International Journal of
Environmental Research and Public Health

MDPI

Article

eHealth literacy in German skin cancer patients

Henner Stege [1,†,*], Sara Schneider [1,†], Andrea Forschner [2], Thomas Eigentler [3], Dorothée Nashan [4], Svea Hüning [4], Frank Meiß [5], Saskia Lehr [5], Martin Kaatz [6], Robert Kuchen [7], Katharina C. Kähler [8], Maximilian Haist [1], Jutta Huebner [9,†], Carmen Loquai [1,†]

1 Department of Dermatology, University Medical Center Mainz, 55131 Mainz, Germany;
2 Department of Dermatology, University Hospital Tübingen, 72076 Tübingen, Germany
3 Department of Dermatology, Venerology and Allergology; Charité – Universitätsmedizin Berlin, corporate member of Freie Universität Berlin and Humboldt-Universität, 10117 Berlin, Germany
4 Department of Dermatology, Hospital Dortmund, 44137 Dortmund, Germany
5 Department of Dermatology, Medical Center – University of Freiburg, Faculty of Medicine, University of Freiburg, 79104 Freiburg, Germany
6 Department of Dermatology, Wald-Klinikum Gera, 07546 Ger, Germany
7 Institute of Medical Biostatistics, Epidemiology and Informatics (IMBEI), University Medical Center,55131 Mainz, Germany
8 Department of Dermatology, Venerology and Allergology, University Hospital Schleswig Holstein, Campus Kiel, 24105 Kiel, Germany
9 Klinik für Innere Medizin II, Hämatologie und Onkologie, Universitätsklinikum Jena, 07747, Jena, Germany
† These authors have contributed equally to this work
* Correspondence: henner.stege@unimedizin-mainz.de

Abstract: The global incidence of skin cancer has steadily increased in recent years, and malignant melanoma still has one of the fastest-growing incidence rates among all malignant tumors in the Western world. Thus, newly diagnosed patients have an increased need for health information concerning their disease. Using a standardized questionnaire, our study aims to investigate the primary sources of health-related information of our patients and their eHealth literacy. We received 714questionnaires. Regardless of age, the primary source of information was the treating dermato-oncologist, followed by the treating general practitioner and the Internet. However, with increasing age, the usage of the Internet decreased. Hence, younger participants were better equipped to find health-related information while using the Internet. Also, comprehending health-related information as well as gaining medical knowledge was significantly increased in better -educated participants. Overall our study shows that with increased use of eHealth services, accessing web-based information increased correlating with a better eHealth literacy of our patients. EHealth technologies are increasingly becoming more prevalent as a primary source of information in our modern health care system. Thus it is crucial to educate cancer patients in eHealth literacy to make autonomous, informed decisions and gain more confidence in dealing with their disease.

Keywords: eHealth, skin cancer, eHealth literacy, health-related information

Citation: Lastname, F.; Lastname, F.; Lastname, F. Title. *Int. J. Environ. Res. Public Health* **2021**, *18*, x. https://doi.org/10.3390/xxxxx

Academic Editor: Firstname Lastname

Received: date
Accepted: date
Published: date

1. Introduction

The incidence of skin cancer has increased dramatically in the past decades, and melanoma still has one of the fastest-growing incidence rates among all malignant tumors in the Western world. At the same time, melanoma is responsible for over 90% of skin cancer deaths owing to its tendency to metastasize early [1, 2]. Thus, these patients have an increased need for health information concerning their disease [3, 4]. Naturally, patients look for information regarding prognosis, treatment options, and associated side effects, as well as second opinion [5, 6]. Still, the treating physician/oncologist remains the primary source of information [7], but time restraints occurring in the regular clinical routine often impede a satisfactory response and might not sufficiently meet all requirements of

cancer patients [8, 9]. Thus, patients turn to other means in order to gather information. While the established source of information such as books, journals, or support groups remain an essential source for information, the use of the Internet for information is increasing rapidly [10]. Various studies have shown that cancer patients use the Internet to collect information on multiple subjects [11, 12], mainly to interpret symptoms, find second opinions, or seek emotional support [13, 14]. Thus, the Internet has become one of the essential tools for cancer patients to seek and find information regarding their disease [15, 16]. Especially in the industrialized world, the accessibility of the Internet through the high volume of cell phone and computer use has dramatically increased [17, 18]. Consequently, the Internet has removed many barriers to access health information [19]. However, the broad offers of information can be challenging and difficult to filter and comprehend, especially since there is often a discrepancy between the accessibility and quality of information, which then, in turn, can lead to wrong decisions [20, 21]. Therefore, patients must develop specific skills to filter, understand and deceiver information regarding their diseases given on the Internet. The ability to understand, appraise and apply health information is summarized in "eHealth literacy" [22]), which consists of 6 different literacy skills: traditional, health, information, scientific, media, and computer literacy. One's ability can be measured through the eHealth literacy scale [23, 24].

Recent studies have demonstrated that lower eHealth literacy is often associated with a significant risk of hospitalization due to lower usage of preventive services, reduced psychosocial health, and increased episodes of anxiety [25]. Therefore, it is crucial to determine the health literacy of patients in order to provide optimal adapted ways and means for medical information. To learn more about the health literacy of melanoma patients and their usage of the Internet, we conducted a survey in six different German skin cancer centers using a questionnaire.

2. Materials and Methods

This survey was an anonymous survey, using standardized questionnaire. All participants were diagnosed with skin cancer and took part in this survey during their regular follow up outpatient visits in 6 German skin cancer centers, including Mainz, Tübingen, Kiel, Gera, Dortmund, Freiburg. This questionnaire has been conceived by experts from the group Prevention and Integrative Oncology of the Working group German Cancer Society [26]. All participants agreed to voluntarily take part in this survey and signed an informed consent.

The questionnaire comprised data on the following subjects:

1. Demographic data (patient during or after treatment, gender, age, type of cancer, year of diagnosis)
2. Data on use of the Internet (focusing on frequency, accessibility and Internet connection) was collected. To obtain a better comparability, we categorized the Internet usage of the participants in two groups “heavy user” (“several times a week”/”daily”) and “occasional user” (“several times a month”/”rarely”/”never”) in accordance with Halwas et al. 2017 [27]
3. Data on the overall satisfaction with the provided information via a Likert scale 1= totally dissatisfied to 5= totally satisfied
4. Data on the general usage of electronical devices, Internet, apps e.g.
5. Data on ehealth literacy. These questions were compiled on the basis of the eHealth Literacy Scale [27]

For this questionnaire solely closed questions were used, therefore a list of possible answers was provided (e.g. “how often did you use the Internet in the last three months?” Daily, serveral times a week, serval times a month, rarer, never). In case of questions which required a self-rating, the participants answered on a Likert scale (e.g. “How would you rate your understanding of health-related Internet offers” 1 = I totally disagree to 10 = I totally agree). The multicenter questionnaire was approved by the Ethics Committee

of Rheinland-Pfalz (837.385.17) and was conducted in accordance with the principles of the Helsinki Declaration in its current version.

Table 1. Baseline characteristics of participants.

	N (%)
Age (years)	61.81 (range 18 – 89)
< 50	136 (19%)
51 - 65	218 (31 %)
> 65	326 (45%)
No data	34 (5%)
Gender	
Female	292 (40.9%)
Male	360 (50.4%)
No data	62 (8.7%)
Tumor entities	
Malignant melanoma	514 (77%)
Basal cell carcinoma	41 (6.1%)
Cutaneous lymphoma	31 (4.6%)
Squamous cell carcinoma	28 (4.1%)
Mycosis fungoides	22 (3.2%)
Merkel cell carcinoma	15 (2,2%)
Cutaneous sarcoma	10 (1.4%)
Adnexal tumor	3 (0.4%)
Melanoma stages (AJCC 2017)	
Melanoma in-situ	3 (0,6%)
I	129 (25,1%)
II	66 (12,8)
III	142 (27,6)
IV	148 (28,8)

GraphPad Prism version 5 was used for data collection. Chi-square test and Fisher exact test were used for analysis of frequency and correlation, $p < 0.05$ was considered significant.

3. Results

3.1. Demographic data

714 patients in six German skin cancer centers participated in this survey. Among these, 292 (40.9%) were female, and 360 (50.4%) were male, whereas 62 (8.7%) did not disclose any information on gender. The average age of the participants was 61.81 years (SD 14.54, range 18 – 89 years). More than three quarters (79.3%) of the participants were older than 51 years, while only 20.7% were younger than 51 years. Thus, we categorized the participants into three age subgroups: < 51 years (20.7%), 51 and 65 years (32.6%) and > 65 years (46.6%) [27]. The education level of the participants was classified into low and high. Hence, participants without a degree, elementary school, general school degree, or secondary school diploma were categorized as participants with low education levels (62.7%). In comparison, participants with high school diplomas and university degrees were classified as participants with high education levels (36.1%).

The majority of participants were diagnosed with malignant melanoma (76.9%; n=514), followed by basal cell carcinoma (n=41), cutaneous lymphoma (n=31), and squamous cell carcinoma (n=28) (table 2). We categorized participants into two subgroups according to melanoma stages: loco-regional (melanoma in-situ, stage I and II) and advanced melanoma (stage III and IV) (Table 1).

3.2. Source of information

Regardless of age, the most often reported source of information was the treating dermato-oncologist (n=526), followed by the general practitioner (n=374) and the Internet (n=301). Internet usage as a primary source declined with the increasing age of the participants (<51 years 62.4%, 51 to 65 years 55.4, > 65 years 23.09%; p=0.052). Contrary, participants over 65 years used their general practitioner as an information source more often than younger participants (54.89% vs. 43.26%; p=0.043). Regarding gender or melanoma stage, no significant differences regarding the primary source of information was noticeable (p=0.139). However, female patients named their practicing dermato-oncologist more often as a primary source of information than male participants (p=0.032). Books and print media were also sources independent of the participant's education level (Figure 1)

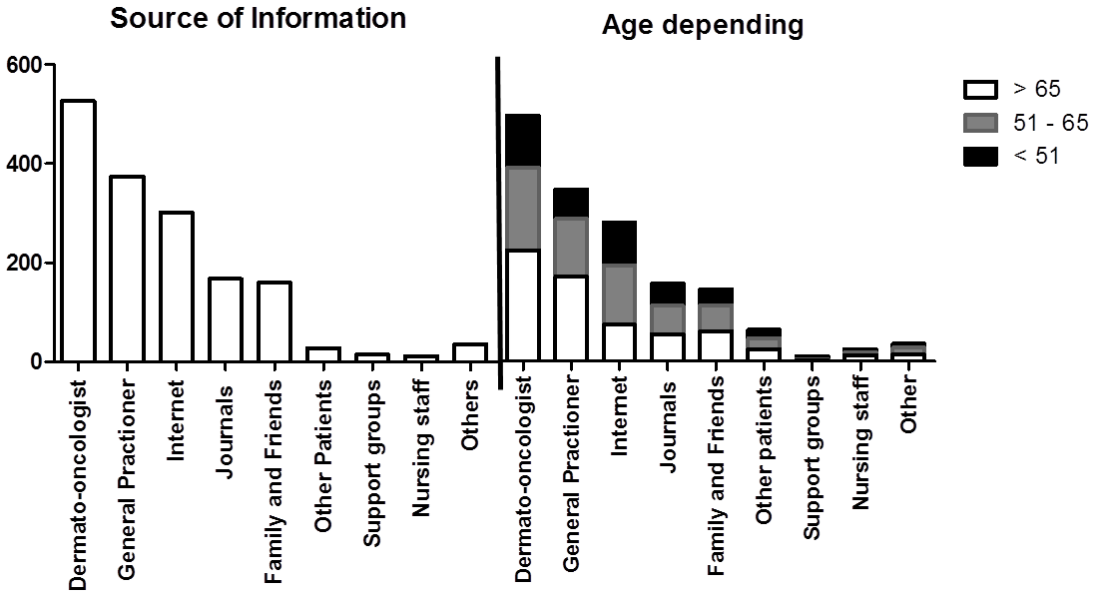

Figure 1. Primary source of information. The results show, participants' primary source of information. Regardless of age the primary source of information was reported to be the treating dermato-oncologist, followed by the treating general practitioner and the Internet. However, with increasing age the usage of the Internet decreased.

3.3. Level of satisfaction with the provided medical information

On a Likert scale from 1 (totally dissatisfied) to 5 (very satisfied), the participants were asked to rate their level of satisfaction regarding the provided information, as described in the methodic part of this manuscript (Table 2).

Regarding the provided information on "Cause of the disease," the mean value was 3.8. Interestingly, female participants yielded a significantly higher mean value (3.9) in comparison to their male counterparts (3.65) (p=0,006). Moreover, the provided information was interpreted significantly more favorable with increasing age (p<0.001). Also, participants with diagnosed melanoma scored higher mean values with 3.87 than those with non-melanoma skin cancer3.61 (p=0.004). No significant differences were found between the educational levels and the tumor stages, even though satisfaction seemed to decrease with increasing tumor stage.

The level of satisfaction on the information regarding the progression of the disease scored a mean value of 3.93. There was no statistically significant difference in gender, level of education, or cancer entities. However, participants diagnosed with melanoma were slightly more satisfied with the provided information (3.99) than those with non-melanoma skin cancers (3.77), albeit without statistical significance. Notably, patients showed a higher overall satisfaction with the provided information with increasing age (p<0.001).

The item that explored the level of satisfaction concerning information about the planned therapy yielded a mean value of 4.09. Thus, the mean value ranked among the highest values of all items (see Table 2). We found no significant statistical difference correlating with gender or education. However, participants with diagnosed melanoma had significantly higher mean values 4.18 than those with non-melanoma skin cancer 3.83 (p=0.005). Again, we observed that the overall satisfaction with the provided information increased with age (p= 0.002).

When assessing the comprehensibility of the provided information, the mean value was 3.91. No significant difference in mean values was found for gender, educational level, or tumor entities. Participants with diagnosed melanoma were significantly more satisfied than participants with non-malignant skin cancers (p=0.045).

In terms of satisfaction with the information on the prescribed medication, the mean value was 3.99. No significant correlation for gender, education, or melanoma stage was observed. Nevertheless, participants with melanoma yielded a significantly higher mean value of 4.07 than those with non-melanoma skin cancer entities 3.74 (p=0.03). Like previous findings, we observed an age-dependent increase in the mean value in our subgroups regardless of malignant or non-malignant skin cancer (p=0.001).

Participants rated the information on potential adverse events with a mean value of 3.87. There were no significant differences regarding gender, education age, or tumor entities. In terms of tumor entities, participants diagnosed with malignant melanoma reported a higher average satisfaction with 3.93 as compared to those with non-melanoma skin cancer which rated an average satisfaction of 3.64.

Table 2. Level of Satisfaction with the provided Information.

	Mean Score	Women	Men	< 51	51 – 65	> 65	Stage I-II	Stage III-IV
Cause of the disease	3.8	3.9	3.65	3.47	3.72	3.98	3.99	3.74
Progression of the disease	3.93	3.77	3.82	3.59	3.88	4.1	3.76	3.94
Treatment options	4.09	4.05	3.70	3.82	4.02	4.24	4.07	4.04
Comprehensibility of the information	3.91	3.44	3.27	3.76	3.92	3.99	4.02	4.04
Medication	3.67	3.53	3.74	3.46	3.64	3.83	3.76	3.78

3.4. Usage of the Internet and other electronical devices

A vast majority of the participants (n=505, 73.9%) reported Internet usage within the last three months. In addition, nearly half of the participants (n=337, 49.13%) reported using the Internet daily, while 19.24% (n=132) of the participants never used the Internet (Figure 2).

67.5% of the participants were classified as "heavy users" while 32.5% were assigned to the group of "occasional users." Furthermore, we observed a statistical difference in the frequency of Internet usage regarding gender (p=0.004). Hence, 72.2% of the male participants reported a frequent usage of the Internet compared to 61.4% of the female participants. With respect to age groups, we observed a significant difference (p= <0.0083) when comparing the Internet usage within the different age subgroups, thus in the age group of patients aged up to 50 years, 93.6% of the participants were classified as "heavy users," while only 45.3% of the participants over 65 years of age reported a frequent Internet use. We observed a significantly higher use of the Internet in participants with higher levels of education as compared to participants with lower levels of education (87.7% vs 57.5% heavy users; p=<0.0001). Nevertheless, we also observed a significant correlation between the age of the participants and their level of education (p<0.0001). Accordingly, we found that 53.6% of the participants aged under 51 years had a higher level of education, while only 25.6% of participates older than 65 years earned a higher level of education, thus showing a declining trend with rising age (see Figure2). Subsequently, we tested for significance within the different subgroups according to the age of the participants (p<0,001).

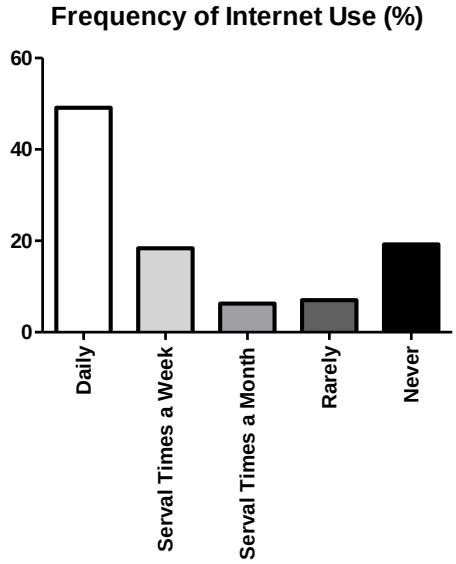

Figure 2. Frequency of Internet use. Most of the participants (< 65%) reported frequent Internet usage. Nonetheless, 19.24% (n=132) of the participants never use the Internet.

Most of the participants (73.5%) rated their Internet connection as sufficient, while only 4.3% (n=29) reported that their Internet connection was not fast enough for regular use. Interestingly, nearly 15% of patients (n=102) documented that they did not have access to an Internet connection at all. In addition, we observed an age-related decrease in the quality of the Internet connection. Furthermore, in the oldest subgroup (> 65 years of age), we observed the highest number of participants without an Internet connection. Also, the availability of a sufficient Internet connection significantly increased in correlation to the education level of the participant, we reason that the social economic status of the participants plays a significant role regarding the availability of a sufficient Internet connection. Due to the tendencies that higher income is often associated with higher level of education (p=<0.001). In general, most of the participants accessed the Internet via a computer/laptop either from their home (74%) or their workspace (26%). Cell phones or other mobile devices were used by 62.9% of the participants.

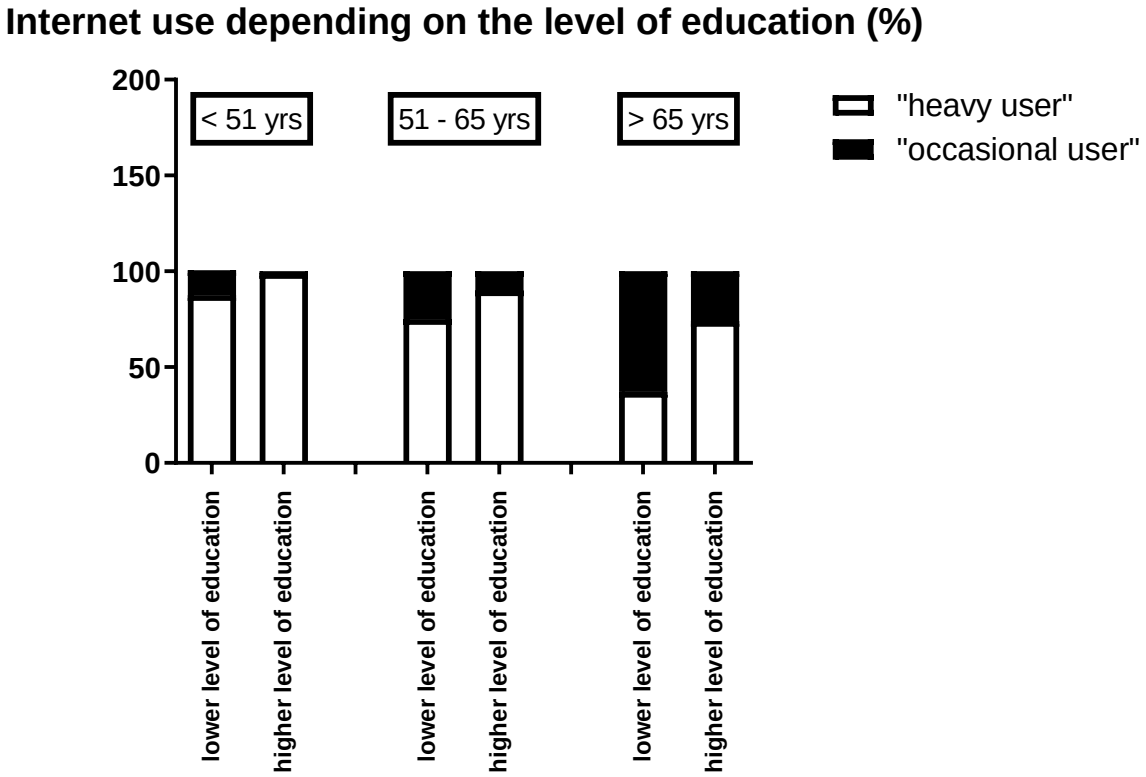

Figure 3. Internet use depending on the level of education. Younger patients and patients with a higher level of education more frequently used the Internet and more frequently gathered health information from the Internet. .

3.5. eHealth usage

Altogether 413 participants out of 488 answered the question about the usage of electronic health services and offers. However, most participants (n=175, 35.8%) reported an infrequent usage while only 7.9% (n=39) confirmed a daily use. A third of the participants (31.5%, n=154) would not consider using eHealth services at all. 19.6% (n=95) of the participants reported of having used eHealth offers once. 21.3% (n=104) did not yet use electronic health services but would hypothetically do so.

We observed a significant difference regarding gender in the usage of eHealth offers (p=0.0008). Specifically, 45% of the female participants were frequently using eHealth offers compared to 33,7% of the male participants. We did not find a significant difference in the usage of eHealth offers regarding age (p=0.932) or education (p=0.09). However, eHealth offers were more often used in the subgroup of participants with a lower level of education than in the subgroup with a high level of education (41,4% vs. 35,4%), albeit without statistical significance. To address eHealth habits, participants were asked about their utilization of different eHealth services. 80,3% of participants have accessed the Internet to search for health information, followed by 49.5% seeking medical terms in an online encyclopedia, and 14.3% searching for medical specialists on the Internet. Modern eHealth tools such as Apps, fitness trackers, or eBooks were rarely used in our patient cohort (see Figure 4).

We could not detect significant differences between female and male participants with regard to the frequency of accessing the Internet to gather health-related information. However, patients with higher education levels (p=0.004) and patients with advanced melanoma (p=0.003) used self-help groups significantly more often. Further, online encyclopedias, journals, and brochures were significantly more often used by participants with a higher level of education.

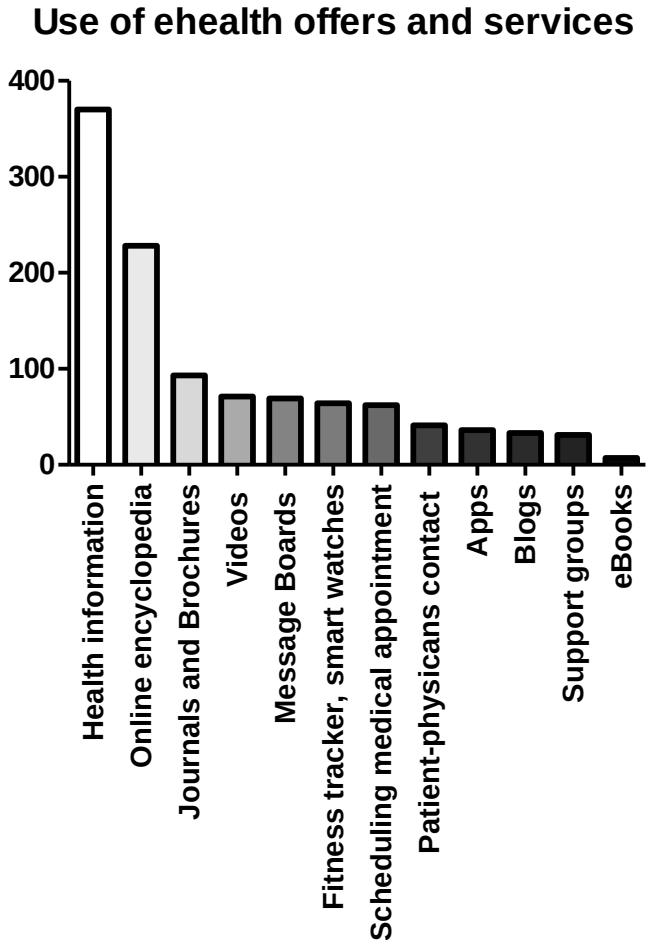

Figure 4. Use of eHealth offers and services. Total number of participants using eHealth offers and services categorized by the different outlets.

3.6. Data on eHealth literacy

To assess the eHealth literacy of the participants the next items were gathered by a Likert scale from 1 (I totally disagree) to 10 (I totally agree) as described in the methodic part of this manuscript (see above).

First, the participants were asked to rate their own level of "Comprehension of health-related information provided by the Internet". 16.5% of the participants were confident in their ability to fully comprehend the information from the Internet. On average, the participants rated their comprehension level as a 6.94. With regard to gender and age, we did not observe a significant difference in the comprehension levels of the participants. In addition, the ability to comprehend health-related information was statistically significant lower in patients with higher levels of education in contrast to patients with lower level of education ($p=0.001$).. Concerning the clinical melanoma stage no significant differences between the subgroup of participants with loco-regional or advanced melanoma were detectable (6.4 vs 6.6 $p=0.242$) (Figure 5).

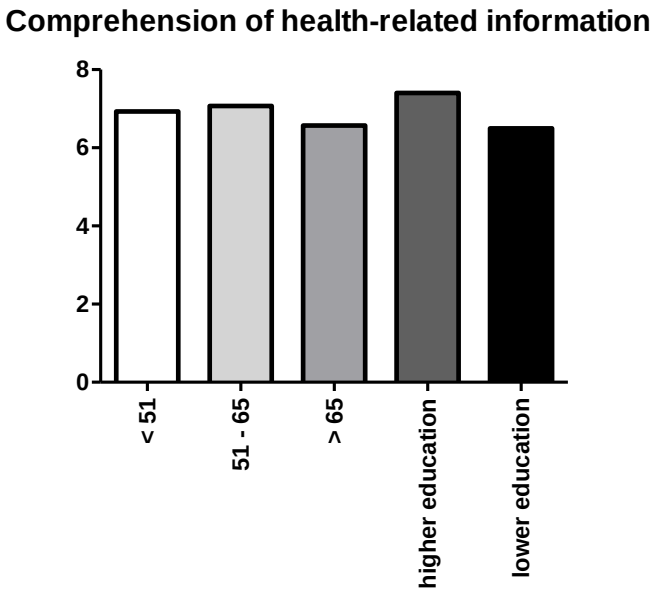

Figure 5. Level of comprehension of health-related information. We noticed a decreasing arithmetic mean value with increasing age of the participants. Also the ability to comprehend health-related information was statistically significant in patients with higher levels of education.

Next, the participants evaluated their ability to find suitable information regarding their health and disease. The arithmetic mean value was 6.57. Again, we did not find a significant difference regarding gender or age. However, there was a significant difference in the subgroup of participants with higher levels of education (7,4) in comparison to those of lower lever of education (6,34) (p=0,0034). Furthermore, the ability to find suitable information significantly increased in participants, who stated a frequent usage of the Internet or other electronical devices.

The next item examined the participant's sense of certainty when making a health-related decision based on information from the Internet. In comparison to the other arithmetic mean values this item yielded the lowest overall score 3.77. With respect to gender, education levels or melanoma stage no statistical association was observed.). Of note, we observed that patients of higher age showed a significantly higher sense of certainty y when making a decision based on information provided by the Internet; p=0.008) (Figure 6).

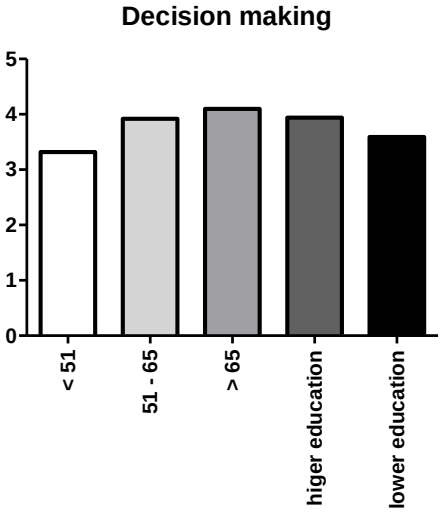

Figure 6: Level of certainty when making a health-related decision based on information from the Internet. In general, older participants were more certain when making a decision based on health-related information from the Internet. Similarly, participants with higher education levels were more certain in their decision making process.

Due to the overflow and constant availability of health-related information, the main difficulty patients face is to discern which information is reliable or appropriate. Thus, the next item examined whether the participants were confident in their ability to allocate health-related information into reliable and unreliable sources. We recorded here the second lowest mean value 3.92 and it is noteworthy that 19.2% had no certainty at all when allocating sources into reliable and unreliable information (participants who previously sated no Internet use were excluded) . We did not notice a statistically significant difference with regard to gender, level of education, melanoma stage or age.

The item aimed to assess if health-related information via the Internet increased the medical knowledge of our participants yielded a mean value of 5.92. While there was no statistical association concerning gender we observed a statistical association regarding age (p=0.016) and level of education (p=0.001). In terms of age we found that older participants and those with higher education levels rated their increase of medical knowledge more favorably than younger participants (.

In the last two items, we examined the usage of mobile health applications in our participant cohort. Here, we assessed if the participants could allocate suitable apps for their daily health care needs. Patients were moderately confident to find apps that could help them with their health (mean value: 5.17). Noteworthy 13.4% had no confidence in their ability to allocate such apps. Interestingly, the older subgroups rated their ability to find suitable apps significantly lower in comparison to the younger participants (<51 years: 5.55, 51 – 65 years: 5.24, >65 years: 4.71; p=0.041). Also, the association between the level of education and the ability to find suitable apps was statistically significant. Thus, participants with higher education levels yielded a mean value of 5.63 while those of low education levels reached a 4.86 (p=0.006).

Secondly, we assessed the practicability of using those apps through smartphones or tablets. The arithmetic mean value was 5.36; however, 12.6% of the participants reported that they considered themselves unable to appropriately apply eHealth apps via smartphones or tablets. While there was no significant association regarding gender, we observed that in our younger subgroups, the ability to use eHealth apps was significantly increased (p=0.001 Also, participants with higher education levels had higher confidence in their ability to use eHealth apps.

3.7. Single Item Literacy Screener (SILS)

The SILS is an effective tool to identify the patients with limiting reading and comprehension ability and therefore required assistance reading health-related materials. Possible answers were: 1—never, 2—rarely, 3—sometimes, 4—often, and 5 always [28]. Most of our participants stated that they never (35.2%) or rarely (31.2%) needed assistance when reading health-related materials, while 21.4% sometimes required help. We classified participants with SILS scores > 2 as patients with "limited reading ability"[27]; thus, 30.1% of the participants fell into this category. No significant associations regarding gender or melanoma stage were observed. Not surprisingly, a significant association between the SILS, education (p=0.001) and age (p=0.006) was prevalent. Accordingly, 34.7% of the participants with lower levels of education had SILS scores higher than 2 and were therefore classified as patients with "limited reading ability." In comparison, only 21.4% of the participants with higher levels of education were grouped into this category. Also, we observed an amplification of participants with SILS scores higher > 2 with increasing age (< 51 years: 18.8%, 51- 65 years: 33.8% and > 65 years: 32.8%). Interestingly, a frequent usage of eHealth services and eHealth literacy was not significantly associated with lower SILS scores.

4. Discussion

The incidence of skin cancer has increased dramatically in the past decades. Hence, an increasing number of patients have to be informed about their disease and possible treatment options and many patients indeed wish to be comprehensively informed about their disease. Recent literature suggests that the Internet is developing into one of the primary sources of health-related information. In particular, it has previously been demonstrated that the Internet is becoming the primary source for health-related information in younger patients on the one hand. On the other hand, for patients of older age, established sources in our health care system (e.g., general practitioner, treating dermato-oncologist) remain the constant and favored vehicle to obtain health-related information. Recent clinical observations suggest an association between eHealth literacy and Internet use. Therefore, it has been proposed that patients with low eHealth are often not skilled enough in searching online for health-related information as well as to differentiate between reliable and unreliable. To our knowledge, this is the first prospective study that used an internally consistent eHealth literacy scale to determine the use of the Internet and other online eHealth services of German skin cancer patients. Here, we obtained several vital findings that corroborate previous concepts of the role of eHealth literacy in acquiring and understanding health-related information from the Internet.

First, our results revealed that physician-patient interaction remains the primary source of information among our participants. However, the use of the Internet as a primary source of information for health issues rapidly increases in younger patients [13, 29, 30]). We observed an age-dependent decline in the use of the Internet [27, 29]. Moreover, with increasing age significantly more male participants used the Internet. Similar observations were made by Zickhur et al.; in American adults. Here nearly half of the adults age 65 and older remain disconnected from the Internet. With the exception of computers seniors age 65 and older are less likely than other age group to own any digital devices [31], while the typical Internet-using student uses the Internet for 100 minutes per day and over 99% possess a digital device [32]

With increasing age, the Internet was used less frequently, and consultation through patient-physician interaction increased accordingly. Our data is consistent with prior published data that show an increase in patient-physician exchange as the primary source in patients over the age of 75 and lower educational background. Primary reasons could be attributed to the unfamiliarity of daily Internet use, which complicates searching, filtering and gathering of online information and frequently requires a certain level of external help to recognize relevant information [5, 27, 33]. Accordingly, with in the last two decades the use of the Internet increased from 29% in 2000 to nearly 94% in 2020 [34]. In comparison, 80.8% of our study participants used the Internet at least occasionally. We attribute the discrepancy in the Internet use to the difference in the average age of our participants (61.55 years) as compared to the younger age of the overall German population (44.5 years) (Bundesinstitut für Bevölkerungsforschung (BiB), 2021).

Second, we demonstrated that older participants appeared to be significantly more satisfied with the currently provided information about their disease in terms of cause, progression, or treatment options than their younger counterparts. We reasoned that the increased level of satisfaction can be attributed to the fact that older participants more often obtain their information from health care specialists. Contrary, younger patients were less satisfied with the provided information from various outlets, most often the Internet. Thus, one could deduce a higher need for information at a younger age or skepticism towards the information received and a need for "better information." Again, our data is consistent with previous studies [35, 36] which found that the Internet became the primary source of information, especially in younger melanoma patients. At the same time, patients were much more satisfied when receiving most of the information on their disease from the treating-physician as compared to getting similar information from the Internet. Our findings indicate that the Internet is gaining relevance as a primary source for information, however it has yet not replaced the patient-physician interaction, due to

the lack of reliability and for some patients a lack in accessibility. Hence, the treating physician remains the most trusted and most widely used source of information in German skin cancer patients [37]. However, the increasing use of online information could benefit the patient and promote shared decision-making by strengthening patient autonomy and improving the physician-patient relationship [5].

Additionally, we could demonstrate that the use of eHealth services is significantly higher in female participants, while age or education did not influence the use of eHealth services. Our findings are in accordance with previous literature that indicates that women are more likely than men to play an active role in obtaining information and to seek information from as many different sources as possible [38, 39].

Furthermore, we observed the lowest mean value when evaluating if eHealth services assisted patients when making health-related decisions, followed by the ability to differentiate between reliable and unreliable sources. However, allocating the information seems to be not the primary problem since participants rated their ability to find relevant information with a mean value of 6.57. Our data rather indicate that the lack of high-quality information might complicate an informed decision-making process for patients, since health-related information on the Internet frequently lacks crucial basic information, thus providing incorrect or incomplete knowledge [40, 41]. Therefore, it seems that patients are skeptical towards online health-related information. Moreover, due to the multitude and complexity of the information, they do not have enough security to make decisions about their health based on this information. One explanation might be that younger patients are more aware of unreliable source [5, 34, 41]. Although the additional certainty provided by the information from the Internet may help patients deal with their disease, this observation also carries the risk of wrong decisions being made based on unreliable and non-evidence-based sources.

Also, we observed that participants with lower education were significantly more often uncertain while using health-related information and making decisions based on this information. In this regard, participants with lower education rated their ability to find and differentiate eHealth-related information significantly lower than their counterparts. Additionally, they showed a poorer understanding and use of eHealth services. Accordingly, participants with higher education used eHealth offers regularly and reported that the application expanded their medical knowledge. In summary, participants with a lower level of education are struggling to deal with electronic health services, presumably due to a lack in competence how to handle these services and thus these patients show a lower eHealth literacy. Hence, it is important to reinforce efforts to increase eHealth literacy in these subgroups, as any patient may benefit from information on their disease. Our findings are in line with current publications by Schaeffer et. al., that low educational status correlates with low health literacy. Thus, these deprived subpopulations are severely challenged by the increased requirements for accessing, understanding and applying health-related information from the Internet. Also, in the last years an increase in misinformation and interest-driven information [42].

Last, our results revealed that nearly one-third of the participants were categorized into the category "limited reading ability" and that these patients showed the lowest levels of competence in the handling of electronic health services. Unfortunately, further investigation of the limited reading ability was not possible, so possible confounders such as limited vision, illiteracy, or poor language skills cannot be ruled out. This observation complements a recent study, which found similar results [27], suggesting that participants with adequate reading ability benefit from eHealth related information. Furthermore, following our previous results, participants with low education levels were more likely to have limited literacy concerning medical instructions, brochures, or other written material. Thus, literacy, eHealth literacy, and education level all seem to impact each other. It should also be noted that the literature not only describes a dependency between (e)Health literacy and educational level [43, 44] but also on prognosis and health status [45, 46]. Therefore, it should be even moreimportant to integrate (e)health literacy into

general education, since the Internet will likely develop into the major source for health-related information. However, it will be necessary to improve the accessibility and handling skills in the daily use of the Internet via both infrastructure concepts and community-based education programs particularly for older people, who were found to have a lower level of competence in dealing with eHealth services and the Internet.

5. Conclusions

In summary, we provide evidence of the growing importance of the Internet as a primary source of information and the need to increase eHealth literacy. In particular, we could show that younger and better-educated participants could use health-related information in their decision-making process by allocating information to reliable or unreliable sources. Furthermore, one-third of the participants had inadequate reading abilities, highlighting the association between eHealth literacy and education. Thus it is crucial to educate cancer patients in eHealth literacy to make autonomous, informed decisions and gain more confidence in dealing with their disease. Based on our observations, further research is needed to identify the needs of our patients in terms of health-related information and thus improve their eHealth literacy skills.

Author Contributions: Writing and editing by H.S., S.S., M.H., H.J.; and L.C.; Methodology, software, validation, formal analysis, funding acquisition and illustration of tables and figures by H.S., S.S., and K.R.; Conceptualization: H.S., H.J., and C.L.; Project administration: H.J.,C.L; Supervision by C.L. Data acquisition: A.F., T.E., D.N., S.H. F.M., S.L., M.K., and C.L. All authors have read and agreed to the published version of the manuscript..

Funding: "This research received no external funding

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: H.S., S.S., M.H., R.K., M.K., S.L., J.H., S.H., T.E. declare no conflict of interest K.C.K has served as consultant or/and has received honoraria from Amgen, Roche, Bristol Myers Squibb, Merck Sharp and Dohme, Pierre Fabre, and Novartis, and received travel support from Amgen, Merck Sharp and Dohme, Bristol Myers Squibb, Amgen, Pierre Fabre and Novartis. AF served as consultant to Roche, Novartis, MSD, BMS, Pierre-Fabre; received travel support from Roche, Novartis, BMS, Pierre-Fabre, received speaker fees from Roche, Novartis, BMS, MSD and CeGaT, outside the submitted work. She reports institutional research grants from BMS Stiftung Immunonkologie outside the submitted work. F.M. has received travel support or/and speaker's fees or/and advisor's honoraria by Novartis, Roche, BMS, MSD and Pierre Fabre and research funding from Novartis and Roche. D.D. declares speakers and advisory board Honoria and/or travel support from BMS, MSD, Novartis, Pierre Fabre and Roche outside the submitted work. D.N. served as consultant and payed referee to MSD, BMS, Novartis, Roche, Almirall Hermal, Mylan and Sanofi outside the submitted work. C.L. declares speakers, advisory board honoraria and travel support from Bristol Myers Squibb, Merck Sharp and Dohme, Merck Serono, Novartis, Roche, Pierre Fabre, Sun Pharma, Kiowa Kirin, Sanofi, Biontech, Almirall Hermal outside the submitted work.

References

1. Siegel, R.L., K.D. Miller, and A. Jemal, *Cancer statistics, 2019.* CA Cancer J Clin, 2019. **69**(1): p. 7-34.
2. Stege, H., et al., *The Status of Adjuvant and Neoadjuvant Melanoma Therapy, New Developments and Upcoming Challenges.* Target Oncol, 2021. **16**(5): p. 537-552.
3. Passalacqua, S., et al., *Information needs of patients with melanoma: a nursing challenge.* Clin J Oncol Nurs, 2012. **16**(6): p. 625-32.
4. Brütting, J., et al., *Unmet information needs of patients with melanoma in Germany.* Melanoma Res, 2019. **29**(2): p. 196-204.
5. Heiman, H., et al., *EHealth literacy in patients with cancer and their usage of web-based information.* Journal of Cancer Research and Clinical Oncology, 2018. **144**(9): p. 1843-1850.
6. Rutten, L.J., L. Squiers, and K. Treiman, *Requests for information by family and friends of cancer patients calling the National Cancer Institute's Cancer Information Service.* Psychooncology, 2006. **15**(8): p. 664-72.
7. Shea-Budgell, M.A., et al., *Information needs and sources of information for patients during cancer follow-up.* Curr Oncol, 2014. **21**(4): p. 165-73.

8. Shiferaw, K.B., et al., *E-health literacy and associated factors among chronic patients in a low-income country: a cross-sectional survey.* BMC Medical Informatics and Decision Making, 2020. **20**(1): p. 181.
9. Crawford-Williams, F., et al., *Information needs and preferences among rural cancer survivors in Queensland, Australia: a qualitative examination.* Australian and New Zealand Journal of Public Health. **n/a**(n/a).
10. Katz, J.E., D. Roberge, and G. Coulombe, *The cancer patient's use and appreciation of the internet and other modern means of communication.* Technol Cancer Res Treat, 2014. **13**(5): p. 477-84.
11. Van de Belt, T.H., et al., *Internet and social media for health-related information and communication in health care: preferences of the Dutch general population.* J Med Internet Res, 2013. **15**(10): p. e220.
12. Rudolph, I., et al., *[Survey on information needs of cancer patients and their relatives in Germany].* Dtsch Med Wochenschr, 2015. **140**(5): p. e43-7.
13. Braun, L.A., et al., *Information needs, communication and usage of social media by cancer patients and their relatives.* Journal of Cancer Research and Clinical Oncology, 2019. **145**(7): p. 1865-1875.
14. Mollema, L., et al., *Disease detection or public opinion reflection? Content analysis of tweets, other social media, and online newspapers during the measles outbreak in The Netherlands in 2013.* J Med Internet Res, 2015. **17**(5): p. e128.
15. Sabel, M.S., et al., *Patterns of Internet use and impact on patients with melanoma.* J Am Acad Dermatol, 2005. **52**(5): p. 779-85.
16. Hamilton, S.N., et al., *Sifting Through It All: Characterizing Melanoma Patients' Utilization of the Internet as an Information Source.* J Cancer Educ, 2015. **30**(3): p. 580-4.
17. Kuss, D.J., et al., *Internet addiction: a systematic review of epidemiological research for the last decade.* Curr Pharm Des, 2014. **20**(25): p. 4026-52.
18. Hesse, B.W., R.P. Moser, and L.J. Rutten, *Surveys of physicians and electronic health information.* N Engl J Med, 2010. **362**(9): p. 859-60.
19. Broom, A., *Virtually he@lthy: the impact of internet use on disease experience and the doctor-patient relationship.* Qual Health Res, 2005. **15**(3): p. 325-45.
20. Liebl, P., et al., *What cancer patients find in the internet: the visibility of evidence-based patient information - analysis of information on German websites.* Oncol Res Treat, 2015. **38**(5): p. 212-8.
21. Herth, N., et al., *Internet Information for Patients on Cancer Diets - an Analysis of German Websites.* Oncol Res Treat, 2016. **39**(5): p. 273-81.
22. Norman, C.D. and H.A. Skinner, *eHEALS: The eHealth Literacy Scale.* J Med Internet Res, 2006. **8**(4): p. e27.
23. Collins, S.A., et al., *Health literacy screening instruments for eHealth applications: a systematic review.* J Biomed Inform, 2012. **45**(3): p. 598-607.
24. Lee, J., E.H. Lee, and D. Chae, *eHealth Literacy Instruments: Systematic Review of Measurement Properties.* J Med Internet Res, 2021. **23**(11): p. e30644.
25. Kim, S.C., et al., *Understanding how e-health interventions meet psychosocial needs of breast cancer patients: The pathways of influence on quality of life and cancer concerns.* Psychooncology, 2020. **29**(10): p. 1704-1712.
26. Ebel, M.-D., et al., *Perception of cancer patients of their disease, self-efficacy and locus of control and usage of complementary and alternative medicine.* Journal of Cancer Research and Clinical Oncology, 2015. **141**(8): p. 1449-1455.
27. Halwas, N., L. Griebel, and J. Huebner, *eHealth literacy, Internet and eHealth service usage: a survey among cancer patients and their relatives.* Journal of Cancer Research and Clinical Oncology, 2017. **143**(11): p. 2291-2299.
28. Morris, N.S., et al., *The Single Item Literacy Screener: Evaluation of a brief instrument to identify limited reading ability.* BMC Family Practice, 2006. **7**(1): p. 21.
29. Ebel, M.-D., et al., *Cancer Patients and the Internet: a Survey Among German Cancer Patients.* Journal of Cancer Education, 2017. **32**(3): p. 503-508.
30. Petrič, G., S. Atanasova, and T. Kamin, *Ill Literates or Illiterates? Investigating the eHealth Literacy of Users of Online Health Communities.* Journal of medical Internet research, 2017. **19**(10): p. e331-e331.
31. Zickuhr, K. and M. Madden, *Older adults and internet use.* Pew Internet & American Life Project, 2012. **6**: p. 1-23.
32. Anderson, K.J., *Internet Use Among College Students: An Exploratory Study.* Journal of American College Health, 2001. **50**(1): p. 21-26.
33. Arcury, T.A., et al., *Older Adult Internet Use and eHealth Literacy.* J Appl Gerontol, 2020. **39**(2): p. 141-150.
34. Frees, B., *ARD/ZDF-Online-Studie 2001: Internetnutzung stark zweckgebunden.* Media Perspektiven, 2001(8): p. 382-397.
35. Brütting, J., et al., *Exploring the Most Visible German Websites on Melanoma Immunotherapy: A Web-Based Analysis.* JMIR cancer, 2018. **4**(2): p. e10676-e10676.
36. Grabbe, P., et al., *Development and validation of a web-based patient decision aid for immunotherapy for patients with metastatic melanoma: study protocol for a multicenter randomized trial.* Trials, 2021. **22**(1): p. 294-294.
37. Brütting, J., et al., *Informationssuche und Nutzung von Informationsquellen durch Melanompatienten deutscher Hautkrebszentren.* JDDG: Journal der Deutschen Dermatologischen Gesellschaft, 2018. **16**(9): p. 1093-1102.
38. Protière, C., et al., *Heterogeneity of cancer patient information-seeking behaviors.* Med Decis Making, 2012. **32**(2): p. 362-75.
39. Kim, S., *An exploratory study of inactive health information seekers.* Int J Med Inform, 2015. **84**(2): p. 119-33.
40. Black, A.D., et al., *The impact of eHealth on the quality and safety of health care: a systematic overview.* PLoS Med, 2011. **8**(1): p. e1000387.

41. LUDGATE, M.W., et al., *Internet Use and Anxiety in People with Melanoma and Nonmelanoma Skin Cancer.* Dermatologic Surgery, 2011. **37**(9): p. 1252-1259.
42. Schaeffer, D., et al., *Health Literacy in Germany - Findings of a Representative Follow-up Survey.* Dtsch Arztebl Int, 2021. **118**(43): p. 723-728.
43. Paasche-Orlow, M.K., et al., *The prevalence of limited health literacy.* Journal of General Internal Medicine, 2005. **20**(2): p. 175.
44. Nutbeam, D., *The evolving concept of health literacy.* Social Science & Medicine, 2008. **67**(12): p. 2072-2078.
45. van der Heide, I., et al., *The relationship between health, education, and health literacy: results from the Dutch Adult Literacy and Life Skills Survey.* J Health Commun, 2013. **18 Suppl 1**(Suppl 1): p. 172-84.
46. Bhat, A.A., et al., *Associations between low literacy and health status measures: cross-sectional analyses of two physical activity trials.* J Health Commun, 2012. **17**(2): p. 230-45.