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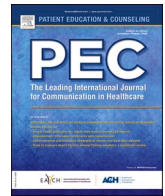
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Health literacy and the use of digital tools in older patients with cancer and their younger counterparts: A multicenter, nationwide study

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ABSTRACT

Objectives: To evaluate health literacy (HL), assess the use of digital tools/sources, and identify factors associated with low or moderate HL in older (aged ≥ 65) and younger (18–64) patients with cancer.

Methods: A cross-sectional multicenter study including patients with cancer was conducted in 26 centers in France. HL was assessed using the Functional, Communicative and Critical Health Literacy (FCCHL) scale. Factors associated with low/moderate HL (score < median) were studied using logistic regression models.

Results: The population comprised 669 patients aged 18–64 and 658 patients aged 65+. The older patients used digital tools less than younger patients did. The median overall HL score was: 3.7 and 3.6, for younger and older patients respectively. The need for help to fill out the questionnaire was associated with low/moderate HL in both age groups. Then, older age and living in rural area were associated with low/moderate HL in younger patients only, and rare internet use in older patients.

Conclusion: This article highlights the importance of considering HL in care management, as well as whom patients may present higher risk of low HL.

Practice implications: It is crucial to assess HL in patients with cancer, and then to seize every opportunity to enhance HL.

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1. Introduction

Cancer is a leading cause of morbidity and mortality worldwide [1]. Patients with cancer typically have to navigate through a complex health care system in which a high level of health literacy (HL) is required to successfully manage the disease and make health decisions. Thus, HL has an important role in the patient's understanding of the diagnosis, suggested treatments, and informed decision-making about care.

HL is broadly defined as the will and ability to access, process, understand and evaluate the health information needed to make appropriate health decisions [2]. Although there is no consensus on the exact definition of HL, the European Health Literacy Consortium defined it as the knowledge, motivation and skills needed to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning health care, disease prevention, and health promotion, with a view to maintaining or improving quality of life during the life course [3]. Hence, HL is commonly conceptualized as knowledge (e.g., basic literacy, declarative knowledge, and judgement ability), a set of skills (e.g., print HL, reading and writing skills, verbal literacy), and a hierarchy of functions requiring various levels of social and cognitive skills [4].

In 2000, Nutbeam developed and described a three-level model of HL in which functional HL refers to basic understanding, interactive HL refers to social skills and the individual's ability to extract information, and critical HL refers to critical skills for the analysis and use of information [5].

Low HL can lead to a loss of health opportunity. Indeed, several literature reviews have shown that a low level of HL is associated with poorer access to care, more frequent hospital admission, greater use of emergency medical services, lower participation in prevention activities (such as cancer screening), more inappropriate use of medical treatments, worse medication adherence, and poor understanding of medical prescriptions and health messages [6–9]. Poor HL is also associated with low quality of life and a higher mortality [6,10].

The level of HL is low in most areas around the world, [11,12] and Europe is no exception. A recent systematic review highlighted the fact that between a third and a half of people in European Union member states had low HL [13]. HL is lower still in older adults, and age is a known risk factor for low HL [14,15]. Given the negative consequences mentioned above, low HL is a public health challenge and a key outcome in health education programs.

In patients with cancer, low HL is associated with difficulties understanding and processing cancer-related information, poorer quality of life, and a worse experience of care [16]. Although several studies have assessed HL in patients with cancer, literacy was usually assessed using screening questions and tools focused on functional HL alone [17–20]. Furthermore, published data on HL in older patients with cancer are scarce [21,22]. The 14-item Functional, Communicative and Critical Health Literacy (FCCHL) scale [23,24] has been used in several studies to evaluate HL in patients with chronic disease [24–27]. Advantageously, the FCCHL scale evaluates [28] all three dimensions of HL: functional, interactive, and critical.

In a world where information is increasingly delivered via digital tools, digital skills in addition to health literacy are increasingly important. In addition, during the health crisis the world faced with COVID-19, digital health became more and more present and useful [28]. Despite an increased part of older adults using the Internet, in particular to seek health information, age is an important factor of the digital divide and information trustworthiness [28,29]. We can then hypothesize that factors associated with lower HL are different regarding age group, and that the use of digital tools may play a role, mainly in older adults.

The objective of the present French multicenter study was to evaluate HL, estimate the prevalence of low or moderate HL, and assess the

use of digital tools in older patients with cancer and in their younger counterparts. We also sought to identify factors associated with low or moderate HL in these two age groups.

2. Methods

2.1. Study design and population

A multicenter cross-sectional study was conducted between September 27th, 2021, and November 14th, 2021, in 26 French centers; these included general hospitals, university medical centers, and comprehensive cancer centers (see the Supplementary material for details). The enrolled patients were aged 18 or over and had been admitted to an outpatient unit or seen in an oncology consultation. All the patients had been given a treatment plan. Patients were included in the study regardless of cancer sites, cancer stage or treatment type. Inpatients were not eligible for inclusion, as well as patients with cognitive impairment that prevent them from answering the questions.

As required by the French regulations, the study was approved by an institutional review board (*Comité de Protection des Personnes Sud-Ouest et Outre Mer III*, Bordeaux, France; reference: SI RIPH2G21.02166.000019). The study was registered at ClinicalTrials.gov (NCT05070897).

2.2. Health literacy

HL was evaluated using the validated French-language version of the FCCHL scale [23,30]. The questionnaire consists of three subscales that respectively evaluate functional HL (access to information – 5 items), interactive HL (understanding of information – 5 items), and critical HL (use of information – 4 items) (Fig. 1). All items were scored on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”. The mean score for each subscale was calculated by summing the item scores and dividing by the number of items; it varies from 1 (low HL) to 5 (high HL). An overall score was calculated by averaging the subscale scores.

While low or inadequate HL has been defined by some researchers as a below-median score [23–25], other researchers considered a score of 3 on a 4-point Likert scale as the cut-off for low HL [26,27]. However, there is no consensus on the FCCHL score cut-off for low HL. In order to study factors associated with low or moderate HL, the patients in each of our age populations were divided into two groups according to the median FCCHL score. Thus, patients presenting a below-median FCCHL score were considered to have low or moderate HL.

2.3. Use of digital tools, and assessment of other covariates

The use of digital tools was evaluated using a self-administered questionnaire adapted from a 11-question previously published questionnaire [32]. The questions were related to the use of several digital tools (the Internet, mobile phone, computer, touch pad), medical applications (regardless of the application), connected objects for health (e.g. connected swatch, pedometer, etc.), and telemedicine. Each question on the frequency of use of the various digital tools and sources (and particularly those related to health) was scored on a 5-point Likert scale defined as follows: never, rarely (i.e. once a year or less), sometimes (i.e. few times a year), often (i.e. several times a month), or always (i.e. on a daily basis).

Data on the patients' demographic, clinical and cancer-related characteristics were also recorded: sex, type and place of residence (urban/rural), living conditions (alone or not), the need for a caregiver to assist with activities of daily living, cancer stage at diagnosis, type of enrollment center, cancer-related treatments, and the requirement for help filling out the study questionnaire.

2.4. Statistical analyses

In order to evaluate HL in older patients with cancer and in younger patients with cancer, we calculated the required sample size separately for two age groups: 18–64 (hereafter referred to as “population Y”) and 65 and over (“population O”). Considering (i) an expected prevalence of FCCHL score ≤ 4 from 70 % to 80 % based on a pilot study, and (ii) 40 % of patients with missing value on FCCHL, the required number of patients with cancer was estimated to be 420 per age group. Sample size was estimated using the Wald method (approximation by normal distribution).

The patients’ characteristics and use of digital tools were described in each population. For exploratory purposes, we compared the two groups’ use of digital tools using a chi-squared test.

The functional, interactive, and critical HL scores and the overall HL score were calculated for each age group. Factors associated with low or moderate HL were studied by performing logistic regression models, with calculation of the odds ratio and the 95 % confidence interval (CI). We considered living alone, type of residence, the presence of a caregiver for activities of daily living, cancer stage at diagnosis, the requirement for assistance with filling out the questionnaire, and Internet use. Variables with p value < 0.20 in univariate analyses were fed into the multivariate model. All models were adjusted for sex, age, and place of enrollment. Next, a stepwise procedure was used to select variables for the final multivariate model ($p < 0.05$). Pertinent interactions between the studied factors were tested by including factors and cross-produced terms in the models. Significant interactions were kept in the final models. Analyses were performed for the two age groups separately. All tests were two-sided, the threshold for statistical significance was set to $p < 0.05$. All statistical analyses were performed using SAS® software (version 9.4, SAS Institute, Inc., Cary, NC).

3. Results

3.1. Study population

Among the 1518 patients enrolled in the study (781 in population Y, and 737 in population O), 191 (12.6 %) presented missing data on the FCCHL scale. Thus, the analysis population comprised 1327 patients (669 in population Y, and 658 in population O). The median (IQR) age was 53 (45–60) in population Y and 74 (70–80) in population O. The

majority of the patients in population Y were women (65.8 %), whereas population O comprised similar numbers of women (50.9 %) and men (49.1 %) (Table 1). In both populations, almost all the patients lived at home (97.9 % and 97.4 % in populations Y and population O, respectively), and more than half lived in an urban area (53.7 % and 57.3 %, respectively) and had a person to help with daily tasks (65.5 % and 59.4 %, respectively). The proportion of patients living alone was 21.7 % in population Y and 29.6 % in population O. In both populations, the most frequent cancer site was the breast. The majority of patients had advanced and/or metastatic cancer (60.4 % and 70.2 % in populations Y and O, respectively) and received or were planned to receive chemotherapy (66.8 % in population Y, 58.8 % in population O).

3.2. Health literacy

The median overall HL score was 3.7 (3.3–4.1) in population Y, and 3.6 (3.1–4.0) in population O. Using the FCCHL cut-off from previous studies to define low to moderate HL, 70.0 % of the patients in population Y and 78.7 % of those in population O had an overall HL score equal or inferior to 4 (Supplementary material).

In populations Y and O, the median scores in each HL domain were respectively 4.0 (3.2–4.6) and 3.6 (2.8–4.4) for functional HL, 4.0 (3.6–4.4) and 3.8 (3.4–4.4) for interactive HL, 3.5 (2.5–4.0), and 3.5 (2.5–4.0) for critical HL (Fig. 2).

3.3. Use of digital tools

Populations Y and O differed significantly with regard to digital tool and source use in all domains (Table 2). Nearly a third (31.0 %) of the patients in population O and 6 % of those in population Y never or rarely used the Internet ($p < 0.001$). Likewise, near half of population O and a fifth of population Y never or rarely used the Internet for their health (i. e. searching for information, booking medical appointments, etc.; $p < 0.001$). Nearly a fifth (21.3 %) of patients in population O and 5.0 % of patients in population Y never or rarely used a smartphone ($p < 0.001$). Overall, the use of medical applications and connected objects was low in both age groups: 83.8 % of population O and 63.7 % of population Y never or rarely used medical apps ($p < 0.001$), and respectively 87.6 % and 76.4 % never or rarely used connected objects ($p < 0.001$).

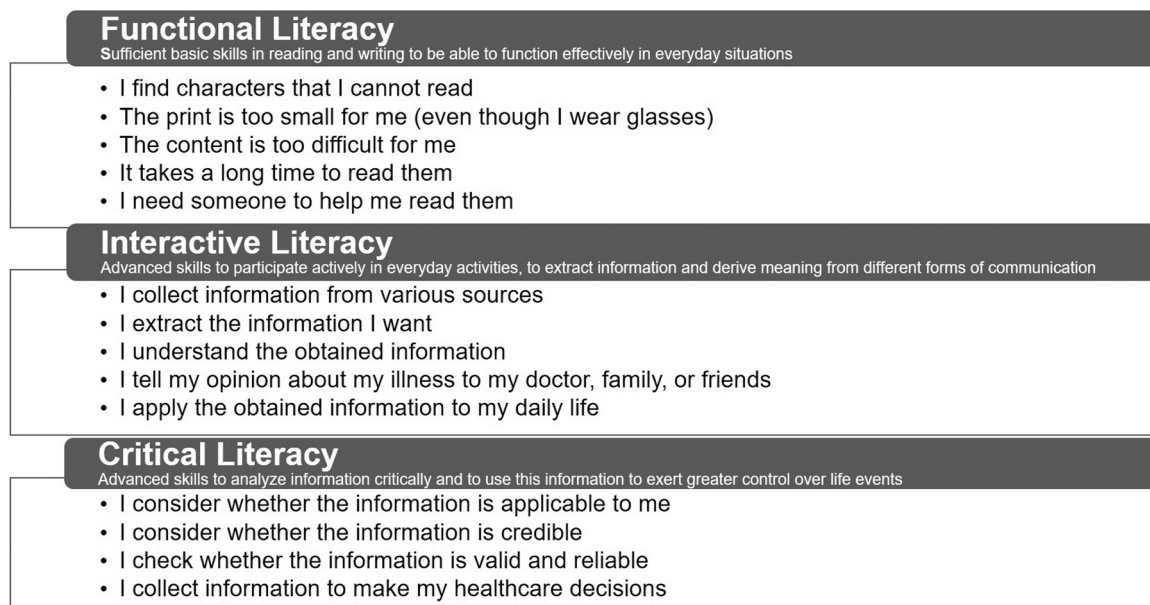


Fig. 1. Health literacy domains in FCCHL scale [22,31].

3.4. Factors associated with low or moderate health literacy

In population Y, older age (OR, 1.13; 95 % CI, 1.03 to 1.23 for overall HL; OR, 1.12; 95 % CI, 1.06 to 1.23 for functional HL) and the need for help to fill out the questionnaire (OR, 2.95; 95 % CI, 1.34 to 6.48 for overall HL; OR, 3.08; 95 % CI, 1.36 to 6.98 for functional HL) were associated with low or moderate overall and functional HL (Table 3). Living in a rural area (OR, 1.41; 95 % CI, 1.01 to 1.97) was also associated with low or moderate overall HL only. Furthermore, women were less likely to have low or moderate functional HL (OR, 0.67; 95 % CI, 0.47 to 0.95). None of the studied factors was associated with low or moderate interactive or critical HL in population Y.

In population O, the need for help to fill out the questionnaire was associated with low or moderate overall, functional and interactive HL

(OR, 2.53; 95 % CI, 1.68 to 3.80 for overall HL; OR, 3.14; 95 % CI, 2.06 to 4.79 for functional HL; OR, 1.81; 95 % CI, 1.21 to 2.70 for interactive HL) (Table 4). Patients who never or rarely used the Internet had a higher likelihood of low or moderate overall and functional HL (OR, 1.87; 95 % CI, 1.24 to 2.81 for overall HL; OR, 2.51; 95 % CI, 1.65 to 3.83 for functional HL). Regarding critical HL, sex was associated with HL, and age and sex presented a significant interaction: thus, with increasing age, men presented a higher level of critical HL and women presented a lower level of critical HL. Regarding the interaction between the need for help to fill out the questionnaire and Internet use, never or rarely using the Internet was not significantly associated with low or moderate critical HL among patients who did not need help to fill out the questionnaire.

Table 1
Characteristics of the two study populations (n = 1327).

	Population Y (n = 669)		Population O (n = 658)	
	N	%	N	%
Sex				
Male	229	34.2	323	49.1
Female	440	65.8	335	50.9
Type of residence				
Home	655	97.9	641	97.4
Nursing home	3	0.4	5	0.8
Other	6	0.9	7	1.1
Missing	5	0.7	5	0.8
Living alone				
Yes	145	21.7	195	29.6
No	517	77.3	457	69.5
Missing	7	1.0	6	0.9
Area of residence				
Urban	359	53.7	377	57.3
Rural	258	38.6	240	36.5
Missing	52	7.8	41	6.2
Help with activities of daily living				
Yes	438	65.5	391	59.4
No	187	28.0	210	31.9
Missing	44	6.6	57	8.7
Need for help to fill out the questionnaire				
Yes	597	89.2	426	64.7
No	40	5.9	182	27.7
Missing	32	4.8	50	7.6
Center				
University medical center or comprehensive cancer center	590	88.2	562	85.6
General hospital	79	11.8	95	14.4
Cancer site*				
Breast	273	40.8	112	17.0
Lung	62	9.2	85	12.9
Colorectal	72	10.8	76	11.5
Prostate	14	2.1	63	9.6
Other digestive	59	8.7	76	11.6
Other gynecological	45	6.7	63	9.6
Other urological	37	5.5	58	8.8
ENT	26	3.9	17	2.6
Hematological	22	3.2	26	3.9
Other**	66	9.8	91	13.8
Cancer stage				
Localised	262	39.2	195	29.6
Advanced and/or metastatic	404	60.4	462	70.2
Missing	2	0.3	1	0.2
Cancer treatment (received or planned)***				
Chemotherapy	447	66.8	381	57.9
Immunotherapy	120	17.9	151	22.9
Targeted therapy	120	17.9	80	12.2
Radiation therapy	80	12.0	70	10.6
Endocrine therapy	76	11.4	85	12.9
Surgery	46	6.9	49	7.4
Other	17	2.5	15	2.3
Missing	8	1.2	10	1.5

Population Y: patients aged 18-64; Population O: patients aged 65 and over

* A given patient could present cancer at several sites;

** Sarcoma, others, and not known;

*** A given patient could have receive several treatment types, alone or in combination

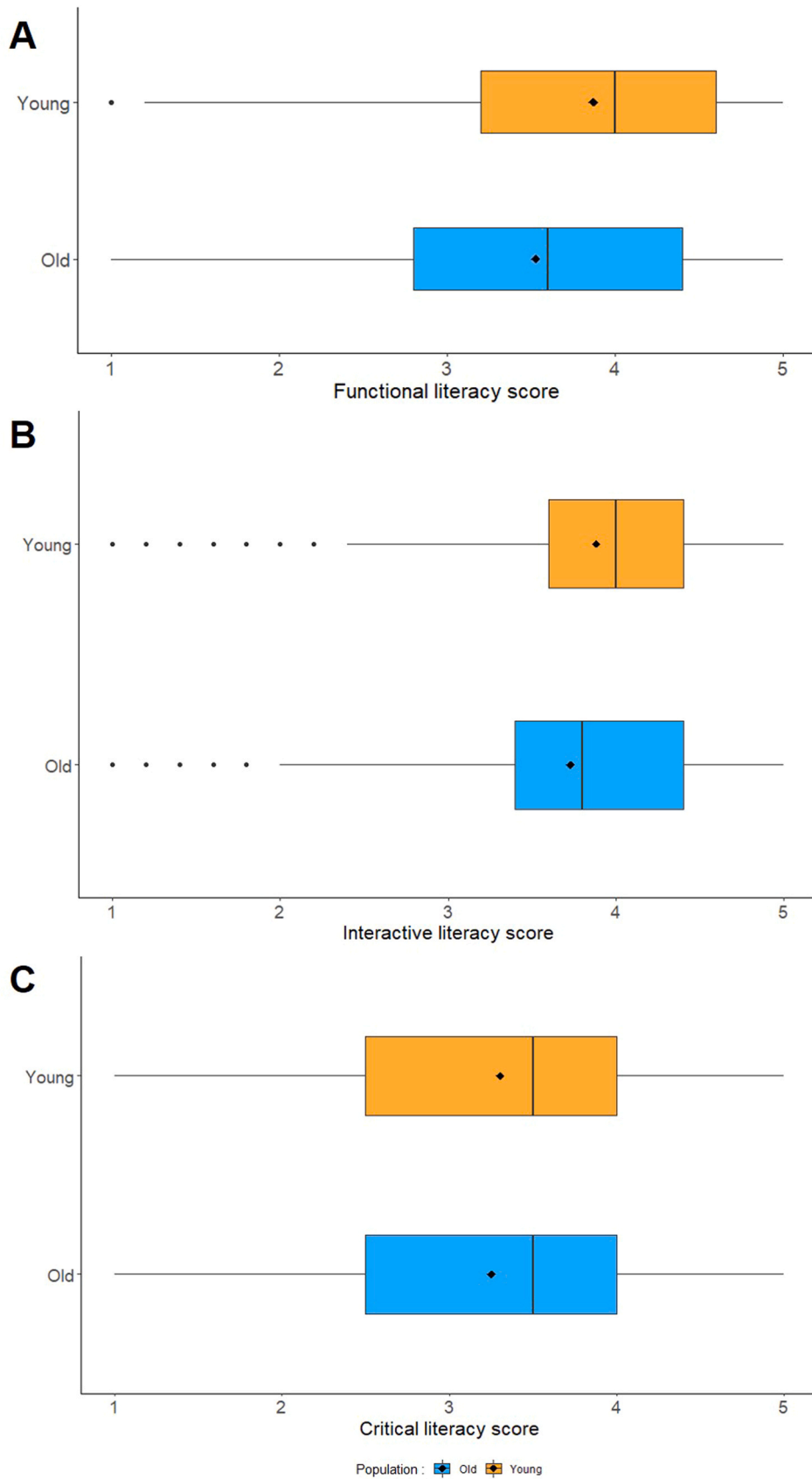


Fig. 2. Box-plots of functional (A), interactive (B) and critical (C) health literacy in patients with cancer aged 18–64 (population Y) and those aged 65 and over (population O).

Table 2
Use of digital tools in patients with cancer, by age groups (n = 1327).

	Population Y		Population O		p-value
	N	%	N	%	
Do you use the Internet?					< 0.001
never - rarely	40	6.0	201	31.0	
sometimes - often - always	621	94.0	447	69.0	
Do you use the Internet for your health?					< 0.001
never - rarely	133	20.2	315	48.7	
sometimes - often - always	526	79.8	332	51.3	
Do you communicate by e-mail in daily life?					< 0.001
never - rarely	88	13.3	251	38.6	
sometimes - often - always	574	86.7	399	61.4	
Do you use a smartphone (with an Internet connection and applications)?					< 0.001
never - rarely	34	5.1	138	21.3	
sometimes - often - always	630	94.9	511	78.7	
Do you communicate by text message in daily life?					< 0.001
never - rarely	31	4.7	188	28.9	
sometimes - often - always	634	95.3	462	71.1	
Do you use a tablet computer (tactile screen) in daily life?					< 0.001
never - rarely	284	43.1	413	63.5	
sometimes - often - always	375	56.9	237	36.5	
Do you use a computer in daily life?					< 0.001
never - rarely	87	13.2	246	37.8	
sometimes - often - always	572	86.8	405	62.2	
Do you use medical apps? (on a smartphone or tablet)					< 0.001
never - rarely	422	63.7	545	83.8	
sometimes - often - always	240	36.3	105	16.2	
Do you use smart objects? (e.g. a smart watch, a pedometer, etc.)					< 0.001
never - rarely	509	76.4	573	87.6	
sometimes - often - always	157	23.6	81	12.4	
Do you use online consultations or telemedicine?					< 0.001
never - rarely	504	76.0	593	90.4	
sometimes - often - always	159	24.0	63	9.6	
Have you changed your habits and used online consultations or telemedicine since the beginning of the COVID-19 pandemic?					< 0.001
never - rarely	509	76.5	594	90.7	
sometimes - often - always	156	23.5	61	9.3	

Population Y: patients aged 18-64; Population O: patients aged 65 and over

4. Discussion and conclusion

4.1. Discussion

Our results highlighted a low or moderate level of HL in younger and older patients with cancer. We also identified factors associated with low or moderate HL; although these differed with the age group, the need for help to fill out the questionnaire was associated with overall and functional HL in both populations.

Compared with population Y, population O was more likely to never or rarely use digital tools and information sources. These results are in line with the generational digital divide reported in the literature: older adults use of digital tools less than younger adults do [33].

In our study, the median overall HL score was 3.7 (3.3–4.1) for patients in population Y and 3.6 (3.1–4.0) for patients in population O. Overall, HL scores differed by subscale and age group. Older patients presented lower functional and interactive HL scores than their younger counterparts, which may lead to greater difficulty finding relevant

Table 3
Factors associated with low or moderate (below-median) health literacy in patients with cancer aged 18–64.

	Overall HL			Functional HL			Interactive HL			Critical HL		
	OR	95 %CI	p-value	OR	95 %CI	p-value	OR	95 %CI	p-value	OR	95 %CI	p-value
Age*	1.13	[1.03; 1.23]	< 0.01	1.12	[1.06; 1.23]	< 0.01	1.01	[0.92; 1.10]	0.83	1.05	[0.96; 1.14]	0.31
Sex			0.63			0.03			0.22			0.12
Male	1.00			1.00			1.00			1.00		
Female	0.92	[0.64; 1.31]		0.67	[0.47; 0.95]		0.80	[0.55; 1.14]		1.32	[0.93; 1.88]	
Living area			0.05			0.68			0.73			0.43
Urban area	1.00			1.00			1.00			1.00		
Rural area	1.41	[1.01; 1.97]		0.93	[0.67; 1.30]		1.06	[0.76; 1.49]		1.14	[0.82; 1.59]	
Center			0.12			0.14			0.74			0.17
University medical center or comprehensive cancer center	1.00			1.00			1.00			1.00		
General hospital	1.51	[0.89; 2.56]		1.49	[0.88; 2.52]		0.92	[0.55; 1.53]		1.44	[0.85; 2.41]	
Need for help to fill out the questionnaire			< 0.01			< 0.01			0.24			0.50
No	1.00			1.00			1.00			1.00		
Yes	2.95	[1.34; 6.48]		3.08	[1.36; 6.98]		1.55	[0.74; 3.25]		0.79	[0.40; 1.57]	

* Per 5-year increase

Table 4

Factors associated with low or moderate (below-median) health literacy in patients with cancer aged 65 and over.

	Overall HL			Functional HL			Interactive HL			Critical HL		
	OR	95 %CI	p-value	OR	95 %CI	p-value	OR	95 %CI	p-value	OR	95 %CI	p-value
Age*	0.94	[0.82; 1.08]	0.37	1.03	[0.89; 1.19]	0.67	1.08	[0.94; 1.23]	0.27	0.83	[0.69; 1.01]	0.07
Sex			0.75			0.85			0.48			0.03
Male	1.00			1.00			1.00			1.00		
Female	0.94	[0.68; 1.32]		0.97	[0.68; 1.37]		0.89	[0.64; 1.23]		0.02	[0.01; 0.61]	
Center			0.12			0.05			0.38			0.31
University medical center or comprehensive cancer center	1.00			1.00			1.00			1.00		
General hospital	1.45	[0.90; 2.35]		1.64	[1.01; 2.68]		1.24	[0.77; 1.98]		1.28	[0.79; 2.07]	
Need for help to fill out the questionnaire			< 0.01			< 0.01			< 0.01			0.54
No	1.00			1.00			1.00			1.00		
Yes	2.53	[1.68; 3.80]		3.14	[2.06; 4.79]		1.81	[1.21; 2.70]		1.17	[0.70; 1.95]	
Use of the Internet			< 0.01			< 0.01			0.15			0.22
sometimes-often-always	1.00			1.00			1.00			1.00		
never-rarely	1.87	[1.24; 2.81]		2.51	[1.65; 3.83]		1.34	[0.90; 2.00]		0.73	[0.43; 1.21]	
Sex × Age**										1.30	[1.01; 1.67]	0.04
Assistance × Internet use***										3.14	[1.41; 7.01]	< 0.01

* Per 5-year increase;

** The interaction between sex and age;

*** The interaction between need for help to fill out the questionnaire and Internet use.

health information through different sources, and understanding health information (e.g. decoding medical language). Scores for critical HL were the lowest in both group, without age group difference, highlighting difficulty to analyze information and using it. Inadequate critical HL may lead to consequences in healthcare decisions, as the patient may not be able to analyze received information and then participate to medical shared-decision. When applying the FCCHL cut-off score of ≤ 4 to define low to moderate HL (as in previous studies) [26,27], 70 % of patients from population Y and 79 % of patients from population O presented low to moderate overall HL. Previous studies of patients with cancer reported low to moderate HL from 7 % to 86 % [16]. The lack of consensus on how to assess HL makes comparisons with the literature difficult. Indeed, in previous studies of patients with cancer, HL was mainly evaluated using a single, validated question [34] or with questionnaires such as the Short Test of Functional Health Literacy [35] and the Rapid Estimate of Adult Literacy in Medicine [36]. These instruments identify individuals with low to moderate HL (using a cut-off score) but focus solely on functional HL and need to be administered by a healthcare professional [37]. The FCCHL scale has rarely been used to assess HL in patients with cancer but has already been validated in French [30] and in patients with chronic disease, including adolescents and young adults with cancer [38]. Furthermore, the FCCHL scale was one of the first self-questionnaires for the assessment of multiple HL domains. Two instruments have been developed to measure cancer health literacy specifically: the 30-item Cancer Health Literacy Test is based on a continuum, and the 6-item Cancer Health Literacy has a cut-off score [39]. Nevertheless, general HL was previously reported to be associated with the ability to understand and process cancer-related information and experience of care in patients with cancer [16]; the assessment of general HL might therefore usefully precede and before an assessment of cancer-related HL.

In addition to providing age-group data on HL in patients with cancer, our study enabled us to identify several factors associated with low or moderate HL. These differed in the two age populations, which highlights the importance of studying older patients with cancer and their younger counterparts separately. However, in both age groups, the need for help to fill out the questionnaire was associated with lower overall and functional HL. To the best of our knowledge, our study is the first to have studied this association. We hypothesize that the need for help is related to a deterioration of the patient's general condition, fatigue, and impaired physical and/or neuropsychological status due to cancer and/or its treatment. Indeed, a study of more than 4000 cancer

survivors reported lower HL in those presenting depression, fatigue, pain, and sequelae [40]. However, this association between the need for help to fill out the questionnaire and low or moderate HL might also be mediated by the educational level (not measured in our study), as the need for help was only associated with lower overall and functional HL in our study. In population Y, older age and male sex were associated with lower overall and functional HL, while living in a rural area was associated with overall HL only. Our results for age, sex, and type of residence are in line with the literature [41–44]. This association might also be mediated by educational level, given the large urban–rural gap in education found in several countries. In our population O, never using or rarely using the Internet was associated with lower overall, functional and interactive HL; this is in line with the results of a previous study of older adults [45]. Accordingly, older adults also present lower eHealth literacy, as highlighted in a recent review of factors influencing this type of HL in patients with cancer [46].

It has been reported that Internet use has a beneficial association with HL, including improvements in medical knowledge, the sense of patient empowerment, and self-management skills [47].

The present study is one of the first to have assessed HL in older adults with cancer. The study's primary strength relates to the large number of investigating centers ($n = 26$) distributed throughout mainland France; this made it possible for us to include a large number of patients. Secondly, full data on HL were available for almost 90 % of the included patients. Thirdly, we evaluated all three HL domains defined by Nutbeam, whereas most published studies focused on functional HL only.

Our study also had some limitations. We did not measure a number of factors reported in the literature as being associated with HL. Several studies have shown an association between low educational level and poor HL [40–42,48]. It would probably have been informative to measure cognition (particularly in older adults) because lower HL in older adults is reportedly associated with poorer cognitive functioning and greater cognitive decline [49]. Internet use might include educational and cognitive health benefits because Internet use in older adults is associated with the educational level and is higher in older adults experiencing successful aging [50–52].

4.2. Conclusion

In this study, we showed that HL is moderate to low in patients with cancer, and even more in older adults. Patients with cancer with low to moderate HL may have limited abilities to access and navigate the

cancer care system, make appropriate health decisions, and act on health care information; this might have consequences for treatments and patient outcomes. This article highlights the importance of considering HL in care management, as well as whom patients may present higher risk of low HL. Thus, it is highly relevant to assess HL in patients with cancer and implement actions for those with low to moderate HL, by prioritizing those with the lowest level of HL. Patient educational and counselling interventions can improve HL [53] and so should be available for patients with cancer. As patient involvement and shared decision-making are components of patient-centered health systems, communication by the patients is essential [54]. Indeed, patients with low to moderate HL are disadvantaged in their ability to obtain process and understand both written and verbal information about cancer. Thus, HL interventions might ultimately improve the patients' health by expanding their communication skills and those of their caregivers.

4.3. Practice implications

Given the burden of cancer worldwide and the negative impact of limited HL [1,16,20], HL is a public health challenge in patients with cancer, with limited HL making it more complex to navigate the healthcare system. Many decisions have to be made by both the patient and the provider in the cancer continuum (from early screening through diagnosis and treatment to recovery or end of life), and HL has been shown to impede patients with cancer at every stage of the cancer journey. Empowering the patients is a key element for better cancer understanding, patient involvement, experience of care and prognosis [55]. Thus, it is crucial to assess HL in patients with cancer, and then to seize every opportunity to enhance HL in multiple levels, including the provider and the patient levels. The improvement of health literacy can participate to improve patient care along the cancer continuum and reduce the cost of unnecessary and inappropriate care.

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CRediT authorship contribution statement

Heidi Solem-Laviec: Writing – review & editing, Investigation. **Solène Doublet:** Writing – review & editing. **Stéphane Culine:** Writing – review & editing, Investigation. **Elena Paillaud:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Mylène Annonay:** Writing – review & editing, Investigation. **Angéline GALVIN:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Conceptualization. **Achille Tchalla:** Writing – review & editing, Investigation. **Christophe Perrin:** Writing – review & editing, Investigation. **Caroline Lalet:** Writing – review & editing, Resources, Project administration, Methodology. **Pascaline Boudou-Rouquette:** Writing – review & editing, Investigation. **Rabia Boulahssass:** Writing – review & editing, Investigation. **Johanne Poisson:** Writing – review & editing, Investigation. **Capucine Baldini:** Writing – review & editing, Investigation. **Pierre Gay:** Writing – review & editing, Investigation. **Simone Mathoulin-P é lissier:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Siavoshe Ayati:** Writing – review & editing, Investigation. **Arnaud Saint-Lezer:** Writing – review & editing, Investigation. **Lucas Hue:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Thomas Grellety:** Writing – review & editing, Investigation. **Marina Pulido:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Diego Teyssonneau:** Writing – review & editing, Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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