

**Health-related internet use in 2023: Predictors of use and relation with mental
well-being**

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Abstract

Background: Health-related internet use has increased over the last few years as people search online for support regarding their physical or mental health concerns. Researchers started to explore the extent of this use and what factors predict this behavior. In addition, research findings have indicated that engaging in such online searches has implications for individuals' mental well-being. However, past research needs to be more extensive in examining the types of health-related internet use and their association with several predictors. Moreover, the association between health-related internet use and mental health has not been sufficiently investigated. **Aim:** This study investigated to what extent people use various health-related internet websites, tools, or apps. Furthermore, the extent to which age, gender, education level, health status, and received treatments predict various types of health-related internet use was examined. In addition, the extent to which health-related internet use was associated with mental well-being was explored. **Methods:** A correlational research design was performed among a sample of 103 participants. To examine the various types of health-related internet use and predictors of health-related internet use, a self-created scale was used with questions on the demographics and the health-related internet use of the participants. The Mental Health Continuum Short Form (MHC-SF) on general mental health was used to research the variable mental well-being. **Results:** The search on the internet for health-related information has been used by most participants in the past. A weak negative bivariate correlation between the variable's health-related internet use and age ($r=-0.21$, $p<0.05$) and a weak positive bivariate correlation between the variable's health-related internet use and education level ($r=0.22$, $p<0.05$), were found. Furthermore, the multiple regression analysis revealed that an increased level of education was significantly associated with an increased reported health-related internet use ($B=0.050$, $\beta=0.262$, $p<0.05$). Additionally, having received treatment for a chronic/life-threatening condition in the past was significantly associated with health-related internet use ($B=0.162$, $\beta=0.401$, $p<0.05$). **Conclusion:** The study's results regarding the predictors' age, educational level, and received treatment (for chronic/life-threatening condition) were consistent with the previous literature. Future research should further investigate the evolving types of health-related internet use, focusing on identifying underlying factors that predict this utilization.

Keywords: health-related internet use, predictors, mental well-being

Introduction

In today's digital age, health-related internet use has emerged as a pervasive and widely used phenomenon, reshaping how individuals access information about their health (Bach & Wenz, 2020). In fact, it has been proven that already four out of ten people do online research before seeking medical treatment (Berg, 2019). The internet offers many opportunities to deal with your health, as there are various types of health-related internet use to get mental or physical support online. When looking for help, internet users encounter a wide variety of websites, online tools, and apps. For instance, internet forums in which those affected by a mental or physical condition can exchange tips and experiences with each other. As well as online portals and video consultations to help patients communicate with their caregivers, facilitating medical care and guidance for health concerns. Additionally, there are online interventions or self-help therapy programs that should prevent or reduce symptoms of a mental illness. Furthermore, numerous apps focus on meditation and relaxation exercises for better sleep or to track feelings throughout the day to offer opportunities to improve the general mood. Moreover, apps specially adapted to users with mental health conditions such as depression, anxiety disorders, eating disorders, etc., provide support as a preventive measure or during therapy. Besides these mental health resources, the internet delivers the possibility to use health assessment checks or self-screening tools. With these applications, users can learn more about their bodies and find out whether there are potential risks to their physical health. In addition, apps about fitness offer support to deal with sports, as well as to get closer to the goal of losing weight with the help of integrated workouts. Apart from this type of app, there are nutrition applications that provide the user with healthy recipes and track the calories of the dishes.

Potential benefits and barriers of health-related internet use

Since health-related internet use exists in many forms and is highly in demand, the question arises about the effectiveness or productivity of such behavior patterns. Therefore, it is worth highlighting the benefits based on the independence, quality, mental health support and improvement of health-related internet use. To begin with, individuals take advantage of the expansion of digital access to health information, which leads to increased self-reliance in their healthcare, and an enhancement of the quality of their patient experience (Estacio et al., 2019). Based on Oeldorf-Hirsch et al.'s (2019b) research, another benefit demonstrates the positive

impact on perceived health status resulting from reading feedback after sharing health information on online platforms. Additionally, online programs that strengthen protective character traits are a possibility to enhance mental well-being (Ungar et al., 2022b), as well as the availability of apps that can also lead to improvements in the field of mental health, especially in rural areas with little access to health care (Chandrashekar, 2018). Through the use of apps, people with mental illness have the opportunity to receive support during their "illness journey", regardless of the availability of a psychiatrist or their area of residence (Chandrashekar, 2018). A further positive aspect is that internet use can have various effects on the mental well-being of society. The results of the study by Rosell et al. (2022) indicate that using the internet as a coping mechanism can serve as an advantage in crisis (such as loneliness during the pandemic) and mainly strengthens the mental well-being of the older generation. These findings are supported by research by Bruggencate et al. (2019), who stated that social technologies could serve as a friend to older people and improve their contact with other network members and the community.

Despite the advantages of health-related internet use, numerous barriers and disadvantages in terms of quality, reliability, access, and impact on mental well-being need to be considered. First, available online tools that patients can use to obtain health information may lack with regard to quality and reliability (Beaunoyer et al. (2017). Therefore these websites and tools are examined for aspects such as content rating and comparison to traditional materials. This potential limitation should not be considered when using online materials for health-related purposes (Beaunoyer et al., 2017). Secondly, access to health-related platforms is particularly difficult for certain groups of people (Herrera et al., 2022c) since the existing digital skills are related to internet access (Estacio et al., 2019c). Based on the article by Herrera et al. (2022c), many obstacles, such as poor customization and connectivity issues, also need to be changed when deploying digital health. Another disadvantage can be detected through research by McMullan et al. (2019), who state a correlation between health anxiety and online health information seeking. This suggests that searching for health-related information online can trigger health-related anxiety in those affected (McMullan et al., 2019). In addition, repeated searches for health-related information, or extensive use of health apps, may also cause stress or "Cyberchondria", which can be described as intense worrying about one's physical health (Mathes et al., 2018). For example, one-third of the participants in a study by Mohammed et al.

(2019) reported on experiences with Cyberchondria through the search for a health-related purpose on the internet.

After discussing the potential benefits and barriers of health-related internet use, it can be detected that this type of internet use affects many aspects of an individual's mental and physical health. The focus now transitions towards examining the predictors of users' internet searches for health-related purposes. Identifying these predictors is essential for attaining more profound knowledge of internet use in the context of health.

Predictors of health-related internet use

Several studies have examined internet use in relation to health, yielding many results of importance in terms of factors influencing internet users' engagement with eHealth. The research of Calixte et al. (2020) was concerned with identifying factors and patterns associated with health-related internet use. For this purpose, a study was conducted among adults in the US, which found that higher age and higher education among the study participants were factors that most strongly predicted a decrease or increase in their health-related internet use. These study outcomes are in accordance with research by Heponiemi et al. (2022), who found that older internet users had a lower tendency to use the internet for health-related services, as their internet usage decreased during the research. Additionally, the predictor user education also gained importance from the findings of this study, as it was found that respondents with higher education tend to have increased general internet use and a higher tendency to search for online health and social services compared to less educated users (Heponiemi et al., 2022). Moreover, the cross-sectional study by Lee et al. (2021) examined the search for health-related information on the internet and how sociodemographic factors affect it. The results of the investigation evaluation show that gender and health status are related to the online search for health-related purposes. Since the female gender and indicating poor or fair health status were linked to increased utilization of the online search for health-related information (Lee et al., 2021). In addition, findings by Ketu and Mishra (2021) confirmed the research by Lee et al. (2021), who claimed that a person's current state of health impacts internet use, as the IoHT (Internet of Healthcare Things) system allows patients to use applications to research their health, which is the reason why those affected tend to use this type of internet more often (Ketu & Mishra, 2021). Factors such as previous medical treatments also impact a person's health-related information-

seeking behavior, as research by Wieldraaijer et al. (2019) states that approximately one in three patients actively searched for information online after undergoing treatment.

Addressing the factors (age, gender, education level, health status, and received treatments) has provided meaningful insights concerning the association between predictors and health-related internet use, and the subsequent implications for individual engagement in such online activities. Following this, the focus will lay on the contribution of the current study.

Contribution of the current study to the previous literature

Despite the research that has already been carried out on internet use in the health field, gaps still need to be addressed. There are limitations when examining the various types of health-related online tools, as the possibilities for obtaining information about one's health online have greatly expanded in the last few years. As already mentioned, numerous websites, online tools, and apps that enable internet users to obtain support for physical and mental health have not been adequately explored. And even though some studies have investigated predictors associated with health-related internet use, only a small number examined whether health factors such as current health status and received treatments (for a chronic/life-threatening or mental condition) predict the use of the expanded options for the online search in the context of health. Besides that, the effects health-related internet use has on the mental well-being of individuals are worth investigating, as the existing research about this topic is limited and mainly focuses on the impact of general internet use.

In light of these research gaps, the current study aims to provide more information about the use of various methods of health-related internet use. This involves examining the extent to which these kinds of eHealth activities are used as associated predictors by exploring important socio-demographic characteristics and the effects of health-related internet use on mental well-being. This research will be supported by an expanded range of possible answers to the items, which offers the possibility of making specific statements about the results.

This study focuses on the first research question, "To what extent are people using various health-related internet websites, tools, or apps?". Then follows the second research question "To what extent are age, gender, education level, health status, and received treatments predictors of various types of health-related internet use?". Finally, the third research question is, "To what extent is health-related internet use associated with mental well-being?".

Methods

Design

To answer the stated research questions, a correlational research design was used in the form of an online survey.

Participants and procedure

Before starting the recruitment of the participants, ethical approval was requested. The intended research population was people of all ages, genders, and education levels who voluntarily participated in the study. The following in- and exclusion criteria were taken into account: the participants had to be at least 16 years old, be able to speak English, German or Dutch, and have access to the Internet. Participants who were under 16 years old, or did not speak English, German, or Dutch, or did not have internet were excluded. The participants were recruited through the BMS test subject pool SONA, a comprehensive research platform to manage the pool of participants in a study, and through the use of the snowball sampling method. With regard to the use of the snowball method, participants who had already taken part in the survey were contacted. The purpose of the study was again explained to them and support for the dissemination of the study was requested. The aim was to reach further potential participants who meet the desired criteria. When the contacted participants agreed to further dissemination of the study, the link to the survey on the online platform was forwarded to them. A total of 40 people were contacted who consented to the dissemination of the study. Overall, 176 participants participated in the survey, and 73 were excluded due to missing and invalid values.

The procedure started with the participants having an internet connection and a device with internet access. After clicking the link, respondents were directed to the online Qualtrics platform where the survey was hosted. The participants received information on the research purpose, background information, and the aim of the study. Afterward, the participants read and confirmed the informed consent form. They were then asked to provide information on their socio-demographic characteristics. In addition, the participants were forwarded to the central part of the survey. In this part, they answered questions about their health-related internet use and the associated mental health. Depending on the person, the survey took about 15 minutes. After completing the questionnaire, respondents received information about the researcher's email address. This contact information could be used for questions about the

survey.

Instruments

The online platform Qualtrics was used to create the questionnaire for the survey in three different languages (English, Dutch, and German). The online survey consisted of several parts, which included questions about the variable's "health-related internet use", "types of health-related internet use", and "mental well-being" and the predictors of health-related internet use. In the beginning, a consent form was created (see Appendix A). This included an introduction to the topic, the research purpose of the survey, and information on how the data collected from the participants was handled.

Sociodemographics

To measure the predictors of health-related internet use, questions about the socio-demographic characteristics of the participants were asked (see Appendix B). The characteristics were age, gender, education level, health status, and received treatment (for a chronic/life-threatening or mental condition). The questions were formulated as follows: "Please enter your age", "What gender do you identify yourself with?", "What is the highest education level you achieved?", "What is your current state of health?", "Have you ever received a treatment or medication for a chronic or life-threatening condition?", and "Have you ever received a treatment or medication for a mental condition?". The participants had various possible answers according to their characteristics (see Appendix B).

Health-related internet use

The variable "health-related internet use" was measured with a self-created scale (see Appendix C), which consisted of questions about the use of several different types of health-related opportunities/tools/apps. The formation of these questions was based on past studies, as well as on eHealth applications that were available for health-related internet use. The questions were formulated as follows: "Have you ever visited/applied... [website or eHealth application]?". The participants can answer with "No, I have not" (coded as 1), "Yes, I have, but not in the past 12 months" (coded as 2), or "Yes, I have in the past 12 months" (coded as 3). The questions related to the eHealth websites and applications were divided into categories to provide

an overview of the eight different types: [1] Free search on the internet, [2] Online support groups, [3] Contact with care providers, [4] Online reviews of care providers, [5] Medical supply through online orders, [6] Use of self-help apps/online tools (smartphone/ smartwatch) for disease management, [7] Use of apps/online tools (smartphone/ smartwatch) to maintain/ improve physical health, [8] Use of apps/online tools (smartphone/ smartwatch) to maintain/ improve mental health. Based on the results of the conduction of a factor analysis, it was impossible to create coherent subscales. To combine the item scores into a scale score, the summation method was used. The scores of all the items scales were added up to obtain a total score for the scale. A high total score of the subscale, associated with health-related internet use, indicates increased use of the eHealth application. The internal consistency of the scale was assessed and resulted in a Cronbach value of 0.82, indicating good reliability (George & Mallery, 2003).

Mental well-being

To measure the variable "mental well-being", the questions of the Mental Health Continuum Short Form (MHC-SF) (Keyes et al., 2008) on general mental health were integrated (Appendix D). This scale includes questions such as: "During the past month, how often did you feel happy?", "During the past month, how often did you feel interested in life?", etc. The participants have the following answer options: ranging from "never" to "every day" (coded from 1 to 6). The summation method was used to combine the item scores into a total score. An increased total score on the MHC-SF scale (ranging from 0 to 70) means higher levels of well-being. The computed Cronbach's alpha coefficient of .66 showed an acceptable internal consistency (George & Mallery, 2003).

Data-analysis

The data was exported from the online platform to perform an analysis using the statistical software R-Studio. Before starting the analysis, it was considered that the data available were entered correctly, and missing and invalid values were excluded.

To examine the following research questions: "To what extent are people using various health-related internet websites, tools, or apps?" a descriptive analysis was carried out. This includes the calculation of means, corresponding standard deviations, and frequencies for all

variables to understand the average usage, variability, and distribution of internet use regarding the different types of eHealth applications.

For the purpose of investigating the research question: "To what extent are age, gender, education level, health status, and received treatments predictors of various types of health-related internet use?" a Pearson's r correlation and multiple regression analysis were applied to investigate the correlation between the independent variables "age", "gender", "education level", "health status", and "received treatments" (for a chronic/life-threatening or mental condition) and the dependent variable "types of health-related internet use". The interpretation of the correlation coefficient was based on the research of Taylor (1990). A correlation coefficient less than or equal to 0.35 was considered weak, and a correlation coefficient of 0.36 to 0.67 is considered moderate correlation. A strong correlation is based on a correlation coefficient of 0.68 to 1.0 (Taylor, 1990).

Furthermore, for the examination of the third research question: "To what extent is health-related internet use associated with mental well-being?" another Pearson's r correlation and multiple regression analysis were performed to analyze the extent to which the independent variable "health-related internet use" predict an effect on the dependent variable "mental well-being".

Results

Description of the study group

The predominantly female participants mainly fall into the age category of 18-29 years, with an average age of 34 years (Table 1). Most of the participants have attained a bachelor's degree, suggesting that the sample received an elevated level of education. Regarding the current health status of the participants, it was found that the majority had no health issues, while a small proportion was affected by a chronic or life-threatening condition. Although most participants have never received treatment for a chronic or life-threatening condition, a significant proportion of the sample has ever received treatment for this type of health issue. In addition, the clear majority of the participants have never been treated for a mental condition.

Table 1

Demographic variables of participants. N = 103

Variables	Categories	Mean (SD)	number	Percentage
Age	<18		1	1
	18-29		61	59.2
	30-39	34 (16.4)	7	6.8
	40-49		5	4.9
	50-59		20	19.4
	60-69		9	8.7
Gender	Male		28	27.2
	Female		74	71.8
	Non-binary/third gender		0	0
	I prefer not to say		1	1
Education	No educational qual.		0	0
	Primary school		0	0
	Secondary school cert.		3	2.9
	Intermediate school cert.		25	24.3
	Technical college entrance qual.		15	14.6
	Higher education entrance qual.		22	21.4
	Bachelor's degree		31	30.1
	Master's degree		7	6.8
	I prefer not to say		0	0
	Health status	No health issues (physical/mental)		66
Chronic/ life-threatening condition			23	22.3
Mental condition			7	6.8
Chronic/ life-threat. &			4	3.9

	mental cond.		
	I prefer not to say	3	2.9
	No	66	64.1
Treatment	Yes, but not in the past	14	13.6
chronic/ life-threat. condition	year		
	Yes, in the past year	23	22.3
	I prefer not to say	0	0
	No	91	88.3
Treatment	Yes, but not in the past	5	4.9
mental condition	year		
	Yes, in the past year	7	6.8
	I prefer not to say	0	0

Usage of various health-related internet websites, tools, or apps

In order to answer the first research question, "To what extent are people using various health-related internet websites, tools, or apps?" the frequencies and percentages of participants' responses to their overall use of the different types of health-related use were calculated (Table 2). The median of the total score of the general health-related internet use is 1.5, with a standard deviation of 0.3. This reveals that, on average, participants were more likely to indicate that they had no general health-related internet use. Since the answer option "No, I have not" was coded with a value of 1, "Yes, I have, but not in the past 12 months" was coded with a value of 2, and "Yes, I have in the past 12 months" was coded as with a value of 3. Differences were recognizable for the various health-related internet websites, tools, or apps. It can be seen that the items of the category "Free search on the internet" stand out in comparison to the other categories, showing that most participants have searched online for health-related information in the last 12 months. Whereas the majority of the participants did not engage in online activities belonging to the items of the categories "Online support groups", "Contact with care providers", and "Use of apps/online tools to maintain/ improve mental health". The other categories, "Online

reviews of care providers", "Medical supply through online orders", "Use of self-help apps/online tools for disease management", and "Use of apps/online to maintain/ improve physical health" show different results regarding the items.

Table 2

Frequency table regarding the extent of types of health-related internet use. N = 103

Have you ever...	Never	Ever	In the past 12 months
Free search on the internet			
...searched for health-related information online for yourself?	6.8%	11.7%	81.6%
...searched for health-related information online for someone else?	23.3%	10.7%	66%
...visited a website with health-related information?	27.2%	7.8%	65%
...searched for information about care providers or institutions?	34%	10.7%	55.3%
Online support groups			
...read along with an online patient support group?	79.6%	8.7%	11.7%
...post a message in an online patient support group?	96.1%	0%	3.9%
Contact with care providers			
...to consult your own electronic patient record?	94.2%	2.9%	2.9%
...to make or change appointments with care professionals?	88.3%	5.8%	5.8%
...to complete questionnaires to prepare	87.4%	5.8%	6.8%

consultations with professionals?

...visited the patient portal of your general practitioner....

...to consult your own electronic patient record?	85.4%	2.9%	11.7%
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...to make or change appointments with care professionals?	80.6%	5.8%	13.6%
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...to complete questionnaires to prepare consultation with professionals?	88.3%	6.8%	4.9%
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...had a digital consultation with your doctor/ nurse...

...via email?	88.3%	1.9%	9.7%
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...via chat?	94.2%	1.9%	3.9%
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...via video-calling?	93.2%	2.9%	3.9%
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...uploaded photos to your doctor for diagnostic purposes?	92.2%	5.8%	1.9%
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Online reviews of care providers

...looked at caregiver's review sites	78.6%	9.7%	11.7%
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...looked at health care institution review sites (e.g., nursing homes, hospitals)?	54.4%	19.4%	26.2%
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...post a review on such a review site?	92.2%	1.9%	5.8%
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Medical supply through online orders

...ordered medication online from your doctor/pharmacy (via email)?	66%	9.7%	24.3%
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...ordered medication online from other (commercial) parties?	57.3%	12.6%	30.1%
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...ordered a tests for use on bodily material online?	79.6%	3.9%	16.5%
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Use of self-help apps/online tools for disease management

...to self diagnose your symptoms?	63.1%	12.6%	24.3%
...to determine if you should seek medical attention?	64.1%	12.6%	23.3%
...to help you make decisions about treatments?	71.8%	13.6%	14.6%

Use of apps/online to maintain/ improve physical health

...to monitor physical activity?	54.4%	4.9%	40.8%
...to monitor weight loss/weight gain?	68.9%	6.8%	24.3%
...to track food/calories?	58.3%	15.5%	26.2%
...to monitor sleep activity?	65%	11.7%	23.3%
...to monitor heart rate?	57.3%	8.7%	34%
...to stop smoking, limit alcohol or substance use?	97.1%	1%	2%

Use of apps/online tools to maintain/ improve mental health

...for mediation or /awareness training?	74.8%	8.7%	16.5%
...to monitor your mood?	90.3%	4.9%	4.9%
...for the treatment of mild mental problems?	94.2%	2.9%	2.9%
...that support face-to-face psycho-therapy?	100%	0%	0%

Note. Titles of the categories are in boldface.

Predictors of various types of health-related internet use

To answer the second research question "To what extent are age, gender, education level, health status, and received treatments predictors of various types of health-related internet use?" a Pearson's r correlation was conducted (Table 3). The statistical measures showed no significant bivariate correlation between the dependent variable, "types of health-related internet use", and the independent variable "gender", "health status", and "received treatments" (for a chronic/life-threatening or mental condition). Nevertheless, the results revealed a significant weak negative correlation between the variable types of health-related internet use and age ($r=-0.21$, $p<0.05$); as age increases, health-related internet use tends to decrease slightly. In addition, a significant weak positive correlation was found between the variable types of health-related internet use and education level ($r=0.22$, $p<0.05$); as education level increases, there is a tendency for a slight increase in health-related internet use. Furthermore, a multiple regression analysis was performed (Table 4). The model statistics revealed a residual standard error of .24, demonstrating the average difference between observed and predicted values of the variable health-related internet use. The model explained 24% of the variance in health-related internet use ($R^2=.24$), with an adjusted R^2 of .17 after adapting the number of predictors. The F statistic was found to be ($F(9, 93)=3.32$, $p<0.001$), which suggests that the regression model was statistically significant. The analysis did not reveal any significant associations between the independent variables "age", "gender", "health status", "received treatment" (for a mental condition), and the dependent variable "types of health-related internet use". However, an increasing education level of the participants was significantly associated with higher internet use for health-related purposes, resulting in a moderately positive effect on health-related internet use. Additionally, participants who received treatment for a chronic or life-threatening condition reported higher use of eHealth websites, tools, or apps, leading to a moderately positive effect on health-related internet use.

Table 3

Results of the bivariate correlations of the variable health-related internet use with the predictor variables. N= 103

Variable	r	p-value
Age	-0.206	.04*
Gender	0.021	.83

Education level	0.220	.03*
Health status	-0.013	.90
Received treatments		
Treatment chronic/life-threatening condition	-0.011	.91
Treatment mental condition	0.027	.79

Note. Dependent variable: health-related internet use; Independent variables are in boldface; r = Pearson correlation; *correlation is significant at the 0.05 level (2-tailed)

Table 4

Results of the multiple regression analysis predicting health-related internet use. N= 103

	B	SE	β	t	p-value
Intercept	0.956	0.175		5.471	<0.001***
Age	-0.003	0.002	-0.210	-1.923	.06
Gender	0.074	0.049	0.142	1.500	.14
Education level	0.050	0.020	0.262	2.449	.02*
Health status					
No physical/or mental condition	-0.071	0.103	-0.114	-0.686	.49
Chronic physical or life-threatening condition	-0.011	0.139	-0.011	-0.080	.94
Mental condition	0.067	0.159	0.044	0.423	.67
Chronic physical/life-threatening condition & mental condition	-0.191	0.173	-0.142	-1.106	.27
Received treatments					
Treatment chronic/life-threatening condition	0.126	0.054	0.401	2.330	.02*
Treatment mental condition	0.075	0.068	0.154	1.099	.27

Note. Dependent variable: health-related internet use; Independent variables are in boldface; B = estimated regression coefficients; β = standardized beta coefficients; SE = Standard Error. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Health-related internet use and mental well-being

For the purpose of answering the third research question, "To what extent is health-related internet use associated with mental well-being?" a Pearson's *r* correlation was executed, which disclosed no significant bivariate correlation between the independent variable "health-related internet use" and the dependent variable "mental well-being" (emotional well-being, psychological well-being, and social well-being) (Table 5). Moreover, a multiple regression analysis was carried out (Table 6). The F-statistic was ($F(3, 99)=0.11, p=.96$), which indicates that the overall model was not statistically significant. The analysis did not reveal significant associations between health-related internet use and mental well-being (emotional well-being, psychological well-being, and social well-being).

Table 5

Results of the bivariate correlations of the variable health-related internet use and mental well-being. N= 103

Variables	r	p-value
Emotional well-being	-0.040	.69
Psychological well-being	-0.051	.62
Social well-being	0.135	.18
Total MHC-SF score	0.056	.55

Note. Dependent variable: health-related internet use; *r* = Pearson correlation

Table 6

Results of the multiple regression analysis for the evaluation of the MHC-SF associated with health-related internet use. N = 103

Variables	B	SE	t-value	p-value
Emotional well-being	-0.005	0.016	-0.299	.77
Psychological well-being	0.015	0.031	0.479	.63
Social well-being	-0.004	0.014	-0.250	.80
Total MHC-SF score	-0.009	0.401	-0.023	.98

Note. Dependent variable: health-related internet use; B = estimated regression coefficients; SE = standard error; MHC-SF = Mental Health Continuum Short Form

Discussion

This research aimed to examine the utilization of different types of health-related internet use. It was studied to what extent such eHealth websites and activities are used and which associated socio-demographic characteristics predict their usage. Additionally, the association of health-related internet use on mental well-being was assessed.

The first research question investigated to what extent people are using various health-related internet websites, tools, or apps. The results of the study reveal that most participants had little or no internet use in the past 12 months or before with regard to general health-related internet use. However, differences became apparent when considering the various self-created categories of health-related internet use. The health-related online activities that fall under the "Free search on the internet" category are predominantly used. The clear majority of the study participants searched the internet for health-related information for themselves and/or for others in the last 12 months. This also includes visiting a website for this health-related purpose and researching service providers or institutions. Despite that, the research outcomes show that most participants have not used the eHealth activities of the categories "Online support groups", "Contact with care providers", "Online reviews of care providers", "Medical supply through online orders", "Use of self-help apps/online tools for disease management", "Use of apps/online to maintain/ improve physical health" and "Use of apps/online tools to maintain/ improve mental health". Nevertheless, there are activities falling under the categories mentioned, which have been used by a significant proportion of the participants in the past. Since almost half of the sample looked at healthcare institution review sites, ordered medication online from (commercial) parties, and used apps/online to maintain/improve physical health to monitor physical activity, and heart rate and track food/calories over the past 12 months or before. Moreover, a notable proportion of almost a third of the participants have ordered medication online from their doctor/pharmacy, used self-help apps/online tools for disease management to self-diagnose their symptoms and to determine if they should seek medical attention, and maintain/ improve physical health to monitor weight loss/weight gain, as well as to monitor sleep activity in the past. Unexpectedly, the vast majority of the sample had never used apps/online for physical health (to stop smoking, limit alcohol or substance use) and mental health (to monitor their mood, treatment of mild mental problems, and support face-to-face -face psychotherapy). These findings are consistent with the previous study by Hong and Cho (2016), which found a

significant increase in seeking health information online over the past few years and only a slight increase in online purchases of medical supplies. The expectation was built that in 2023 the various types of health-related use would be extensively widespread; however, the results of the study show that this is only true to a certain extent, as the far majority uses the internet for searching health-related information. Whereas it is visible that the other types of health-related internet use are less frequently used, which can be a result of the general healthy sample of the current study. When looking at the feedback from the study participants, another possible explanation for the differences in the use of the internet for health purposes could be that many of the eHealth applications were unknown to the participants. Additional reasons could be problematic utilization, lack of access or perceived usefulness, insufficient dissemination, or the absence of interest and confidence in engaging with new online applications. Future researchers should investigate in advance which eHealth websites, tools, and applications are already known in society. Based on this information, questions and different scales could be created that help to make more precise statements about the differences in health-related internet use.

The second research question examined to what extent age, gender, education level, health status, and received treatments predict various types of health-related internet use. The results revealed a weak negative bivariate correlation between age and health-related internet use, demonstrating that younger people may be slightly more inclined to use the internet for health-related purposes than older people. In addition, the weak positive bivariate correlation between education level and health-related internet use showed that individuals who received a higher education might be slightly more likely to use the internet for health-related activities. Furthermore, the multiple regression analysis outcomes also identified an association between the predictor education and the variable health-related internet use, indicating that the education level is an important factor that predicts internet use for health-related internet activities. An additional association between the predictor received treatment for a chronic or life-threatening condition and health-related internet use exhibited that individuals who received treatment for such conditions are more likely to use the internet for health-related purposes. These study outcomes align with the findings of the research by Calixte et al. (2020) and Bach and Wenz (2020), who claimed that the sociodemographic factor education is related to eHealth usage. Their results show that lower levels of education status were associated with decreased use of health-related applications (Calixte et al., 2020) and that higher levels of education, such as a

university degree, result in a higher likelihood of searching online for health information and the usage of health apps (Bach & Wenz, 2020). In addition, earlier investigations by Dee et al. (2020) on the health-related internet use of cancer survivors revealed that adults who survived this life-threatening condition demonstrated an increased use of the internet for the health context over time. The research outcomes indicate that the variable's gender, health status, and received treatments for chronic/life-threatening or mental conditions do not have a direct linear relationship with health-related internet use, as these factors alone do not show an association with an individual's probability of engaging in health-related internet activities. Moreover, the findings of multiple regression analysis showed no significant association between health-related internet use and the predictors age, gender, health status, and received treatment for a mental condition. These discoveries are to some extent contradictory to the previous literature which identified patterns of internet use for health-related purposes depending on age, as the findings of research by Park and Kwon (2018), revealed that the youth used the internet more often for health information seeking. Additionally, Heponiemi et al. (2022), state that older users have a lower tendency for the utilization of the internet for health-related purposes. The outcomes of the current study regarding the predictor gender are inconsistent with those of other researchers, such as Bach and Wenz (2020), who found that women tend to be more engaged in online searches and app use for their health. Furthermore, the discoveries of the investigation by Shiferaw et al. (2020) found that internet use in the health context was measured as low in patients with a chronic disease. This is supported by the outcomes of the study by Jacobs et al. (2017), which revealed that people who are more likely to develop chronic conditions rather rely on medical professionals as a source of health information. Although there is limited research on the association between received treatment for a mental condition and health-related internet use, there are results that examined the online behavior of people with a mental illness and found that 68.5% of the patients who are being treated for a psychiatric disorder used the internet to search for health-related information (Khazaal et al., 2008). An explanation for the insignificant results could be the sample differences between the current (see Table 1) and past studies. The outcomes of the previous literature that found an association with age referred to participants aged 24 years and younger (Park & Kwon, 2018) or were between 70 and 100 years (Heponiemi et al., 2022). Whereas the participants of the present research have an average age of 34. Furthermore, the study by Bach and Wenz (2020), who demonstrated an association with gender, consisted of

1,959 participants who were almost equally divided between men and women. In contrast, the current outcomes are based on a smaller sample, which consists mainly of women. Moreover, the sample of studies showing an association with health status differs from the population of the current investigation. Since the participants only consisted of patients with a chronic disease (Shiferaw et al., 2020) or were asked limited questions about their health status (Jacobs et al., 2017). Additionally, the discoveries of Khazaal et al. (2008) showing increased internet use in the health context of patients with treatment for a mental health disorder were more concerned with individuals who were still in treatment and had not yet completed it. Besides that, it is also important to consider that the research results have evolved over time and, therefore, may show a different outcome at the present time. Therefore, for future research purposes, it would be advisable to ensure that all the differences in the study sample are considered. Thus, the sample should be large enough to represent the population and contain enough variety in characteristics that all age classes can be studied. In addition, the participants should not only be limited to individuals affected by a certain condition and should receive detailed questions about their health status and previous treatments.

The third research question analyzed to what extent is health-related internet use associated with mental well-being. Surprisingly, the analysis outcomes illustrated no significant association between internet usage for health-related purposes and mental-wellbeing. Nevertheless, discoveries by Rouvinen et al. (2021) demonstrated that internet use is a danger to the mental health and well-being of highly educated students. Whereas research by Zhu et al. (2021), who investigated the connection between internet use and the health of the older population, displayed an association between internet usage and mental well-being, as older adults (under 70 years) internet use showed beneficial outcomes for their psychological health. These findings align with the study by Forsman and Nordmyr (2015), which found a positive relationship between internet utilization and mental well-being among the elderly population. The differences in the results can be explained by the fact that the past studies mainly refer to the general internet use of the participants. Thus, the missing relationship could result from the fact that the effect of internet use in relation to one's own health cannot be compared with that of general internet use. There is also the possibility that other undiscovered factors influenced this association. Additionally, there is little and rather old research on the impact of internet searches in the health context on mental health. Therefore, future research on this topic should focus more

on examining internet use in the context of health, paying attention to important factors, such as mediator or moderator variables, that may need to be included in the analysis.

Strengths and limitations

The strengths of this study relate to examining internet use in the health context, including the number of new eHealth tools and applications that have emerged in recent years. The results of this study provide valuable insights into this type of internet use and its widespread usage in the present sample. In addition, the feedback from the participants draws attention to the unfamiliarity of most eHealth activities. It shows the necessity of sufficient dissemination of these digital health technologies so that online users can use the possible advantages for their health. Moreover, the examination of the influence of health factors such as "received treatments" on health-related internet use provides essential insights for the identification of new correlations. Besides that, the investigation of mental well-being associated with health-related internet use represents another strength of this research, as past literature has primarily focused on general internet use and its connections. Therefore, this study offers new insights into the little existing knowledge in this area.

Despite the strengths of this study, some limitations should encourage future researchers to improve the discoveries. Besides the small sample size, one of the limitations of this research is generalizability, as the majority of study participants are female with a mean age of 34 years, and in general healthy, as this may not be fully representative of the larger population. In addition, a more differentiated examination of the various eHealth activities that fall under health-related internet use could have provided more information about possible associations with the predictors or mental well-being. Moreover, the reason that the study was based on subjective data could be a limitation of the research, as participants may not have been able to recall experiences from the distant past.

Conclusion

This study showed that the various possibilities of health-related internet use have not yet been fully used by the sample population. Searching for health information on the internet is widespread, while participants have not become adequately familiar with eHealth applications, such as numerous programs, tools, and applications for mental or physical health. The analysis of

the factors that predict internet use in the health context shows the importance of the predictor education level, as an increased level of education is associated with increased use of the internet for health-related purposes. Furthermore, the predictors' age and received treatment for chronic/life-threatening were associated with health-related internet use. Whereas no association was found between health-related internet use and mental well-being. Future researchers of this research topic should examine the possible growth in the various types of health-related internet use on a representative sample population. In addition, already investigated and undetected influencing factors of online health information seeking should be explored in detail to be able to make more precise statements about the relationships between these variables. Furthermore, the association of internet uses related to health with mental well-being needs further investigation.

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Appendix A

Informed consent form

Dear participants,

Studies in recent years show that people increasingly use the internet, (mobile) apps, and online tools to manage their health and illness. Nowadays, people have the possibility to search the internet for health-related information, contact their care provider online, share experiences and tips with others through online support groups, as well as to read and write reviews about their caregiver. Medical supplies or diagnostic tests can be ordered online with little effort. Self-help apps and online tools are available to manage illness or improve physical or mental health. Lastly, more (wearable) tools are becoming available (such as smartwatches) to track a wide range of health-related variables, such as activity, heart rate, food intake and sleep. In this study, we want to examine the extent to which people use the different tools that are available. Moreover, we want to investigate if this use differs for a variety of characteristics (such as age, gender, education level, health status, and received treatments). Finally, we want to examine to what extent health-related internet use is related to the mental well-being of users. The results of this study might contribute to a better understanding of these relationships.

- I voluntarily agree to participate in this research study.
- I understand that my data will be stored anonymously.
- I understand that filling in the survey will take approximately 15 minutes.
- I have had the purpose and nature of the study explained to me in writing.
- I understand that I will not benefit directly from participating in this research.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research, my identity will remain anonymous.
- I understand that I can cancel my participation in this study at any time without needing to provide an explanation.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

If you have any questions about this study, feel free to contact:

c.schomaker@student.utwente.nl

By signing below, you acknowledge that:

You have fully understand and accept the terms mentioned above

Appendix B

Questions about the socio-demographic characteristics

Please enter your age:

What gender do you identify yourself with:

- Male
 - Female
 - Non-binary/third gender
 - I prefer not to say
-

What is the highest education level you achieved:

- None
 - Primary school
 - Highschool
 - Bachelor's degree
 - Master's degree
 - I am still studying to achieve the following level of education:

 - I prefer not to say
-

What is your current state of health:

- I do not suffer from any kind of condition (neither physical/or mental)
 - I suffer from a chronic physical or life-threatening condition, such as asthma, diabetes, rheumatic disease, heart disease, cancer, etc.
 - I suffer from a mental condition, such as autism, depression, anxiety disorder, schizophrenia, eating disorder, addictive behavior, etc.
 - I prefer not to say
-

Have you ever received a treatment or medication for a chronic or life-threatening condition?

- No
 - Yes, but not in the past year
 - Yes, in the past year
 - I prefer not to say
-

Have you ever received a treatment or medication for a mental condition?

- No
- Yes, but not in the past year
- Yes, in the past year
- I prefer not to say

Appendix C

Questions about health-related internet use

Free search on the internet

Have you ever...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
...searched for information about health, illnesses, symptoms, or treatments on the web, using search engines (such as Google, Bing, etc.) for yourself?			
...searched for health-related information on the web, using search engines (such as Google, Bing, etc. for someone else?			
...visited a website with health-related information (eg WedMD, NHS Direct, NetDoctor, etc.)?			
...searched for information about care providers or institutions (eg doctors, hospitals, nursing homes)?			
Online support groups			
Have you ever...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
...read along with an online patient support			

group?

...post a message in an online patient support group?

Contact with care providers

Have you ever visited the patient portal of your <u>hospital</u>	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...to consult your own electronic patient record?

...to make or change appointments with care professionals?

...to complete questionnaires to prepare consultations with professionals?

Have you ever visited the patient portal of your <u>general practitioner</u>	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...to consult your own electronic patient record?

...to make or change appointments with care professionals?

...to complete questionnaires to prepare consultations with professionals?

Have you ever had a digital consultation	No, I have	Yes, I have,	Yes, I have in the
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with your doctor/ nurse...	not	but not in the past 12 months	past 12 months
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...via email?

...via chat?

...via video-calling (eg Teams, Zoom, etc.)?

Have you ever ...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...uploaded photos to your doctor for
diagnostic purposes?

Online reviews of care providers

Have you ever...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...looked at caregiver's review sites (eg
ratemds.com, sitejabber.com, etc.)?

...looked at health care institution review
sites (eg nursing homes, hospitals) such as
(eg healthgrades.com, etc.)?

...post a review on such a review site?

Medical supply through online orders

Have you ever...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...ordered medication online from your doctor/pharmacy (via email)?

...ordered medication online from other (commercial) parties (e.g. Amazon, etc.) without consulting your doctor?

...ordered a tests for use on bodily material online (eg DNA, blood glucose HIV, Corona, etc.)?

Use of self-help apps/online tools(smartphone/ smartwatch) for disease management

Have you ever used apps/online tools...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...to self diagnose your symptoms (eg symptom-checkers, etc.)?

...to determine if you should seek medical attention (eg emergencyfirstresponse.com, scripps.org, etc.)?

...to help you make decisions about

treatments (eg patient decision aids, etc.)?

**Use of apps/online tools (smartphone/
smartwatch) to maintain/ improve
physical health**

Have you ever used apps/online tools...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
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...to monitor physical activity (eg strava,
virtuagym)?

...to monitor weight loss/weight gain (eg
noom, foodvisor)?

...to track food/calories (eg myplate,
lifesum)?

...to monitor sleep activity (eg sleepscore,
sleepwatch)?

...to monitor heart rate (eg instant heart
rate)?

...to stop smoking, limit alcohol or
substance use?

**Use of apps/online tools (smartphone/
smartwatch) to maintain/ improve mental
health**

Have you ever used apps/online tools...	No, I have not	Yes, I have, but not in the past 12 months	Yes, I have in the past 12 months
---	-------------------	---	--------------------------------------

...for mediation, or /awareness training (eg

headspace, calm)?

...to monitor your mood (eg moodnotes,
daylio journal)?

...for the treatment of mild mental problems
such as anxiety, depression, problematic
eating or drinking, etc. (eg WorryTree,
Happify)?

...that support face-to-face psycho-therapy
(eg mytherapy, what's up)?

Appendix D

Mental Health Continuum Short Form (MHC-SF)

During the past month, how often did you feel...	Never	Once or twice	About once a week	2 or 3 times a week	Almost every day	Every day
...happy?						
...interested in life?						
...satisfied with life?						
...that you had something important to contribute to society?						
...that you belonged to a community (like a social group, your neighborhood, your city)?						
...that our society is a good place, or is becoming a better place, for all people?						
...that people are basically good?						
...that the way our society works makes sense to you?						
...that you liked most parts of your personality?						
...good at managing the responsibilities of your daily life?						
...that you had warm and						

trusting relationships with others?						
...that you had experiences that challenged you to grow and become a better person?						
...confident to think or express your own ideas and opinions?						
...that your life has a sense of direction or meaning to it?						