



The guided use of an e-health tool to strengthen health literacy. A pilot study in a multicultural diabetes population in a primary care clinic in Brussels



Lien Mertens^{a,*}, Harrie Dewitte^a, Lieve Seuntjens^b, Rita Vanobberghen^c, Bert Aertgeerts^a

^a Department of Family Medicine and Primary Care, University of Leuven (KULeuven), Belgium

^b Department of Family Medicine and Primary Care, University of Antwerp (UAntwerpen), Belgium

^c Department of Family Medicine and Primary Care, University of Brussels (Vrije Universiteit Brussel), Belgium

ARTICLE INFO

Keywords:

Health literacy
Application
Health education
Health promotion
e-health
Self-management
Low literacy
Public health

ABSTRACT

Objectives: We aimed to investigate whether the use of an e-health tool, guided by a healthcare provider, can improve health literacy (HL) in primary care.

Methods: We set up a longitudinal prospective cohort study in a primary care clinic in Brussels. Diabetes patients were invited to participate in two study consultations with a trained healthcare provider, in which an e-health tool was introduced. The *Health Literacy Questionnaire* (HLQ) was used to evaluate HL before ($n = 59$) and after intervention ($n = 41$). The data were analysed within SPSS, Version 26. Additionally, impressions and experiences of both patients and healthcare providers were collected throughout the different phases of the study.

Results: Patients feel significantly stronger in finding good health information after intervention ($p = 0.041$), with relatively stronger progress for the subgroup with weaker digital skills ($p = 0.029$). Participants also declare understanding health information better after intervention ($p = 0.050$). Specifically, the lower educated participants feel reinforced to correctly evaluate and assess health information and come closer to the skill level of the higher educated patients after intervention. The relationship with the healthcare provider was also more markedly enhanced within the group of the lower educated ($p = 0.008$; difference between higher and lower educated), which could strengthen self-management in the long run.

Conclusions: The guided use of an e-health tool in primary care strengthens various patient HL skills. Most particularly the skills “the ability to find good health information” and “understand health information well enough to know what to do” are reinforced. Moreover, patient populations with lower HL, such as the lower educated and lower digitally skilled, show a greater learning potential.

Innovation: Our results offer further proof for the learnable and flexible nature of HL, and show that even a small e-health intervention, in a very diverse patient population, can produce significant, positive effects on HL. These results need to be considered as promising, and a motivation for further investments in more widely accessible e-health tools to further improve HL at population level and to bridge health differences.

1. Introduction

Health literacy (HL) is an international term used to describe people's ability to collect, understand and apply health information in order to make informed choices and decisions about their health [1,2]. The definition and interpretation of the term 'health literacy' has evolved significantly over the years. Most recent definitions integrate the patient's 'digital literacy' or 'eHealth Literacy' as a form of health literacy that is defined as “the set of skills and knowledge necessary for productive interactions with technology-based health tools” [3]. This digital literacy is now becoming increasingly relevant in the capacity to find and obtain health information, given the already far-reaching digitalisation of information provision

in healthcare and prevention [4] and the current context of the internet as one of the main sources of health information [5,6].

However, obtaining reliable health information on the internet is still a challenge for a large part of the population. The capacity to find health information is often overestimated by patients [7] and the assessment of the quality and reliability of the information found is often difficult. If patients try to diagnose themselves based on internet information, they often get it wrong [8]. This can be risky for their health [9], particularly if a patient has lower digital literacy and limited knowledge about health [7], which – unfortunately – often goes hand in hand [10,11].

Our society and healthcare system have become complex since the advent of the digital revolution [4], and the more complex the system, the

Abbreviations: HL, health literacy; HLQ1, Health Literacy Questionnaire 1 (pre-intervention); HLQ2, Health Literacy Questionnaire 2 (post-intervention).

* Corresponding author at: Kapucijnenvoer 33 blok J, 3000 Leuven, Belgium.

E-mail address: lien.mertens@kuleuven.be (L. Mertens).

<http://dx.doi.org/10.1016/j.pecinn.2022.100056>

Received 3 January 2022; Received in revised form 7 June 2022; Accepted 7 June 2022

2772-6282/© 2022 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

more difficult it is for users to competently deal with [12]. There is an increasing understanding that HL is defined not only by individual patient skills, but also by the way health information is transmitted and health services are organised [12]. This has led to a shift from the 'clinical' to the 'public health' approach of HL, which represents a shift from the individual (patient) responsibility to a shared responsibility of individuals, society and health services. In this approach, society and health services are considered responsible for offering support tailored to individuals with different health literacy needs and for supporting them in strengthening their HL [13], especially in a complex, digital world.

Lower HL is associated with worse health outcomes and a higher prevalence of chronic disease [2]. Within the group of diabetes patients in particular, lower HL is associated with poorer glycaemic control, more diabetes complications, fewer self-care activities, less knowledge on diabetes, lower self-efficacy and poorer communication with healthcare providers [14,15]. HL among diabetic patients is even more predictive for all aspects of self-management than demographic or disease-specific characteristics [16]. Diabetics also generally have more difficulty understanding health information than the general population, even when adjusting for sociodemographic factors and comorbidities [17]. Considering the abovementioned reasons and the growing global prevalence of this chronic disease [18], the search for strategies to strengthen HL in this specific patient group can be considered as challenging and relevant for public health.

If patients can be supported to use the internet in a critical way, and to select high-quality websites, it can help and empower them to better manage health and disease, to improve prevention, to obtain a more accurate diagnosis and treatment, and improve communication with healthcare providers [19,20]. Moreover, e-health can contribute to more equal access to healthcare by increasing access to health information [11]. Due to the frequent use of sound, image and photo material online, the understanding and retention of the message is often improved and the connection with patients with limited HL is even better [21]. E-health can be a valuable addition to and support for oral communication and personal care [10], and healthcare providers should be encouraged to explore this new medium and support patients in using it. E-health could be a promising part of a new, future-proof and inclusive HL approach in primary care.

That is why we aimed to investigate whether the use of an e-health tool, guided by a healthcare provider, can improve HL in a diabetes population in a primary care clinic.

2. Methods

2.1. Study design

A longitudinal prospective cohort study was set up in a primary care setting with the purpose of strengthening HL of patients by means of the guided use of an e-health tool. The intervention, which took place from July to December 2020, included type II diabetes patients and consisted of two 20-minute consultations with a trained healthcare provider. The HL skills of the participants were assessed before and after intervention, using a validated questionnaire (*Health Literacy Questionnaire*, HLQ[®]; Swinburn University, Australia), which could be filled in autonomously or with help if needed.

2.2. Intervention

The intervention consisted of at least two study consultations between the patient and a trained healthcare provider at the clinic. An online health tool was viewed together during the study consultations, and a supportive communicative approach was delivered by the healthcare provider. At the end of the first consultation the patient was handed a printout containing the URL link and encouraged to revisit the tool at home. In the follow-up study consultation, patients were asked about tool use in the home setting and their answers were registered for further analysis of any supplementary effect.

The intervention was aimed at strengthening HL, with a specific focus on skills concerning 'the ability to find good health information', 'the

capacity to evaluate and assess health information' and 'being actively engaged with one's health'. The selected online tool was a Canadian diabetes website that aimed to improve patient health information gathering skills. The communicative approach was aimed at supporting patient self-management, with the use of supportive talk and person-centred communication techniques. Participating healthcare providers were trained in using this approach in preparatory sessions.

2.3. Setting and participants

The intervention was set up in a multidisciplinary primary care clinic in Schaerbeek (Brussels, BE). Type II diabetes patients were selected as the target population for the abovementioned reasons. The participating healthcare provider team consisted of five GPs (two of whom were trainee GPs) and one nurse.

2.4. Inclusion criteria

Patients were included if they met the following criteria: 1. Age of 18 years or older; 2. In possession of an active medical file within the clinic; 3. With a confirmed diagnosis of diabetes at the start of the intervention; 4. Access to the internet, through own or borrowed device.

Because of our multicultural work setting, speaking a foreign language or low literacy did not constitute strict exclusion criteria. However, some social support was expected in these cases. Patients were expected to have a basic understanding of French or English or to have social support for understanding, in order to ensure usability of the tool, which was offered in these two languages.

Patients who met the inclusion criteria ($n = 199$) were listed. 145 randomly selected patients from this list were actively invited (Figure 1), either by phone or during a consultation with one of the healthcare providers in the clinic. This invitation took place during the period December 2019 - February 2020, and 102 of the 145 invited patients (70%) gave verbal consent to participate during this period. In this population and considering a 95% confidence interval and margin of error of 10% [22], approximately 70 participants are required. This corresponds to a response rate of 35%. Given the nature of the target population and the anticipated drop-out throughout the study, we approached our study as a pilot study, targeting a final participation of 20-30 patients (10-15% of the target group). (See Fig. 2.)

2.5. Ethics

This research is part of a Master's thesis, which was submitted to the Ethics Committee OBC (Education Guidance Committee for Medical Ethics) of the KU Leuven (Catholic University of Leuven, BE). The submission was approved on November 26, 2019.

3. Preparation and training of the healthcare providers

Before the start of the intervention, preparatory sessions were organised for the participating healthcare providers. A total of three 1-hour group sessions were provided, in the period of January-June 2020, substantively prepared and presented by the principal investigator (participating trainee GP) and in the presence of the other four participating healthcare providers.

During these sessions the healthcare providers were introduced to the concepts of HL and HL-friendly communication, aimed at raising awareness for HL [12] and improving the health literacy friendliness of their communicative care [23]. Communicative techniques to encourage self-management were overhauled, with the intention of strengthening this skill in the patient. Finally, the participating healthcare providers were trained in the integration of the online health tool in the consultation, and instructed to follow a uniform consultation structure, with the aim of standardising the intervention and reducing the chance of caregiver-dependent differences.

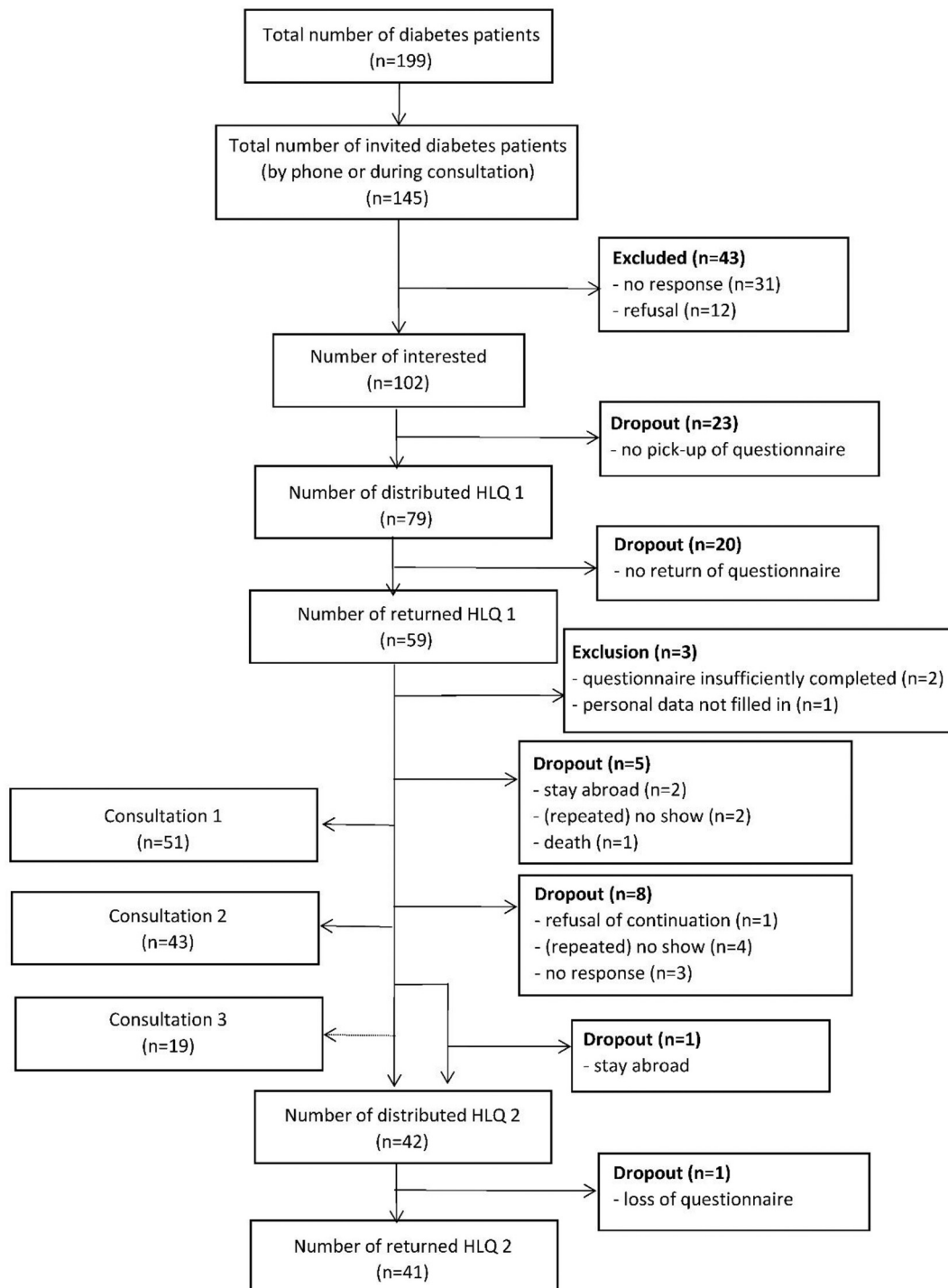


Fig. 1. Flowchart of included and excluded patients

4. Strengthening of patient HL through e-health

In addition to the aim of strengthening patient self-management, the intervention was also intended to reinforce the HL skill “the ability to find good health information” given that this skill is often the least taken for granted [24]. We selected an online tool based on the availability of information about diabetes and lifestyle, and the availability of this information in the principal spoken languages of our patient population, which were French and English in particular. We also took into account three criteria that had been selected by the participating healthcare providers as priority

‘quality criteria’ for an online health tool. In order of importance, these were: 1. Reliability of information, 2. Free availability and 3. Ease of use. On the basis of these requirements the website of the Canadian non-profit organisation 'Diabète Québec' (www.diabete.qc.ca) was selected. This website offers free and reliable information about diabetes and lifestyle in French and English, including information in the form of videos and images. The presence of videos and images was of particular interest for the ease of use in our work setting, since our study group consisted of a mixed patient population including illiterate, low literate and foreign language speaking patients.

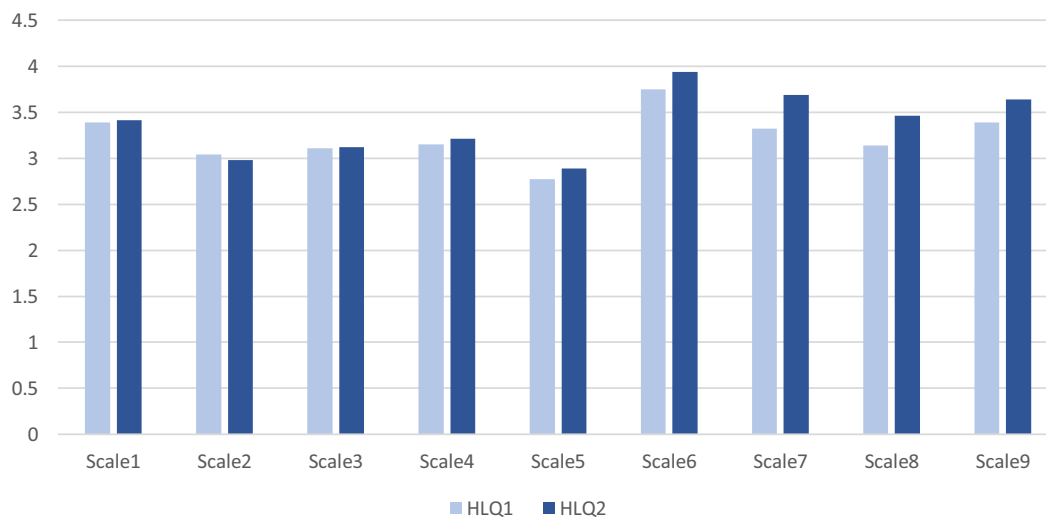


Fig. 2. Representation of the average scores per scale, which can be distinguished in the first five scales (score 1-4), and the last four scales (score 1-5). Each scale is presented twice, one before intervention ('HLQ1'; n = 58) and one after intervention ('HLQ2'; n = 41).

4.1. Statistical analysis

The quantitative effect of the intervention was objectified by a pre- and post-intervention measurement of HL, using the internationally cross-validated *Health Literacy Questionnaire* (HLQ). Approval for use of this questionnaire in our study was obtained from the corresponding authors. This questionnaire measures HL within 44 questions, divided over nine different scales, which are scored separately and correspond to nine different 'dimensions' of health literacy. Differentiated measurement of HL has the advantage of providing a better understanding of the stronger and weaker HL skills within a population and showing the dimensions in which more support is needed ('needs assessment') [25]. Since our intervention was specifically aimed at enhancing the skills 'the ability to find good health information' and 'be actively engaged with one's health', the corresponding scales were carefully analysed. The other scales were also included within the measurements, as we considered these to be interesting complementary data that could help further elucidate the variety of health literacy needs within the study population and that might reveal additional effects of the intervention [13]. Questionnaires were provided in five languages (French, English, Dutch, Spanish and Arabic), which corresponded to the five main spoken and native languages of our study population. The questionnaires could be filled in by the patient autonomously or with help, either from someone in their social network or – in the absence of social support – from the principal investigator in a face-to-face session.

Finally, we supplemented the questionnaire with some sociodemographic questions, including several questions about education level and digital skills. Education level was defined as 'lower' if no secondary school diploma was obtained (categories: secondary school not completed, primary school education level or less), and 'higher' if the patient had obtained at least a secondary school diploma (categories: secondary school completed or higher studies). Digital skills were categorised as lower or higher according to the participant's answer to the question "Do you use the internet?". Patients who answered 'never' or 'with help' were categorised as lower digitally skilled, those answering 'a few times a week' or 'on a daily base' as stronger digitally skilled. Descriptive statistics were used to calculate the sociodemographic data and they were associated with the HLQ results.

All statistical analysis were performed using SPSS, Version 26. All significance tests were two-tailed and those with a p value <0.05 were considered statistically significant.

5. Results

5.1. Patient characteristics

The age of the participants ranged between 40 and 84 years, with a mean of 58 years. The majority of participants were first-generation migrants (50/58, 86%), with the largest groups coming from the Philippines and Morocco (Table 1). These distributions were similar within the group that completed the first questionnaire (HLQ1; n = 59) and the - remaining - group that completed the second questionnaire (HLQ2; n = 41); the age and ethnic distributions within these groups did not differ significantly. The proportion of lower education, however, fell significantly throughout the study from 28% (16/58; HLQ1) to 22% (9/41; HLQ2). In other words, the education level distribution of the dropout group (n = 18), containing a far greater share of lower educated people (7/17; 41%, 1 missing data), differed significantly from the distribution in the remaining group (HLQ2) (p = 0.022). The share of the weaker digitally skilled patients remained virtually the same (11/58; 19% to 7/41; 17%); the distribution was not statistically different in the dropout group (p = 0.458). A majority of those surveyed (51/58; 88%) were found to have a habit of using the internet, with or without help, of which 39/51 (76%) of them on a daily basis. Thirty-four per cent of the participants (20/59) were helped to complete the questionnaire, of which 15/59 (25%) by means of a face-to-face session by the principal investigator. Also, in the administration of the second questionnaire (HLQ2), a quarter of the participants (10/41; 24%) was assisted in completing the questionnaire by the principal investigator.

5.2. HLQ results

Analysing the nine different scales of the HLQ, the highest mean scores were observed on Scale 1 ('Feeling understood and supported by healthcare providers') and Scale 6 ('Ability to actively engage with healthcare providers'), both in the first and second questionnaire. The lowest mean scores were seen on Scale 5 ('Appraisal of health information') and Scale 8 ('Ability to find good health information'), again in both questionnaires, although significant progress was measured within Scale 8 (p = 0.041). Also, on Scale 9 ('Understand health information well enough to know what to do') a positive trend was obtained in the second questionnaire (p = 0.050). On Scale 7 ('Navigating the healthcare system') a significantly higher score was also obtained within the second questionnaire (p = 0.019).

Table 1
Sociodemographic characteristics of the study population, before intervention ('HLQ 1') and after intervention ('HLQ 2').

	HLQ 1 (n = 59)		HLQ 2 (n = 41)		p-value
	n	(%)	n	(%)	
Female	34*	58	24	59	0.984
Age < 65 years	40*	69	28	68	0.925
Land of birth					0.882
Belgium	9	15	8	20	
Morocco	18	31	11	27	
Philippines	19	32	15	37	
Turkey	4	7	1	2	
Other	8	14	6	15	
In case of birth abroad: years living in Belgium					0.477
0-5 years	0	0	0	0	
5-10 years	2	3	2	5	
+ 10 years	47	80	31	76	
Native language					0.927
French	7	12	5	12	
English	2	3	1	2	
Dutch	2	3	2	5	
Spanish	2	3	1	2	
Arab	17	29	12	29	
Tagalog	17	29	14	33	
Turkish	4	7	1	2	
Other	8	14	5	12	
Second language					0.929
French	31	53	20	49	
English	19	32	16	37	
Dutch	2	3	1	2	
Spanish	0	0	0	0	
Arab	2	3	2	5	
Tagalog	2	3	1	2	
Turkish	1	2	1	2	
Other	1	2	0	0	
None	1	2	0	0	
Education					0.022
Primary school or less	11	19	4	10	
Secondary school (not completed)	5	8	5	12	
Secondary school (completed)	23	39	16	38	
Higher studies	19	32	16	38	
Internet use					0.458
Never	7	12	4	10	
With help	4	7	3	7	
A few times a year	0	0	0	0	
A few times a month	0	0	0	0	
A few times a week	8	14	5	12	
Daily	39	66	29	69	

(* stands for: '1 missing data')

5.3. Results in relation to education level

The higher educated of our study group (n = 42) scored significantly better on Scale 5 ('Appraisal of health information') (p = 0.032) compared to the lower educated (n = 16). After intervention, however, the lower educated group improved greatly on this scale, with the result that the difference with regard to the higher educated narrowed and was no longer significant after intervention (p = 0.212; difference between higher and lower educated after intervention). Also, on Scale 1 ('Feeling understood and supported by healthcare providers'), the lower educated made great progress throughout the intervention, significantly distinguishing themselves from the higher educated group after intervention (p = 0.008). On Scale 3 ('Actively managing my health') and Scale 4 ('Social support for health') we also objectified relatively stronger score increases within the lower-educated group, which caused them to narrowly surpass the scores of the higher-educated group after intervention.

5.4. Results in relation to digital skills

Stronger digitally skilled participants (n = 47) were significantly better at finding the right health information (Scale 8) (p = 0.001) and understanding this information well enough to know what to do (Scale 9) (p = 0.038), compared to the participants with weaker digital skills (n = 11). These differences remained after intervention, but both groups did improve throughout the intervention, with significant progress for the group with weaker digital skills on Scale 8 (p = 0.029; score comparison of the digitally weaker before and after intervention) and a reduction of the score differences between the two groups as a result.

5.5. Results in relation to website use at home

In total, 14 out of 41 patients (34%) confirmed website use in the home setting, supplementary to the website exposure during the study consultations. The percentage of stronger digitally skilled (13/14; 93%) and higher educated (12/14; 86%) was relatively higher in this group compared to the total group (83% stronger digitally skilled and 78% higher educated respectively), and mean scores were higher on almost all scales compared to the group that had viewed the website exclusively during the study consultations.

Nevertheless, no statistically significant score differences between these groups were found nor did the website-use-at-home group make statistically significant progress on the different scales throughout the intervention. The only exception was on Scale 7 ('Navigating the healthcare system'), for which statistically significant progress was seen within the website-use-at-home group (p = 0.015), comparable to the progress seen in this scale for the total group (p = 0.019).

6. Discussion and conclusion

6.1. Discussion

6.1.1. Relationships between health literacy and education level

The skill 'Feeling understood and supported by healthcare providers' was stronger within the lower educated group before intervention, and was further strengthened throughout the intervention. In other studies, this skill does emerge as the strongest HL skill in general [24], but we could not find an education-level-dependent effect. It is known that lower-educated patients are more likely to have weaker HL in general, and that patients with weaker HL consult their general practitioner more often [26]. However, since GPs generally invest less in a qualitative relationship with lower educated patients [27], we would have expected a lower score on this scale in the lower educated. The explanation for the opposite result in our study could be the pre-existing expertise of several participating healthcare providers in working with a very diverse patient population and the prosocial vision of the clinic, including special attention to social vulnerability and patient empowerment. The further improvement of the caregiver-patient relationship for the lower educated throughout our intervention could be considered as an added effect of the study-related communication training of the healthcare providers, and offers a positive response to their greater need for support [28].

The effect of education level on other HL skills is further substantiated in this study. Previous research showed that higher educated people are generally better at finding, understanding and evaluating health information [24,29] and this is consistent with our study results. The relativity of this influence however, which is apparent from our study, is refreshing. On the scale 'Appraisal of health information', a significant difference in scores between higher and lower educated people was seen before intervention, but had disappeared after intervention.

6.1.2. Relationships between health literacy and digital literacy

Participants with lower digital skills had a much more difficult time finding and understanding correct health information, and the gap with

the stronger digitally skilled participants was remarkably large in our study before intervention ($p = 0.001$, Scale 8. 'Ability to find good health information'; $p = 0.038$, Scale 9. 'Understand health information well enough to know what to do'). It is known that people with lower HL are more likely to have lower digital skills [10], and that the lower digitally skilled are less strong in the autonomous collection of health information [11]. However, our research shows that the impact of digital skills on finding and understanding health information is even greater than the impact of education level. Nonetheless, we do see potential for strengthening HL skills within the lower digitally skilled, as shown by the learning curve within our lower digitally skilled group through the intervention. After intervention, they scored significantly better on the ability to find good health information ($p = 0.029$), and narrowed the gap with the stronger digitally skilled.

6.1.3. Impact of the intervention on self-management

No direct effect of the intervention on self-management was seen, measured within Scale 3 ('Actively managing my health'). The score on this scale remained the same for the entire group after intervention. The 1-year follow-up time may have been too short for real change in patient activation, as previous research on self-management in diabetics suggests [30]. We should probably also not ignore the impact of the COVID-19 pandemic in the year 2020. From the testimonials of participants during the study consultations, we infer that the COVID-19 pandemic, and the associated social restrictions, regularly had a constraining effect on self-management. The score of the lower educated on Scale 3, however, did increase relatively more, and they narrowly surpassed the higher educated in this skill area. Testimonials from the study consultations confirm that some participants had become more committed to their health. The high scores on the skill 'Feeling understood and supported by healthcare providers', more pronounced within the lower educated group, could also be considered promising in a potentially further, indirect strengthening of self-management in the long run.

6.1.4. Strengths and limitations

One of the strengths of our study is certainly the broad and differentiated approach to HL. We have deliberately chosen to follow the perspective of the most current – 'public health' – approach to HL, according to which HL is considered a shared responsibility of individuals and the health care system [12], and opportunities to strengthen HL are sought. The expanded questionnaire offered us the opportunity to make a well-founded HL needs assessment of the study population, in order to develop an adapted and effective intervention and health literacy responsive care [24,31]. The team of participating healthcare providers was fully involved in this process. In this way, an intervention was finally developed that focused on the HL skills that were most relevant to our study population.

The longitudinal follow-up of health literacy throughout this study is also unique. Many previous studies have examined health literacy in a specific population [13,24,32], but none of them – to the best of our knowledge – have repeated this measurement within the same group or have tested the effect of an intervention. Few previous interventions have addressed the healthcare providers or have examined the impact of education of health care providers on the patient's HL [33].

Our study results seem to provide further evidence that health literacy to some extent is 'learnable' and can be further developed [28]. The potentially empowering role of the GP in this is clarified. Patient populations with lower HL, such as the lower educated and lower digitally skilled, also appear to be prone to a greater learning potential. Due to our intervention, we succeeded in bringing these groups to a higher level, and reducing differences with other groups. This approach corresponds to the current Belgian national health literacy approach, which recommends targeting the most vulnerable population groups [31].

However, the results should be interpreted with caution due to the small and select sample size and the shortness of the intervention and follow-up period. Given the limited time frame and limitations of this follow-up study (such as dropout) a larger sample size was not possible. Given the freedom of participation, we have to take into account a possible selection bias of patients who were more interested in digital tools, lifestyle or diabetes care. The researchers tried to reduce the chance of this bias by not distinguishing in recruitment, and also by actively motivating patients to (continue to) participate, even when they had lower digital skills and/or less motivation for diabetes care. However, we must admit that we probably haven't fully succeeded in eliminating this bias, given the somewhat greater dropout from some more vulnerable patient groups, such as the lower educated. This is a well-known issue in longitudinal research [34]. Moreover, our study group was characterised by some particular features, such as the relatively older age (40-84 years, average 58 years) and the above-average share of migrants (50/58; 86%), which have potentially influenced certain skills, and should be taken into account when interpreting the study results.

The shortness of the intervention and the follow-up assessment make it difficult to offer clear statements on the sustainability of the observed effects on HL in this patient population. Nevertheless, the fact that we succeeded in achieving immediate, significant and meaningful effects on HL in a very diverse patient population with a small intervention is promising and motivating for further research in HL interventions.

The selected HLQ questionnaire was characterised by some difficulties in use, which were previously identified by HLQ researchers [35] and may have affected the results. The questionnaire contains multiple questions whose answer options only differ slightly, and are therefore sometimes difficult to differentiate by the participant. Some statements are rather abstract, which can make it more difficult to choose an answer. Participants may have been prone to misinterpreting some of the statements. Although misinterpretations are accepted by the developers of the HLQ [35], it may bias the results. Especially scales that contain more abstract questions, such as Scale 7 ('Navigating the healthcare system'), are potentially more prone to misinterpretations and biased results. In line with that, the unexpectedly positive effect of our intervention on Scale 7 could possibly be a measurement bias.

Moreover, the face-to-face administration of the questionnaire, which was organised for a part of the study population, could have impacted the collected data as well. Any social desirability bias in the answers of this group is difficult to exclude, the more so since this group already constituted a more vulnerable patient group (limited literacy and limited social support), more likely to suffer from a lack of skills and possible shame because of it.

Another limitation within this study was the testing of only one digital tool. The selected tool had to be an existing tool, and had to satisfy in terms of content and available languages. Given these narrow selection criteria, there was a limited number of tools to choose from. This caused some limitations that impacted the usability of the tool and the motivation – of healthcare provider and patient – to use them. These shortcomings should be taken into account when making a broader analysis of the use of digital health tools.

A final limitation is the absence of a formal measurement of the intervention fidelity, although multiple healthcare providers were involved in the intervention. Nonetheless, we did check the adherence of participating healthcare providers to the study protocol, with the help of consultation 'checklists'. These checklists contained the main elements of the consultation structure and were used as self-measurement instruments for the participating healthcare providers, rating their adherence to the protocol during the consultation. Analysis of these checklists showed a very good adherence of participating providers overall. We should note, however, that the adherence was suboptimal concerning the task of the digital tool demonstration during the consultation. We noted that in 10/43 (23.3%) intervention

trajectories the tool was not actively demonstrated by the healthcare provider in one or more consultations. This seems to be related to the suboptimal usability of the tool, but may certainly have impacted the results.

6.2. Innovation

The novelty of our research certainly lies in the dynamic approach to HL, and the objective and elaborate measurement of intervention effects on HL. Developing interventions aimed at strengthening HL is not new in Europe [36], but the number of studies evaluating the effects of these interventions on HL is much more limited.

This study also strongly shows how the digital revolution is increasingly influencing our health: the impact of a patient's digital skills on HL seems to be currently greater than the impact of his education level. The magnitude of the current impact of low digital skills on HL has never been so strongly demonstrated in previous research, as far as we know. This finding needs to be considered a wake-up call for future research in HL, in paying more attention to the development of this crucial and learnable skill.

Moreover, our intervention was targeted towards the main 'needs' of the study population, based on a thorough and differentiated needs assessment in the target population.

Lastly, our study provides further evidence for the learnable and flexible nature of HL. Our study results confirm that healthcare providers can have a potentially empowering role in HL, especially for the most vulnerable patient groups, have the power to bridge HL skills gaps between patient groups and to mitigate health disparities. The significant and meaningful effects of our small intervention on HL in a very diverse patient population is promising and motivating for further research in HL interventions.

At this moment, the landscape of online health information tools is still very fragmented and insufficiently known, as was apparent from the survey of our healthcare providers. Moreover, Belgium has many isolated HL initiatives but there is currently no overarching HL policy in place [31].

The findings of our study suggest two main implications:

1. A need for online centralisation of accessible patient information, available in multiple languages, and adapted to low literacy, to help patients and healthcare providers work together in strengthening the patient's information gathering skills and help overcome the digital divide;
2. A systematic integration of the concept of HL and the principles of 'health literacy friendly' communication into the educational programmes of all healthcare providers, to ensure that the healthcare system contributes to a strengthening of HL at the population level.

7. Conclusion

This study suggests that guided use of e-health in primary care can strengthen patient HL. The most significant improvements are seen in 'the ability to find good health information', 'understand the health information well enough to know what to do' and the provider-patient relationship. Patient populations with lower HL, such as the lower educated and lower digitally skilled, show the greatest learning potential. Our results seem to prove that caregivers have the ability to empower those with lower HL, and can help to reduce health inequalities. Investments in more widely accessible e-health tools probably have the potential to further improve HL at the population level and should be seen as a priority in a future-proof HL approach that can bridge health differences.

Funding

There was no funding provided for this study, since it was part of a Master's thesis in the context of a Master educational programme for GP trainees.

Declaration of Competing Interest

The authors have no conflict of interest.

Acknowledgements

We would like to thank all of the reviewers for their insightful comments on our study, as their comments led us to improve the work.

References

- [1] Th T. Laaggeletterdheid en beperkte gezondheidsvaardigheden vragen om een antwoord in de zorg. *Ned Tijdschr Geneeskd.* 2009;153:A250.
- [2] Kennissynthese JR. gezondheidsvaardigheden: niet voor iedereen vanzelfsprekend. *NIVEL Utr.* 2014;1:7.
- [3] Chan CV, Kaufman DR. A framework for characterizing eHealth literacy demands and barriers. *J Med Internet Res.* 2011;13:94.
- [4] Bohenn E, Oosterberg E, te Hennepe L, van Lennepe M, Beijaert R, van Bommel H, Huijser van Reenen N. Begrijp je lichaam. Eenvoudige afbeeldingen en teksten over het menselijk lichaam en veelvoorkomende gezondheidsproblemen voor laaggeletterde patiënten. *CBO.* 2012:77–8.
- [5] Schulz PJ, Nakamoto K. Health literacy and patient empowerment in health communication: The importance of separating conjoined twins. *Patient Educ Couns.* 2013;90(1): 4–11.
- [6] Manafo E, Wong S. Exploring older adults' health information seeking behaviors. *J Nutr Educ Behav.* 2012;44(1):85–9.
- [7] Le Deuff O. Vers La Littérature Digitale de Santé: *Un Domaine En Émergence*; 2015.
- [8] McCarthy DM, Scott GNCD. What did you Google? Describing online health information search patterns of ed patients and their relationship with final diagnoses. *West J Emerg Med.* 2017;18:928–36.
- [9] Cultures&Santé. Fiche Lisa: Comment Accompagner Un Groupe à Évaluer l'information Pour La Santé Sur Le Web?; 2018.
- [10] Van den Muijsenbergh M, Oosterberg E. Communicatie; laaggeletterdheid. *Zorg Voor Laaggeletterden, Migranten En Sociaal Kwetsbaren in de Huisartsenpraktijk. Praktische Tips En Inspirerende Voorbeelden*; 2017. p. 65–73.
- [11] Eurobarometer F. European Citizen's digital health literacy; 2014; 404.
- [12] 322As KR. *Gezondheidsgeletterdheid: Welke Lessen Trekken Uit de Ervaring van Andere Landen?* 2019.
- [13] Osborne. The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ). *BMC Public Health.* 2013;13:658.
- [14] Lee E-H, Lee YWA. structural equation model linking health literacy to self-efficacy, self-care activities and health-related quality of life in patients with type 2 diabetes. *Asian Nurs Res (Korean Soc Nurs Sci).* 2016;10(1):82–7.
- [15] Schillinger D, Grumbach K. Association of health literacy with diabetes outcomes. *J Am Med Assoc.* 2002;288:475–82.
- [16] Heijmans M, Waverijn G, Rademakers J, van der Vaart R. Functional, communicative and critical health literacy of chronic disease patients and their importance for self-management. *Patient Educ Couns.* 2015;98:41–8.
- [17] Friis K, Lasgaard M, Osborne H. Gaps in understanding health and engagement with healthcare providers across common long-term conditions: a population survey of health literacy in 29 473 Danish citizens. *BMJ Open.* 2016;6.
- [18] Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 an projections for 2035. *Diabetes Res Clin Pr.* 2014(103):137–49.
- [19] Schulz PJ, Fitzpatrick MA, Hess A, Sudbury-Riley L, Hartung U. Effects of ehealth literacy on general practitioner consultations: a mediation analysis. *J Med Internet Res.* 2017; 19(5):166.
- [20] Kwakernaak J, Eekhof JAH, De Waal MW, Barenbrug EACN. Patiënten en online informatie over kleine kwalen. Helpt internet de patiënt beter inzicht te krijgen? *Huisarts Wet.* 2020;63. <https://doi.org/10.1007/s12445-020-0897-x>.
- [21] Van den Muijsenbergh M, Oosterberg E. E-health bij beperkte gezondheidsvaardigheden. *Zorg Voor Laaggeletterden, Migranten En Sociaal Kwetsbaren in de Huisartsenpraktijk. Praktische Tips En Inspirerende Voorbeelden.* Pharos: NHG; 2017. p. 139–46.
- [22] Altman Douglas G. *Practical Statistics for Medical Research*; 1997..
- [23] Beauchamp A BR. Distribution of health literacy strengths and weaknesses across socio-demographic groups: a cross-sectional survey using the Health Literacy Questionnaire (HLQ). *BMC Public Health.* 2015;15:678.
- [24] Beauchamp ABR. Distribution of health literacy strengths and weaknesses across socio-demographic groups: a cross-sectional survey using the Health Literacy Questionnaire (HLQ). *BMC Public Health.* 2015;15:678.
- [25] Zelfmanagementondersteuning' N 'Inventarisatie meetinstrumenten. *Instrumentenkiezer: HLQ.* <https://zelfzorgondersteund-instrumentenkiezer.nl/health-literacy-questionnaire-hlq/>. Published 2017.
- [26] Franssen MP, Harris VC, Essink-Bot ML. Beperkte gezondheidsvaardigheden bij patiënten van allochtone herkomst. *Ned Tijdschr Geneeskd.* 2013;157:A5581.
- [27] Willems SMS. Socio-economic status of patient and doctor-patient communication: does it make a difference? *Patient Educ Couns.* 2005;56:139–46.
- [28] Van den Muijsenbergh M, Oosterberg E. Determinanten van gezondheid; Gezondheidsvaardigheden. *Zorg Voor Laaggeletterden, Migranten En Sociaal Kwetsbaren in de Huisartsenpraktijk. Praktische Tips En Inspirerende Voorbeelden*; 2017.

- [29] Vancorenland S, Avelosse H, et al. Bilan des connaissances des Belges en matière de santé. *MC-Information*. 2014;258:47–54.
- [30] GEHM Rutten, et al. Person-centered diabetes care and patient activation in people with type 2 diabetes. *BMJ Open Diabetes Res Care*. 2020;8(e001926).
- [31] Adriaenssens J, Rondia K, et al. Hoe kunnen we de gezondheidsgeletterdheid van onze patiënten verbeteren? *Tijdschr Geneesk*. 2020:663–9.
- [32] Hawkins M, Gill SD, Batterham R, Elsworth GR, Osborne RH. The Health Literacy Questionnaire (HLQ) at the patient-clinician interface: a qualitative study of what patients and clinicians mean by their HLQ scores. *BMC Health Serv Res*. 2017;17:309.
- [33] NHS. The Health Literacy Place – What we can do about low health literacy. <http://www.healthliteracyplace.org.uk/evidence/what-we-can-do-about-low-health-literacy/>.
- [34] Reinwand DA, Crutzen R, et al. Impact of educational level on study attrition and evaluation of web-based computer-tailored interventions: results from seven randomized controlled trials. *J Med Internet Res*. 2015;17(10):e228.
- [35] (Australia) DU. How to administer the HLQ (Health Literacy Questionnaire). <https://www.youtube.com/watch?v=fM0c8ohNWqU>. Published 2017.
- [36] Commission E. Study on Sound Evidence for a Better Understanding of Health Literacy in the *European Union*; 2015.