SEMMELWEIS EGYETEM

DOKTORI ISKOLA

Ph.D. értekezések

3178.

RADÓ NÓRA

Magatartástudományok

című program

Programvezető: Dr. Kovács József, egyetemi tanár

Témavezető: Dr. Győrffy Zsuzsa, egyetemi docens

DIGITAL HEALTH AND SOCIAL INEQUALITIES: HOW TO INCLUDE VULNERABLE GROUPS, ESPECIALLY PEOPLE EXPERIENCING HOMELESSNESS, IN DIGITAL CARE?

Ph.D. thesis

Nóra Radó

Semmelweis University Doctoral School
Mental Health Sciences Division

Supervisor:	Zsuzsa Győrffy, Ph.D.
Official reviewers:	Sára Simon, Ph.D. Júlia Helga Moldvai, D.M.D., Ph.D.

Head of the Complex Examination Committee:
Prof. László Tringer, M.D., Ph.D.

Members of the Complex Examination Committee:
Zsombor Zrubka, M.D., Ph.D.
Péter Vajer, M.D., Ph.D.

Budapest
2025

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CAM	Complementary and Alternative Medicine
DHWG	Digital Health Working Group at Semmelweis University
DoI	Diffusion of Innovation
FEANTSA	European Federation of National Organisations Working with the Homeless
HCSOM	Hungarian Charity Service of the Order of Malta
HRCCS	Hungarian Red Cross Charity Service
UN	United Nations
UK	United Kingdom
WHO	World Health Organization

1. INTRODUCTION

1.1. A Technological and Cultural-Social Revolution in Healthcare

Technologies profoundly shape the world around us, and in recent decades, individuals and communities have had to come to terms with not one but multitudes of new inventions. The development of communication and information technologies has resulted in personal computers, laptops, tablets, the Internet, smartphones, smartwatches, sensors, wearables, and many other devices specialized for communication and data management (generation, processing, and storage). The functions in brackets are characteristics of digital tools (1).

However, three inventions, the Internet, the smartphone, and generative artificial intelligence, can be regarded as milestones when it comes to the transformation of societies, with special regard to healthcare. Although its vision, various nods, and network prototypes had existed before, the official birthday of the Internet is 1 January 1983, since prior to this date, the various computer networks did not have a standard way to communicate with each other (2). Since then, the vast knowledge of the world has been increasingly digitized and is theoretically accessible to anyone in any part of the globe – fulfilling the democratization of knowledge, one of the promises of the early Internet (3)., The concept of the smartphone was also born with the birth of the iPhone in 2007 (4). Since then, with the help of what is defined by the Cambridge Dictionary as a small computer that connects to the Internet, the unlimited potential of the Internet is available in a pocket-sized, user-friendly device (5). As the latest milestone, generative artificial intelligence, especially the release of ChatGPT on 30 November 2022, should be mentioned, which can create textual content, images, and videos as a response to any prompt and any question, even complex ones, and which has started a conversation about the edges of human and machine intelligence.

The exponential spread of communication and information technologies has not left healthcare untouched. Developments in this area initially focused on eHealth technologies that used information and communication technologies to improve the existing processes of communication in healthcare, e.g. through the use of electronic health records (6). The increasing power and prevalence of mobile devices later opened up new potential applications of mobile devices for health, inspiring the term ‘mHealth’, which seeks to empower individuals and provide new services such as the remote monitoring of health status and wellbeing. More recently, substantial increases in the volume, velocity, and variety of available health data and data-driven tools to analyze ‘big data’, including via machine learning, have taken place. Thus, the term ‘digital health’ has become an umbrella term for the concepts of eHealth, mHealth, health information technology, or health IT, as well as developments in big data and new technology (6), such as wearables and other futuristic health-improving tools.

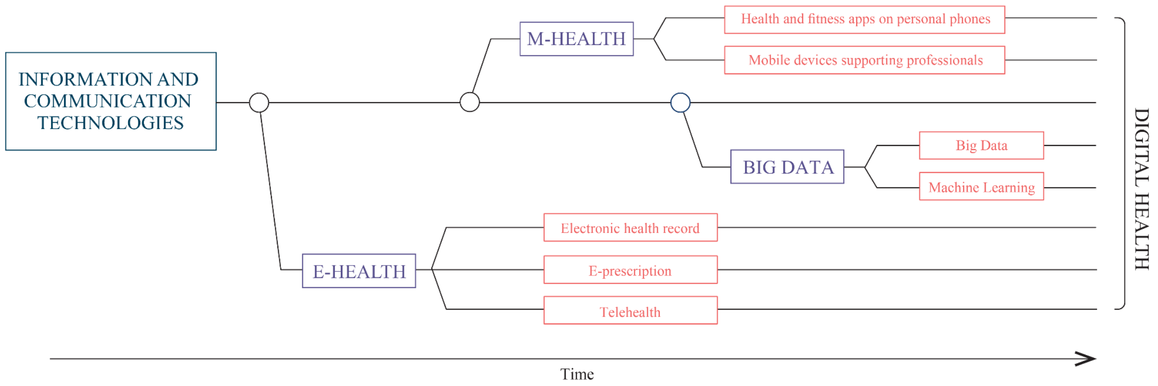


Figure 1. The evolution of digital health. Note: This diagram contains some examples of digital health tools in the areas of eHealth, mHealth and big data, but is not an exhaustive list. Source: (6).

As information and communication technologies developed, they started to reshape social interactions, for example, communication and information gathering, and through that, the behavior of individuals and communities. In the realm of healthcare, the use of computers and electronic medical records has become widespread over the last few decades (7). Across all medical specialties, doctors have transitioned from traditional paper and pen practices to incorporating or augmenting these with technology-mediated approaches in their medical processes (7). This change has enabled quick access to clinical information, easier management of drug prescriptions, more efficient retrieval and storage of medical records, and it has resulted in the reduction of medical errors by enabling easy access to scientific literature, healthcare guidelines, and drug composition (7).

1.1.1. The Rise of e-Patients

Just as it has become easier for doctors to access information, things have also become easier for patients. Instead of medical professionals being the sole repositories of medical knowledge, patients can become knowledgeable about their own condition due to the vast amounts of information available online. Access to such medical knowledge has resulted in a change in patient-doctor communication and the patient-doctor relationship in general. On the one hand, this has led to the empowerment of patients (8) with the rise of e-patients as the precipitation of this empowerment; on the other hand, it has led physicians towards serving their patients as guides in the jungle of healthcare information and technologies, moving from being an authority to not being the only one to make every decision (9).

Empowerment is defined by the WHO as ‘a process through which people gain greater control over decisions and actions affecting their health’(8) , while the term e-patient or ‘empowered patient’ was first mentioned by Thomas Ferguson, who started to create a manifesto known as the e-patient white paper, which was completed by his colleagues due to his untimely death in 2006 (10,11). According to Ferguson’s widely accepted definition, the ‘e’ in ‘e-patient’ stands for ‘electronic’, ‘equipped’, ‘enabled’, ‘empowered’, ‘engaged’ or ‘expert’. In this sense, such patients are ‘electronic’ as they use digital technologies and the Internet with ease; ‘equipped’ as they have such digital health technologies at their disposal; ‘enabled’ as their social and cultural environment fosters their activities; ‘empowered’ by technologies, gaining more control over their health, and ‘engaged’ in as much as they are fully committed to their healing and care process; and finally, ‘experts’ in being fully competent in their own illness and healing. As Meskó et al., 2019 put it, e-patients are health consumers who fully participate in their own medical care, which has been made possible by the online or digital information collected by them, which influences their own or their relatives’ health state(10).

The first e-patients emerged in the 2000s and 2010s. Their activities are hallmarked by Dave de Bronkhart (12), Sara Riggare (13,14), or Dana Lewis (15), who have done pioneering work as early adopters of both technology and the mindset of empowered patients who actively participate in their own care, and who regard physicians as partners (10). They are early adopters in the sense of Everett Rogers' theory of the Diffusion of Innovations (DoI) (16). In relation to a new innovation, DoI classifies the population of potential adopters into 'adopter categories', and each classification contains a percentage of the population. Early adopters belong to the 13.5 percent of an average population who are in the first line to experiment with and use a new innovation (17). As to the reasons why these specific individuals are so keen on taking on new technologies, Rogers et al. found that an increased level of literacy and education is associated with an increased rate of innovation adoption (16,17).

As time passed on, the adoption of digital technologies and the Internet for health-related purposes took off: a survey conducted in 2020, just before the COVID-19 pandemic, shows that 55 percent of Europeans aged 16–74 had sought health-related information online, with a 21 percent increase since 2010, and the percentage of online health information seeking had reached over 70 percent in Finland, the Netherlands, Denmark, and Germany (18,19). The use of wearables for health monitoring also increased between 2005 and 2019, with nearly 1 percent of patients having documentation of a device based on data from 492,000 primary care patients (20). This means that e-patients are not early adopters anymore, they are in the majority within the population.

1.1.2. Digital Health and its Definitions

As it can be discerned from the above, technological innovation is only one component of the systematic change that is taking place in medicine. A social and cultural transformation is underway, where the successful long-term use of digital health solutions requires adaptation on both the patient and the provider side (21).

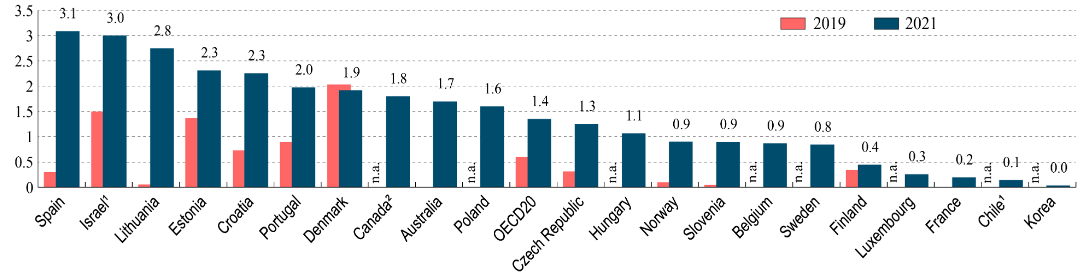
As technological progress has changed the patients' and doctors' behavior, instead of a purely technological and taxonomical definition, digital health is now understood as "the field of knowledge and practice associated with the development and use of digital technologies to improve health" (22). A review of 95 definitions of digital health discerned that digital health is about the proper use of technology to improve people's health and well-being at individual and population levels, as well as enhancing patient care through the intelligent processing of clinical and genetic data (23). As Meskó et al. put it, digital health is a cultural and social transformation of healthcare (9), and it requires cultural and social contextual change, learning, and adaptation. Moreover, it is important to make sure that the technology is accessible and usable to segments of the population where it is most needed (24).

This systemic change received an unexpected boost from the COVID-19 pandemic, which the World Health Organization (WHO) declared a public health emergency of international concern (PHEIC) on 30 January 2020 and which ended on 5 May 2023.

1.2. Global Trends in the Usage of Digital Health Solutions

The COVID-19 pandemic accelerated the uptake and spread of digital tools in healthcare at a previously unknown rate. In many instances, as personal visits were made impossible due to curfews and quarantines, using digital health solutions, which was previously regarded as an interesting potential opportunity, became an immediate necessity (6).

An illustrative example is telemedicine, which can be defined as the use of information and communication technologies to deliver health care at a distance (25). According to an OECD report, there were no teleconsultations, i.e. remote medical consultations between a patient and a doctor through a secure digital communication channel, in Belgium in January and February 2020, the very beginning of the COVID-19 pandemic. The numbers then soared to over 1.2 million teleconsultations performed in March 2020 alone (26). In Norway, the number of teleconsultations increased more than 10 times, from around 43,000 in January 2020 to over 470,000 in March 2020. In England, the number of teleconsultations almost doubled from February to March 2020 and grew further in the months after March to almost three times the number of teleconsultations in January 2020 (26). The chart below shows the change in various countries concerning telemedical visits before and during the COVID-19 pandemic. In 2019, there was an average of 0.6 teleconsultation per patient per year among OECD countries, while by 2021, this rate had more than doubled (27).



1. Public sector only. 2. Latest data from 2020.

Figure 2. Annual teleconsultations in various OECD countries per person, 2019 and 2021 (or nearest year). Source: OECD Health Statistics, 2023.

In the United States, approximately 50 percent of visits took place through telemedicine during the peak of the pandemic in April 2020. While the number of telemedicine visits has since declined, recent estimates still suggest steady use. In 2021 and 2022, 20 to 39 percent of adults had telemedicine healthcare encounters in the United States (28). Similar trends can be observed in other high-income countries, such as Israel (29), Norway, or the entire WHO European region (30).

Several global trends converge in these statistics. First of all, although digital health technologies other than telemedicine, such as EHRs (31), e-Prescriptions (32), or mHealth solutions (33), also gained popularity due to the pandemic, nowhere was it more palpable to patients than in the case of telemedicine. Secondly, the rate at which various countries took up digital health depended on their state of technological and healthcare infrastructure, which means that while it grew roots more quickly in better-developed, wealthier countries, it was underutilized in areas that were poorer in resources (24). The long-running health and social inequalities that can be experienced within a society and among different societies are also echoed in this digital health divide. It is one of the most significant questions of this thesis whether digital health technologies might help alleviate health inequalities on a local level for vulnerable populations in a country like Hungary.

1.3. Local Trends in the Usage of Digital Health Solutions

While digital health technologies only appeared sporadically in Hungary before the COVID-19 pandemic, the pandemic gave an unprecedented boost to systemic changes in the country. According to Döbrössy et. al. and Meskó, 2022, although a digital health revolution took place in just a few months of rapid policymaking related to the pandemic, cultural transition is lagging behind (24,34). In this sense, culture means a context where medical professionals and patients have the necessary digital skills, attitude, as well as resources to take up digital health solutions regularly, on a systemic level. According to the Digital Economy and Society Development Index 2022 (35), Hungary ranks 22nd among the 27 EU Member States. This means that 49 percent of the population has at least basic digital skills, which is significantly below the EU average of 54 percent. However, the country's performance in broadband subscriptions, 5G spectrum, and very high-capacity fixed network (VHCN) coverage exceeded the EU average (24).

In terms of usage patterns and attitudes towards digital health solutions, the Digital Health Working Group (DHWG) at Semmelweis University conducted a national, representative, population-based survey (n=1500) in 2021, during the COVID-19 pandemic, to find out how patients experience digital health tools, what advantages and disadvantages they experience, and how it transforms the doctor-patient relationship (36). The survey found that 81.3 percent of the respondents used the Internet, and 71.2 percent also utilized it to look for answers to questions about health and illness. Their main sources of information were websites (76.3 percent) and social media (47.3 percent); the best-known digital health tools included e-prescription (92.6 percent) and online appointment booking (85.2 percent), while almost half of the respondents wanted to try telehealth. E-prescription and online booking was introduced during the pandemic, when personal visits were limited, which might explain the high percentages of usage. The results also highlight that the effect of age, education, and gender is decisive when it comes to access to digital health, while the effect of the type of settlement is insignificant (36). This means that younger, more educated individuals, who tend to be women, have more access to and are more inclined to use digital health solutions.

The DHWG at Semmelweis University repeated this national, representative survey in February 2024. According to their latest results, 91 percent of Hungarians initiate online health and illness-related information searches, an almost 20 percent rise compared to 2021. Websites are still the most important platforms for such searches (79 percent), followed by social media channels (22.6 percent), although their share has decreased significantly. ChatGPT does not yet play a significant role in health information search, although more than a third of the respondents (35 percent) have already heard about generative artificial intelligence. The survey also found that in 2024, almost every second Hungarian patient had already used a smart device or sensor for managing their health, and one-third had a health-related application on their smartphone. Telemedicine, on the other hand, is hardly present: 14 percent use remote patient care or telediagnostics in their everyday life (37). This also means that the concept of e-patients has started to take root in Hungary as well.

1.4. The Digital Health Paradox

The above-presented local trends show how an average Hungarian patient accesses and uses digital health solutions. However, health and social inequalities might significantly alter this general picture. Detrimental social determinants of health can lead to negative health outcomes, and approximately 15 percent of premature deaths are attributed to social determinants of health (38). The WHO defines these as "forces and systems shaping the collective conditions in which people are born, grow, work, live, and age, as well as the conditions of their daily lives" (39), which are shaped by the distributions of money, power, and other resources (40). Emerging research shows a strong relationship between socioeconomic factors, geography, demographics, and health, with poverty, housing problems, food insecurity, abuse, gender, and ethnicity creating chronic stress, which can leave the human organism with maladaptive mechanisms that result in damage to the body's functioning systems (41–43). These have been linked to hypertension, premature aging, cardiovascular disease, type 2 diabetes, stroke, cancer, pulmonary disease, kidney disease, and many other health problems (40,42,44).

Lately, digital literacies and Internet connectivity have been called the "super social determinants of health" because they address all other social determinants of health (45); however, there is a growing body of evidence indicating that a greater reliance on digital tools has the potential to widen the gap between those who possess such digital literacies and Internet connectivity and those who do not, thereby increasing already existing health inequalities (45). Regarding this definition, we can understand digital literacies as the ability to use information and communication technologies to find, evaluate, create, and communicate information, which requires both cognitive and technical skills (46); and

Internet connectivity as the ways people can be connected to the internet, which includes dial-up telephone lines, broadband connections, and wireless devices (47).

Although digital solutions might be designed following various guidelines, such as the WHO Global Strategy on Digital Health 2020-2025, which states that "digital health should be an integral part of health priorities and benefit people in a way that is ethical, safe, secure, reliable, equitable, and sustainable," certain groups might be unintentionally left out of the digitization boom (22). Paradoxically, these groups often represent patients with complex psychosocial needs and specific sociodemographic characteristics, who often have multiple chronic conditions. According to previous research, these persons would benefit the most from the use of digital health technologies (42,48–51). Van Kessel et. al. have termed this phenomenon the digital health paradox (50). It might include vulnerable groups such as people living in rural areas, elderly people over 65, people living with activity-limiting conditions, or people experiencing homelessness.

1.4.1. Vulnerable Groups and the Digital Health Paradox in Hungary

Based on the above-described national, representative survey of the Digital Health Working Group at Semmelweis University, the digital health paradox can be detected in the case of at least two vulnerable groups: adults over 65, and people living with long-term activity-limiting conditions.

In the case of older adults, the survey results showed significant interest in and openness towards digital technologies: only a quarter of 65–74-year-olds (26.5 percent) and a third of 75 + −year-olds (31.9 percent) responded that they would not like to try digital technologies in the future, while nearly 70 percent of both age groups would like to learn about such tools (24). 43.9 percent of older adults accessed the Internet at least once a month (as compared to 81.3 percent of the total population shown in Section 1.3.), and they were significantly less likely to search for health information online than the total population. This difference was also seen in the use of other digital health solutions. While 42.8 percent of the total population booked medical appointments online, only 27.9 percent of older adults had done so. Their use of e-prescriptions was roughly 10 percentage points lower than that of the general population (76.4 percent vs. 86.4 percent). Older adults also used mobile health applications (14.3 percent vs. 27.3 percent) and smart devices or sensors less (13.7 percent vs. 37.3 percent) (24). That is unfortunate, as a study examining the relationship between Internet use and self-rated health in adults over 70 in Sweden found that the use of the Internet was associated with better self-rated health, although it proved to be of minor importance (52).

In the case of people living with long-term activity-limiting conditions in Hungary, the results showed fewer benefits and more limitations to digital technologies. Respondents with activity-limiting conditions reported that digital technologies (such as e-mailing, sharing electronic health records, and online appointment booking) were less common in physician interactions. The digital transmission of health-related data was used by 58.5 percent of people with no activity limitations, 34.8 percent with mild activity limitations, and only 25.7 percent with severe limitations. Smart sensors were used by 32.8 percent of people with no activity limitations, 21.7 percent with mild limitations, and 17.6 percent with severe limitations. When asked about their needs in connection with digital communication and device usage, people living with activity-limiting conditions reported experiencing disadvantages both in terms of the technologies they already use and in the options that the respondents had not tried before but would like to use if they had access to them (24). In contrast, a study in Poland in 2019 among 2,529 people living with disabilities found that Internet use by people with disabilities was associated with improved well-being, better mental health, and more beneficial health behaviors (53).

1.5. One of the Most Vulnerable Groups in Society: People Experiencing Homelessness

This thesis focuses on the socioeconomically most vulnerable group in any society: people experiencing homelessness. Homelessness involves a complex set of social, economic, and health challenges at both the individual and the community level, and these challenges leave people experiencing homelessness at the extremely low end of health outcomes, healthcare access, and health literacy (42,54).

Homelessness can be defined and categorized using different methods and frameworks; the expression itself is a generic term for people who live on the street or are rough sleepers, people who do not have permanent living arrangements, or those with inadequate habitations or non-conventional dwellings. In Hungary, the law defines people experiencing homelessness as persons without any registered place of residence or whose registered place of residence is the accommodation for homeless individuals (55). In the present thesis, we categorize and define “homeless” or “homelessness” to include every individual who has engaged with institutions providing homeless services according to the categories of the European Typology of Homelessness and Housing Exclusion, the standard used by European Union member states for reporting on homelessness and precarious housing circumstances (56).

Homelessness is a widespread phenomenon both across Europe and in Hungary; however, it is difficult to assess its scale, as a significant fraction of people experiencing homelessness never interact with the social services systems. It has been noted that their number is increasing in the European Union (57), and this growth is partly attributed to worsening economic conditions, a lack of affordable housing, and the lingering effects of the COVID-19 pandemic. According to FEANTSA, the European Federation of National Organisations Working with the Homeless, overall, Europe counted 1,286,691 rough sleepers, people in night shelters, and people in temporary accommodation for the homeless in 2024 (58). In Hungary, systematic information on homeless populations are scarce, meaning that there is a lack of basic demographic studies, and no public databases are available on the size of this group (54). According to the Third of February Homeless Survey, in 2023, 7268 people used homeless shelters on the day they filled out the survey, and the annual data from this non-governmental organization show that more and more people appear in the shelter system in Hungary (55,59).

1.5.1. Health and Homelessness

Research shows that having a precarious living situation is associated with worse health outcomes and a shorter life expectancy: significantly higher rates of bacterial and viral infections, diabetes, hypertension, cardiovascular disease, mental health issues, and problematic substance use characterize people experiencing homelessness compared to populations with adequate housing options (42,60–62). Moreover, the vulnerabilities and health risks of people experiencing homelessness have also increased due to the COVID-19 pandemic (63). Life expectancy data for people experiencing homelessness compared to the general population also support these findings (42). In a systematic review, Aldridge et al. found that vulnerable groups living on the edge of societies have an eight times higher mortality rate for men and twelve times higher mortality rate for women than the average population (64). In Western high-income countries, studies have shown that homelessness is an independent risk factor for mortality, and life expectancy varies between 50 and 65 years on average (65).

Worse health outcomes and shorter life expectancy are also connected to access to healthcare, quality of received care, and state of self-care. People experiencing homelessness frequently face structural barriers when it comes to getting healthcare services, including the lack of health insurance in countries without universal health insurance, as well as competing interests in healthcare settings to their disadvantage alongside their own financial troubles and competing priorities, which might lead them to secure food and accommodation before getting adequate healthcare services, treatment, or medicine (63,66). Previous research has also highlighted mistrust in healthcare systems and instances of discrimination within care settings. Bureaucracy and rigid opening hours, as well as discrimination and stigma, hinder these persons' access to health and social care (67). Lower health literacy observed among individuals experiencing homelessness, compared to the general population, may also contribute to poorer self-rated health and reduced adherence to medical advice and prescribed medications.

1.5.2. Digital Engagement of People Experiencing Homelessness

People experiencing homelessness and living in precarious housing situations are also less likely to have access to not only adequate healthcare and treatment options but also to digital technologies and the Internet. A study has shown that the rates of smartphone and Internet use among people experiencing homelessness in the United States were lower than those among housed, low-income adults of any age (68); and homelessness in the United States in another study caused a 68 percent less likelihood to not access the Internet than when housed (69).

A systematic review analyzing studies published between 2015 and 2021 with the research questions (1) “What mobile health-related technology is used by homeless populations?” and (2) “What is the health impact of mobile technology for homeless populations?” found that most homeless participants across the 17 studies included in the review owned a mobile phone or smartphone and 80 percent owned a mobile phone (54,70). The majority of the studies were undertaken in the United States, followed by Canada, Italy, and the UK, thus the systematic review summarizes the experiences of high-income, Western countries. Age appeared to be a significant factor regarding ownership and use, and confirmatory responses to questions on access to mobile internet services, smartphone functions, and apps dropped significantly in this group (70). The authors of the study, Heaslip et al. mention a lack of charging points, limited or no access to data traffic, and anxiety over potential theft and harassment as barriers to mobile phone use. Other barriers presented were privacy concerns and distrust in the management of data, the tracking of information, the government, and the "system" (70).

Beyond physical barriers and trust issues, access to digital health might also be hindered by a lack of usage skills. Populations at risk for limited health literacy are similarly vulnerable to having challenges with digital tools. Poor IT skills among homeless populations have also been implicated in poor mental health outcomes (54,71,72).

However, despite the existing barriers, several studies have reported an interest on the part of the homeless population in digital health tools, such as appointment and prescription reminders (54). Atkins et al. note that their study participants were positive about using a mobile phone to obtain advice and help address issues such as depression, anxiety, self-harm, abuse, substance use, emotional problems, insomnia, and stress (73). As interest and curiosity is present, we assume that there might be early adopters within the population who could be compared with the concept e-patients and their activities.

1.6. The Research Agenda of the Digital Health Working Group (DHWG) at Semmelweis University for Vulnerable Groups

As the above literature review shows, people experiencing homelessness have worse health outcomes and a shorter life expectancy on the one hand, and lower access to digital health tools and the Internet on the other hand. This presents them as a highly illustrative example of the digital health paradox. Moreover, as physical, mental, social, and cultural barriers are at a complex interplay, these factors might strengthen their impact and leave this vulnerable group at an extremely low end of possibilities.

Moreover, while the associations between people experiencing homelessness and their health status are well researched, especially in English-speaking countries such as Canada, the United Kingdom, and the United States, a lot less is known both about the access of people experiencing homelessness to digital health tools, their digital health literacy, their attitudes toward digital technologies, or their overall characteristics in Central and Eastern Europe, and in the specific local setting of Hungary, and about the specific groups that exist within homeless populations (42).

For these reasons, the DHWG and the Hungarian Charity Service of the Order of Malta (HCSOM) have undertaken an overarching research agenda aiming to explore the relationship between digital health and homeless populations in Hungary. This thesis is part of this large-scale undertaking. Previous research has mapped the attitudes of people experiencing homelessness in Budapest, Hungary, toward telecare services. The main finding was that homeless individuals can have at least as much trust in telemedical services as patients in general medical practice, but when it comes to the decision whether or not to trust such a service, trust in the general healthcare system is the core decisive factor (74).

This study served as a starting point for a pilot project assessing the viability of a telecare system for homeless populations. 75 individuals experiencing homelessness participated in the pilot project and engaged in six biweekly online consultations with the help of social workers as telemedical assistants. The study achieved a 92.2 percent completion rate, with 73.3 percent attending all sessions. Both patients and physicians reported high satisfaction levels, averaging 4.52 and 4.79 out of 5 on a Likert scale from 1 to 5, respectively. Physicians noted that therapy change was part of the sessions, which suggests medically meaningful doctor-patient interactions. Patient satisfaction also remained high during follow-up. The study suggests that telehealth services, utilizing shelter infrastructure and on-site assistance, can enhance care continuity and reduce digital exclusion for homeless populations (75). Since then, HCSOM launched its permanent telemedical services in 2023. More than 100 people have accessed its online primary care service, in the framework of which physicians have already performed more than 400 medical visits (76).

2. OBJECTIVES

The WHO says that to ensure equitable access to digital health interventions, particularly for marginalized and underserved populations, certain efforts, such as strategies for overcoming various biases and barriers, should be undertaken to ensure that no one is left behind in the digital transformation of health (77). The DHWG has undertaken a research initiative aimed at providing policymakers and decision-makers with a precise, comprehensive, and nuanced analysis of digital health inclusion in Hungary, with particular emphasis on vulnerable populations, including people experiencing homelessness. This thesis fits in with the DHWG research agenda presented in the introductory chapter and builds upon the results it has already achieved.

The general aim of this thesis was to uncover how the relationship between digital health and people experiencing homelessness in Budapest, Hungary can be grasped to clearly see the opportunities and barriers that present themselves for this population, and based on these findings, to offer recommendations so that people experiencing homelessness could reap the benefits of the digitalization of health (e.g. better access to the healthcare system in general, and better patient outcomes in particular).

Specifically, this thesis sought to address the following, building on the research agenda and previous results of the DHWG:

(1) Firstly, we had the objective to map out how people experiencing homelessness in Hungary, especially Budapest, use digital tools, and how they utilize such devices and services for health-related reasons;

(2) Secondly, we aimed to find clearly delimitable variables, such as age, education, institutional and social services environment, or any other demographic data that can be associated with the use of digital tools for health-related reasons (54).

(3) Thirdly, we wanted to examine whether a group of digitally engaged people experiencing homelessness exists who have access to digital tools and services despite all the barriers in their environment and who use their tools for health-related purposes. If there is such a group, we wanted to investigate their specific characteristics to see whether they have any specific characteristic or behavioral

trait that would allow them to invite their peers to participate in the digital health ecosystem.

Based on the literature, the specific hypotheses were as follows:

(1) Due to the digital health paradox, people experiencing homelessness have less access to mobile phones, smartphones, the Internet, and Internet-based products and services than the general population in Hungary.
(2) Building on the first assumption, people experiencing homelessness in Hungary use digital tools for health-related reasons less than the general population.
(3) Structural, institutional-level, and individual-level barriers and enablers of digital tool usage for health-related reasons can be identified.
(4) There is a small group of people experiencing homelessness, who exhibit the characteristics of digitally engaged persons.

3. METHODS

To achieve the objectives of this thesis, a two-tier research agenda was adopted, with a wider-scale quantitative analysis and a narrower-scale, in-depth qualitative analysis building on each other and complementing their findings.

3.1. Methodology for the Quantitative Analysis

As the first item on the research agenda, and to lay down the foundations for the in-depth qualitative analysis, we conducted a face-to-face survey with the help of social workers in 28 institutions offering health and social services to people experiencing homelessness. Altogether, six types of institutions participated in our research (See Appendix 1). As inclusion criteria, we welcomed clients who were in contact with the HCSOM social care system tailored to people experiencing homelessness, but we excluded clients with diagnosed mental health disorders, psychiatric problems, dementia, and severe disabilities, as including them in the analysis would require different methodological considerations.

3.1.1. Survey Development and Survey Characteristics

As a first step, based on the Digital Inclusion Survey (78), which is specifically used in homeless contexts, we developed our own questionnaire (See Appendix II). Two independent medical translators translated the original questionnaire from English to Hungarian, and a consensus meeting was held to merge the two versions. This draft questionnaire was then refined during a workshop with social workers working in the HCSOM system, and ten participants completed a test survey to check the questionnaire for clarity and intelligibility. Based on this feedback, subtle changes were applied, resulting in the final version of the survey material (54).

As the next step, we contacted the 28 institutions listed in Appendix I. With the help of the social workers, we surveyed 662 people in Budapest, Hungary, between April 19, 2021, and August 11, 2021. Participation was voluntary, and respondents filled out the survey in paper and pencil form. Social workers were asked to help the participants interpret the questions, but they were not allowed to influence the responses (54).

As we indicated in Radó et al., 2022, the questionnaire asked about sociodemographic data (age, gender, level of education, self-defined homelessness, and length of homelessness) and health status (frequency of medical visits, existing medical diagnoses, and self-assessment of health status). Questions 6-10 were used to gather information about health-related knowledge and general literacy skills, whereas questions 11-13 and 14-17 asked about access to mobile phones and the Internet. Next, questions 18-21 inquired about Internet use habits, while questions 22 and 23 were about the potential barriers and enablers of Internet access. Question 24 presented a set of statements about digital health literacy, and question 25 asked about mobile apps (54).

For the questions "How frequently do you visit a medical doctor/do you use medical services?" "Do you have any chronic disease or a long-term health problem?" "Have you ever used the Internet for any purpose? If yes, have you used it in the last six months?" and "Have you ever used any health-related mobile applications?" the responses of a representative sample of the Hungarian population were used as a reference group to provide more context. As indicated in the introduction, the DHWG conducted this survey in 2021, among Hungarian adults (n=1500) (79).

3.1.2. Statistical Methods Applied

We performed a descriptive analysis of the survey results (frequencies, averages, percentage distributions) to examine the first and second hypotheses. To examine the third hypothesis, as also indicated in Radó et. al., 2022, the use of digital tools and its various correlates (demographic variables and variables related to access to health services) were compared with a single variable analysis using the Pearson Chi-square test, with a significance level of $P<.05$ (54). As binary comparisons proved to be incomplete, a multivariate analysis, a binary logistic regression model was used specifically for the question "Have you ever used the Internet for health reasons?" Beyond this dependent variable, control variables such as gender, type of institution and social service, level of education, age, frequency of medical visits, and prevalence of chronic illness were used. Independent variables affecting the dependent variables were selected using enter regression. The significance of the regression coefficients of the given variables was described using the P value of the Wald. Variables with $P<.05$ were retained in the final model (54).

For examining the fourth hypothesis, whether a digitally engaged group of people experiencing homelessness exists, we created a filtering methodology in the following order: we selected participants who responded that

1) they used the internet at least every second week,
2) they had smartphone ownership with either a data contract, pay-as-you-go service, or free Wi-Fi or computer or tablet ownership,
3) they were average or more competent internet users,
4) they had used the internet for health-related reasons before.

As we indicated in Radó et al., 2022, we also considered filtering the subpopulation based on the question "Have you ever used any health-related mobile application?" However, as only 18.5 percent (277/1500) in the reference group responded positively to this question, we expected a significantly lower number in the homeless population, bordering on analyzability (54).

3.2. Methodology for the Qualitative Analysis

A separate qualitative analysis was performed to continue the examination of the fourth hypothesis, mapping out the characteristics and behavioral specificity of a digitally engaged subgroup of people experiencing homelessness. The methodology for this research agenda is based on the *consolidated criteria for reporting qualitative research* (COREQ) checklist (See Appendix III.) and the methodological framework of a previous DHWG study (80).

Due to the specificity of the sample and with an assumed limited prevalence in the overall population, purposive sampling was used to select the participants for the semi-structured interviews, and a smaller sample size was chosen, following Malterud et al. These authors suggest that the size of a sample that has sufficient information power depends on (a) the aim of the study, (b) sample specificity, (c) the use of an established theory, (d) the quality of the dialogue, and (e) the analysis strategy (81). Purposive sampling was based on the following criteria, mirroring the filtering methodology of the quantitative analysis:

1) the respondent is registered in the social care system of HCSOM,
2) uses the Internet every second week or more frequently,

3) accesses the Internet with their own smartphone, computer, tablet, or another device with a data contract, pay-as-you-go service, or free Wi-Fi,
4) rates themselves as average or more competent Internet user,
5) had used the Internet for health-related reasons before.

As indicated in Radó et al., 2024, although the sampling criteria of the qualitative research and the filtering criteria for the quantitative analysis match, the latter was performed as anonymous data collection, and this purposive sampling did not use the previous data pool as a starting point. Thus, there may or may not be an overlap between the two groups (42).

Although as we described in Radó et al., 2024, twelve interviews were conducted, only ten were included in the final analysis, as two interviews did not contain any reference to digital health usage. Social workers contacted four shelters run by HCSOM or their partner institutions. These shelters either served as night shelters (n=1) or provided accommodation on a 24/7 basis (n=3) in Budapest, Hungary. Based on the recommendations of the social workers, one-on-one, semi-structured interviews were conducted between 18 August and 27 October 2022 (42).

As described in Radó et al., 2024, the interview guide (See Appendix IV), was developed based on the experiences of the quantitative analysis and the objectives of this thesis. It is based on the following topics: access to and attitude towards the healthcare system in general, access to and attitude towards digital tools in general, and usage patterns of the Internet and digital tools, access to and attitude towards digital health and usage patterns of the Internet and digital tools for health-related reasons (42). The interview guide was tested on a smaller sample of the specific subgroup (n=2), and subtle changes were made in response to the feedback received. We conducted the interviews in Hungarian. The conversations were audio recorded in person, with an average interview length of 30 minutes. All audio-recorded interviews were transcribed verbatim, and each transcript was anonymized and attributed a unique code. The interviewer checked the transcriptions for accuracy. They were not sent back to the interviewees, as Thomas et al. argue that evidence does not support the idea that member checking increases the credibility or trustworthiness of qualitative data (42,82).

3.2.1. Thematic Analysis as an Analytical and Theoretical Framework

We used thematic analysis outlined by Braun & Clarke, 2006 as our analytical and theoretical framework. In coding, we followed the ‘theoretical’ technique in an essentialist or realist method, driven by the analytic interest to report on study participants’ experiences and realities. In coding, we followed the deductive technique, i.e. we worked with predetermined assumptions and themes, which followed the interview guide; however, clearly characterizable subthemes also emerged around the previously identified main themes (42,83).

The theoretical thematic approach was used to analyze the data and identify patterns of themes based on the checklist elaborated by Braun & Clarke, 2006: (1) familiarizing ourselves with the content of the data, taking notes and coming up with ideas for coding based on previous assumptions and following the interview guide, (2) generating initial codes manually, (3) identifying and indexing different codes across the data set manually, (4) creating relationships between the themes and subthemes, (5) defining, mapping, and naming themes and (6) interpreting our results (42,83). The final thematic map was then laid out with participants’ anonymized quotes supporting the results (See Appendix V).

3.3. Ethics Approval

Ethics approval for the study was issued under TUKEB:133/2020 and IV/10927/2020/EKU by the Scientific Research Ethics Committee of the Medical Research Council of Hungary. Quantitative and qualitative data collection was anonymized. Written informed consent statements were obtained in all interview cases and from every respondent of the quantitative survey.

4. RESULTS

4.1. Results of the Quantitative Analysis

All in all, 662 adults responded to our survey. As described in Radó et al., 2022, 71.2 percent (459/662) were men, and 38.8 percent (247/662) represented the age group of >60 years, whereas participants aged 18 to 44 years accounted for only 25.9 percent (165/662). The mean age was 53.9 years with an SD of 13.08 years. The majority, 70.7 percent (468/662), considered themselves homeless, whereas 25.8 percent (171/662) did not. A total of 66.6 percent (441/662) of respondents indicated how long they had been experiencing homelessness: 21.6 percent (143/662) had been homeless for 1 to 5 years, 16.5 percent (109/662) for 5 to 10 years, and 28.5 percent (189/662) for >10 years, with a mean of 11.35 years and an SD of 9.27 years. Most of the respondents had only completed primary education (252/662, 38.1 percent) or vocational training (232/662, 35 percent), whereas 20.4 percent (135/662) of the respondents had graduated high school, and 4.5 percent (30/662) said they had completed their college or university education (54). The demographics of the sample are shown in Figure 3.

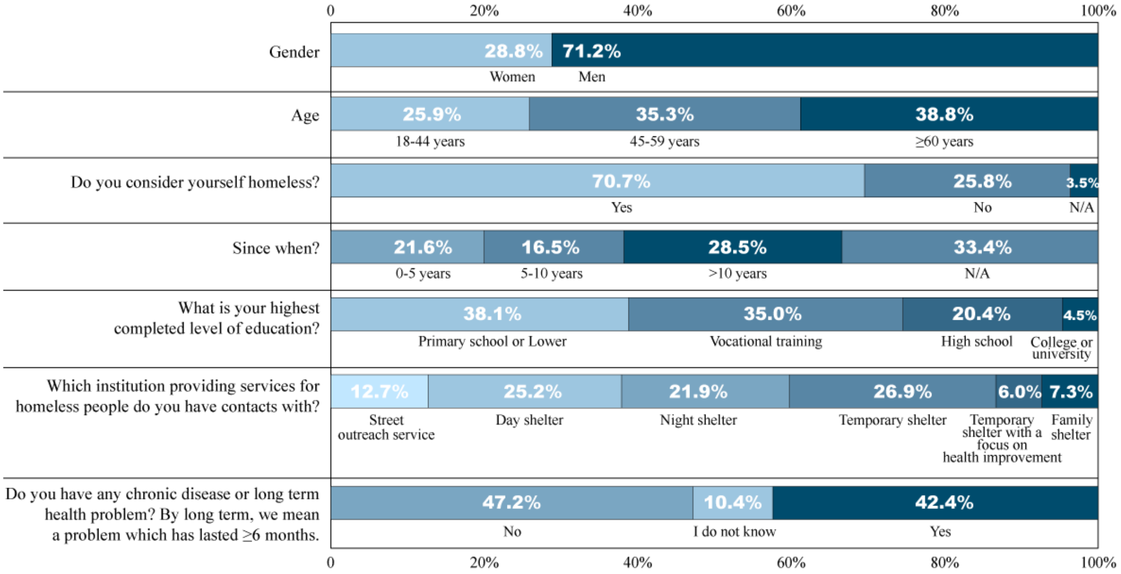


Figure 3. Demographic composition of the sample. Source: Radó et al., 2022.

In terms of the health demographics of the sample, as described in Radó et al., 2022, of the homeless participants, 46.1 percent (305/662) reported no chronic or long-term illnesses requiring treatment lasting ≥6 months. Still, there was only a slight difference in the distribution of those who did (274/662, 41.4 percent). Those who had a chronic disease listed chronic obstructive pulmonary disease, asthma, diabetes, hypertension, mental illnesses, and chronic heart conditions among others. As to how they self-evaluated their own health, 12.1 percent (80/662) and 20.4 percent (135/662) of the respondents said "very good" or "rather good," respectively, whereas most people (284/662, 42.9 percent) considered it "average." In addition, 14 percent (93/662) and 6.6 percent (44/662) of the respondents said they considered their health "rather poor" and "very poor," respectively (54). The health status of the sample is shown in Figure 4 in comparison with the reference group.

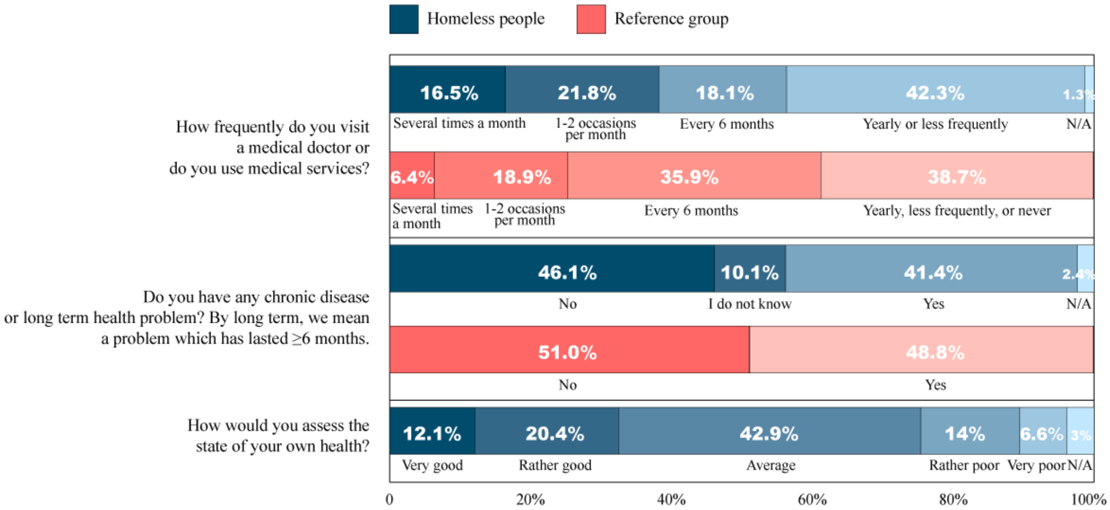


Figure 4. The health status of the sample. Source: Radó et al., 2022.

When surveyed about the sources they used for gathering medical information, as described in Radó et al., 2022, 20.5 percent (136/662) of respondents reported searching online, which ranked third after consulting their primary care physician (352/662, 53.1 percent) and seeking guidance from social workers within social institutions (260/662, 39.2 percent). More notably, respondents were more likely to use the Internet for medical information than to consult family members or friends (108/662, 16.3 percent) (54).

4.1.1. Access to Digital Tools and Web-Based Products and Services

For the multiple-choice question "How do you access the Internet at the moment?", as outlined in Radó et al., 2022, 98 out of 551 respondents (17.8 percent) indicated they had their own smartphone with a data contract, while 100 respondents (18.1 percent) used a pay-as-you-go service for their smartphone. Additionally, 118 respondents (21.4 percent) accessed the Internet via free Wi-Fi hotspots using their own smartphones, and 136 respondents (24.7 percent) utilized publicly available PCs in social institutions or shelters. Only 15 respondents (2.7 percent) owned a personal computer, while 84 respondents (15.2 percent) selected "Other," which included using another person's device, visiting internet cafés, or owning a tablet. Frequently mentioned in the "Other" category were responses indicating no access to the Internet, lack of interest, or non-usage. Comparatively, 81.3 percent of the reference group (1220/1500) reported frequent Internet use, whereas in the homeless group, 67.2 percent (445/662) stated they had used the Internet for any purpose (54) (See below in Figure 5).

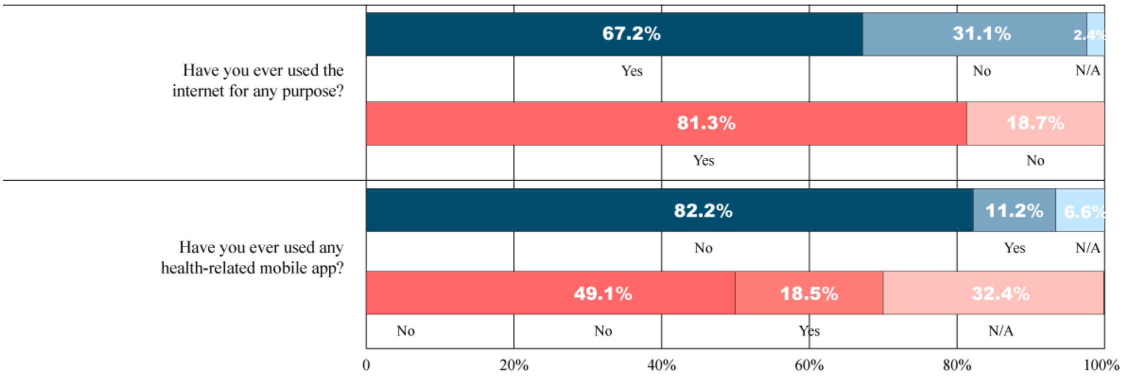


Figure 5. Internet Usage Habits in the Sample and the Reference Group. Source: Radó et al., 2022.

As described in Radó et al., 2022, among the respondents who had used the Internet, 52.9 percent (350/662) reported usage within the past six months. However, daily Internet use was significantly lower, at 34.6 percent (229/662), with an additional 10.6 percent (70/662) indicating usage multiple times per week. Cross-tabulation revealed no significant associations between Internet usage frequency and variables such as age, type of institution or social service, gender, education level, duration of homelessness, or frequency of medical visits (54).

Among the respondents experiencing homelessness, as indicated in Radó et al., 2022, 69.6 percent (461/662) reported owning a mobile phone, with 39.9 percent (264/662) indicating that their phone had smartphone functions. Additionally, 11.2 percent (74/662) of this group reported having used at least one mobile health (mHealth) app, compared to 18.5 percent (277/1500) in the reference group. Those who used mHealth apps cited functions such as step counting, accessing emergency assistance, obtaining medical information, and sharing health data. The use of mHealth apps was associated with two variables: type of institution or social service (P=.02) and frequency of medical visits (P=.03); meaning that mHealth apps were more commonly used in temporary shelters than in other institutional settings, and their usage increased with more frequent medical visits (54).

When asked about their perceived level of expertise when it comes to Internet use, Radó et al., 2022, also write that 10 percent (66/662) of respondents considered themselves "very much" experienced, 14.5 percent (96/662) reported being "rather experienced," and 21.5 percent (142/662) identified as having "mediocre" experience. In contrast, 10.3 percent (68/662) felt "rather not experienced," and the most common response, chosen by 35.3 percent (234/662), was "not at all" experienced. Additionally, 8.5 percent (56/662) did not respond to the question. Chi-square tests revealed associations between self-reported technology literacy and age (P<.001), type of institution or social service (P=.01), and education level (P=.01). This means that older individuals reported lower technological literacy, while those with higher educational attainment reported greater proficiency. Most respondents did not consider themselves experienced technology users, particularly the clients of temporary shelters with a health improvement focus. Conversely, the most experienced technology users were associated with daily and family shelters offering broader social services and having a lower mean age (54).

4.1.2. Factors Hindering and Enabling Internet Use

In response to the multiple-choice question, “What barriers, if any, restrict your Internet use?”, Radó et al., 2022, describe that 30.8 percent (210/682) of respondents indicated that they faced no hindrances. However, 15.2 percent (104/682) reported insufficient free Wi-Fi hotspots as a barrier, and 6.7 percent (46/682) noted owning a smartphone but lacking a data contract or pay-as-you-go service. Additionally, 7.6 percent (52/682) stated that although they had Internet access, they did not know how to use it. A lack of smartphone ownership was reported by 21.4 percent (146/682), while 8.8 percent (60/682) mentioned the scarcity of publicly accessible PCs, such as those in social service institutions. Lastly, 9.4 percent (64/682) indicated they had no access to the Internet anywhere (54) (See Figure 6).

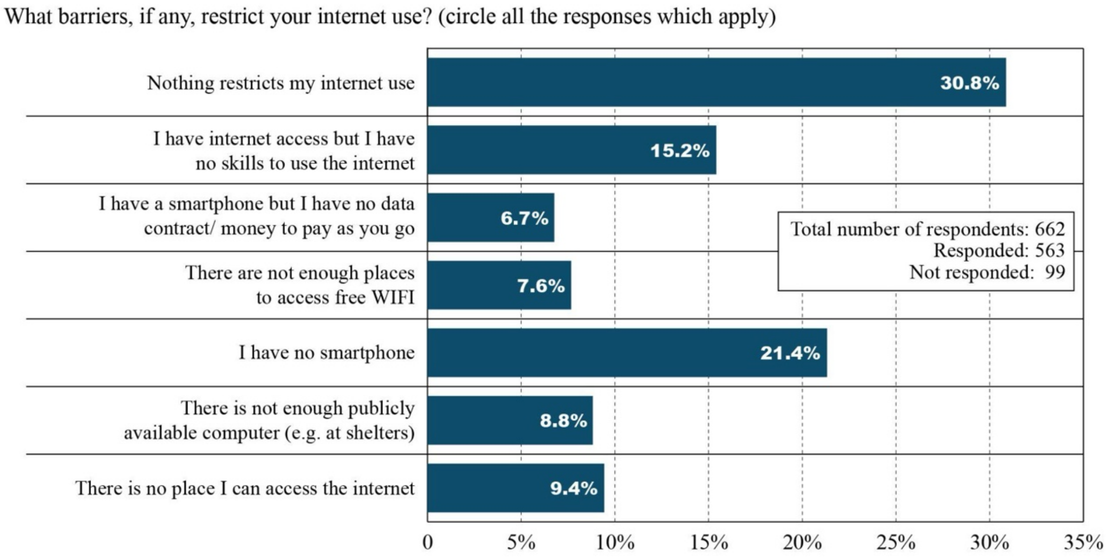


Figure 6. Barriers to Internet Use. Source: Radó et al., 2022.

In response to the question “What would help you use the Internet more?”, Radó et al., 2022, indicate that 24.2 percent (145/598) of respondents expressed a desire to have a smartphone. Another 18.4 percent (110/598) sought better access, indicating they owned a smartphone but lacked an Internet connection option. Additionally, 9.4 percent (56/598) reported needing better access to publicly accessible PCs, as the availability of these was limited in the shelters. Furthermore, 22.6 percent (135/598) mentioned that gaining more knowledge about the Internet would help, as they did not know how to use it and would benefit from assistance. For 25.4 percent (152/598), the question was not relevant, as they already used the internet as much as they wanted (54) (See Figure 7).

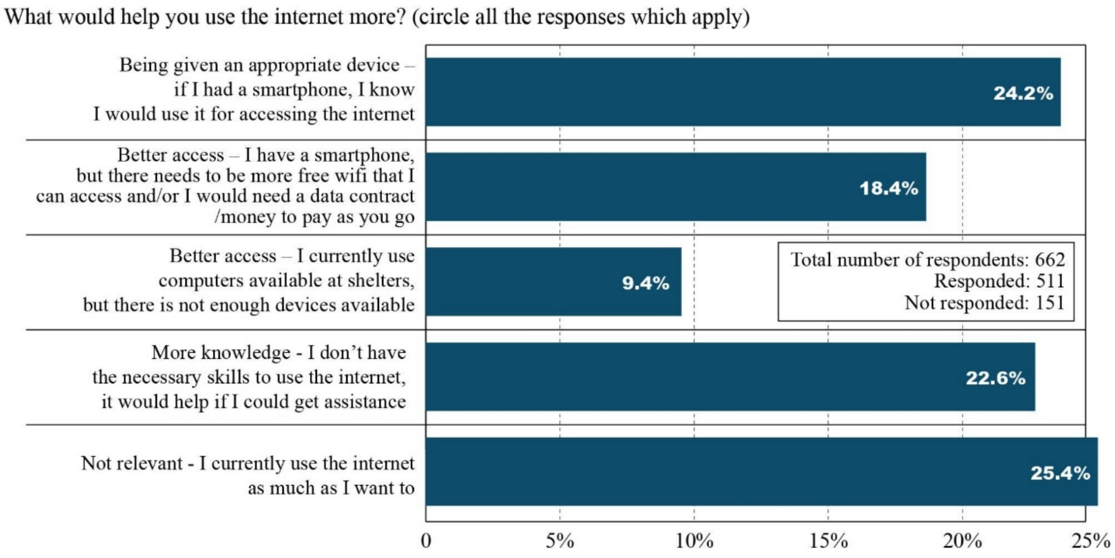


Figure 7. Enablers of Internet Use. Source: Radó et al., 2022.

4.1.3. Digital Health Literacy and People Experiencing Homelessness

Five statements were important when we looked at digital health literacy (See Figure 8.). 43.5 percent of the population agreed with the statement "I know how to use the internet and find answers to my health-related questions.” On the other hand, 34.9 percent said that they agreed or rather agreed with the statement “It does not cause any trouble understanding the terminology used on the Internet for health-related topics”. In comparison, 51.3 percent said they rather did not or did not agree with the statement, which means that a notable proportion of our respondents was rather unsure about their ability to properly understand the terminology of health-related topics.

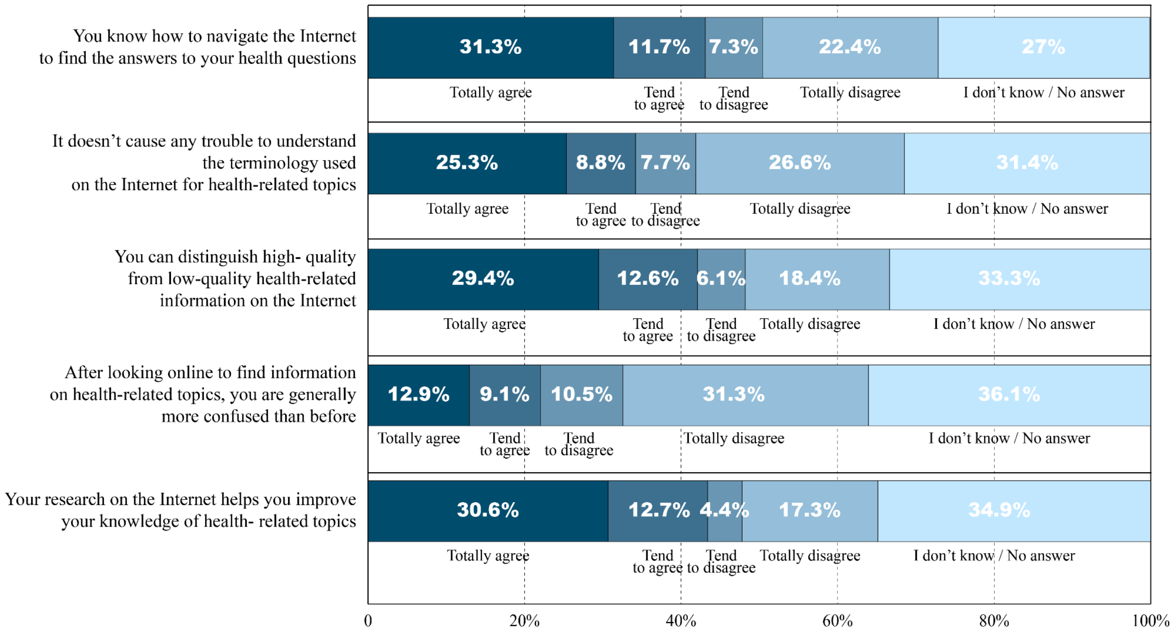


Figure 8. Responses to Questions about Digital Health Literacy.

When we asked whether they agreed with the statement that they could distinguish high-quality from low-quality health information, 42.8 percent said that they could distinguish or rather distinguish between such health information, but 24.3 percent said they could rather not, while 17.7 percent said they did not know, so there was a lot of uncertainty here as well.

We received very similar responses to the statement “After looking online to find information on health-related topics, I am generally more confused than before”. 42.9

percent said they were rather not or not confused, while 22 percent said rather yes or yes, and 19.5 percent did not know. This was also similar to how they responded to the question as to whether the Internet helps them improve their knowledge. 44.4 percent said that the Internet helped them or rather helped them improve their knowledge, which was a lot more than the 21.6 percent who said it did not or rather did not, while 18.1 percent said they did not know.

These results mean that there are huge differences in terms of digital health literacy skills within the homeless population, and there is a lot of uncertainty around the topic, with a significant share of respondents saying they "don't know". When we analyzed these statements with Chi-square tests, level of education and age was significantly associated with the level of digital health literacy among people experiencing homelessness. This means that younger and more educated people experiencing homelessness responded more positively to the statements enquiring about their digital health literacy levels.

4.1.4. Responses for Health-Related Internet Use

When asked "Have you ever used the Internet for health reasons?", in Radó et al., 2022, we found that 34.6 percent (229/662) of people experiencing homelessness reported having done so. In comparison, the reference group showed higher usage rates, with 10.7 percent (160/1500) using the Internet daily, 18.4 percent (276/1500) weekly, 18.2 percent (273/1500) monthly, and 24 percent (360/1500) less frequently, representing 71.3 percent (1069/1500) of the general sample. This indicates that the general population used the Internet for health purposes more than twice as often as the group of people experiencing homelessness. Chi-square tests revealed significant associations with gender ($P=.007$), age ($P<.001$), and frequency of medical visits ($P=.01$), indicating that younger female respondents and those who visited a physician more frequently were more likely to use the internet for health-related purposes (54).

4.1.5. A Digitally Engaged Group of People Experiencing Homelessness

During our analysis, we found a specific subpopulation in the sample that we labeled a "digitally engaged group of people experiencing homelessness." The members of this group were unique in that they did not need further digital inclusion. This group was selected for further analysis based on the criteria specified in the Methodology section and as described in Radó et al., 2022.

First, we selected respondents who said they used the Internet at least every second week (339/662, 51.2 percent). In the next step, we asked the respondents who reported smartphone ownership with a data contract, pay-as-you-go service, or free Wi-Fi or computer or tablet ownership to the question “How do you currently access the internet?” (241/662, 36.4 percent). We then filtered out respondents who reported being an average or more competent internet user (208/662, 31.4 percent). We selected those who responded “yes” to whether they had ever used the Internet for health reasons (129/662, 19.5 percent). We also filtered the subpopulation based on the question “Have you ever used any health-related mobile application?”, to which 39 people (39/662, 5.9 percent) responded positively. The use of mHealth apps was low in the reference population as well (277/1500, 18.5 percent), indicating that mHealth app use is not necessarily meaningfully associated with overall health-related digital engagement (54). Thus, we created two subpopulations: a more broadly defined and a more strictly defined group, analyzing the characteristics of the broadly defined group as it was more meaningful for this thesis (See below in Figure 9).

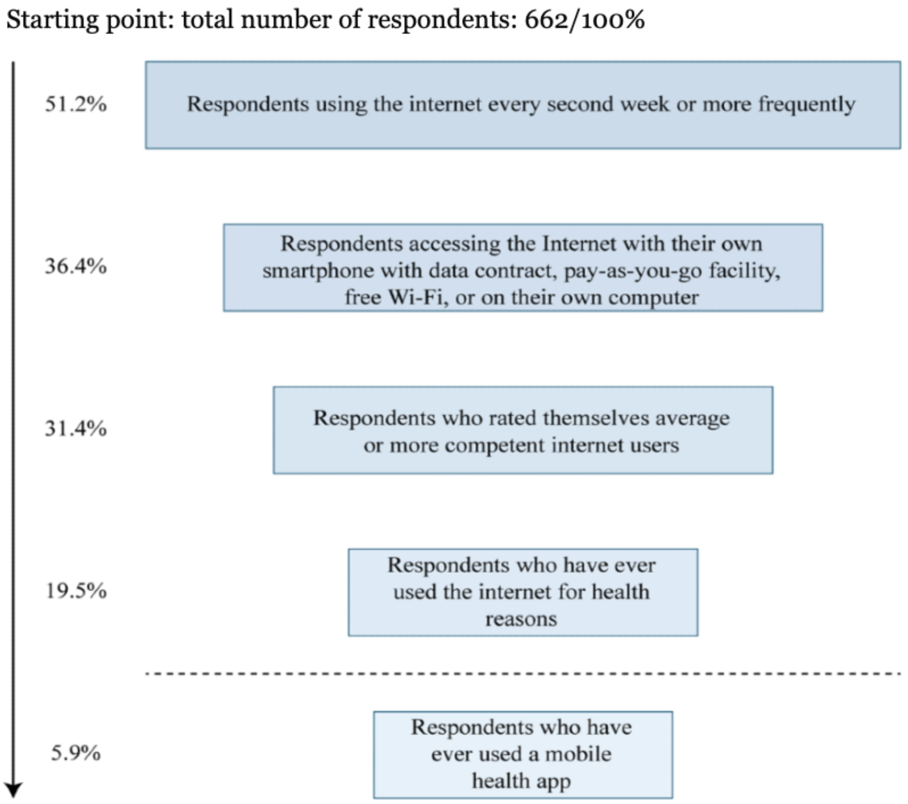


Figure 9. The Flowchart for Selecting Members of the Digitally Engaged Group. Source: Radó et al., 2022.

As Radó et al., 2022. describe, the broadly defined subgroup included 19.5 percent (129/662) of the total group of people experiencing homelessness, with significantly more women (47/129, 36.4 percent) than in the original population (186/662, 28.8 percent). Chi-square test results were significant for the prevalence of chronic disease (P=.047); meaning that respondents with chronic diseases were more likely to frequently use the Internet for health-related reasons. Although the institutional setting was not an associative variable, temporary shelters (40/129, 31 percent) and day and night shelters (28/129, 21.7 percent and 22/129, 17 percent, respectively) housed most respondents in the subpopulation (90/129, 69.7 percent) (54).

4.1.6. Multivariate Analysis

As we described in Radó et al., 2022, the Chi-square test results indicated that gender, age, and frequency of medical visits were associated with health-related Internet use. To further explore which demographic or health status variables influenced health-related Internet use, a binary logistic regression model was applied. The dependent variable was health-related Internet use, and the model included gender (1=woman, 2=man), age (as a continuous variable), type of institution and social service (6 categories), education level (4 categories), frequency of medical visits, and the prevalence of chronic conditions (54).

The logistic regression model was found to be significant (Nagelkerke $R^2 = 0.154$). After controlling for the variables, the analysis revealed that health-related internet use was strongly influenced by age, with a statistically significant association with gender, education level, and the prevalence of chronic conditions ($P<.05$). To break that result down, younger homeless women without chronic conditions were more likely to use the internet for health-related purposes (54). (See Appendix VI for the details.)

4.2. Results of the Qualitative Analysis

As we indicated in Radó et al., 2024, the sample contained ten interviews, with the demographic characteristics of the sample specified in Table 2. Here we summarize the unique themes, subthemes, and codes that we identified, with anonymous quotes from the interviewees designated with a letter indicating the initials of the shelter where the interview took place, and the number of the interview. All quotes were published in Radó et al., 2024.

Table 2. Demographic Composition of the Interviews. Source: Radó et al., 2024.

Gender	Male - 6	Female - 4		
Age	<40 years old - 1	40-50 years old - 4	50-60 - 2	>60 - 3
Education	primary school or below - 2	vocational school - 3	high school - 4	university - 1
Shelter	Feszty - 2	Integrated shelter in Miklós utca - 4	Budaörs - 2	REVIP - 2

4.2.1. Theme 1: Attitudes

4.2.1.1. Subtheme 1: Subjective experiences around health and the healthcare system

Code 1: Experiences related to personal healthcare

As we described in Radó et al., 2024, respondents' experiences with mainstream healthcare systems, including hospitals, doctors, nurses, pharmacists, prescription medicine, etc. varied widely. In a few cases (2 interviews), interviewees reported positive experiences regarding access to care, the quality of the treatment, and the behavior of the medical personnel. However, the majority described negative encounters, primarily due to negative attitudes, stigmatization, and mistreatment by medical staff, as well as the perceived inadequacy of the provided care. These accounts reflected an overall distrust and negative perception of the general healthcare system (42).

> *'(...) ...they notice where they have to go and then they have a completely different stance. Also, the emergency medical doctor, who is here, or if the ambulance services come. They behave completely differently. (...) They are condescending. Okay, we'll do it later. Okay, come back later. And another one: do pack your stuff already, we are set to go. So, they (...) are not helpful.' (Interview B09)*

Code 2: Turning to complementary and alternative medicine

In a minority of interviews (three interviews), as indicated also in Radó et al., 2024, participants mentioned using complementary and alternative medical (CAM) solutions, such as medicinal herbs or Chinese medicine, which they regarded as viable alternatives to traditional Western medicine. Conversely, in two interviews, participants expressed a negative view of drugs and medicines, often discussed in the same context. These perspectives highlight the respondents' search for alternative solutions for their health issues. Some individuals felt that the mainstream healthcare system and conventional pharmaceuticals had failed to provide satisfactory solutions. As a result, they turned to medicinal herbs or other ingredients recommended by trusted sources or discovered through online research (42).

> *'I can feel if something's off in my body, and then I look up certain things, but to be honest, I always start with medicinal herbs, and not with pills. I go to the pharmacy, and I look up on the internet what is recommended for example for lower abdominal pain or a story with joints.' (Interview M07)*

4.2.1.2. Subtheme 2: Subjective experiences of innovation and technology

According to Radó et al., 2024, respondents' subjective experience of and attitudes toward novelties, technology, and digital tools were mixed. In nearly half of the interviews (four interviews), participants expressed an openness to trying new programs and applications, demonstrating a willingness to engage with emerging technologies. However, in two interviews, participants reported a complete lack of interest. Attitudes towards digital tools and internet usage were similarly varied. Negative experiences and concerns included risks such as data misuse (one interview), errors due to autocomplete features and the rapid pace of digital tools (one interview), and perceived inaccuracies in step-counting functions (two interviews). Despite these concerns, an openness to new technologies and applications was evident in several accounts (four interviews), while a minority (two interviews) expressed disinterest (42).

> *'As I'm homeless at the moment, I don't have enough (money) on my pay-as-you-go service that I could use the internet unlimited. Where there is free Wi-Fi, I certainly search for things I think of, what I gather from my environment, or my godchildren. So, I want to keep up with today's world even though I'm now a little bit on the brink of it. (Interview M07)*

4.2.2. Theme 2: Access

4.2.2.1. Subtheme 1: Access to health

Code 1: Individual health

The majority of interviewees rated their health status as average or worse, as we described it in Radó et al., 2024. Common health issues included chronic diseases such as cardiovascular and heart conditions, Type 2 diabetes, cancerous tumors, and long-term injuries. Managed alcohol problems were noted in four interviews, while drug abuse was not mentioned; in two interviews, an aversion to drugs was expressed. Diagnosed mental health issues were also absent from the responses. Some participants reported regularly taking prescribed medications, while others acknowledged having been prescribed medications but choosing not to take them. In several cases, interviewees made medical decisions based on personal beliefs or opinions rather than professional medical advice or evidence (42).

> *'My troubles look like heart, liver, kidney, arterial obstructions. I had deep vein thrombosis in both legs but I carried that for a long time. I have very high pain tolerance. I usually operate on myself. I froze both of my legs and I cut the ulcer out as deep as I could. Then I put herbs into the wound. It recovered within 2 weeks.' (Interview F01)*

Code 2: Institutional healthcare

The interviewees were clients of four homeless shelters in Budapest, which granted them institutional access to basic healthcare services, as we indicated in Radó et al., 2024. Under Hungarian law, their social security status can be facilitated by social institutions on account of their homeless status. The available healthcare services include primary care, such as the prescription and dispensing of medicines, specialist referrals, and care work. Additionally, publicly funded specialized outpatient care, inpatient hospital care, and emergency rescue services are accessible to this population (42).

> *'If I have any problem, the Maltesers (HCSOM) have a doctor's office. And if I can go there on my own two feet, then I go there. If you can't, you will be transported to the hospital by default. Some decent people help or call an ambulance. In the doctor's office, they refer you to any specialist, whether*

> *dermatology or cardiology. Thus, they can get you to any kind of specialist.' (Interview F03)*

Code 3: Access to clear healthcare information

According to Radó et al., the lack of access to clear and comprehensible healthcare information was noted in at least one interview. Several participants mentioned using digital tools to search for medications and ingredients online to better understand their effects on the body. The need for accessible health-related information emerged as a recurring theme, present in at least half of the interviews. For instance, participants reported having researched prescription medicines (five interviews) and their ingredients (four interviews) online. In at least one case, this effort extended to seeking information about a family member's health needs (42).

> *'(….) most of the time, physicians use such Latin words as lawyers do. Make it simple! No one is that much overeducated to know these. For example, laboratory tests. They should include what this means, sodium was X. There are some apps where you can look that up.' (Interview F01)*

4.2.2.2. Subtheme 2: Access to digital technology

Code 1: Access to digital tools

The overwhelming majority of interviewees reported using smartphones (seven interviews), while notebook usage was mentioned in one case and tablet usage in two cases, as we described in Radó et al., 2024. One participant also noted the use of a power bank to charge their device. However, in two interviews, it was reported that phones, tablets, and computers were sometimes sold during times of financial need, making these devices temporarily inaccessible (42).

> *'in this living situation, people get such digital devices much easier off their hands, if they are not in such a whacking need of them, simply to be able to make money out of it.' (Interview F04)*

Code 2: Access to digital services

As Radó et al., write, in homeless shelters, interviewees had access to computers provided by the shelters, which enabled Internet use. Some shelters also offered free Wi-Fi and facilities to charge phones. A majority of the participants actively sought out free Wi-Fi options both within and outside shelters (six interviews). Subscription-based Internet access (three interviews) or pay-as-you-go services (five interviews) were less common due to affordability constraints. In some instances, interviewees (three interviews) visited cafés specifically to charge their phones or access the Internet (42).

> *'(...) the Wi-Fi is so strong that you don't have to go in and consume something, or if you go in and drink a cup of coffee or water, you get the Wi-Fi password, then sit in front of it on a bench, and it has such a strong signal that you can use it there as well until it is open.' (Interview M07)*

Code 3: Gaps in access to digital technology

Interviewees highlighted challenges related to both the availability of devices and network coverage, also indicated by Radó et al., 2024. Several participants emphasized the need to secure a device, such as a smartphone, or to explore ways to reduce the costs of subscriptions and pay-as-you-go plans. In isolated cases (one interview each), the idea of implementing smart benches in public spaces or providing free Wi-Fi on trams and buses in Budapest was suggested. While the adequacy of computer facilities and Wi-Fi network coverage was not a widespread concern, one interviewee mentioned the need for additional power outlets in shelters to make charging devices more convenient (42).

> *'I would tell you the truth… I'm sure it would be feasible to have free Wi-Fi on buses and low-floor trams. So here, we have Wi-Fi, since this is a shelter but when we go 20 meters further, there isn't any, the network disconnects.' (Interview M05)*

4.2.3. Theme 3: Usage patterns

4.2.3.1. Subtheme 1: Differences in usage patterns: age and generations

All interviewees reported that they used the Internet on their own devices with a measurable frequency, with participants ranging in age from 35 to 69, as described in Radó et al., 2024. Although the interviewer did not explicitly inquire about internet usage by age, the topic emerged spontaneously in several discussions about attitudes toward innovations. Many participants highlighted generational differences, describing older individuals as less engaged with the digital world and less interested in new technologies, whereas younger people were perceived as inherently familiar with digital devices, making their use seem intuitive. However, one interview revealed that individual motivation could override age as a barrier to digital engagement (42).

> *'This is a fundamental thing, really, but many don't know, especially the older generation. (...) So, I'm quite digital, but I'm only 40 years old. We more or less already grew up with these devices.' (Interview F03)*

4.2.3.2. Subtheme 2: Usage patterns

According to Radó et al., 2024, interviewees primarily used the Internet for entertainment and social connection. Activities such as watching movies, listening to music, reading e-books, and playing mobile games were commonly reported. Social media platforms were frequently mentioned, with Facebook being the most referenced, and X (formerly Twitter) appearing in one interview. A minority of participants also used the internet for purposes such as information gathering, reading the news, and conducting online banking (42).

> *'I had a smartphone, so it's not only the music, YouTube, Facebook pages that are important to me, but also Wikipedia, where I can look up everything, or for example, I read a lot about various things, and the diseases that I had. This is very important to me.' (Interview M05)*

4.2.3.3. Subtheme 3: Usage for medical purposes

Several interviewees reported using the Internet to seek medical information, as we indicated in Radó et al., 2024. Common activities included researching prescribed medications (five interviews), their active ingredients (four interviews), and alternatives such as medicinal herbs or foods (two interviews). One participant mentioned having purchased a product believed to have medical benefits after seeing a Facebook advertisement. A 30-something interviewee communicated with their doctors via email, researched their health conditions and prescribed medications online, and used a health app along with a step counter. Two other participants also used health apps, although one stopped using the step counter because they found it inaccurate (42).

> *'I look up the active ingredient of a pill, for example, when before chemotherapy certain medicines were prescribed for me, and I looked up what kind of active ingredients they have, what side effects they could have,*

> *because a package leaflet is one thing and a real person who already had this experience and took the medicine, and what their opinion is, is another thing.' (Interview M05)*

4.2.4. Theme 4: Solutions for problems of usage

4.2.4.1. Subtheme 1: Individual solutions

The interviewees included in the qualitative analysis had previously indicated that they used digital tools frequently and considered their skills to be at least average. Most interviewees did not report significant issues with using these tools. When problems did arise, one participant sought assistance from family members but noted a preference for resolving issues independently whenever possible (42).

4.2.4.2. Subtheme 2: Peer-to-peer support

On the other hand, many interviewees reported that they offered assistance to fellow shelter residents who encountered difficulties with digital tools or Internet usage (six interviews) as we described in Radó et al., 2024. They helped peers with tasks such as SIM card registration, activating pay-as-you-go services, performing anti-virus operations on devices, troubleshooting issues with online platforms like Facebook and Messenger, and addressing questions related to online purchases. These issues were generally basic in nature, and most interviewees possessed the knowledge and skills to resolve them (42).

> *'Usually Facebook, Messenger, or when they cannot download a game. And there is an antivirus program on every smartphone with a broom icon but they don't know what that is. So, I tell them, to pick it up and swipe with it. Clean it. And then they look at me confused. Okay, give it to me. So, then I do it, and they look. Wow, then they say, it went down to zero. Yeah, and then I say that's the point, not to have anything on it. So, there are always things like this.' (Interview B09)*

4.2.4.3. Subtheme 3: Institutional solution: the role of social workers

Interviewees did not report any institutional programs specifically aimed at developing digital skills. In one instance, a social worker was mentioned who took the initiative to teach a client the basics of tablet use. However, this was an individual effort on the part of the social worker rather than a service offered by the shelter (42).

> *(…) then the social worker came up to me and taught me the basics, and then they said that I should now keep pressing the buttons around nicely, and then I'll figure everything out by myself. (Interview R12)*

5. DISCUSSION

5.1. Lower Access to Mobile Phones and Smartphones among People Experiencing Homelessness in Hungary

This thesis aims to uncover whether and to what extent the digital health paradox is prevalent when looking at one of the most vulnerable populations, people experiencing homelessness in Hungary. As described in the introductory chapter, this term means that vulnerable groups of people who might benefit the most from digital health solutions have lower access to them (50). Homelessness is described in the literature as a risk factor for several health conditions, for a complex set of chronic diseases (42,60–62), and for premature mortality (65); moreover, people experiencing homelessness have generally poor access to adequate healthcare and social care services (67).

To mitigate these health inequalities among homeless populations, digital technology, a new health determinant, can be considered on a broader scale (54). However, to do so, it is important to examine various preconditions for digital technology usage, for example, various systemic-level preconditions, institutional-level preconditions, and individual-level preconditions, including whether this particular population would be open and willing to use such technologies, and the level of their digital literacy. These factors might be key to reaping the benefits of digital health solutions. As indicated in the introduction, the DHWG examined homeless individuals' attitudes and openness regarding telecare in a Hungarian sample, and a significant proportion of people experiencing homelessness with mid or long-term residency in homeless shelters was open to using telecare via live web-based video consultations. As a step forward, we conducted a quantitative survey assessing the existing access to digital platforms (smartphones and the Internet) and the barriers and facilitating factors in both physical and educational spaces among homeless populations, as well as basic digital literacy skills (54).

Analyzing the results of our quantitative survey, we can also test our first hypothesis, which states that people experiencing homelessness have lower access to mobile phones, smartphones, the Internet, and Internet-based products and services than the general population in Hungary. Based on our findings, the surveyed homeless population showed an aptitude for health-related technology use, had partial access to digital tools, and a significant proportion of the homeless population used digital tools for health-related purposes. On the other hand, the first hypothesis was proven to be valid, as people experiencing homelessness have lower access to mobile phones, smartphones, the Internet, and Internet-based products and services than the general population in Hungary.

A significant proportion of our respondents had a mobile phone (461/662, 69.6 percent), and a lower but still significant number of respondents possessed a smartphone (264/662, 39.9 percent). In comparison to the general Hungarian population, that is significantly lower: according to the Hungarian Central Statistics Office, in Q3 2023, the number of active, callable SIM cards on the last day of the period reached 152.5 pieces per 100 inhabitants, which means that mobile phone penetration is more than a 100 percent in the country (84). Smartphone penetration is also very high: the international statistics website Statista puts it at 96 percent for 2023 (85).

Findings from the homeless population are congruent with the results presented in the literature, although according to our findings, the ownership of devices and access to the internet lag behind that of Western countries. In 2013, McInnes et al. reported in a systematic review that mobile phone ownership ranged between 44 and 62 percent, computer ownership between 24 and 40 percent, computer access and usage between 47 and 55 percent, and Internet usage between 19 and 84 percent in this population (54,86). In 2017, Rhoades et al. found that the overwhelming majority of homeless individuals (94 percent) owned a cell phone, more than 50 percent of them owned a smartphone, and 51 percent accessed the Internet on their cell phones. One-third of the participants reported no Internet use in the past 3 months (54,87). In 2021, Thurman et al. analyzed feasibility studies related to mHealth interventions among people experiencing homelessness and found that 52 percent of the participants (n=31) reported having a personal cell phone, and of those with phones at baseline, the majority (87 percent) reported that their phones were capable of SMS text messaging, picture messaging, and mobile app use (54,88).

Lower access rates to digital health tools among people experiencing homelessness show the existence of a significant digital divide in Hungary based on socio-economic conditions. The ownership of mobile phones, smartphones, or Web-based services is lower in this vulnerable group, although smartphones are still more accessible than personal computers or tablets. According to our quantitative analysis, only 15 respondents (2.7 percent) owned a personal computer, while 84 respondents (15.2 percent) selected the response “Other” for the question “How do you access the Internet at the moment?”, which included using another person’s device, visiting internet cafés, or owning a tablet (54). According to our qualitative analysis, the majority of the interviewees (7/10) had a smartphone, while two individuals possessed personal computers, and one of them had a tablet (42). This is in line with previous research that says that pocket-sized and significantly lower-priced smartphones with lower-priced Internet access are more accessible to people with a low socioeconomic status (89). Moreover, mobile phone and smartphone ownership is often non-exclusive among people experiencing homelessness, as reported in our quantitative analysis, and using the devices as assets in times of need as reported in a minority of interviews (2/10) in our qualitative analysis has also been described in the literature (70).

Furthermore, technological adoption is slower in lower socioeconomic groups, and previous studies have found that the rates of smartphone and Internet use among homeless populations were lower than those among housed, low-income adults of any age, which might explain the generally lower Internet use statistics for this specific group (54,68). This is in line with the findings of Von Holtz et al., who showed that participants had a 68 percent less likelihood to access the Internet while experiencing homelessness than when they were housed (54,69,90).

5.2. Lower Use of Digital Tools for Health-related Reasons among People Experiencing Homelessness

Building on the first assumption, we assumed that people experiencing homelessness in Hungary use digital tools for health-related reasons less than the general population. Usage differences already materialize when looking at Internet usage patterns: 67.2 percent of people experiencing homelessness (445/662) stated they had already used the

Internet for any purpose (54); in contrast, 81.3 percent of the reference group (1220/1500) reported frequent Internet use.

Our results showed that 34.6 percent (229/662) of people experiencing homelessness reported health-related Internet use. In comparison, the reference group showed higher usage rates, with 10.7 percent (160/1500) using the Internet daily, 18.4 percent (276/1500) weekly, 18.2 percent (273/1500) monthly, and 24 percent (360/1500) less frequently, representing 71.3 percent (1069/1500) of the general sample. This indicates that the general population used the Internet for health purposes more than twice as often as the group of people experiencing homelessness (54). Additionally, 11.2 percent (74/662) of this group reported having used at least one mobile health (mHealth) app, compared to 18.5 percent (277/1500) in the reference group. Those who used mHealth apps cited functions such as step counting, accessing emergency assistance, obtaining medical information, and sharing health data (54). They could also name specific mHealth app brands, which indicated meaningful usage, presumably accompanied by frequent access and use. Our results also showed that people experiencing homelessness turn to their family physician and social worker for help with medical issues the most frequently, although their third most frequent choice is the Internet (20.5 percent), even before asking family members or friends (54).

When we asked interviewees in the qualitative study for what purpose they used their digital tools, the digitally engaged subgroup of people experiencing homelessness reported that they used their devices for entertainment purposes and to maintain their personal relationships. This is in line with previous research. Rice et al. reported that mobile phones can facilitate communication with family or friends and provide social support, which is in turn associated with more favorable health outcomes (54,91,92). In contrast, two-thirds of the participants of a cohort of 350 adults experiencing homelessness aged >50 years in Oakland, California, reported using their phones to communicate with their healthcare providers, suggesting both interest and feasibility (54,68).

In terms of healthcare, the interviewees of the qualitative analysis used their devices as new channels to find solutions for their health problems outside the conventional healthcare system and to search for health-related information (42). They seemed to utilize their digital tools to circumvent mainstream healthcare institutions and services and verify the medical recommendations they received. Moreover, turning to alternative and complementary medical solutions, such as homeopathy, herbal medicine, and Chinese medicine, can be construed as a way of expressing mistrust in conventional care settings, and digital solutions can open up a channel outside the conventional health care system to find such alternative solutions. Mistrust and negative attitudes toward the health care system, coupled with the need to understand health-related language, prescription drugs, and active ingredients, were associated with the main health-related use of digital tools and services for the majority of the interviewees (8/10) in the qualitative analysis (42).

5.3. Barriers and Facilitators of Technology Use

To explain the lower access to digital health tools and health-related Internet usage statistics, we can examine whether there are variables in place that limit or enable the access and/or the use of digital health tools or the access and/or the use of the Internet for health-related reasons. According to our third assumption, such barriers and enablers might exist on a contextual, institutional, or individual level, and several such factors can be shown based on our results.

According to a scoping review, digital health technologies and inequalities can be described through individual characteristics, intermediary determinants, and the techno-social-economic-political context. Individual characteristics describe patients' social position focusing on disparities seen in disadvantaged subgroups, with disparities according to age, gender, education, income, socioeconomic status, or ethnicity (93). As intermediary determinants, Badr et al. describe access to technology, digital literacy, or attitudes toward digital health technologies. Building on the findings of this scoping review, in this thesis we examine digital health literacy and infrastructural, especially institutional and national-level infrastructural conditions, which could serve as barriers or facilitators for accessing and using digital health tools (93). Finally, the third level constitutes a bird’s eye view, or as Badr et al. label it, the social-technical-economic-political context, which refers to determinants related to policies, strategies, values, healthcare payment systems, or the cultural background (93). In this thesis, we consider the existence or non-existence of policies and strategies on a public or private level, which might serve as barriers or facilitators for digital health access for vulnerable groups, such as people experiencing homelessness.

5.3.1. Individual Barriers and Facilitators

According to the results of our quantitative analysis, individual-level barriers and enablers to accessing digital health tools include gender, age, level of education, the prevalence of chronic conditions, and socioeconomic status. Regarding the latter, the affordability of digital tools or data contracts was mentioned as the main barrier to accessing technology in both the quantitative and the qualitative analysis (42,54). As a need, a supply of devices was also primarily mentioned by the interviewees of the qualitative analysis, which is in line with the quantitative study, where 21.4 percent of respondents mentioned the lack of a smartphone as the main barrier for not using the Internet, and 24.1 percent mentioned that the availability of an appropriate device would help them use the Internet more (54).

5.3.1.1. Gender and Level of Education

In the quantitative analysis, the logistic regression model showed that gender was an influencing factor when it came to health-related Internet use, which means that within the homeless group, mainly women tended to use digital tools for health-related purposes (54). This is congruent with the trends in the general population, as Bidmon et al. found that women were more engaged in using the Internet to search for health-related information in Germany (n=1006) (94), and via the 2017 and 2018 National Cancer Institute Health Information National Trends Survey (n=6789) Rising et al. found that in the United States, women were more likely to use digital health tools than men (54,95). As a noteworthy limitation, it has to be mentioned that women were almost 2.5 times more underrepresented in our quantitative sample (186/662, 28.8 percent), which might have influenced mHealth use patterns along gender lines (54).

More generally, women tend to act as the health manager of the family, as women's roles within the family tend to position them as the promoters of overall family health, as described in the literature (96). This also emerged in at least one of the qualitative interviews, where the female interviewee stated that she used her smartphone to look up medicines and the ingredients of medicines online for her husband.

We can mention level of education as a second enabling or limiting factor. Individuals with higher levels of education were more likely to use digital health tools. However, only 4.5 percent (30/662) of the sample reported having completed a college or university education, a factor that, like the gender composition of the sample, may influence usage patterns. This observation aligns with participants' self-assessment of their own technological literacy. The Chi-square test revealed a significant relationship between education and self-assessed digital competencies (P=.01), indicating that higher education levels correlate with an increased sense of technological literacy, which may lead to more frequent usage (54).

Concerning the prevalence of chronic conditions, the results showed that homeless individuals without chronic diseases or any long-term illnesses tended to use the Internet more for health-related purposes. This might be explained by the fact that those who were more concerned about their own health tended to use a diverse tool kit for health care and well-being, including digital tools, whereas those with serious chronic illnesses might neglect their state. This might stem from the struggle of people experiencing homelessness to accommodate basic human needs or a lack of resources for accessing care (67). These results were in line with the findings of the representative study conducted by DHWG in 2021 (79).

5.3.1.2. The Significance of Age

According to the results of the quantitative and qualitative analysis, age proved to be a key individual factor or sociodemographic variable affecting the use of technology by people experiencing homelessness, which is in line with previous research. The participants of the study conducted by Harris et al. felt that the shift in the United Kingdom to more digital social services had assumed that users were well-versed in IT, although this may not be the case (97). Initially, age did not appear to be a significant factor in individuals experiencing homelessness accessing technology, as a majority of respondents (461/662, 69.6 percent) owned a mobile phone, with most respondents being over 60 years old. However, age seemed to play a critical role in their self-perceived competence with web-based services and health-related Internet use. Younger respondents (ages 18-44) generally viewed themselves as more competent, while older ones (ages 45-59 and over 60) were less likely to consider themselves proficient in using the Internet. Furthermore, the regression model indicated that younger homeless individuals were more likely to use the Internet for health-related purposes (54).

The quantitative results were also supported by the qualitative analysis. When asked about usage patterns, several interviewees spontaneously shared their views on how age differences matter in usage prevalence, outlining that older generations might be less involved and less interested in novel technologies. Moreover, the likelihood of respondents considering themselves less competent in using the Internet as they get older also appeared in at least one of the interviews, with the respondent explaining less elevated technological skills with age (42). At least three interviews indicated that age was associated with openness toward or willingness to try new technologies, which is in line with the findings of the representative questionnaire survey of the DHWG on digital health-related knowledge, attitudes, and needs described in the introductory chapter. This survey found that a quarter (26.5 percent) of individuals aged 65-74 years and a third (31.9 percent) of individuals aged older than 75 years would not like to try digital technologies in the coming years (42).

Overall, the results of the quantitative and qualitative analysis for the individual barriers and enabling factors were in line with the trends seen among the general population: younger and more educated people tend to use digital health tools (98,99), and this finding means that in the course of planning health care interventions for homeless populations, the patterns observed in the general population might be taken as a basis for further action.

5.3.2. Intermediary Barriers and Enabling Factors

As the next step concerning our third hypothesis, we examine digital health literacy and the infrastructural, especially institutional and national-level infrastructural conditions, that could serve as barriers and facilitators for accessing and using digital health tools. For our purposes, we used the definition of digital health literacy as the degree to which individuals have the capacity to obtain, process, and understand basic health information from electronic sources to make appropriate health decisions (100,101).

5.3.2.1. Digital Health Literacy

As the quantitative results showed, level of education and age were significantly associated with the level of digital health literacy among people experiencing homelessness. This means that younger and more educated people experiencing homelessness responded more positively to the statements enquiring about their digital health literacy levels - just as in the case of health literacy in general (102,103). Previous studies show that digital literacy and the capacity to use digital technologies were considered prerequisites for digital health use, although general literacy and health literacy were also found to be an impacting factor in access and usage patterns (93). Leader et al. found that those with lower education were less likely to have the ability to download apps by themselves and were less keen to communicate electronically with healthcare providers (104).

Higher levels of general and health literacy were also associated with better use of digital health tools in the literature (93,105,106), particularly when administrative and medical language was employed (100). This was also shown via our quantitative study, as the level of education was an associative factor in the binary logistic regression analysis of our quantitative results. The issue of medical language also came up in the qualitative interviews. In at least one of the interviews, the difficulty of reading medical documents was mentioned, and the need to use complex medical expressions in medical reports was questioned.

5.3.2.2. Infrastructural Access to Technology, Healthcare and Digital Health Education

In terms of infrastructural consideration, we should consider physical access to technology, access to healthcare, as well as access to health education or digital health education. In terms of physical infrastructure, i.e. Wi-Fi networks, broadband Internet access, and the accessibility of devices and services, several studies have shown the homeless population’s interactions with technology to be significantly affected by the lack of resources and structural constraints (54,97), which is also indicated by our results.

As the main barriers to accessing technology, respondents mentioned the affordability of digital tools or data contracts, the low number of free Wi-Fi hotspots, and PCs available at social institutions. To foster Internet use, a significant number of respondents suggested overcoming these barriers rather than stress the need for learning assistance (54).

Social institutions often lack adequate physical infrastructure in Budapest, Hungary, although in an ideal institutional setting, they might provide a space for using digital tools. The respondents of the quantitative analysis mentioned not enough available PCs, while respondents of the qualitative analysis mentioned that some shelters had free Wi-Fi or available charging stations for phones. However, not only social institutions pose infrastructural barriers for people experiencing homelessness but also public spheres, which are already part of the national regulatory, social-political context. We will return to this issue in the next section. On the other hand, it was interesting to see that the type of social institution or social service provided did not influence access to digital tools or patterns of digital health use for people experiencing homelessness. When analyzing the quantitative results, neither the Chi-square tests nor the binary regression model showed statistically significant results, except for the digitally engaged subgroup (54).

Access to primary care is provided via the care settings of the Health Center of the HCSOM, thus this is the institutional setting where drugs are prescribed, basic care services are provided, and clients are referred to specialists. In line with previous research (107), interviewees of the qualitative study had mixed experiences with accessing health care (42). Some interviewees mentioned the feeling of being unwelcome in conventional health care settings. Some of them mentioned difficulties in getting appropriate treatment and a negative attitude from health care personnel, which might negatively influence their desire to seek health care in the future and their overall trust in the health care system. This might explain why they turn away from mainstream health care solutions. These aspects might also include a negative impact on medication adherence and an overall mistrust in mainstream medical solutions such as taking antibiotics and chronic disease drugs, with a turn to alternative solutions, such as CAM or digital health solutions, as previously mentioned (42).

In terms of access to further training opportunities concerning digital health literacy, there was no institutional-level program, although the seeds of demand could be seen in the qualitative analysis. In one of the interviews, the interviewee mentioned that a social worker provided them with basic information on tablet use. However, it was the social worker's initiative and not an element built into the services of the given institution (42).

5.3.3. The Social, Technical, Economic, and Political Context

As outlined before, this contextual barrier or enabler of the digital health use of people experiencing homelessness refers to determinants related to policies, strategies, values, healthcare payment systems, and cultural backgrounds on a broader level, i.e. on a municipal or national level, or even at the level of the European Union (93).

The COVID-19 pandemic also has to be mentioned as a contextual factor that impacted the social, economic, and political context around the globe. The quantitative analysis was conducted between April 19, 2021, and August 11, 2021, thus between the third and fourth waves of the COVID-19 pandemic in Hungary, while the qualitative analysis was conducted between 18 August and 27 October 2022, thus slightly after the Hungarian government had lifted the epidemiological emergency in June 2022 (108). Although the pandemic could have made its imprint on our analyses, as these represent a cross-sectional analysis and we do not possess any longitudinal data to compare it with from previous time periods, we could not account for the impact of COVID-19 in the survey, and we only touched upon it in the qualitative analysis. We assumed that the COVID-19 pandemic might have exacerbated access to technology for this population, as many facilities with potential free Wi-Fi options, such as libraries, museums, or cafés, where people experiencing homelessness used to go to connect to the Wi-Fi or charge their devices, were temporarily closed. For example, in a survey from November 2020 conducted among their clients, Arrels Fundació (Barcelona) found that 41 percent of the interviewees said it was very difficult for them to access the Internet, and 34 percent said it was a challenge to charge their batteries (109).

However, when the interviewees were asked whether they experienced any change in their usage patterns before and after COVID-19, two interviewees (2/10) said that they used their tools more, and one said that nothing changed in their usage patterns. Other interviewees did not mention the COVID-19 pandemic in the context of digital tool usage, and in terms of access, no one mentioned any change as compared to before the pandemic. Respondents to the quantitative analysis also did not mention any usage or access change in response to COVID-19; however, it has to be mentioned that we did not explicitly ask them about this issue. A few respondents of the qualitative analysis (three interviewees) mentioned that they used cafés for connecting to the Wi-Fi, but other public institutions such as libraries, or museums were not mentioned.

In terms of general access to technology, the majority of participants (6/10) in the qualitative analysis looked for free Wi-Fi options outside the shelters as well. One interviewee mentioned the lack of free Wi-Fi on public transport services and the lack of smart benches in Budapest as barriers to usage. Such infrastructural problems were mentioned as causes of non-usage by 7.6 percent of respondents in the quantitative analysis. On the other hand, several interviewees mentioned using the paid services of cafes to charge their phones or use the Wi-Fi (42). We should mention that Budapest lacks an adequate number of free Wi-Fi hotspots (54); and neither the state nor the municipality provides a sufficient financial or infrastructural background to ensure equitable internet connectivity, although the UN Secretary-General's Roadmap for Digital Cooperation states in its goals that every person should have safe and affordable access to the Internet by 2030, including a meaningful use of digitally enabled services that are in line with the Sustainable Development Goals (110).

In line with previous studies, increasing public access to high-speed Internet and providing discounted smartphones for high-need, low-income individuals may also increase access to the Internet in the context of the homeless populations in Hungary (111). As Raven et al. note, private-sector technology and telecommunication companies might also be incentivized to fund initiatives that increase the use of their services among underserved populations, thereby increasing access to reliable mobile technology (54,68). The need for a potential decrease in internet service or device prices was also expressed by several interviewees in the qualitative analysis, although 18.4 percent of the participants in the quantitative analysis also mentioned that better access to free Wi-Fi, pay-as-you-go facilities, or data contracts would also help them use the Internet more. As a positive example, it should be mentioned that in 2023, the Hungarian Red Cross Charity Service (HRCCS) partnered with Yettel in the framework of a Digital Inclusion Fund to support the purchase of devices (mobile phones, tablets, laptops) or software for socializing, learning, and accessing the Internet in general. Institutions such as health, social and child welfare institutions (hospitals, nursing homes, family shelters, and children's homes), and people in need (especially students, elderly people, large families, people in need of care, children of single-parent families, and people in social and child welfare institutions) can apply for support (112).

In terms of access to healthcare, Hungary has universal healthcare coverage, which means that under the law on health (1997 CLIV), every patient is entitled to access to life-saving services, as well as services preventing severe or permanent damage to health. Specialist services are available free of charge for those who have a social insurance card. Homeless service providers can provide help in the supplementation of the documents (identity card, social insurance card) necessary to get access to these services. The delivery of in-patient services to people with no permanent address takes place based on a so-called central bed register. The delivery of specialist services at outpatient departments for homeless people is unsolved, and they often face refusal. Homeless patients who have no social insurance card can access 24-hour health care services at health centers financed by the National Health Insurance Fund. So far there are five such institutions in Budapest and several more in the countryside (e.g. in Pécs and Miskolc) (113).

In terms of access to training programs, especially education on digital health products and services, we have not found any public program that works with people experiencing homelessness and their digital inclusion specifically, although there are programs for other vulnerable groups, such as the elderly, or people living in small villages in the Hungarian countryside (114). For example, anyone can take part in the National Media and Infocommunications Authority's "Netre fel!” (Get online!) program, which aims to develop the digital skills of older people. The program website includes a knowledge portal with useful information on mobile internet, films, music, exhibitions, and more (115).

5.4. The Digitally Engaged Subgroup

The last hypothesis of this thesis was that there is a small group of people experiencing homelessness that exhibits the characteristics of digitally engaged persons, thus resembling the characteristics of e-patients, who are electronic, empowered, engaged, equipped, and enabled, as it was outlined in the introductory chapter.

In our quantitative analysis, we found that the homeless population was a diverse group in terms of health-related Internet use and access to digital tools, with a significant number of digitally engaged participants. When analyzing the data, the research team found two digitally engaged homeless subpopulations: a subpopulation without health-related mobile app use (129/662, 19.5 percent) and another with such use (39/662, 5.9 percent). In the end, we included the broadly defined digitally engaged group in our analysis, as mHealth app use did not indicate meaningful digital health engagement, as its usage was very low in the reference population as well. Generally speaking, the digitally engaged group included more women and younger respondents than the homeless population, which was in line with the findings of the linear regression model of the quantitative analysis. The overall results were also congruent with previous literature stating that low-income populations rely on smartphones rather than computers for internet access; the latter was less frequent than owning a smartphone in our digitally engaged sample as well (54).

A Chi-square test on the association between demographic factors and the more broadly defined subgroup showed that the type of institution and social service, as well as the level of education mattered as factors for becoming digitally engaged (the higher the level of completed education, the more substantial the digital engagement). Temporary shelters (40/129, 31 percent) and day and night shelters (28/129, 21.7 percent and 22/129, 17 percent, respectively) housed most respondents in the subpopulation (90/129, 69.7 percent), which means that long-term living conditions seem to be associated with digital inclusion. The same pattern emerged in the more strictly defined subgroup; a Chi-square test on the association between demographic factors showed that only the type of institution providing social services mattered as a factor for becoming digitally engaged.

Almost half of the selected subgroup used temporary shelters, whereas very few digitally engaged users were found among rough sleepers and those who used emergency accommodations (54).

5.4.1. Peer to peer support

In contrast with the quantitative analysis of a digitally engaged subgroup, the qualitative analysis clearly showed a behavioral trait that was characteristic of these shelter clients. Most interestingly and most importantly, the majority of the interviewees (6/10) of the qualitative analysis shared that this subgroup supports their peers in taking up digital skills and helps them solve their problems related to usage and the devices themselves. This previously unknown behavioral trait of the community has a lot of untapped potential for widening digital health usage among the homeless population (42).

While interviewees recognized some support from shelters in solving infrastructural and service-related technology issues, there was a perceivable lack of systematic solutions when it came to usage-related problems and digital literacy issues, as it was already mentioned above. As we selected interviewees based on at least average self-reported digital health literacy skills and aptitude toward digital technology, with some demonstrating previous educational or professional background in IT services, their less digitally skilled peers turned to them for help (42).

The majority of interviewees (6/10) provided unintentional peer support concerning technology usage issues, solved technology-related problems, and provided guidance for future scenarios. Peer support within this context can be defined as a process whereby individuals with lived experiences of a particular phenomenon provide support to others by explicitly drawing on their personal experiences (42,116). Intentional peer support works as a formalized framework of this process, fostered and developed by institutions, while unintentional peer support remains under the radar of the institutions. The literature recognizes the potential of peer support and peer support workers, who have the necessary training and provide intentional support to their peers by sharing their lived experiences in different areas of life. Members of this digitally engaged subgroup might show potential for offering intentional peer support in digital upskilling in service providing shelters (42,116,117).

Moreover, anyone considering a comprehensive digital health program for homeless groups in Hungary that would concentrate on offering solutions to infrastructure and skill-related problems should take into account the untapped potential of members of digitally engaged subgroups. Through their elevated trust levels among their peers, these individuals might provide better outcomes in digital upskilling than official and institutionalized digital health literacy programs (42). A systematic review found that empowerment and self-esteem in the homeless population increased when working with homeless peers as mentors and educators, and that peer support in general facilitates the acceptance of illness and recovery, and it increases efficacy, social skills, and coping (42,118).

6. CONCLUSIONS

Having looked at the results of the quantitative and qualitative analysis and examined our hypotheses about the relationship between digital health and people experiencing homelessness in Budapest, Hungary, we can draw some general conclusions. Overall, this thesis shows that digital health services have great potential for managing and preventing health issues in community shelters (42). Although the quantitative analysis showed that health-related Internet use is lower among people experiencing homelessness than in the general population, the results also point out that the idea of involving homeless populations in Hungary in the digital health ecosystem is a viable concept, especially if barriers to access are systematically reduced and the enablers of use are strengthened (54). Moreover, the pattern of use seems to be similar between the two groups, and the usage characteristics of digitally engaged people experiencing homelessness resemble that of digitally engaged patients in the reference characteristics, with certain special features, such as peer-to-peer support and turning to complementary and alternative medicine.

6.1. Strengths

This thesis aimed to enrich the still relatively small body of research concerning the health and technology-related characteristics of the homeless population in Central and Eastern Europe, including behaviors related to digital health. Heaslip et al. note this asymmetry and encourage further research in the United Kingdom, Europe, and lower-income countries (42,70). In North America and Western Europe, where the majority of studies involving people experiencing homelessness are conducted, both the demographic composition of such populations as well as the health care system may differ significantly from the Central and Eastern European, and specifically Hungarian experiences, with different problems and solutions at individual and systemic levels (42).

In terms of the quantitative analysis, compared with other studies that examine people experiencing homelessness in particular areas, the sample size (N=662) is considered notable and large enough to draw statistically significant conclusions (54). In terms of the qualitative analysis, the characteristics of a unique subgroup of digitally engaged people experiencing homelessness could be explored in a less studied area of digital health for equitable health care, where a systematic mapping of review studies showed notable gaps (42,119).

6.2. Limitations

The thesis has certain limitations that have to be acknowledged. First, the samples of both the quantitative and qualitative analysis represent urban homeless populations from Budapest, Hungary, where socioeconomic conditions, access to digital tool, and usage patterns might differ from those living in the countryside (54). For example, a study from 2022 showed that households in rural compared to urban areas in the United States were significantly less likely to have access to computers with high-speed Internet (30.64 percent versus 48.01 percent) and smartphones with wireless data plans (20.29 percent versus 33.08 percent). A lack of any kind of digital access was twice as common in rural than in urban populations (23.42 percent versus 13.03 percent) (93,120). Second, although the sample of the quantitative analysis was not representative, conducting such analysis on hard-to-reach groups does present challenges (121). Little is known about homeless individuals outside the social system, such as rough sleepers, squatters, those staying with friends or relatives, those staying in lodgings in forests or make-shift habitations around cities. In Hungary, no representative homeless survey has been conducted due to methodological issues and a lack of basic demographic data, although surveys by the Third of February Group (Február Harmadika Csoport) are the closest attempts (59).

Third, the homeless population recruited in both our quantitative and qualitative research projects had a connection to the social infrastructure; therefore, rough sleepers and other people with unstable housing conditions who were not connected to any social initiatives were not represented. Moreover, the sample covered only the clientele of HCSOM, and so the clients of other charity services, foundations, non-governmental organizations supporting people experiencing homelessness were not included. Fourth, both the quantitative and the qualitative analysis excluded people experiencing homelessness with mental health disorders, psychiatric problems, dementia, or severe disabilities. Furthermore, our two-tier analysis relied exclusively on self-reporting digital tool access, such as mobile phone or smartphone ownership, Internet access, and Internet use, and it did not attempt in any way to verify these reports (e.g. via phone bills, direct observation, or other methods) (42,54). We also used in-depth semi-structured interviews in the qualitative research among digitally engaged people experiencing homelessness, which represents a unique subgroup among people experiencing homelessness. However, it can be assumed that the subgroup itself has a low number of members, thus the sample size of the qualitative analysis turned out to be small. This should be taken into account when drawing inferences (42).

In addition, the quantitative analysis was conducted between April 19, 2021, and August 11, 2021, thus between the third and fourth waves of the COVID-19 pandemic in Hungary, while the qualitative analysis was conducted between 18 August and 27 October 2022, thus close after the Hungarian government had lifted the epidemiological emergency in June 2022. As mentioned before, the COVID-19 pandemic could have made its imprint on our analyses, however, as the research methodology represents cross-sectional analysis and we do not possess any longitudinal data to compare it with from previous periods, we could not account for any potential change in terms of access or usage patterns that might have emerged due to the impact of the COVID-19 pandemic. Finally, concerning people experiencing homelessness, there is an increased risk of social desirability bias when conducting interviews or when taking survey questionnaires in person, meaning that respondents tend to modify their responses in the presence of an interviewer or the surveyor perceived to be in a different socioeconomic and overall social situation than their own (in the case of the quantitative analysis, it was a social worker connected to the respondents via their institution) (42,122).

6.3. Policy Recommendations

People experiencing homelessness find themselves at the very brink of society, where inadequate access to social determinants of health, as well as the healthcare system, has dire consequences, materializing in significantly shorter life expectancy (123) and the prevalence of a range of acute, infectious, or chronic diseases (124). Unequal access also materializes in unequal access to digital technology, a so-called super social determinant of health (45).

To mitigate the digital divide and make sure that vulnerable groups in societies, e.g. people experiencing homelessness, also have the chance to experience the benefits of digital health technologies, the "equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere" (125), would be the ideal state of play. This is how the UN defines digital inclusion, and it also refers to all the necessary activities that ensure equitable access to and use of information and communication technologies in general. These include (1) affordable broadband Internet service, (2) Internet-enabled devices, (3) access to digital literacy training, (4) quality technical support, and (5) applications and online content designed to enable and encourage self-sufficiency, participation, and collaboration (45). These also constitute the basis for the use of digital health technologies.

Comparing our findings to these five preconditions, we can make several recommendations to public and private decision-makers, non-governmental organizations, or foundations to help vulnerable groups be more involved in the digital health ecosystem. When looking at affordable broadband Internet service and Internet-enabled devices, the unavailability and poor affordability of devices and subscriptions and the lack of publicly available free Wi-Fi hotspots was mentioned as barriers to digital technological access. All these factors might be improved by making adequate changes, enabling more Wi-Fi hotspots, and installing more publicly available computers in social institutions (54). Government agencies may consider strengthening the infrastructural background of shelters and making free Wi-Fi accessibility an option in more public places, such as busses and piazza places, which could greatly reduce the issues of access this population has. Institutional aid for accessing services and digital tools may also offer a viable option for people experiencing homelessness (42). For example, according to FEANTSA, France has created several 'Espaces Publics Numériques' (digital public spaces). These are centers that have staff working as 'digital mediators' and equipment that everyone can access, aiming to reach digitally excluded groups. However, even if this staff is an expert on digital issues, they lack knowledge on the social dimension. That is why some shelters in France are trying to partner with the closest centers, so their beneficiaries could also make use of them (109).

In addition, when looking at access barriers on the service provider side, an Internet service scheme specifically designed for the homeless population (eg, prepaid services available for medical purposes) could facilitate a shift toward better digital health (54). Telephone companies may consider subsidy programs to support mobile ownership and data services for this vulnerable population, as well as specific discount packages and more publicly available recharge options, as these would greatly support this group, which is often in crisis and need (42). As a positive example mentioned before, in 2023, HRCCS partnered with Yettel to support the purchase of mobile phones, tablets, laptops or software for socializing, learning, and accessing the Internet in general. Health, social, and child welfare institutions and people in need can apply to this Digital Inclusion Fund for support (112). Another positive example is Vodafone, who have partnered with several social services in the Czech Republic to make monthly data subscriptions more accessible to people in need, while in France, ‘Emmaüs Connect’ has partnered with companies to give devices and/or data plans at a low price to people in need. In Romania, the Casa Ioana homeless shelter has worked with Amazon to provide tablets for children in their shelter so they could follow online lessons during the COVID-19 pandemic (109).

The higher digital accessibility of an institution in terms of both infrastructure and digital literacy is associated with a greater likelihood of an increase in the number of digitally engaged people experiencing homelessness. The ‘Maraud’IN’ project coordinated by Fédération des Acteurs de la Solidarité (FAS) in France can be mentioned as a good example, aiming to provide devices and digital skills directly to people sleeping rough in the streets (109).

It has to be noted that we did not find any trace of the latter three preconditions for digital inclusion in our results (i.e. digital literacy training, quality technical support, and applications and online content designed to enable and encourage self-sufficiency, participation, and collaboration), meaning that shelters, private companies, and governmental actors have the opportunity to fill these gaps with products or services for people experiencing homelessness. However, it is important to note that despite all the barriers to accessing digital technologies, our research identified a digitally engaged homeless subgroup whose members actively use digital tools for health purposes. The qualitative analysis of this group delineated the characteristics, motivations, and potential for widening access and use, showing that this group could form a baseline for holistic and appropriate digital public health interventions (54).

Our most important finding is that digitally engaged homeless individuals demonstrate a strong aptitude for technology and a willingness to share their knowledge with their peers. This positions them as potential mediators between their peers and any potential comprehensive digital health program, for example, digital health literacy training programs. These individuals are trusted within their communities, recognize the advantages of digital technology, and provide valuable assistance for technology-related challenges. With suitable training, they could serve as tutors to help upskill other people experiencing homelessness, creating a bridge to digital technologies and health ecosystems. Moreover, these technologically capable peers could play a role in building trust in the healthcare system by potentially participating in institutional programs that encourage peer-to-peer recommendations of reliable health information sources (42). As FEANTSA also mentions, many people experiencing homelessness first need a contact point to trust, which is often lacking, just as in the case of ‘Citizen’s advice’ in the UK or ‘Espaces Publics Numériques’ in France. These are not often used by people experiencing homelessness, even if they could potentially benefit from them, because they do not have a trust relation with the staff (109). Peer-to-peer support could change this for the better.

7. SUMMARY

The COVID-19 pandemic has accelerated the uptake of digital technologies in healthcare; however, the distribution of the access and use of digital health solutions greatly varies among countries, communities and individuals according to social determinants of health. The literature describes the phenomenon of the digital health paradox, i.e. those vulnerable populations who could benefit the most from the uptake of digital health solutions are less likely to be accessing and using them.

In this thesis, my aim was to explore the existence of the digital health paradox in one of the most vulnerable populations in Hungary: people experiencing homelessness in Budapest, and thus enrich the still relatively small body of research on the health and technology-related characteristics of this population in Central and Eastern Europe. Based on the literature and previous research by the DHWG, the following research goals crystallized:

1) Based on a quantitative analysis, the thesis examined whether people experiencing homelessness have access to digital tools and the Internet, and whether they use them for health-related purposes.
2) As a digitally engaged subgroup of people experiencing homelessness was detectable in the quantitative sample, a qualitative research project was designed to explore how the digitally engaged subgroup accesses and uses digital tools and the Internet for health-related purposes.

The results show that people experiencing homelessness have partial access to digital tools, and more than a third of the population has used their devices for health-related purposes. The results point out that the idea of involving homeless populations in Hungary in the digital health ecosystem is a viable concept, especially if barriers to access are systematically reduced and enablers of use strengthened.

Moreover, digitally engaged people experiencing homelessness represent a subgroup in the population that actively uses their devices for health-related purposes, and that performs peer to peer support when it comes to technological issues. Their presence might form a basis for any potential digital health literacy program in shelters, as they have the trust and technical knowledge that are the preconditions for the success of any such program within this vulnerable group.

8. REFERENCES

1. Pullen DL. Back to Basics: Electronic Collaboration in the Education Sector. In: Salmons J, Wilson L, editors. Handbook of Research on Electronic Collaboration and Organizational Synergy [Internet]. IGI Global; 2009 [cited 2025 Jan 18]. p. 205–22. Available from: http://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-60566-106-3.ch014
2. Online Library Learning Center. A Brief History of the Internet [Internet]. [cited 2025 Jan 2]. Available from: https://www.usg.edu/galileo/skills/unit07/internet07_02.phtml
3. Mößner N, Kitcher P. Knowledge, Democracy, and the Internet. Minerva. 2017;55(1):1–24.
4. iPhone History: From the Original iPhone to iPhone 16 [Internet]. [cited 2025 Jan 18]. Available from: https://www.seamgen.com/blog/iphone-history-original-iphone-to-current-iphone
5. smartphone [Internet]. 2025 [cited 2025 Jan 18]. Available from: https://dictionary.cambridge.org/dictionary/english/smartphone
6. Williams GA, Fahy N. Use of digital health tools in Europe: before, during and after COVID-19. 2021 [cited 2024 Dec 12]; Available from: https://iris.who.int/handle/10665/345091
7. Marino F, Alby F, Zucchermaglio C, Fatigante M. Digital technology in medical visits: a critical review of its impact on doctor-patient communication. Front Psychiatry. 2023 Jul 27;14:1226225.
8. WHO. Patient empowerment and health care. In: WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care Is Safer Care [Internet]. World Health Organization; 2009 [cited 2025 Jan 4]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK144022/
9. Meskó B, Drobni Z, Bényei É, Gergely B, Győrffy Z. Digital health is a cultural transformation of traditional healthcare. mHealth [Internet]. 2017 Sep 14 [cited 2025 Jan 3];3(9). Available from: https://mhealth.amegroups.org/article/view/16494
10. Meskó B, Radó N, Győrffy Z. Opinion leader empowered patients about the era of digital health: a qualitative study. BMJ Open. 2019 Mar;9(3):e025267.

11. Ferguson T. doctom.com: Home of Tom Ferguson's Page [Internet]. 2006 [cited 2025 Jan 20]. Available from: https://www.doctom.com/
12. deBronkart D. How the e-patient community helped save my life: an essay by Dave deBronkart. BMJ. 2013 Apr 2;346:f1990.
13. Riggare S. E-patients hold key to the future of healthcare. BMJ. 2018 Feb 26;360:k846.
14. Riggare S. Patient researchers - the missing link? Nat Med. 2020 Oct;26(10):1507.
15. Lewis D, Scott P. BMJ HCI launches partnership programme for patients and carers as authors and peer reviewers. BMJ Health Care Inform. 2021;28(1):e100471.
16. ROGERS EM, SINGHAL A, QUINLAN MM. Diffusion of Innovations. In: An Integrated Approach to Communication Theory and Research. 2nd ed. Routledge; 2008.
17. Masters K, Ng'ambi D, Todd G. "I Found it on the Internet." Sultan Qaboos Univ Med J. 2010 Aug;10(2):169–79.
18. Eurostat. One in two EU citizens look for health information online [Internet]. 2021 [cited 2025 Jan 20]. Available from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210406-1
19. Jia X, Pang Y, Liu LS. Online Health Information Seeking Behavior: A Systematic Review. Healthcare. 2021 Dec;9(12):1740.
20. Al-Alusi MA, Khurshid S, Wang X, Venn RA, Pipilas D, Ashburner JM, et al. Trends in Consumer Wearable Devices With Cardiac Sensors in a Primary Care Cohort. Circ Cardiovasc Qual Outcomes. 2022 Jul 1;15(7):e008833.
21. Gyorffy Z, Döbrössy B, Radó N, Boros J, Békási S. State of vulnerable populations in the techquity framework in Hungary. Front PUBLIC Health. 2023 Jul 6;11.
22. WHO. Global Strategy on Digital Health 2020-2025. 1st ed. Geneva: World Health Organization; 2021. 1 p.
23. Fatehi F, Samadbeik M, Kazemi A. What is Digital Health? Review of Definitions. Stud Health Technol Inform. 2020;275:67–71.
24. Győrffy Z, Döbrössy B, Radó N, Boros J, Békási S. State of vulnerable populations in the techquity framework in Hungary. Front Public Health. 2023;11:1215325.
25. Hashiguchi O. OECD. 2020 [cited 2025 Jan 18]. Bringing health care to the patient. Available from: https://www.oecd.org/en/publications/bringing-health-care-to-the-

patient_8e56ede7-en.html

26. OECD. OECD. 2023 [cited 2025 Jan 18]. The COVID-19 Pandemic and the Future of Telemedicine. Available from: https://www.oecd.org/en/publications/the-covid-19-pandemic-and-the-future-of-telemedicine_ac8b0a27-en.html
27. OECD [Internet]. [cited 2025 Jan 18]. Digital health. Available from: https://www.oecd.org/en/topics/digital-health.html
28. Chang E, Penfold RB, Berkman ND. Patient Characteristics and Telemedicine Use in the US, 2022. JAMA Netw Open. 2024 Mar 22;7(3):e243354.
29. Haimi M, Sergienko R. Adoption and Use of Telemedicine and Digital Health Services Among Older Adults in Light of the COVID-19 Pandemic: Repeated Cross-Sectional Analysis. JMIR Aging. 2024 Apr 24;7:e52317.
30. Gullslett MK, Ronchi E, Lundberg L, Larbi D, Lind KF, Tayefi M, et al. Telehealth development in the WHO European region: Results from a quantitative survey and insights from Norway. Int J Med Inf. 2024 Nov 1;191:105558.
31. Jiang J (Xuefeng), Qi K, Bai G, Schulman K. Pre-pandemic assessment: a decade of progress in electronic health record adoption among U.S. hospitals. Health Aff Sch. 2023 Nov 3;1(5):qxad056.
32. Gleeson LL, Ludlow A, Wallace E, Argent R, Collins C, Clyne B, et al. Changes to primary care delivery during the COVID-19 pandemic and perceived impact on medication safety: A survey study. Explor Res Clin Soc Pharm. 2022 Jun 1;6:100143.
33. Yang L, Wu J, Mo X, Chen Y, Huang S, Zhou L, et al. Changes in Mobile Health Apps Usage Before and After the COVID-19 Outbreak in China: Semilongitudinal Survey. JMIR Public Health Surveill. 2023 Feb 22;9:e40552.
34. Meskó B. COVID-19's Impact on Digital Health Adoption: The Growing Gap Between a Technological and a Cultural Transformation. JMIR Hum Factors. 2022 Sep 19;9(3):e38926.
35. DESI. Magyarország a digitális gazdaság és társadalom indexében | Shaping Europe's digital future [Internet]. 2022 [cited 2025 Jan 19]. Available from: https://digital-strategy.ec.europa.eu/hu/policies/desi-hungary
36. Girasek E, Boros J, Döbrössy B, Susánszky A, Győrffy Z. E-páciensek Magyarországon: Digitális egészséggel kapcsolatos ismeretek, szokások egy

országos reprezentatív felmérés tükrében. 2022 Jul 17 [cited 2025 Jan 3]; Available from: https://akjournals.com/view/journals/650/163/29/article-p1159.xml

37. Győrffy Z, Girasek E. E-páciensek Magyarországon, 2024. Reprezentatív felmérés a digitális egészségügyi megoldásokkal kapcsolatos tudásról, attitűdökről, lehetőségekről a magyar lakosság körében. 2024.
38. Abernethy A, Adams L, Barrett M, Bechtel C, Brennan P, Butte A, et al. The Promise of Digital Health: Then, Now, and the Future. NAM Perspect. 2022;2022:10.31478/202206e.
39. WHO, Regional Office for South-East Asia. Social determinants of health. report of a regional consultation, Colombo, Sri Lanka, 2-4 October 2007 [Internet]. 2008 [cited 2025 Jan 3]; Available from: https://iris.who.int/handle/10665/206363
40. Lathrop B. Moving Toward Health Equity by Addressing Social Determinants of Health. Nurs Womens Health. 2020 Feb 1;24(1):36–44.
41. Braveman P, Gottlieb L. The Social Determinants of Health: It’s Time to Consider the Causes of the Causes [Internet]. 2014 [cited 2025 Jan 3]. Available from: https://journals.sagepub.com/doi/10.1177/00333549141291S206
42. Radó N, Békási S, Győrffy Z. Health Technology Access and Peer Support Among Digitally Engaged People Experiencing Homelessness: Qualitative Study. JMIR Hum Factors. 2024 May 14;11:e55415.
43. Steptoe A, Marmot M. The role of psychobiological pathways in socio-economic inequalities in cardiovascular disease risk. Eur Heart J. 2002 Jan 1;23(1):13–25.
44. Cockerham WC, Hamby BW, Oates GR. The Social Determinants of Chronic Disease. Am J Prev Med. 2017 Jan 1;52(1S1):S5–12.
45. Sieck CJ, Sheon A, Ancker JS, Castek J, Callahan B, Siefer A. Digital inclusion as a social determinant of health. Npj Digit Med. 2021 Mar 17;4(1):1–3.
46. NDIA. Digital Inclusion: Definitions [Internet]. National Digital Inclusion Alliance. 2024 [cited 2025 Jan 19]. Available from: https://dev.digitalinclusion.org/definitions/
47. Krishnasamy HN. Elementary School Educational Practices and the Need for Flexibility in Remote Learning Environments: In: Courtney-Dattola A, editor. Advances in Early Childhood and K-12 Education [Internet]. IGI Global; 2022 [cited 2025 Jan 3]. p. 136–54. Available from: http://services.igi-

global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-7998-8405-7.ch009

48. Digital inclusion, exclusion and participation | Iriss [Internet]. 2020 [cited 2025 Jan 19]. Available from: https://www.iriss.org.uk/resources/esss-outlines/digital-inclusion-exclusion-and-participation
49. Menendez ME, Moverman MA, Puzzitiello RN, Pagani NR, Ring D. The Telehealth Paradox in the Neediest Patients. J Natl Med Assoc. 2021 Jun;113(3):351–2.
50. van Kessel R, Hrzic R, O'Nuallain E, Weir E, Wong BLH, Anderson M, et al. Digital Health Paradox: International Policy Perspectives to Address Increased Health Inequalities for People Living With Disabilities. J Med Internet Res. 2022 Feb 22;24(2):e33819.
51. Ziebland S, Hyde E, Powell J. Power, paradox and pessimism: On the unintended consequences of digital health technologies in primary care. Soc Sci Med 1982. 2021;289:114419.
52. Falk Erhag H, Ahlner F, Rydberg Sterner T, Skoog I, Bergström A. Internet use and self-rated health among Swedish 70-year-olds: a cross-sectional study. BMC Geriatr. 2019 Dec 23;19(1):365.
53. Duplaga M, Szulc K. The Association of Internet Use with Wellbeing, Mental Health and Health Behaviours of Persons with Disabilities. Int J Environ Res Public Health. 2019 Sep;16(18):3252.
54. Radó N, Girasek E, Békási S, Győrffy Z. Digital Technology Access and Health-Related Internet Use Among People Experiencing Homelessness in Hungary: Quantitative Survey. J Med Internet Res. 2022 Oct 19;24(10):e38729.
55. Nagy-Borsy E, Vági Z, Skerlecz P, Szeitl B, Kiss I, Rákosy Z. Health status and health behaviour of the Hungarian homeless people. Arch Public Health. 2021 Feb 2;79(1):15.
56. Amore K, Baker M, Howden-Chapman P. The ETHOS Definition and Classification of Homelessness: An Analysis. 2011;5(2).
57. FEANTSA. Social Justice Ireland. 2024 [cited 2025 Jan 4]. Overview of Homelessness in Europe: Key Insights from the 2024 Report by FEANTSA and Fondation Abbé Pierre. Available from: https://www.socialjustice.ie/article/overview-homelessness-europe-key-insights-2024-report-feantsa-and-fondation-abbe-pierre

58. FEANTSA. HOMELESSNESS IN EUROPE - THE STATE OF PLAY [Internet]. 2024. Available from: https://www.feantsa.org/public/user/Activities/events/2024/9th_overview/EN_Chap/1.pdf
59. Február Harmadika Kutatócsoport. HÚSZ ÉV UTÁN - A Február Harmadika Országos Hajléktalan Adatfelvétel elemzései [Internet]. 2024 [cited 2025 Jan 4]. Available from: http://www.menhely.hu/index.php/hajlektalansag/tanulmanyok/8090-husz-ev-utan-a-februar-harmadika-orszagos-hajlektalan-adatfelvetel-elemzesei
60. Graffy P, McKinnon S, Lee G, Remington P. Life Outside: A Narrative Ethnographic Inquiry into the Determinants of Homelessness. J Poverty. 2018 Dec 13;23:1–27.
61. Schreiter S, Bermpohl F, Krausz M, Leucht S, Rössler W, Schouler-Ocak M, et al. The Prevalence of Mental Illness in Homeless People in Germany. Dtsch Arzteblatt Int. 2017 Oct 6;114(40):665–72.
62. Zhang L, Norena M, Gadermann A, Hubley A, Russell L, Aubry T, et al. Concurrent Disorders and Health Care Utilization Among Homeless and Vulnerably Housed Persons in Canada. J Dual Diagn. 2018;14(1):21–31.
63. Bedmar MA, Bennasar-Veny M, Artigas-Lelong B, Salvà-Mut F, Pou J, Capitán-Moyano L, et al. Health and access to healthcare in homeless people: Protocol for a mixed-methods study. Medicine (Baltimore). 2022 Feb 18;101(7):e28816.
64. Aldridge RW, Story A, Hwang SW, Nordentoft M, Luchenski SA, Hartwell G, et al. Morbidity and mortality in homeless individuals, prisoners, sex workers, and individuals with substance use disorders in high-income countries: a systematic review and meta-analysis. Lancet Lond Engl. 2018;391(10117):241–50.
65. van Dongen SI, van Straaten B, Wolf JRLM, Onwuteaka-Philipsen BD, van der Heide A, Rietjens JAC, et al. Self-reported health, healthcare service use and health-related needs: A comparison of older and younger homeless people. Health Soc Care Community. 2019 Jul;27(4):e379–88.
66. Liu M, Hwang SW. Health care for homeless people. Nat Rev Dis Primer. 2021;7(1):5.
67. Omerov P, Craftman ÅG, Mattsson E, Klarare A. Homeless persons' experiences of

health- and social care: A systematic integrative review. Health Soc Care Community. 2020;28(1):1–11.

68. Raven MC, Kaplan LM, Rosenberg M, Tieu L, Guzman D, Kushel M. Mobile Phone, Computer, and Internet Use Among Older Homeless Adults: Results from the HOPE HOME Cohort Study. JMIR MHealth UHealth. 2018;6(12):e10049.
69. VonHoltz LAH, Frasso R, Golinkoff JM, Lozano AJ, Hanlon A, Dowshen N. Internet and Social Media Access Among Youth Experiencing Homelessness: Mixed-Methods Study. J Med Internet Res. 2018 May 22;20(5):e184.
70. Heaslip V, Richer S, Simkhada B, Dogan H, Green S. Use of Technology to Promote Health and Wellbeing of People Who Are Homeless: A Systematic Review. Int J Environ Res Public Health. 2021 Jun 25;18(13):6845.
71. Odoh C, Vidrine JI, Businelle MS, Kendzor DE, Agrawal P, Reitzel LR. Health Literacy and Self-Rated Health among Homeless Adults. Health Behav Res. 2019 Oct;2(4):13.
72. Smith B, Magnani JW. New technologies, new disparities: The intersection of electronic health and digital health literacy. Int J Cardiol. 2019 Oct 1;292:280–2.
73. Adkins EC, Zalta AK, Boley RA, Glover A, Karnik NS, Schueller SM. Exploring the potential of technology-based mental health services for homeless youth: A qualitative study. Psychol Serv. 2017 May;14(2):238–45.
74. Girasek E, Döbrössy B, Boros J, Győrffy Z. Exploring the attitudes and experiences of Hungarian primary care physicians on the utilisation of digital health solutions. BMC Prim Care. 2024;25(1):396.
75. Békási S, Girasek E, Győrffy Z. Telemedicine in community shelters: possibilities to improve chronic care among people experiencing homelessness in Hungary. Int J Equity Health. 2022;21(1):181.
76. DocRoom. First year of telemedicine in service of people experiencing homelessness. 2024 Mar 13; Available from: https://docroom.hu/en/first-year-of-telemedicine-in-service-of-people-experiencing-homelessness/
77. Global Digital Health Monitor. The State of Digital Health 2023 [Internet]. 2023. Available from: https://static1.squarespace.com/static/5ace2d0c5cfd792078a05e5f/t/656f97969301e337ada15270/1701812128734/State+of+Digital+Health_2023.pdf

78. Dorney-Smith S, Burridge S, Bell J, Ellis J, Snowball L. Digital health inclusion for people who have experienced homelessness – is this a realistic aspiration?
79. Girasek E, Boros J, Döbrössy B, Susánszky A, Győrffy Z. [E-patients in Hungary: Digital health use and attitudes based on a representative nationwide survey]. Orv Hetil. 2022 Jul 17;163(29):1159–65.
80. Gyorffy Z, Radó N, Pölczman L, Sükösd A, Boros J. Creating work-life balance among physicians in the age of digitalization: the role of self-consciousness and communication – a qualitative study. BMC Health Serv Res. 2023 Oct 24;23.
81. Malterud K, Siersma VD, Guassora AD. Sample Size in Qualitative Interview Studies: Guided by Information Power. Qual Health Res. 2016;26(13):1753–60.
82. Thomas D. Feedback from research participants: are member checks useful in qualitative research? Qual Res Psychol. 2017 Jan 2;14:23–41.
83. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006 Jan 1;3(2):77–101.
84. Hungarian Central Statistical Office. Information, communication – Hungarian Central Statistical Office [Internet]. 2023 [cited 2025 Jan 19]. Available from: https://www.ksh.hu/information-communication
85. Statista. Statista. 2023 [cited 2025 Jan 19]. Hungary: smartphone penetration 2023. Available from: https://www.statista.com/statistics/1130493/hungary-smartphone-penetration/
86. McInnes DK, Li AE, Hogan TP. Opportunities for engaging low-income, vulnerable populations in health care: a systematic review of homeless persons' access to and use of information technologies. Am J Public Health. 2013;103 Suppl 2(Suppl 2):e11-24.
87. Rhoades H, Wenzel S, Rice E, Winetrobe H, Henwood B. No Digital Divide? Technology Use among Homeless Adults. J Soc Distress Homeless. 2017;26(1):73–7.
88. Thurman W, Semwal M, Moczygemba LR, Hilbelink M. Smartphone Technology to Empower People Experiencing Homelessness: Secondary Analysis. J Med Internet Res. 2021 Sep 29;23(9):e27787.
89. Woods SS, Forsberg CW, Schwartz EC, Nazi KM, Hibbard JH, Houston TK, et al. The Association of Patient Factors, Digital Access, and Online Behavior on

Sustained Patient Portal Use: A Prospective Cohort of Enrolled Users. J Med Internet Res. 2017 Oct 17;19(10):e345.

90. Von Holtz LAH, Frasso R, Lu Y, Hanlon AL, Dowshen NL. New media use and health information-seeking behavior among homeless adolescents. J Adolesc Health. 2015;56(2):S55.
91. Rice E, Kurzban S, Ray D. Homeless but connected: the role of heterogeneous social network ties and social networking technology in the mental health outcomes of street-living adolescents. Community Ment Health J. 2012;48(6):692–8.
92. Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and physiological processes: a review with emphasis on underlying mechanisms and implications for health. Psychol Bull. 1996 May;119(3):488–531.
93. Badr J, Motulsky A, Denis JL. Digital health technologies and inequalities: A scoping review of potential impacts and policy recommendations. Health Policy. 2024 Aug 1;146:105122.
94. Bidmon S, Terlutter R. Gender Differences in Searching for Health Information on the Internet and the Virtual Patient-Physician Relationship in Germany: Exploratory Results on How Men and Women Differ and Why. J Med Internet Res. 2015 Jun 22;17(6):e4127.
95. Rising CJ, Jensen RE, Moser RP, Oh A. Characterizing the US Population by Patterns of Mobile Health Use for Health and Behavioral Tracking: Analysis of the National Cancer Institute’s Health Information National Trends Survey Data. J Med Internet Res. 2020 May 14;22(5):e16299.
96. Goodwin P, Garrett D, Galal O. Women and Family Health: The Role of Mothers in Promoting Family and Child Health. Int J Glob Health Health Disparities. 2005 Jan 1;4(1):30–42.
97. Harris J. The digitization of advice and welfare benefits services: re-imagining the homeless user. Hous Stud. 2020 Jan 2;35(1):143–62.
98. Bol N, Helberger N, Weert JCM. Differences in mobile health app use: A source of new digital inequalities? Inf Soc. 2018 May 27;34(3):183–93.
99. Chandrasekaran R, Katthula V, Moustakas E. Patterns of Use and Key Predictors for the Use of Wearable Health Care Devices by US Adults: Insights from a National Survey. J Med Internet Res. 2020 Oct 16;22(10):e22443.

100. Kaihlanen AM, Virtanen L, Buchert U, Safarov N, Valkonen P, Hietapakka L, et al. Towards digital health equity - a qualitative study of the challenges experienced by vulnerable groups in using digital health services in the COVID-19 era. BMC Health Serv Res. 2022 Feb 12;22(1):188.
101. Norman CD, Skinner HA. eHealth Literacy: Essential Skills for Consumer Health in a Networked World. J Med Internet Res. 2006 Jun 16;8(2):e9.
102. Klinger J, Berens EM, Schaeffer D. Health literacy and the role of social support in different age groups: results of a German cross-sectional survey. BMC Public Health. 2023 Nov 16;23:2259.
103. Lima ACP, Maximiano-Barreto MA, Martins TCR, Luchesi BM. Factors associated with poor health literacy in older adults: A systematic review. Geriatr Nur (Lond). 2024 Jan 1;55:242–54.
104. Leader AE, Capparella LM, Waldman LB, Cammy RB, Petok AR, Dean R, et al. Digital Literacy at an Urban Cancer Center: Implications for Technology Use and Vulnerable Patients. JCO Clin Cancer Inform. 2021 Aug;(5):872–80.
105. Sarkar U, Karter AJ, Liu JY, Adler NE, Nguyen R, López A, et al. Social disparities in internet patient portal use in diabetes: evidence that the digital divide extends beyond access. J Am Med Inform Assoc JAMIA. 2011 May 1;18(3):318–21.
106. Tappen RM, Cooley ME, Luckmann R, Panday S. Digital Health Information Disparities in Older Adults: a Mixed Methods Study. J Racial Ethn Health Disparities. 2022;9(1):82–92.
107. Baggett TP, Liauw SS, Hwang SW. Cardiovascular Disease and Homelessness. J Am Coll Cardiol. 2018 Jun 5;71(22):2585–97.
108. Net Jogtar WKH. Government Decree 181/2022 (24 May) on the termination of the state of emergency declared by Government Decree 27/2021 (I. 29.) on the declaration of a state of emergency and the entry into force of emergency measures [Internet]. 2022 [cited 2025 Jan 19]. Available from: https://net.jogtar.hu/jogszabaly?dbnum=1&docid=A2200181.KOR
109. FEANTSA. Digital Inclusion for Homeless People and Homeless Service Providers: An analysis of benefits, challenges, and solutions [Internet]. 2021. Available from: https://www.feantsa.org/public/user/Digitalisation_Policy_Paper.pdf
110. UN. Secretary-General's Roadmap for Digital Cooperation [Internet]. 2020 [cited

2025 Jan 19]. Available from: https://www.un.org/en/content/digital-cooperation-roadmap/

111. Jaeger PT, Bertot JC, Thompson KM, Katz SM, DeCoster EJ. The Intersection of Public Policy and Public Access: Digital Divides, Digital Literacy, Digital Inclusion, and Public Libraries. Public Libr Q. 2012 Jan;31(1):1–20.
112. Hungarian Red Cross Charity Service. Hungarian Red Cross Charity Service. 2023 [cited 2025 Jan 19]. Digitális Felzárkóztatási Alap - Digital Inclusion Fund. Available from: https://voroskereszt.hu/digitalis-felzarkoztatasi-alap/
113. Bakos P, Gurály Z. The Right to Health is a Human Right: Ensuring Access to Health for Homeless People in Hungary - for FEANTSA [Internet]. 2006. Available from: https://www.feantsa.org/download/hungary_health__report-2904160466429023O927.pdf
114. Digitális Falu Program [Internet]. [cited 2025 Jan 19]. Digitális Falu Program. Available from: https://digitalisfalu.hu/
115. Orzói Á. The Elderly and the Digital World (In Hungarian: Az idősek és a digitális világ) [Internet]. 2024 [cited 2025 Jan 19]. Available from: https://fogjunkossze.hu/az-idosek-es-digitalis-vilag
116. Miler JA, Carver H, Foster R, Parkes T. Provision of peer support at the intersection of homelessness and problem substance use services: a systematic ‘state of the art’ review. BMC Public Health. 2020 May 7;20(1):641.
117. Homeless and Housing Resource Center. Expanding Peer Support Roles in Homeless Services Delivery: A Toolkit for Service Providers. 2023; Available from: https://hhrctraining.org/system/files/paragraphs/download-file/file/2023-08/HHRC_Peer_Support_Toolkit-508.pdf
118. Barker SL, Maguire N. Experts by Experience: Peer Support and its Use with the Homeless. Community Ment Health J. 2017 Jul;53(5):598–612.
119. Ibrahim MS, Mohamed Yusoff H, Abu Bakar YI, Thwe Aung MM, Abas MI, Ramli RA. Digital health for quality healthcare: A systematic mapping of review studies. Digit Health. 2022 Jan 1;8:20552076221085810.
120. Curtis ME, Clingan SE, Guo H, Zhu Y, Mooney LJ, Hser YI. Disparities in digital access among American rural and urban households and implications for telemedicine-based services. J Rural Health. 2022;38(3):512–8.

121. Marpsat M, Firdion JM. The Homeless in Paris: A Representative Sample Survey of Users of Services for the Homeless. In 1999. p. p.221-252.
122. Stefkovics Á, Sik E. What Drives Happiness? The Interviewer's Happiness. J Happiness Stud. 2022 Aug 1;23(6):2745–62.
123. Romaszko J, Cymes I, Dragańska E, Kuchta R, Glińska-Lewczuk K. Mortality among the homeless: Causes and meteorological relationships. PLoS ONE. 2017 0;12(12):e0189938.
124. Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries: descriptive epidemiology, health consequences, and clinical and policy recommendations. Lancet Lond Engl. 2014 Oct 25;384(9953):1529–40.
125. UN. Roundtable on Digital Inclusion - Definition of Digital Inclusion [Internet]. Office of the Secretary-General's Envoy on Technology; Available from: https://www.un.org/techenvoy/sites/www.un.org.techenvoy/files/general/Definition_Digital-Inclusion.pdf

9. BIBLIOGRAPHY OF PUBLICATIONS

9.1. Publications related to the thesis (∑IF: 10)

Radó N, Békási S, Győrffy Zs. Health Technology Access and Peer Support Among Digitally Engaged People Experiencing Homelessness: Qualitative Study. JMIR Hum Factors 2024;11:e55415. doi: 10.2196/55415 (IF: 2,6)

Radó N, Girasek E, Békási S, Győrffy Z. Digital Technology Access and Health-Related Internet Use Among People Experiencing Homelessness in Hungary: Quantitative Survey. J Med Internet Res 2022;24(10):e38729. doi: 10.2196/38729 (IF: 7,4)

9.1. Publications not related to the thesis (∑IF: 15,136)

Győrffy Z, Döbrössy B, Radó N, Boros J, Békási S. State of vulnerable populations in the techquity framework in Hungary. Frontiers in Public Health. 2023 Jul 6;11:1215325. doi: 10.3389/fpubh.2023.1215325. PMID: 37483940; PMCID: PMC10357289. (IF: 3,0)

Győrffy, Z., Radó, N., Pölczman, L. et al. Creating work-life balance among physicians in the age of digitalization: the role of self-consciousness and communication – a qualitative study. BMC Health Serv Res 23, 1141 (2023). https://doi.org/10.1186/s12913-023-10101-w (IF: 2,7)

Győrffy Z, Békási S, Döbrössy B, Bognár VK, Radó N, et al. (2022) Exploratory attitude survey of homeless persons regarding telecare services in shelters providing mid- and long-term accommodation: The importance of trust. PLOS ONE 17(1): e0261145. https://doi.org/10.1371/journal.pone.0261145 (IF: 3,7)

Győrffy Z, Radó N, Meskó B. Digitally engaged physicians about the digital health transition. PLoS ONE 15(9): e0238658. https://doi.org/10.1371/journal.pone.0238658 (IF: 3,240)

Meskó B, Radó N, Győrffy Z. Opinion leader empowered patients about the era of digital health: a qualitative study. BMJ Open 2019;9:e025267. DOI:10.1136/ bmjopen-2018-025267 (IF: 2,496)

10. ACKNOWLEDGEMENTS

This work could not have been completed without the direct or indirect contribution of many people, all of whom I owe a lot.

First and foremost, my heartfelt thank you goes out to my supervisor, Dr. Zsuzsa Győrffy, Ph.D., who guided me throughout my Ph.D. years and throughout the ups and downs of research and bureaucracy. I cannot appreciate more her availability, her constant understanding, and all the energy and thought that she put into my guidance.

I would like to thank the support of the entire Digital Health Working Group at Semmelweis University, namely the encouragement and useful pieces of advice from Edmond Girasek Ph.D. – I'm especially grateful for the help with statistics -, Bence Döbrössy, Dr. Julianna Boros PhD., and Dr. Szilvia Zörgő, PhD.

I'm grateful to Dr. Sándor Békási and the entire team at the Hungarian Charity Service of the Order of Malta for their constant cooperation and receptiveness for every new idea and research plan. Without their help, this research could not have been undertaken. I'm especially thankful for all the shelter clients for sharing their views, their opinions, and letting us researchers have a glimpse into their life.

Hereby, I would like to express my thanks to the mayor of Tárnokréti, Katalin Molnárné Boross, for helping me with the experimental research project about small villages and for disseminating the surveys to the inhabitants of the village. Unfortunately, we had to let that part of the research go, but I'm still incredibly grateful for the openness and helpfulness of the entire village. In the same way, I'm grateful to my late friend, Zoltán Gasztonyi, for being open and helpful in organizing the surveying in another small village, Rábasebes.

I'm thankful for the support, guidance and knowledge-sharing throughout our PhD-years to Lea Pölczman and Dóra Mladoneczki-Leszkó, and also for all the support from the esteemed colleagues of the Institute of Behavioral Science.

In an indirect way, this research work was also greatly supported by the editorial team of Qubit, which I'm wholeheartedly thankful for. I'm especially grateful for the help of Róbert Jónás Tóth with the graphics.

Hereby, I would like to thank my friends for all their support and listening ears throughout the years. Júlia Molnár, Anna Debreczeni, Lilla Szabó for always being there;

Orsolya Domaniczky, Erna Burai, and Réka Futász, for their always expert, insightful and in-depth opinions and research support, and the lindy hop friends for always showing the sunny part of life.

And last but not least, I cannot express the words how thankful I am to my husband, Ádám Németh, for his unflinching patience and unwavering support through every step of the way on this journey, as well as my parents and my sister, Anikó Radó, for their never-ending love.

APPENDIX I.

List and characteristics of participating institutions and social services. Source: (54)

Type of service	**ETHOS classification**	**Characteristics**	**Client**	**Number of participating institutions**	**Number of participants**
Street outreach service	1.1	No accommodation offered	Rough sleepers	4	106
Day shelter	N/A	No accommodation offered	Homeless persons	5	167
Night shelter	2.1	Accommodation offered only for short periods (you can stay from 6 p.m. until next morning)	Homeless persons	7	145
Temporary shelter	3.2-7.2	Accommodation offered for longer periods with a maximum of 1+1 years	Homeless persons	7	178
Temporary shelter with a focus on health improvement	3.2-7.2	Accommodation offered for longer periods with a maximum of 1+1 years	Homeless persons with severe health status	2	40
Family shelter	7.2	Accommodation offered for longer periods with a maximum of 1+1/2 years	Homeless families	3	48

		Family shelters are not considered a part of homeless social services according to the law in Hungary (these institutions operate under the Child Protection Act), they were included in the research based on the housing instability of their clients and the temporary nature of the provided accommodation			
Totals:				28	662

APPENDIX II.

DIGITAL HEALTH ACCESS AND LITERACY SURVEY FOR PEOPLE EXPERIENCING HOMELESSNESS

DEMOGRAPHICS AND GENERAL INFORMATION

Gender: **Female / Male** **Date of birth:**

1. Do you consider yourself homeless? NO YES (If yes, since when) YEAR:

2. What is your highest completed level of education?
primary school or lower vocational training high school university, college

3. How frequently do you visit a medical doctor/ do you use medical services?
Several times a month 1-2 occasions per month Every six months Yearly or less frequently

4. Do you have any chronic disease or a long-term health problem? By long-term, we mean a problem which has lasted 6 months or longer.
Yes, and that is No I don't know

5. How would you assess the state of your own health?
Very good Rather good Average Rather poor Very poor I don't know

HEALTH LITERACY

6. Have you ever had any trouble reading health-related documents? Yes/No

7. Did you ask for any help filling in official documents or forms in the last year? Yes/No

8. How would you assess your general knowledge of health-related topics? Would you say it is...?
Very good Rather good Average Rather poor Very poor I don't know

9. When you need to search for health-related information, what do you usually do?
You ask your doctor
You ask a pharmacist
You ask your friends/ relatives
You ask someone in the shelter
You search for it online

Other

10. When trying to access general information on health-related topics or ways to improve your health, which of the following types of information did you look for?
Information on diseases (symptoms, treatments, interventions)
Results of medical exams
Information on pregnancy, childbirth and early infancy
Information on prescribed pharmaceuticals, medical treatments
Testimonials or experiences from other patients
Other

MOBILE PHONE

11. Do you have a mobile phone? Yes / No

12. If yes, is your mobile phone a smartphone (e.g. able to run apps? Yes / No

13. If yes, do you share your phone with others (e.g. family member, friend)? Yes / No, I'm the only user

INTERNET USE

14. Have you ever used the Internet for any purpose? Yes/ No

15. If yes, have you used it in the last six months? Yes / No

16. If you have used the Internet, approximately how often have you used it?
Every day Several days a week Every week Every second week
Once a month Less than once month

17. How do you currently access the Internet? (circle all the responses which apply)
Own SMART phone using a data contract
Own SMART phone using a pay as you go facility
Own SMART phone using free wifi access
Computer at hostel or day centre
Own computer
Other

18. To what extent do you consider yourself a competent Internet user?
Very competent Rather competent Average Less competent Not at all competent

19. What do you use the Internet for? (circle all the responses which apply)
Official business e.g. benefits, job applications
Personal email
Social media (e.g. Facebook, Twitter, Instagram etc)
Playing Games

Viewing things on Youtube
Finding local health / mental health / addictions / homelessness services
Other

20. Have you ever used the Internet for health reasons? Yes / No

21. If yes, what form does this take? (circle all the responses which apply)
Look up health advice
Look up medication advice
Finding health services for homeless persons
Talking to others about health-related topics
Other

22. What barriers, if any, restrict your Internet use? (circle all the responses which apply)
Nothing restricts my internet use
I have Internet access but I have no skills to use the Internet
I have a smartphone but I have no data contract/ money to pay as you go
There are not enough places to access free WIFI
I have no smartphone
There is not enough publicly available computer (e.g. at shelters)
There is no place I can access the Internet

23. What would help you use the Internet more? (circle all the responses which apply)
Being given an appropriate device – if I had a smartphone, I know I would use it for accessing the internet
Better access – I have a smartphone, but there needs to be more free Wi-Fi that I can access and/or I would need a data contract/money to pay as you go
Better access – I currently use computers available at shelters, but there is not enough devices available
More knowledge - I don't have the necessary skills to use the Internet, it would help if I could get assistance
Not relevant - I currently use the Internet as much as I want to

24. Do you agree with the following statements?
You know how to navigate the Internet to find the answers to your health questions
Totally agree Tend to agree Tend to disagree Totally disagree (I don't know)

It doesn't cause any trouble to understand the terminology used on the Internet for health-related topics
Totally agree Tend to agree Tend to disagree Totally disagree (I don't know)

You can distinguish high- quality from low-quality health-related information on the Internet
Totally agree Tend to agree Tend to disagree Totally disagree

(I don’t know)

After looking online to find information on health-related topics, you are generally more confused than before
Totally agree Tend to agree Tend to disagree Totally disagree
(I don’t know)

Your research on the Internet helps you improve your knowledge of health- related topics
Totally agree Tend to agree Tend to disagree Totally disagree
(I don’t know)

MOBILE APPLICATIONS

25. Have you ever used any health-related mobile application? Yes / No
If yes, which one?

APPENDIX III.

COMPLETED CHECKLIST OF THE CONSOLIDATED CRITERIA FOR REPORTING QUALITATIVE RESEARCH (COREQ)[1]

No. Item	Description
Domain 1: Research team and reflexivity *Personal Characteristics*	
1. Facilitator	Interviews were conducted by a professional interviewer (1 person)
2. Credentials	MA
3. Occupation	Researcher
4. Gender	Female
5. Experience and training	Trained interviewer; several years of experience in fieldwork
Relationship with participants	
6. Relationship established	None (interviewees were unknown to the interviewers)
7. Participant knowledge of the interviewer	Interviewees were informed in oral form in advance of the purpose of the interview
8.Interviewer characteristics	Interests in the research topic
Domain 2: study design *Theoretical framework*	
9.Methodological orientation and Theory	Theoretical thematic analysis
Participant selection	
10. Sampling	Purposive sample
11. Method of approach	Face-to face
12. Sample size	12
13. Nonparticipation	0
Setting	
14. Setting of data collection	In 4 Shelters of the Charity Service of the Order of Malta
15. Presence of non-participants	Only the participants and the interviewer were present
16. Description of sample	Purposive sample from people experiencing homelessness, the interviews were taken between 18 August 2022 and 27 October 2022. The interviewees were chosen by social workers/ assistants working in the 4 shelters. A total of 10 interviews were used for the analysis, 2 did not contain any reference to digital health. The interviewees included 4 women and 6 men. In

	terms of age, 1 was in the youngest category, under 40, 4 in the 40-49 age group, 2 in the 50-59 age group and 3 were over 60. In terms of education, 2 interviewees completed primary school or had a lesser education, 3 completed vocational school, 4 completed high school, and 1 had a university degree. All the interviewees resided in the capital city of Hungary, Budapest.
Data collection	
17. Interview guide	2 pilot interviews were conducted. The topic guide was finalized based on the feedback, previous research, and literature review.
18. Repeat interviews	N/A
19. Audio/visual recording	Audio recording and transcription
20. Field notes	No field notes at the setting; ex-post notes about the circumstances of the interviews
21. Duration	Average interview length: 30 minutes
22. Data saturation	No
23. Transcripts returned	No, due to the specific interviewee sample
Domain 3: analysis and findings *Data analysis*	
24. Number of data coders	3
25. Description of the coding tree	See Appendix V.
26. Derivation of themes	Theoretical thematic approach
27. Software	no
28. Participant checking	no
Reporting	
29. Quotations presented	Participant quotations are presented to illustrate the themes/findings; each quotation is identified with interview number
30. Data and findings consistent	yes
31. Clarity of major themes	yes
32. Clarity of minor themes	yes

1. *Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007. Volume 19, Number 6: pp. 349 – 357.*

APPENDIX IV.

Interview Guide

Overview of previous research:

You are now participating in a research project done by the Institute of Behavioral Sciences at Semmelweis University and the Hungarian Charity Service of the Order of Malta. The aim of the study is to map out how you use digital tools so that in the future, the healthcare service might be improved in the long run, perhaps with digital tools.

In a previous study, it turned out that many people living without stable accommodation use smartphones, apps, the internet, even for health-related purposes. So, we do this interview to get to know more about how you use such digital tools, and to collect ideas how to involve others so that they could also benefit from technology.

There is no right or wrong answer, but with every response, we will get a clearer view what we could do together for better care.

Responding to our questions is totally up to you: if you feel that you don’t want to give an answer to any of the questions, that is completely okay.

Thank you for your cooperation, we appreciate your time and energy that you invested in this interview.

Questions

Demographics (Place and date of birth; Educational background; Do you consider yourself to be a homeless person at the moment?)

Health demographics (How do you consider your health in general? Do you have a chronic condition? If yes, can you talk about it? Do you take medication regularly? Have you had any problem with the healthcare system in the last year?)

Do you have a mobile phone? Do you have a smartphone? Do you share it with anyone?

Do you use the internet? If yes, where and what type of service do you use? (free Wi-Fi, pay as you go facility, subscription, other solution)

Can you regularly charge your phone? Where do you do that?

Do you remember when did you start to use your smartphone and/or the internet?

Did you get help from anyone? Did you go to any training?

What do you usually use the internet and/or your smartphone for?

Can you tell me anything that makes it difficult for your to use your smartphone and/or the internet? (not enough free Wi-Fi, not enough smartphones, no subscription or pay as you go facility, no option for charging, no computer at the shelter, cannot use online or digital tools)

Is there anything that would help you use the internet and/or your smartphone? (free Wi-Fi, charger, more smartphones, more computers, training etc.)

Do you use your smartphone and/or the internet for anything health and medicine-related?

Have you ever used a mobile health app?

Have you ever used an online registration system?

Would you use any health app, online registration system, or medical messaging system if there were one?

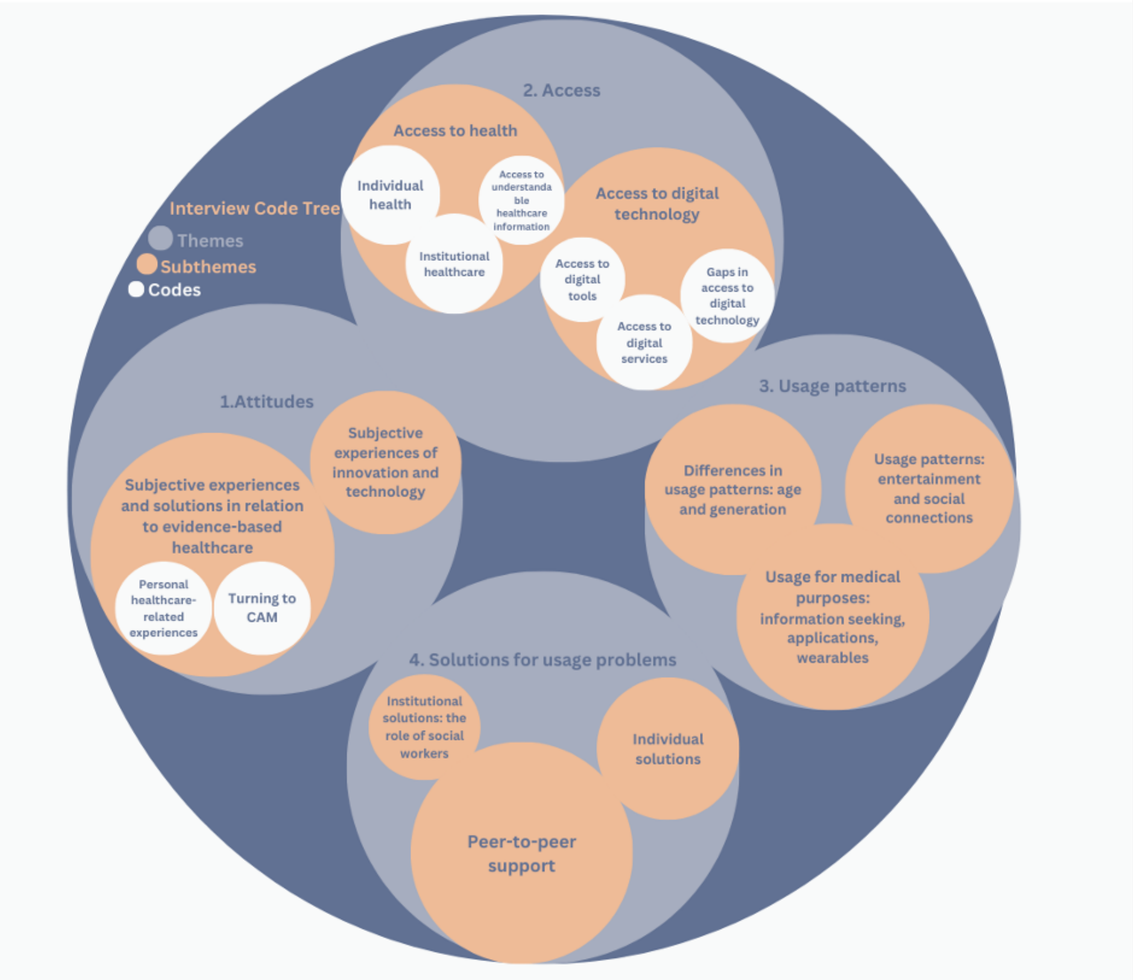
How do you usually reach your doctor and your nurse?

Did anything change during COVID for you? Did you have less or more health issues? Did you use your smartphone/ the internet differently?

Do you have any ideas how could the others living in the shelters be helped so that they could use the internet and/or digital tools as much as they want to?

APPENDIX V.

Qualitative Interview Code Tree.
Source: (42)



APPENDIX VI.

Results of the Binary Logistic Regression Model. Source: (54).

Nagelkerke R Square .154	**B**	**S.E.**	**Wald**	**df**	**sig.**	**Exp(B)**
Gender (1=female; 2=male)	-.480	.222	4.660	1	.031	.619
What is your highest completed level of education?			9.186	3	.027	
What is your highest completed level of education? (1=primary school)	.458	.483	.899	1	.343	1.581
What is your highest completed level of education? (2=vocational training)	-.191	.480	.158	1	.691	.826
What is your highest completed level of education? (3=high school)	-.141	.495	.081	1	.777	.869
How frequently do you visit a medical doctor/ do you use medical services?	.155	.099	2.453	1	.117	1.168
Do you have any chronic disease or a long-term health problem?*	-.481	.238	4.077	1	.043	.618
Age	.049	.009	30.033	1	.000	1.050
Which institution providing services for homeless people do you have contacts with?			3.607	5		

Which institution providing services for homeless people do you have contacts with? (1=outreach service)	.606	.458	1.752	1	.186	1.833
Which institution providing services for homeless people do you have contacts with? (2=day shelter)	.356	.397	.804	1	.370	1.428
Which institution providing services for homeless people do you have contacts with? (3=night shelter)	.058	.431	.018	1	.894	1.059
Which institution providing services for homeless people do you have contacts with? (4= temporary shelter)	.109	.434	.063	1	.801	1.115
Which institution providing services for homeless people do you have contacts with? (6=family shelter)	.223	.585	.145	1	.703	1.249
Constant	-2.052	.838	6.002	1	.014	.128
Dependent variable: Do you ever use the Internet for health reasons? (0=no; 1=yes)						

*By long-term, we mean a problem which has lasted six months or longer.