissions to 1 day surgical clinics, GP consultations, ER visits and medication use. The results regarding the costs of medication use are again inconsistent, with higher costs for individuals with limited HL compared to those with sufficient HL (IRR=1.08, p=0.001), but lower costs for the insufficient group (IRR=0.83, p<0.001). It is noted that the findings related to psychiatric hospitalisations, costs of psychiatric consultations, consultations with specialist practitioners, medication use and costs of admissions in 1 day clinics are no longer significant when a correction is applied for multiple comparisons.

DISCUSSION

Numerous studies have associated low health literacy with less efficient use of healthcare services, such as hospitalisations and use of emergency care.[3 35] However, studies relating health literacy to health service use and healthcare costs in Europe remain scarce. Moreover, most existing studies rely on self-report methods to measure healthcare use, rather than on objective data. This study investigated whether low health literacy is linked to greater use of healthcare services and higher costs in Belgium, using objective patient records over an extended period of time as outcome variables.

The findings show that individuals with low health literacy make more use of certain healthcare services, such as general hospitals, 1 day clinics, GP home visits, psychiatrist consultations and ambulance transportations, and incur more costs related to the higher use of these services. Low health literacy was also linked to more psychiatric hospitalisations and consultations with specialist practitioners, although these relations are no longer significant when correcting for multiple comparisons.

Our results confirm those of previous studies conducted in the USA and Asia, showing that the use of healthcare services is greater among individuals with lower levels of health literacy. Although the healthcare systems of European countries differ from these countries, the relationship between health literacy and the greater use of healthcare services seems to be generalisable to European countries like Belgium, even when objective patient records are used instead of self-reports, and when an extended period of time (more than 10 years) is considered. Furthermore, it confirms the finding from other studies[9 22] that low health literacy is linked to poorer mental health, resulting in more psychiatric consultations. Moreover, while most existing studies on the relationship of health literacy and healthcare use concern specific patient groups,[24] our study provides evidence that low health literacy is also related to greater use and costs of healthcare services in the general population. Finally, unlike studies finding inconsistent evidence regarding the impact of health literacy on healthcare costs,[9 23] our findings suggest that low health literacy is indeed associated with greater costs related to the use of certain healthcare services. Although the healthcare costs in this study do not represent exact healthcare expenditures but the costs based on a nationally established fee schedule applied by health insurance funds, it is an exact and accurate estimation of the health insurance funds' expenditures related to their members' use of healthcare services.

For other healthcare services, including admissions to 1 day surgical clinics, consultations with the GP and ER visits, we found no relation to health literacy. This may be explained by the organisation of these services in the Belgian healthcare system. Surgeries performed in 1 day surgical clinics are usually concerned with minor interventions, such as plastic surgery, hand or eye surgery, removal of tonsils or extraction of wisdom teeth. As such, admission to a 1 day surgical clinic does not require a high level of access to or understanding of complex information about diseases or treatments. Similarly, GP consultations in Belgium have a low threshold, and a large proportion of the Belgian population visits a GP at least once per year, often for minor and common health problems. So again, this type of consultation does not require a high level of health competence on the part of the patients. On the other hand, the mixed results regarding medication use and costs suggests that low health literacy is primarily associated with poorer medication adherence and self-care management, rather than with the medication use and costs themselves.

This study is not without its limitations. First, the study sample is not entirely representative of the Belgian population, in the sense that women, older people and Dutch speakers are over-represented. While the divergence from the composition of the Belgian population is not large, it cannot be denied that the composition of the sample has an influence on some results, as age and gender are related to both health literacy and health service use. Furthermore, compared to the participant sample that was initially contacted, the response rate is low, which may limit the generalisability of the results. However, low response rates are not uncommon for surveys where a very high number of participants are contacted,[36] which may be explained by factors such as the length of the questionnaire, invalid email addresses or survey weariness. Second, although the variables used in this study are objective measures of the use and costs of healthcare, they are only indirect indicators of the participants' health status. While it can be assumed that individuals who more often use healthcare services have poorer health, it is possible that some relatively healthy individuals overuse healthcare services, while others with poorer health status do not use them as often as they should. Subjective and objective health was, however, not measured and therefore could not be taken into account in the analyses. Third, health and healthcare utilisation is predicted by a wide range of biological, psychological, social and environmental factors. Although health literacy significantly predicts several healthcare variables and indirectly also the health status and outcomes of the persons concerned, it only partially explains the variance of these variables. A last limitation concerns the statistical analyses that were used. The distribution of healthcare use and cost data typically shows particular properties, such as positive skewness, heavy tails and excess zeros, which makes methods based on assumptions of normality, linearity of relationship and homogeneity of variances unsuitable.[28 29] Unfortunately, there is no optimal approach that provides unbiased and efficient estimates for these kinds of data.[35] While we applied the statistical methods that we considered as the most appropriate, the lack of consensus in the literature on how to treat these kinds of variables means that other types of analyses could also have been performed.

Despite these limitations, this study has several important implications for practice. First, it highlights the importance of health literacy in the population as a way to limit unnecessary healthcare utilisation and costs. Since health literacy impacts on the adequate use of healthcare services, increasing the health literacy of the population may reduce inadequate use of health services, and thus reduce related costs. Second, it emphasises the importance of helping individuals with low health literacy to navigate the health systems and make more efficient use of the healthcare services. Healthcare professionals should be aware of their patients' limited health literacy and adapt their communication to avoid possible negative outcomes (eg, poor medication adherence).[17]

What is already known on this subject

- Low health literacy has been related to a higher prevalence of unhealthy lifestyles, more inefficient use of healthcare services and poorer health outcomes.
- The evidence on the impact of health literacy on healthcare costs is inconsistent.
- Studies relating health literacy to health service use and healthcare costs in Europe are scarce.

What this study adds

- This is one of the first studies to investigate whether health literacy is related to health services use and the related costs in a European country.
- Healthcare use was measured objectively via patient records over an extended period of time.
- The study confirms that the relationship between low health literacy and higher use of more costly healthcare services found elsewhere can be generalised to European countries.
- While most studies on the relationship of health literacy and healthcare use consider specific patient groups, this study provides evidence that low health literacy is related to greater healthcare use and costs in the general population.

Policy implications

- Since health literacy impacts on the adequate use of healthcare services, increasing the health literacy of the population may reduce inadequate use of health services, and thus reduce related costs.
- Healthcare professionals should be aware of their patients' limited health literacy and adapt their communication to avoid possible negative outcomes.

CONCLUSION

This study confirms the findings from previous research suggesting that individuals with low levels of health literacy overall have a greater use of healthcare services and incur higher costs than those with higher levels of health literacy. This may reflect both poorer health status and less effective use of the services that are available to them. Increasing the level of health literacy in the population can be an effective strategy to improve the correct use of healthcare services, to enhance the effectiveness of treatment, and thus to improve people's health status and outcomes. Further research should then investigate effective strategies to reduce the negative effect of low health literacy on the use of healthcare services and health outcomes.

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REFERENCES

1 Simonds SK. Health education as social policy. *Health Educ Monogr* 1974;2:1–10.
2 Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int* 2000;15:259–67.
3 Sørensen K, Van den Broucke S, Pelikan JM, *et al*. Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). *BMC Public Health* 2013;13:948.
4 Marmot M, Friel S, Bell R, *et al*., Commission on Social Determinants of Health. Closing the Gap in a Generation: health equity through action on the social determinants of health. *Lancet* 2008;372:1661–9.
5 Van den Broucke S. Health literacy: a critical concept for public health. *Arch Public Health* 2014;72:10.
6 Institute of Medicine. *Health literacy: a prescription to end confusion*. Washington DC: The National Academies, 2004.
7 Sørensen K, Pelikan JM, Röthlin F, *et al*. Health literacy in Europe: comparative results of the European health literacy survey (HLS-EU). *Eur J Public Health* 2015;25:1053–8.
8 Vancorenland S, Avalosse H, Verniest R, *et al*. Bilan des connaissances des Belges en matière de santé. *MC-Informations* 2014;258:48–55.
9 Berkman ND, Sheridan SL, Donahue KE, *et al*. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med* 2011;155:97–107.
10 Cho YI, Lee SYD, Arozullah AM, *et al*. Effects of health literacy on health status and health service utilization amongst the elderly. *Soc Sci Med* 2008;66:1809–16.
11 Sentell T, Baker K, Onaka A. Low health literacy and poor health status in Asian Americans and Pacific Islanders in Hawai'i. *J Health Commun* 2011;16(Suppl 3):279–94.
12 Lee S-YD, Arozullah AM, Cho YI. Health literacy, social support, and health: a research agenda. *Soc Sci Med* 2004;58:1309–21.
13 Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *Am J Health Behav* 2007;31:S19–26.
14 Schillinger D, Grumbach K, Piette J, *et al*. Association of health literacy with diabetes outcomes. *JAMA* 2002;288:475–82.
15 Williams MV, Baker DW, Parker RM, *et al*. Relationship of functional health literacy to patients' knowledge of their chronic disease: a study of patients with hypertension and diabetes. *Arch Intern Med* 1998;158:166–72.
16 Dolan NC, Ferreira MR, Davis TC, *et al*. Colorectal cancer screening knowledge, attitudes, and beliefs among veterans: does literacy make a difference? *J Clin Oncol* 2004;22:2617–22.
17 Lindau ST, Tomori C, Lyons T, *et al*. The association of health literacy with cervical cancer prevention knowledge and health behaviours in a multiethnic cohort of women. *Am J Obstet Gynecol* 2002;186:938–43.
18 Peterson NB, Dwyer KA, Mulvaney SA, *et al*. The influence of health literacy on colorectal cancer screening knowledge, beliefs and behaviour. *J Natl Med Assoc* 2007;99:1105.
19 Scott TL, Gazmararian JA, Williams MV, *et al*. Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Med Care* 2002;40:395–404.
20 Suka M, Odajima T, Okamoto M, *et al*. Relationship between health literacy, health information access, health behaviour, and health status in Japanese people. *Patient Educ Couns* 2015;98:660–8.
21 Ishikawa H, Yano E. Patient health literacy and participation in the health-care process. *Health Expect* 2008;11:113–22.
22 Lee SYD, Tsai TI, Tsai YW, *et al*. Health literacy, health status, and healthcare utilization of Taiwanese adults: results from a national survey. *BMC Public Health* 2010;10:614.
23 Eichler K, Wieser S, Brügger U. The costs of limited health literacy: a systematic review. *Int J Public Health* 2009;54:313–24.
24 Franzen J, Mantwill S, Rapold R, *et al*. The relationship between functional health literacy and the use of the health system by diabetics in Switzerland. *Eur J Public Health* 2013;24:996–1002.
25 Mikolajczak M, Avalosse H, Vancorenland S, *et al*. A nationally representative study of emotional competence and health. *Emotion* 2015;15:653–67.
26 Pelikan JM, Röthlin F, Ganahl K, *et al*. Measuring comprehensive health literacy in general populations—le HLS-EU instruments. *Presentation at the Second International Conference of Health Literacy and Health Promotion*; Taipei, Taiwan, 2014.
27 Van Oyen H, Tafforeau J, Hermans H, *et al*. The Belgian health interview survey. *Arch Public Health* 1997;55:1–13.
28 Atkins DC, Gallop RJ. Rethinking how family researchers model infrequent outcomes: a tutorial on count regression and zero-inflated models. *J Fam Psychol* 2007;21:726.
29 Coxe S, West SG, Aiken LS. The analysis of count data: a gentle introduction to Poisson regression and its alternatives. *J Pers Assess* 2009;91:121–36.
30 Diehr P, Yanez D, Ash A, *et al*. Methods for analyzing health care utilization and costs. *Annu Rev Public Health* 1999;20:125–44.
31 Mihaylova B, Briggs A, O'Hagan A, *et al*. Review of statistical methods for analysing healthcare resources and costs. *Health Econ* 2011;20:897–916.
32 Barber J, Thompson S. Multiple regression of cost data: use of generalised linear models. *J Health Serv Res Policy* 2004;9:197–204.
33 French MT, McGeary KA, Chitwood DD, *et al*. Chronic illicit drug use, health services utilization and the cost of medical care. *Soc Sci Med* 2000;50:1703–13.
34 Zarkin GA, Bray JW, Babor TF, *et al*. Alcohol drinking patterns and health care utilization in a managed care organization. *Health Serv Res* 2004;39:553–70.
35 Kickbusch I, Pelikan JM, Apfel F, *et al*. *Health literacy, the solid facts*. Copenhagen: World Health Organisation, Regional Office for Europe, 2013.
36 Avalosse H, Peters B, Vancorenland S, *et al*. Congrès de la MC 'Ensemble innovons'—enquête réalisée lors du congrès: des pistes pour l'avenir. *MC-Informations* 2016;263:7–14.