Hjälpmedel för personer med funktionsnedsättning

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Executive summary

B-SPORT+ är ett europeiskt projekt som syftar till att skapa ett samverkande nätverk mellan intresseorganisationer för att stödja personer med funktionshinder i att bli mer fysiskt aktiva och anta en hälsosammare livsstil.

Inom ramen för B-SPORT+-projektet finns det ett konsortium av nio länder (Albanien, Belgien, Danmark, Italien, Spanien, Slovakien, Slovenien, Sverige och Turkiet) och tio partners genomförde forskning med hjälp av båda enkäter till personer med funktionsnedsättningar och yrkesverksamma. Samt insamlande av data som litteraturgranskning och resurser från webben för att samla information i) om och hur tekniker effektivt kan stödja personer med funktionshinder i att engagera sig och upprätthålla en hälsosam livsstil, ii) om vilka är de potentiella fördelarna relaterade till användningen av teknik som förbättrar deltagande i idrott och fysisk träning, kostbeteenden och antagandet av hälsosammare livsstilar, och iii) vilka är de otillfredsställda behoven hos personer med funktionshinder relaterade till användningen av teknik för att få tillgång till hälsosamma vanor.

Litteratursökningen resulterade i totalt 120 artiklar som var publicerade mellan juli 2002 och juli 2020. Granskningen bekräftade att teknik kan hjälpa personer med funktionsnedsättning att engagera sig i en hälsosam livsstil. Teknik har visat sig ha inte bara ha potentialen att hjälpa till att kompensera för fysiska begränsningar. Utan också att teknik effektivt kan stödja patienter i att hantera kroniska sjukdomar. Därigenom kan teknik ge en öka graden av självständighet kopplat både till färdigt och kunskap för beteendeförändring.

I allmänhet visade litteraturen att för att anses vara effektiva måste teknikrelaterade verktyg och tjänster uppfylla en rad kriterier som: att vara gratis tillgängliga och lätta att använda; vara tillgängligt genom via portabla enheter, alternativt vara tillräckligt små för att hålla och användas i handen; tillhandahålla utbildningssessioner till användare; integrera möjligheten att ta emot hälsoinformation; över lag ha en användarcentrerad design.

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Bland de kritiska och ännu inte förbättrade aspekterna av tekniken lyfte litteraturen fram: misslyckandet med att ta hänsyn till målgruppernas specifika behov; behovet av att underlätta användningen för att undvika att utesluta de som inte är bekanta med användningen av dessa enheter; behovet av att kunna kontrollera utvärdering av mobilapplikationer genom att uttryckligen ange vilken vårdpersonal (om någon) som var inblandad i deras design; behovet av att implementera och integrera patientenheter i rutinvård och patientprocesser som tillsammans stödjer hälsa och välbefinnande; behovet av att tillhandahålla utbildningsverktyg och beslutsstöd genom mobilapplikationer, behovet av samarbete mellan en mångsidig expertgrupp för att producera bättre tjänster eller enheter.

Om tekniken förbättras ytterligare kan användandet öka användarnas tillfredsställelse och ge en förbättra hälsa. Våra enkätundersökningar av personer med funktionsnedsättning och experter bekräftade resultaten från litteraturen. Mer specifikt visade undersökningen av personer med funktionsnedsättning att en relativt hög andel av de tillfrågade var inte alls eller bara till viss del nöjda med i vilken grad hälsorelaterade teknologier hade förbättrat deras livskvalitet. Beslutet att sluta använda teknik, där så var tillämpligt, verkade överlag vara förknippat med teknikrelaterade faktorer snarare än personliga faktorer. Bland de teknikrelaterade faktorerna ansågs den begränsade anpassningen av enheten till användarens grundläggande behov/preferenser/förväntningar, behovet av en bättre eller annorlunda enhet och det faktum att enheten slutade fungera som de mest kritiska faktorerna som ledde användarna till för att sluta använda enheten. Flera faktorer ansågs nödvändiga för att öka frekvensen av användning av och tillfredsställelsen med teknik: multifunktionaliteten och tillhandahållandet av tydliga bruksanvisningar, bekvämligheten att använda, gratis eller låg kostnad, integritet och höga säkerhetsnivåer, flexibilitet att anpassa till olika användarbehov, och antagandet av ett tvärvetenskapligt tillvägagångssätt (t.ex. kost, träning, psykologiskt stöd, etc.).

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När det gäller onlineundersökningen bland yrkesverksamma rapporterade en hög andel av dem att de skulle föreslå/rekommendera användning av teknikbaserade enheter eller tjänster till sina patienter/klienter. Bland de faktorer som yrkesverksamma nämnde som positivt för påverkade hälsa, kost och sport/träning vid patienters/klienters användning teknikbaserade enheter och tjänster, var den viktigaste användarens önskan att använda teknik; andra viktiga faktorer var önskan om självständighet, samarbete med terapeuten och rehabiliteringsplanen. När det gäller de faktorer som kan påverka yrkesverksamma i tillhandahållandet/rekommendationen av teknikbaserade apparater och tjänster för hälsa, kost och sport/träning, rapporterade nästan alla yrkesverksamma att kunskap om teknikbaserade apparater, resurser och passion för att förbättra resultat för deras patienter/klienter är viktiga faktorer som påverkar professionella tillhandahållande eller rekommendationer av teknik till sina patienter/klienter. Dessutom bedömdes tillgången till utbildning om teknikbaserade enheter och resurser också vara en faktor som starkt påverkar tillhandahållandet eller rekommendationen av teknik.

Sammantaget tyder dessa fynd på att även om teknologin har många styrkor och tillhörande fördelar, krävs det fortfarande betydande förbättringar för att förverkliga dess maximala potential effektivt. För att förverkliga denna potential krävs också gemensamma ansträngningar från beslutsfattare, utvecklare, tjänsteleverantörer och forskare för att undersöka hela systemet för teknisk design, utveckling och tillhandahållande.

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SECTION 1: Introduction

Technology plays a crucial role in the lives of people with disabilities, shaping the way they think about and the experiences they do with their disability. The use of technologies, including the Internet and the wide range of emerging interactive technologies (e.g., personal digital assistants, interactive voice response, etc.) appears to have the greatest short-term potential for health-related behaviour change (e.g., Sullivan & Lachman, 2017). However, studies show that continuing use of technology by people with disabilities is hard to achieve. Several reasons make that hard, such as: lack of access to technologies, lack of information about devices, repair and maintenance, professionals' influence, changes in the user's functional abilities or activities, inflexibility or ineffective device performance, lack of support, lack of motivation, minimal or no perceived need for a device, and so on. In general, scholars have argued that the use or non-use of technologies may depend not only on the individual or on the specific technology, but also on the complex interactions between the individual, the technology itself and the social environmental (Federici et al., 2018). Sometimes, it happens that although a technology appears perfect for a specific individual's need, it may be used inappropriately or go unused when key personal preferences, psychosocial characteristics or needed environmental support are not considered.

This research report offers an overview of the current state of and future directions for technologies promoting sport participation, physical exercise and, more in general, the adoption of healthier lifestyles of people with specific kind of disabilities addressed in B-SPORT+ project (i.e., mental health issues, diabetes, visual impairment, paediatric obesity).

The research had three main goals:

- To consolidate the best available evidence on how technologies can support people with disabilities in engaging and maintaining healthy lifestyles;

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- To assess the benefits of technologies improving participation in sport and physical exercise, dietary behaviours and the adoption of healthier lifestyles;

- To examine the unmet needs of people with disabilities related to the use of technologies for accessing healthy habits.

Four main lines of investigation were used, bringing together the assessment of the person's needs, attitudes and preferences, the technology and the environment:

- Review of the international peer-reviewed literature;
- Research of the grey literature and web-related resources for each country involved in B-SPORT+ project;
- Survey of people with disabilities;
- Study of the opinions of professionals involved in the care and treatment of people with disabilities.

The study's findings are organised in relation to each of the lines of investigation.

What is Assistive Technology?

According to the World Health Organization, "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (WHO and World Bank, 2011, p. 101) can be defined as an Assistive Technology (AT). Based on this definition, what makes a device an AT is who uses the product, rather than its intrinsic characteristics. Thus, a specialized product, a mainstream or everyday technology, such as smartphones, software and apps are considered ATs when they are used for enhancing capabilities and functioning of individuals with disabilities. Recently, the Global cooperation on Assistive Health Technology (GATE), a WHO initiative to improve access to high-quality affordable AT world-wide, proposed to change this definition adopting a more positive approach, specifically stressing the AT primary purpose of maintaining or improving an individual's functioning and independence, and facilitating participation. Framed within this framework, it is no longer the user of a product (the person with disability) that determines whether that product is an AT, but the purpose of use, that is, to promote well-being regardless of who uses it (Riva et al., 2012).

Nowadays, a great amount of information about ATs can be retrieved from many websites, each generally focusing on specific kind of disability/ies, such as the American Printing House for the Blind (https://www.aph.org/) or the Cambium Learning Technology Company website (http://www.cambiumlearningtechnologies.com/), and databases, that generally collect extensive list of ATs, also providing their related technical information. To date, one of the largest and most complete databases of devices is the European Assistive Technology Information Network (EASTIN, http://www.eastin.eu), which currently offers information on 67745 products (data updated in June 2021). All products and associated information in the EASTIN databases are classified according to the ISO 9999 (2016) international standard. The website works in all European Union official languages.

The impressive number of products that can be found through the existing websites and databases evidences the growth in AT devices that has occurred. However, it remains underscored if these technologies actually meet the diverse needs of people with disabilities in all facets of their lives (e.g., self-care, medical treatment, support for school or work, recreational and leisure activities). Thus, while companies work to develop novel products as well as to product upgrading and updating, at the same time, literature seeks to document product usability, use versus discard, and on the optimal matching of user and technology (Federici & Scherer, 2018). In this respect, prior research has consistently documented that the assessment of the subjective experience with technology is a focal point in identifying the best AT solution for a given user, and its underestimation has a primary role in AT abandonment (Scherer et al., 2005).

Assistive Technology for improving engagement in healthy lifestyles

This study primarily focused on ATs supporting people with disabilities in facilitating and increasing their participation in sport and physical exercise, adopting healthy dietary behaviours and, in general, healthier lifestyles. Therefore, for the purposes of this study, three specific kinds of technologies were considered (Merilampi & Sirkka, 2016):

- **specific assistive technologies,** enabling people with a visual impairment to participate in sport and physical exercise. This kind of technology is somewhat different from other technologies that people might have, as they are special, sophisticated, and exclusive devices. As such, they are generally difficult to obtain because of their high cost and limited availability;

- **health technologies**, including self-monitoring and self-care systems and equipment, such as blood pressure monitors, mobile devices and computers, electronic Health portals and other internet-based services. For example, a user can get a consultation from a doctor via these portals and access different health-related tests;

- **technologies for self-activation and personal development**, which can be referred to as sports technologies designed to support, analyse and monitor individuals' development and performance. This kind of technology includes but is not limited to heart rate monitoring, pedometers, activity bracelets, and mobile apps that monitor activity levels and also remind the user to be active and cheerful. Although this technology may not originally be targeted for healthcare purposes, it provides huge potentials for rehabilitation and self-care. This equipment has the potential for encouraging people to be more active by 1) providing interesting data about the personal progress

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or 2) by increasing the feeling of safety because the bodily functions can be monitored and healthy stress level thus be maintained. Among these technologies, gamification is one of the most recent trends (see, for instance, Chow et al., 2020). In a gamified system, core elements from games are embedded into the desired activities to engage and motivate players to establish behaviour change (Johnson et al., 2016). To give an example, gamification in health and wellbeing context may refer to making exercising more motivating by providing some sort of meaning for the action such as a progress in a game. The term exergame typically refers to games in which progress depends on physical exercise. Commercial game consoles already provide a wireless game controller that may be used to track body movements and control various commercial exergames. The health and wellbeing games can also be educational.

In the case of health technologies and technologies for self-activation and personal development, an important point concerns the definition of electronic Health (eHealth) and mobile Health (mHealth) technologies. eHealth Technology refers to the general use of information and communications technologies (ICT) to support health and health-related fields, including healthcare services, health surveillance, health literature, health education, knowledge and research (WHO, 2011).

mHealth technologies have emerged as a sub-dimension of eHealth. To date, no standardized definition of mHealth has been established. Using the recent definition adopted by WHO, mHealth or mobile health can be intended as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices (WHO, 2011). Nowadays, mHealth has been demonstrated to be an important new tool for the management of chronic health conditions, confirming all the original expectations (Jones et al., 2018).

There exist two main comprehensive databases of mHealth apps:

- MyHealthApps, which offers the most comprehensive list of apps available online and originating in the U.S. and throughout Europe. There is no formal evaluation or scoring of apps, but all are recommended by healthcare communities, including consumers, patients, caregivers, patient groups, charities, and other not-for-profit organizations.
- BridgingApps, edited by Easter Seals Greater Houston, a community of parents, veterans, therapists, doctors, educators, and people with disabilities who share information on how apps and mobile devices can help people of all abilities reach their highest levels of physical, social and cognitive development. It provides caregivers and professionals with the best resources for choosing apps to enhance everyday life for people with disabilities and sharing their successes with others.

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Overview of the disabilities addressed in the study

B-SPORT+ is a European Erasmus+ project aiming at increasing the participation of people with disabilities in sport, physical activity and healthy lifestyles. Each partner in the project focuses on specific disability profiles that will be used to tailor the development of capacity building programmes to activate people with disabilities and engage them in adopting healthy lifestyles. These profiles have also been used for the purposes of this research.

More specifically, the identified profiles of disabilities for each partner and country involved in the project are:

- patients with mental health disorders (Asociación de Psicología Evolutiva y Educativa de la Infancia [INFAD] – Spain; FUNDACIÓN INTRAS – Spain; OZARA storitveno in invalidsko podjetje d.o.o. - Slovenia, TOPCOACH - Slovak Republic);
- people with an occupational disease (Trendhuis cvba - Belgium);
- children with disabilities (ISTANBUL AVRUPA ARASTIRMALARI DERNEGI [IAAD] - Turkey);
- people, including children, with type 2 diabetes or cardiovascular disease (STICHTING WONCA EUROPE – Denmark; European University of Tirana U.E.T. SHPK - Albania);
- young adults with celiac disease, food allergies/intolerances and type 1 diabetes (SInAPSi – University of Naples Federico II, Italy);
- patients visual impairment (Kungliga Tekniska Hoegskolan [KTH] - Sweden).

SECTION 2: Research on Assistive Technology for People with Disabilities

Scope and Research Questions

The six research questions addressed by the study were:

- What does research evidence tell us about what is the most effective health technology (in terms of products and service provision) to support people with disabilities to improve their sport participation and physical exercise, healthy dietary behaviours and the adoption of healthier lifestyles? – *Results from the literature review*
- What does research evidence tell us about the unmet needs of users in this regard? – *Results from the literature review*
- What evidence is available from grey literature in each country involved, and internationally? – *Results from web-related resources*
- What are the views of users and professionals responsible for supporting the users in adopting healthy lifestyles? – *Results from the surveys*
- What lessons can be identified from this evidence? – *Conclusions*
- What are the implications arising from this report? – *Conclusions*

Methodology

The study was performed using three methods to gather information about i) if, and how, technologies can effectively support people with disabilities in engaging and maintaining healthy lifestyles, ii) what are the benefits of technologies for improving participation in sport and physical exercise, dietary behaviours and the adoption of healthier lifestyles, and iii) what are the unmet needs of people with disabilities related to the use of technologies for accessing healthy habits.

▪ ***Peer-reviewed literature***

First, we conducted a series of search for peer-reviewed publications to gather information about the current state of adaptive technologies and electronic healthcare for people with disabilities, with a specific focus on healthy habits, such as physical activity, nutrition and diets, health and care.

Two preliminary activities were conducted:

- Identification of keywords and database for research

- Identification of articles describing evaluation studies of assistive technologies and devices developed for enhancing participation in healthy lifestyle for people with disabilities

Keywords were clustered into three categories: two main topics (common to all the investigated target groups) and one varying topic referring to the specific target group under investigation. The identified keywords were as follows:

Section a	Main Topic	"assistive technology" or "assistive devices" or "adaptive technology" or "mobile health" or "electronic health" or "mobile app*" or "Supporting devices" or "ICT" or "internet service*" or "medical device*" or "mobile information technolog*"
		AND
Section b	TARGET GROUPS (Varying across research for target groups)	"mental disorder*" or "mental illness" or "mental health issues" or "psychological disorder*" or "anxiety disorder*" or "anxiety" or "generalized anxiety disorder*" or "depression" or "depressive disorder*" or "depressive symptom*" or "major depressive disorder*"

		“occupational disease” or “behavioral disorder*” or “burn out” or “burnout” or “compassionate fatigue” or “moral distress” or “stress” or “emotional exhaustion” or “psychological stress” or “chronic stress”
		Children and (obesity or overweight or fat or obese or unhealthy weight or high bmi OR physical disabilities or physical disability or mobility impair* OR mobility disorder*)
		“diabetes type 2” or “diabetes mellitus type 2” or “diabetes 2” or “type 2 diabetes” or “t2dm” or “dm2”
		“food allergy” or food allergies” or “food intolerance* or “celiac disease” or “celiacs disease” or “coeliac disease” or "diabetes type 1" or "type 1 diabetes"
		"visual impairment" or "visual disabilit*" or blind* or "visual disorder" or "low vision"
		AND
Section c	Main topic	sport* or "physical activity" or "fitness" or nutrition or diet* or "healthier lifestyle" or "quality of life" or "wellbeing" or "well-being" or "health-related quality of life"

Table 1 Identification of the keywords for the literature review.

Relevant literature was retrieved from a search of several databases. More in detail, we used:

- EBSCO

EBSCO Information Services is the leading global provider of resources for libraries including discovery, resource management, databases and e-books.

The search on EBSCO was limited to:

- MedLine and MedLine complete
- CINAHL Complete
- APA PsycInfo
- APA PsycArticles
- Psychology and Behavioral Sciences Collection
- Applied Science & Technology Source
- Food Science Source

- COCHRANE LIBRARY

The Cochrane Library is a collection of databases that contain different types of high-quality, independent evidence to inform healthcare decision-making.

As regards the search criteria, we included in the review all the articles that met the following criteria:

- Language: English
- Peer reviewed material
- Date range: no limits

We excluded all the articles that did not include people with disabilities as the target users, articles presenting conceptual or theoretical models, or articles that described a study planned or underway but not completed.

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The results for each target group were recorded using a common template that included:

Author(s)

Year of publication

Title

Country

Methodology (Quantitative/Qualitative/Mixed-method)

Target Group (Children and/or adolescents (<=18)/Adults (>18)/Older people (>65)/Mixed sample)

Type of assistive device

Cited examples (if any)

Key findings / Conclusions

Usage Statistics (if any)

Benefits (if any)

Barriers/obastacles to the use of assistive technology (if any)

Facilitators of technology use (if any)

Unmet needs/ Suggestions for improvement (if any)

- ***Internet search: grey literature and web-related resources***

Second, we searched the Internet for grey literature (outside of traditional academic publishing) and web resources related to assistive technologies that are used or could be used by people from the

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study’s target groups to engage in healthy lifestyles. We used the Google search engine to search for information. The same search terms as for the literature search above described were used.

For each device or technology-based resource, information about the name, the functionality, the specific target group they are addressed to, the advantages for people with disabilities and in increasing their engagement in healthy lifestyles, and the url was collected.

- ***Survey of people with disabilities and experts***

As a third step, we conducted an online survey of people with disabilities from the study’s target groups to investigate their current use and experience with technologies for health, sport and nutrition. Furthermore, we involved health and sport professionals that work in the field of the identified disabilities to gauge their opinion, as professionals, about personal and psychosocial factors that might incentivize or disincentive their patients or clients to the use of technology to maintain wellness-related routines, such as regular physical activity, sport, and good nutrition, as well as factors that might influence professionals’ provision and recommendation of this kind of technologies.

The surveys were structured based on the Matching Person & Technology Model (MPT; Federici and Scherer, 2018), recommended by the Association for advancement of Assistive Technology in Europe. Framed within the ICF perspective, this model uses a person-centred approach to foster user engagement and guide a person-provider team in the selection of the most appropriate assistive technology or "support solution" for that individual's functional gain and life quality. It has been tested with different populations and technology use situations (e.g., Pousada García T et al., 2021; Koumpouros et al., 2016, Wynne et al., 2016), showing good applicability across individuals, categories of disability, types of technology, and environments of use.

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The survey for people with disabilities requested demographic and disability information and included a series of sections focusing on:

- healthy habits,

- the general use of and the overall experience with technology,

- the personal and psychosocial characteristics (such as, mood, self-esteem, self-determination, autonomy, family support, friend support, therapist and program reliance, and motivation to use support),

- the use of and experience with technologies for health, nutrition, and sport,

- the perceived benefits related to the use of these technologies and, if relevant, the reasons for non-use,

- the technology-related features that could serve as facilitators for continuing use of a specific technology.

The survey for professionals requested demographic information and employment sector (healthcare, nutrition and diet, physical activity, sport & fitness, other), and include a series of questions asking:

- their predisposition to recommend technologies for health, nutrition and sport to their patients/clients,

- the individual and psychosocial characteristics of the users they think could influence the user's approach to technology,

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- the factors they think could influence professionals in the provision/recommendation of technology.

Respondents to the surveys were reached out via email or other digital channels to encourage them to participate in the online survey. The survey was active from April to June 2021.

Data analyses reported throughout the document consisted of descriptive statistics (frequencies) and bivariate correlations (Pearson's r) with a threshold significance level set to $p < .05$.

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Results

Peer-reviewed literature

- ***Size and characteristics of the knowledge base***

The literature search yielded 148 articles in total, published between July 2002 and July 2020. Abstracts for all 148 citations were reviewed. Twenty articles did not meet the search criteria above reported and therefore were excluded.

The remaining 128 articles were as follows:

	Total number
Diabetes type 2	44
Mental health	24
Visual impairment	10
Stress related mental health problem	17
Diabetes type 1, food allergies and intolerances	10
Children with disabilities	24
Total number	139

Table 2 Number of reviewed articles by category.

A summary of the main findings for each target group is reported below.

- ***What is known about use of AT by people with mental health diseases?***

The research identified 20 research and five review articles. The main topics were serious mental illness, depression and anxiety, depression in patients with cancer, and post-partum depression. Only 4 studies were conducted in Europe (Spain, Netherlands, Finland, the UK), whereas the remaining part were primarily from the US.

Types of Assistive Technologies Investigated

The literature has highlighted a recent increase in the use of ICT for the provision of information to and support for people with severe mental illness in order to improve their wellbeing.

Specific examples of technologies mentioned in the literature were:

- Receiving monthly SMS reminders of clinic appointments, which may have the potential to improve adherence to treatment;
- A variety of apps, including those for relaxation, mindfulness, cognitive apps, exercise, gaming, social media and wellness to help managing depressive symptoms. An example is Flowy, a mHealth game that digitally delivers breathing retraining exercises for managing symptoms of anxiety, panic and hyperventilation (www.flowygame.com);
- Ecological Momentary Interventions (EMIs) for anxiety, depression, stress and positive mental health;
- Telephone interventions;
- Tailor-made cognitive behavioural therapy (CBT) mobile application, such as HARUToday;
- Digital cognitive behavioural coach-led programme for anxious adults in primary care;
- Fitbit Zip device and mobile application, generally used by people with severe mental illness and obesity enrolled in a lifestyle intervention for weight loss.

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Benefits related to the use of Assistive Technologies

mHealth technologies generally used by people with mental health disorders can be clustered into four main categories on the basis of their primary use: skill acquisition, social connectedness, inquisitive trial, and safety netting (Pung et al., 2018). Several studies have highlighted that people with mental health disorders perceive mHealth technologies as an effective option for mental health treatment (Ham et al., 2019). People with depression, for instance, use health apps every day, especially free apps (Verhoof et al., 2013). The most common reason for using a health app is to keep track of some health-related data, with a focus on training or habit-forming.

In a recent systematic review, Gomez-de-Regil et al. (2020) reported that patients with severe mental illness in comorbidity with overweight or obesity are highly satisfied and motivated with the use of a mobile app to improve their physical activity and also their social interactions. Their literature review also suggested the feasibility and effectiveness of mobile apps to manage weight and mental disorders.

Several studies have looked at the benefits of using m-Health in relation to anxiety. More in detail, studies that have compared traditional health education programmes and CBT apps have found that both are associated with improvements in anxiety, mood and quality of life. However, the CBT app seems to be more beneficial than health education for patients with severe baseline anxiety (Greer et al., 2019). In a study by Pham et al. (2016), at the conclusion of the trial, participants found a mHealth game, Flowy, very acceptable as an anxiety management intervention. Through the engagement in a proactive play, Flowy allowed participants in the game to reduce their anxiety, panic and hyperventilation scores, as well as to perceive a higher quality of life. Flowy has been described as a fun and useful intervention, to be used as part of patients' care.

The literature review also highlighted that a digital cognitive behavioural programme facilitated by a coach prescribed in primary care is feasible and acceptable (Oser et al., 2019). More specifically, the study by Oser et al. (2019) found that primary care patients prescribed a digital cognitive behavioural programme for anxiety experienced significant improvements in anxiety symptoms, quality of life and reduced medical utilisation. This effect was also observed among patients with chronic medical conditions and behavioral health comorbidities.

A cognitive behavioural therapy programme with mobile application may be a possible solution to alleviate depression and anxiety also in cancer patients who have many constraints in terms of time and space (Ham et al., 2019). A cognitive behavioural therapy mobile app tailored to treat anxiety in patients with advanced cancer helps to improve access to evidence-based supportive care in a convenient, private and timely manner (Greer et al., 2019).

It has also been observed how in some cases (Kauppi et al., 2014) the use of telephone reminders can increase attendance rates in community mental health services. In adolescent services, telephone reminders reduced non-attendance from 20% to 8%.

Facilitators of Technology usage

The opportunity to receive support for the use of m-Health technologies was mentioned among the strongest facilitators of technology usage by people with mental health disorders. In a study by Naslund et al. (2016), participants stressed the need for more detailed training through group tutorials and more description of practical functions on smartphones, which could help them feel more confident when navigating the smartphone interface and accessing the accompanying mobile app. In their qualitative study conducted through semi-structured phone interviews with primary care patients, Pung et al. (2018) found that factors that influenced app use included accessibility, perceptions of technology, and personal compatibility. Health care providers also had a role in initiating app use.

Barriers and obstacles related to the use of Assistive Technologies

When implementing lifestyle interventions using smartphones or wearable mHealth technologies, further careful consideration of the needs of the target population is essential to ensure that individuals with limited prior knowledge or experience can also reap similar benefits. However, this is not always the case. One of the issues that emerged from the literature concerns the fact that the physical health conditions of people using m-Health, often do not make consistent and continuous use of the app usable (Ham et al., 2019).

According to a recent systematic review by Gomez-de-Regil et al. (2020), apps to record physical activity would need to be integrated with an app to monitor psychological well-being. Another issue that emerged from the literature review was the usability of m-Health by professionals. In a study by Sibeko et al. (2017), for example, mental health professionals had difficulty interacting with the text messaging system. This compromised monitoring and rescheduling of appointments.

Unmet needs and suggestions for improvement

The literature outlined the recommendation of a mobile app for comorbidity management, considering the target age group (i.e., adults, adolescents, or children) and the presence of psychiatric symptoms at the clinical or subclinical level.

Another issue regards the need to be supported in the choice of the “right” mHealth technology. What the literature highlighted is the user’s need to know if an app that offers mental health support, and that is available in the health section of the app store, has been evaluated and recommended from a health or clinical perspective. The app listings should be required to explicitly state which health professionals (if any) were involved in its design, what evidence (if any) is available for the techniques it offers, and also provide guidance on what contexts of use the developers consider appropriate.

Several studies have emphasised the effects of age on the usability of mobile technologies. According to Naslund et al. (2016) changes to the way mHealth technologies are introduced and delivered are necessary to avoid excluding anyone who may be unfamiliar with the use of these devices. On the other hand, mHealth interventions have the potential for multi-component interventions that could address multiple health behaviours in this patient group. This is particularly important given the high rates of other unhealthy behaviours such as smoking and poor nutrition among people with severe mental illness. This suggests that future mHealth interventions for people with severe mental illness could potentially address physical activity, healthy eating and smoking cessation simultaneously.

▪ ***What is known about use of AT by people with stress and burnout?***

We identified 15 research and two review articles. Only four studies were conducted in Europe, more specifically in the UK, Norway, Italy, and Spain.

Types of Assistive Technologies Investigated

For people coping with chronic stress and burnout, the literature has highlighted the use of mobile and web-based applications, in some cases integrated with wearable sensors. Example of technologies cited were:

- Wearable devices, mobile apps, and other equipment that provide biofeedback that can be used to monitor stress and sleep (e.g., FitBit Flex, FitBit Charge 2, Amiigo, DynaFeed, Moxy, Breezing).
- StressProffen, a mobile app to manage stress in cancer patients;
- Happify, a gamified breathing component of a mobile health app;
- StressLess, a mobile app that provides self-directed psychological intervention for caregivers of people with disabilities with high levels of caregiver burden and stress;
- BioBase, a wearable and associated app focused on deep breathing exercises;
- Calm, or Headspace, two mobile apps focused on mindfulness and meditation;
- Positive Technology, a mobile app for the self-management of psychological stress;
- My Breathefree, Breathcount, Asthma Tracker, Log, Pranayama Free, 7pranayama - Yoga Breath Calm, Loving Meditations—Bring Calm to Cancer, Lung+ Pioneering Healthcare, COPD Disease, a series of mobile apps marketed as tools for breath management and stress reduction, aimed specifically at adults with chronic lung disease;

- PTSD Coach, Daylio, NuCalm, PTSD STOPS HERE!, Headspace, free mobile apps available for the Android operating system that target smartphone users with PTSD;
- Electronic Health Records (EHR) that hospitals and similar medical organizations use for their administrative work;
- Provider Resilience, a mobile app designed to address burnout in mental health professionals.

Benefits related to the use of Assistive Technologies

Overall, the literature has consistently confirmed that one of the greatest benefits associated with the use of technology by people with stress and burnout is the strengthening of self-efficacy (Hwang & Jo, 2019; Serino et al., 2014).

The study by Plans (2020) showed that a 4-week digital intervention was effective in reducing anxiety and increasing well-being in a population of students with high levels of self-reported stress and anxiety. These effects were sustained 2 weeks after the intervention ended, suggesting sustained effectiveness over time. The use of technology devices, such as the HRVB (Heart Rate Variability Biofeedback) training cited by Hunter (2019), has been demonstrated an effective strategy to reduce acute stress. They are also useful for general stress management and perceived work stress (Elin Børøsund, 2018). Brief mindfulness training through a cell phone app format may be an effective means of reducing stress and promoting well-being in medical school (Elaine Yang et al., 2018). Using the Provider Resilience app resulted in reduced levels of burnout and compassion fatigue in mental health providers. This led to improved patient care (as reported by mental health professionals themselves) (Wood et al., 2017).

Furthermore, although the best-validated approach to stress management is cognitive behavioural therapy (Bisson & Andrew, 2005; Thomson & Page, 2007; Whalley et al., 2011), there is now a

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demand for brief, semi-structured interventions aimed at helping individuals manage their emotions. From this perspective, smartphones may offer a new platform to provide a stress management program. In particular, they offer the possibility to include interactive feedback, which increases both users' compliance with treatment and their self-efficacy through the autonomous acquisition of active coping skills.

Finally, smartphones are equipped with a variety of sensing capabilities (i.e., geo-referenced data, accelerometer, proximity, ambient light detector, and so on), which allow them to detect, recognize, and identify a range of activities and contextual information. This data can be used in conjunction with subjective self-reports to determine the psychophysiological state of individuals. The incredible convergence of ubiquitous computing and wearable biosensors that enable real-time collection, aggregation, and visualization in reports of personal health data opens up new possibilities for the healthcare system, namely the use of "smart tools." (Silvia Serino et al., 2014). Some studies have suggested the importance of mobile apps also to improve the general levels of stress, anxiety, and depression experienced by the caregivers or family members of people with disabilities (Fuller-Tyszkiewicz, 2020).

According to Peake et al. (2018), accessible, real-time, personalized biofeedback (heart rate, hours of sleep, sweat analysis, etc.) can be used to predict or self-diagnose certain medical and/or psychological conditions.

Important benefits are also related to the use of electronic health records (EHR) by physicians. In the study by Robinson et al. (2018), with the use of electronic health records, most physicians (85% to 98% across all trainings) reported improved quality, readability, and clinical accuracy of records, as well as fewer medical errors, and greater efficiency in chart review and retrieval. Most physicians (78%) reported an estimated time savings of 4 to 5 minutes or more per hour; 98% said they would recommend the training to their colleagues. The innovative fusion of physician wellness approaches and clinical EHR training helped improve physician performance and well-being, as well as improve patient care. (Robinson et al., 2018).

Facilitators of Technology usage

Among the strategies used to encourage youth with stress and burnout to use mobile apps, the literature identified accessibility, ease of use, free, and the ability to download them to tablets and smartphones, which, associated with relaxation, are the perfect devices for software focused on user relaxation (Peakeet al., 2018; Børøsund, 2018).

In addition, it is practical and environmentally sound to use a phone immediately after going through a stressful experience. Our smartphones are convenient for us at most times, and thus, we have this effective stress reduction tool at our disposal anytime and anywhere we need it (Owens et al., 2018). The incredible spread of mobile platforms reduces the digital divide and ensures that content is available anytime, anywhere (Hunter, 2019). Because smartphones and tablets are now widely integrated into individual and social lives, people can perform stress management exercises anywhere, including in the workplace, where they are beneficial in reducing maladaptive stress responses (Serino et al., 2014). However, the importance of users' motivation for using technologies should be not underscored. Hwang et al. (2019), for instance, found that when a user's reasons for using the app were clear, satisfaction and amount of use were significantly higher than when a user was unsure, so this aspect deserves special attention.

Barriers and obstacles related to the use of Assistive Technologies

The literature suggests that the routinely use of mobile apps for stress management requires considerable effort (Hwange et al., 2019). Sometimes, technologies have flaws that compromised their usefulness for populations with low technology use or self-efficacy. The same could be said of their usefulness for audiences with lower reading levels (Owens et al., 2018).

Unmet needs and suggestions for improvement

The literature review emphasizes the importance of designing health technologies that take into account consumers, real-world needs, and investing in research to prove the effectiveness of products made by different companies (Peake et al., 2018). One of the crucial needs for people coping with chronic stress or burnout is to have tools that leverage the technological possibilities and ubiquity of smartphones to put stress reduction tools in the palm of their hands (Hunter, 2019). Future research may consider the value of providing a tailored experience to app users, so that the program for stress management dynamically adapts to the participant's context and usage. For instance, mobile apps could send push notifications with recommendations to engage in specific modules at a given time, based on the usage patterns of the user. Such personalization, based on knowledge of a user's past behaviour, may provide benefits to users of mHealth interventions by providing support at the time of need based on previous usage behaviour (Fuller-Tyszkiewicz, 2020). Future research should investigate the feasibility of incorporating digital mental health interventions into existing treatment pathways, thereby encouraging both preventive and intervention-driven approaches to mental health tailored to the needs of individuals (David Plans, 2020).

In the case of apps to promote mindfulness-based strategies among adults with chronic disease, Owens et al. (2018) outline five key recommendations to improve their accessibility:

- Establish stricter regulations of health apps;
- Use evidence-based frameworks and participatory design processes for app design;
- Use culturally sensitive language and imagery in health-related apps;

- Ensure apps are written in plain language;
- Follow up evidence.

In addition, a future challenge is to include more advanced stress monitoring features based on the analysis of heart rate variability indices. Indeed, several spectral and temporal or nonparametric methods can be used to calculate heart rate variability indices to specifically assess autonomic nervous system response as indicators of psychological stress (Serino et al., 2014).

- ***What is known about use of AT by children with disabilities?***

The literature search identified 20 research and four review articles, primarily focusing on childhood obesity. Of these, nine were conducted in Europe (Sweden, Ireland, Finland, Spain, Italy, the UK).

Types of Assistive Technologies Investigated

For children with disabilities, especially with obesity, the literature mostly focused on the use of mobile and web-based applications. Cited examples of how technologies might support children with disabilities are:

- eHealth and mHealth intervention programs intended to stop obesity in preschoolers: MINISTOP, for instance, is an obesity prevention intervention aimed at parents of 4.5-year-olds; Time2bHealthy is an internet-based childhood obesity prevention for parents of preschool-aged children;
- Multicomponent mobile health prevention programs, such as the Mandolean training, that is supported by myBigO app, aiming at collecting behavioural data along with measures of environmental conditions (e.g., urban built environment, physical activity infrastructure, food marketing) among young people in general and in clinical cohorts of individuals with obesity;
- Time to Eat, a mobile app- based intervention with a virtual dog, with and without a point-based reward system. This app is designed to promote and persuade children to practice healthy eating habits. Time to Eat game gives children control of a pet that responds to pictures showing the food it consumes. In addition, the pet sends an email message as a reminder to eat healthily. The message is changed depending on the day of the week. Players

in the game must take and send photos of their meals. Conversely, the users then receive scores given by the pet, depending on the amount and healthiness of the food eaten.

- Educational programs based on motor games, active video games and virtual learning environments to improve children's long-term health, such as the PROVITAO (Active videogames program for Outpatient Treatment of Obesity) program, using Wii Fit Plus, TANGO:H platform, video conferencing through ICT, Kahoot, exergames, serious games, web apps, sensory libraries, wearables;
- Mobile applications for nutrition education, such as HyperAnt. The application is a series of "Hyper Activity Cards" that provides children with ideas for health and fitness activities in various areas, including HE, PA and sleep. The app received high marks because it covers multiple domains, engages parents, and includes information on HE and PA goals (eliminating sugary drinks, eating fruits and vegetables, and engaging in at least 1 hour of physical activity. HyperAnt does not require any feedback from the user. It simply pushes out information, eliminating user interaction with the app, removing the opportunity for the user to set goals and self-monitor their behaviours. In addition, it does not meet the criteria of being a game and connecting users to social media.

Other examples of mobile applications include:

- Smash Your Food, that tells children what their recommended daily servings are for fat/sugar/salt and then asks them to guess the contents of popular foods. After the child guesses, the app shows the food being crushed and reveals the true fat/sugar/salt content of the food alongside the child's guess and their recommended daily intake. Smash Your Food also offers an email service to engage parents in the learning process and update them on their child's progress in the game. While fun, Smash Your Food could be improved by including nutrition tips with the game, for example, a message about increasing fruit and vegetable consumption or eating meals at home could be incorporated into the screens associated with unhealthy fast food;

- Lose It!, that allows the user to track their food, exercise, and weight and develop personalized plans for weight loss;

  iMapMyFitness, that is a fitness-tracking app that includes route tracking, a workout log, calories burned, and social networking for group support;
- Fooducate, that provides nutritional highlights of goods in the grocery store, helping teens and adults make healthier choices;
- TreC-LifeStyle, based on the delivery of evidence-based educational content on nutrition, a low-burden reporting of children's food intake by parents by means of an intuitive food dashboard screen on the app and Automatic tracking of children's physical exercise by means of commercial devices like Jawbone and Misfit bracelets integrated with the app's features.
- Traditional electronic health records (EHR), the systematized collection of patients' electronically stored health information in a digital format.
- Newer electronic health systems proposed by primary care providers: Choose My Plate, Let's Move y Let's Go.

Benefits related to the use of Assistive Technologies

According to the reviewed literature, health information technology (electronic health records [EHRs], telemedicine, text message or telephone support) has the potential of improving the diagnosis and management of pediatric obesity (Flood et al., 2015; Jo Smith et al., 2011; Thaker et al., 2016; Shaikh et al., 2015). Analyzing the quality of EHR data in US, Flood et al. (2015) suggested that they might be extremely useful for the purposes of health promotion and public health surveillance, beyond the use for tracking individual patient health. The systematic review by Jo Smith et al. (2018) supported this line, highlighting the potential of health IT for improving screening rates and access to treatment.

The literature review confirms that in general, app use results in improved nutrition education. Time2bHealthy resulted in significant improvement in the frequency of discretionary food intake, parental self-efficacy in nutrition, and feeding practices of children under pressure (Megan L Hammersley et al., 2019). The use of apps allows children to be educated and sensitized on knowledge of healthy eating and physical activity achieving higher levels in the long term (Gómez del Río et al., 2019). Mobile applications for nutrition education offer the opportunity to perform behaviour change interventions for healthy eating and weight management in a scalable and cost-effective manner (Gabrielli et al., 2017; Lee et al., 2017) and also support primary care physicians in providing more effective prevention and health promotion programs related to children's lifestyles (Gabrielli et al., 2017).

In a study conducted by Antwi et al. (2013), it was found that web-based programs have a positive impact on reducing BMI, BMI z-scores, and weight in obese adolescents. These web-based programs to help reduce obesity generally provide education on healthy eating and physical activities, as well as using peer support in an online forum. Users can record their progress as they work toward their weight loss goals. These benefits are related to the frequency and accuracy with which users record their adherence to recommended diet, activity, and weight control (Kaufman et al., 2020).

Children's nutritional knowledge has been found significantly improved after game-based interventions (Chow et al., 2020), as demonstrated by more positive attitudes and increased self-efficacy toward healthy eating. Current evidence suggests that gamification may promote healthy eating behaviour, including a more balanced diet, increased healthy food intake, reduced sugar intake, and unhealthy snacks (Majumdar et al., 2013; Sharma et al, 2015; Turnin et al., 2001;

Viggiano et al., 2018). In addition, these kind of interventions have the potential to perfectly fit into school curricula, with a low risk of disruption of classroom activities.

Facilitators of Technology usage

The literature has consistently confirmed gamification elements as strong facilitators for technology use. More specifically, the review has highlighted as effective elements: self-representation with avatars, 3D environments, narrative context, rewards (point/score/badge, etc.), feedback, ranks of achievements (ranks/levels/leaderboards, etc.), different levels of play (Chow et al., 2020).

Other facilitators related to the use of mobile applications are the ease of accessibility that allows individuals to engage in behavioural changes without temporal and spatial restrictions (Lee et al., 2017) and the user-centred design (Gabrielli et al., 2017), that makes the application more attractive.

Barriers and obstacles related to the use of Assistive Technologies

Limitations specifically relate to the limited presence of weight loss apps dedicated to children, so parents may have difficulty finding tools to help their children (Quelly et al., 2015).

Another problem with using technology to assist health behaviour change in children with disabilities, such as pediatric obesity, is that most children (e.g., ages 4-7) do not have their mobile devices. This means that it is crucial to target parents both for searching for health promotion apps as well as incorporating parents in the activities of the apps themselves (Quelly et al., 2015).

In the study conducted by Browne et al. (2020), individual factors contributed to the poor adherence with smartwatch wearing, including early abandonment, sensory issues, forgetting to charge, forgetting to wear, and feeling self-conscious.

Some paediatricians also think that mobile applications might increase children's workload instead of being a tool to facilitate their work (Giorgi Rossi et al., 2020). Also, culture is known to have a considerable impact on life choices, but, unfortunately, there is no study investigating its effect on technology use for health and wellbeing (Antwi et al., 2013).

Unmet needs and suggestions for improvement

The literature review emphasizes the importance of increasing the duration of technology-based interventions, as well as of periodically changing the content of the intervention to help maintain healthy habits in the long-term (Nyström et al., 2018). Indeed, to date, there is no evidence establishing the long-term effects of web-based interventions (Antwi et al., 2013).

In some cases, there is a lack of information about how the application will actually be used and whether it will be effective in promoting healthy behaviours in children (Giorgi Rossi et al., 2020).

The studies included in this review suggest that components such as parental involvement, face-to-face mentoring, and feedback and reminders, when combined with web-based weight management interventions, may improve patient outcomes.

A future direction of mobile app development should involve promoting discussions about nutrition and physical activity with parents and families. Designing mobile apps that include rewards or incentives to initiate these discussions in the family should be explored because parental support and the role is vital, and parents typically control the majority of food and beverage purchases for the family (Quelly et al., 2015).

It is evident from the review by Schoffman et al. (2013) that mobile apps are very capable of promoting some of the expert recommendations for healthy habits and physical activity, including setting goals/limits and reducing sugary beverage consumption. However, other recommendations were completely absent, likely because they are not areas of behaviour change that app developers thought about targeting.

The lack of health content and concrete recommendations in the apps reviewed, including apps with high scores (e.g., HyperAnt and Smash Your Food), highlights the need for collaboration among a diverse group of experts in order to produce better apps. This could take shape in the app development, including more interdisciplinary work between health behaviour researchers with mobile app developers, as well as health promotion professionals and evaluators to design research programs that empirically test apps.

Finally, it is considered critical to think about developing a good system that can monitor and control obesity through a system that combines a good network of sensors to monitor the parameters involved in obesity measurements and an efficient algorithm capable of evaluating the data collected and make the most appropriate decisions to reduce overweight and obesity in people (Mohammed et al., 2018).

As regards EHRs, Flood et al. (2015) highlighted an important concern regarding the fact that EHR is a convenience sample of people sick visits and visits for preventive services. Therefore, the captured data are a biased sample of clinic-goers and may be systematically missing the heights and weights necessary to calculate BMI. The review by Jo Smith et al. (2018) illustrates that, although health Information Technology (IT) may improve screening rates and access to treatment, it seems to have little to no impact on behaviour change and weight loss thus far. The central limit of EHRs is that they are designed primarily to assist clinician decision-making and record-keeping, not directly parents or children. Similarly, health IT interventions, such as text message support, need further improvements. IT interventions that have been effective for other conditions could be trailed for childhood obesity. Text message reminders increase attendance for paediatric appointments and could reduce obesity treatment dropout. Personalized daily text messages have been shown to increase smoking cessation in young adults; messages about diet and nutrition might augment group counselling if delivered at a similar intensity. Pop-up alerts for BMI above healthy thresholds have been used effectively in adult weight management.

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▪ ***What is known about use of AT by people with type 2 diabetes?***

We identified 43 research articles and one article documenting a specific program for type 2 diabetes management (Dong & Frank, 2018). Of these, only 13 came from Europe: Belgium, Germany, the UK, Slovenia, Spain, Norway.

Types of Assistive Technologies Investigated

For people with type 2 diabetes, the literature mainly focused on the use of mobile and web-based applications, in some cases integrated with wearable sensors (in particular, for diabetes management). Examples of technologies cited were:

- Diabetes self-management devices: Glucometers, continuous glucose monitors or insulin pumps (Diabetes Tele Management System DTMS);
- M-Health apps: Glucose Buddy, mySugr, MyFitnessPal, MapMyWalk, Fitbit, Apple Watch, wireless scale, glucometer;
- The iDAT application for mobile phones. It enables users to track daily calories consumed and burned using a database of locally available foods. It can function as a supportive role for patients (iOS step counts, FitBit, Apple watch and glucose monitoring iHealth glucose meter, Agile Software Methodology);
- Diabetes education programs, as MEDIAS 2 ICT;
- The personalized nutrition project, delivered by a mobile phone application or website (personalizednutrition.org);
- GlycoLeap, a mobile lifestyle management program delivered through a mobile app (Glyco) and a series of assistive devices for diabetes management (i.e., Accu-Chek Performa [F. Hoffmann–La Roche Ltd] glucometer kit with lancets and test strips, BodyTrace [BodyTrace Inc], wireless weighing scale, and a resistance band for strength training;

- Bant II, a mobile phone application intended to simplify diabetes management and to be used by adolescents and younger people with diabetes;
- GlucoNote, a self-management support app for patients with type 2 diabetes and prediabetes;
- DiaFit (version 1.0), an open-source, inclusive iOS app that incorporates nutrition data, physical activity data, and medication and glucose values
- BLUESTAR, a mobile app designed to improve the self-management of diabetes.

Benefits related to the use of Assistive Technologies

Overall, the literature has consistently confirmed that people with type 2 diabetes view technologies as a valuable support tool. mHealth apps are generally described as helping the patients to increase their chance of being in the action stage for physical activity and dietary change.

The study by Glenn Goh et al. (2015) showed that using the iDat app improved exercise motivation in people with type 2 diabetes. In the study of Hong et al. (2015), there was a significant weight loss using the app, increased self-monitoring of blood sugar, and a good combination of nutrition education and app usage.

The Bant app (Shivani Goyal et al., 2016) was found to facilitate self-monitoring of blood glucose, physical activity, diet, and weight; promotes better identification of glycemic patterns in relation to lifestyle; corrective decision making; and positive behaviour change through incentives.

The study by Koot et al. (2019) evaluated the effectiveness of a technology-based program – GlycoLeap - in helping adults with type 2 diabetes attaining better diabetic control. The program was aimed at supporting users to i) monitor blood glucose; ii) change dietary habits; iii) engage in physical activity. The findings revealed a significant increase of days that blood glucose was monitored and of days with fruit and vegetable consumption and, parallelly, a significant decrease of days with hat food consumption. No differences were found in engagement in physical activity compared to baseline information. In terms of health outcomes, participants in the program showed a significant reduction in glycated haemoglobin and weight. Overall, the authors concluded that mHealth interventions, including mobile phone apps like Glyco, might be highly scalable, requiring comparatively fewer manpower resource.

Facilitators of Technology usage

The study by Wei Peng et al. (2016) shows that participants would be more willing to use apps regularly if they could receive some type of tangible incentive. They would also be more incentivized to use the apps if there were organized training sessions with participants on how to use the web tool (Antonio Martinez-Millana et al., 2019).
Other features that encourage the use of technologies are the creation of free, public, easy-to-use platforms, available on the two most common smartphone platforms (iOS and Android), also available on tablets. also available for people who want to monitor their calories (Glenn Goh et al., 2015).

Barriers and obstacles related to the use of Assistive Technologies

Individuals face a myriad of barriers to diabetes management, including a lack of education or knowledge about the disease. It was found that participants wanted tangible rewards. They stated that they would be more likely to stay engaged with the app over time if they received tangible rewards, such as gift certificates, cash, reduced health insurance premiums, or other monetary incentives (Wei Peng et al., 2016).
In the case of web-based interventions, the study by Koot et al. (2019) highlighted the need to deliver all the components of the program using the same platform or device. In their evaluation

study of the GlycoLeap program, for instance, they found that delivering online lessons on a different platform rather than on the Glyco app led to a poor completion rate by users.

More careful consideration should be given to patients' age and technological knowledge to facilitate technology use (Pichayapinyo et al., 2019).

The utilization of the mHealth app by professionals has been reported as low.

Concurrent development and introduction of the app led to user frustration when the app did not work as expected, requiring frequent software updates, which reduced provider enthusiasm (Bentley et al., 2016, and Doocy et al., 2017).

Other barriers include uncommon access to smartphones for all, willingness to use the app, and cost (Yamaguchi et al., 2019).

Unmet needs and suggestions for improvement

Engaging diabetic patients in a web-based intervention had only a transient impact on their functional health status (Antonio Martinez-Millana et al., 2019).

The literature review suggests that the need to better design, implement, and integrate patient devices into routine care and patient processes that together support health and wellness (Bentley et al., 2016).

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- ***What is known about use of AT by young people with type 1 diabetes, food allergies, food intolerance or celiac disease?***

We identified nine research articles and one review paper, primarily focusing on type 1 diabetes. Only one research article focused on celiac disease, whereas no study investigated the use of technologies for health, sport and nutrition by people with food allergies or intolerances.

Studies conducted in Europe were four (Germany, Norway, and the UK).

Types of Assistive Technologies Investigated

For people with type 1 diabetes and celiac disease, the literature primarily focused on the use of mobile and web-based applications, in some cases integrated with wearable sensors (in particular, for diabetes management). Examples of technologies cited were:

- IDMVis: Temporal Event Sequence Visualization for Type 1 Diabetes Treatment Decision Support, an open-source browser-based interactive visualization tool designed to help clinicians to visualize type 1 diabetes patients data and then perform temporal inference tasks;
- Few Touch Application (Norwegian Centre for Integrated Care and Telemedicine): a mobile application for recording food intake (six categories of food: low carbohydrate snack, high carbohydrate snack, low carbohydrate drink, high carbohydrate drink, low carbohydrate meal, and high carbohydrate meal);
- MyHealthyGut: a smartphone app to promote effective self-management of celiac disease and improve gut health;
- DiaTrace: a mobile phone with digital camera which is able to track user physical activity;
- iDECIDE: a mobile app which allows users to self-track diabetes management in real time.

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Benefits related to the use of Assistive Technologies

Overall, the literature consistently confirmed that the major benefit associated with technology use by people with type 1 diabetes or celiac disease was the more effective participation in their own health management.

According to the literature review by Chaves et al. (2017), mobile and web-based applications that allow young people with type 1 diabetes to monitor glycemic levels are essential in order to achieve glycemic control and reduce risks of complications; alarm sound with application feedback on clinical information led users to reflect on the influence of behaviour on glycemic control, helped them to take on decision making and problem-solving tasks, increased their self-efficacy for self-care. They also provide a foundation for discussion with healthcare personnel (Skrøvseth et al., 2012). In the case of the iDECIDE app, the possibility offered by the app for self-tracking exercise behaviour and simultaneously gather information about the rate of change in their glucose levels was associated with an average of 0.3 days more of exercise per week than the wristband heart rate monitor (Groat et al., 2018).

Furthermore, the use of these technologies may help reduce the risk of acute complications, such as severe hypoglycaemia in the case of type 1 diabetes (Prahald et al., 2018).

Facilitators of Technology usage

Among the strategies used to encourage young people with diabetes 1 to use mobile apps, the literature highlighted the goal achievement award for glycaemic control, including interactive elements, such as goal achievement score, competition, and decision making, since these features increase the intrinsic motivation for self-care and users competence to reach their goals (Chaves et al., 2017). Other elements include the possibility for users to communicate with their peers in a chat room to share experiences and obtain or provide support (Chaves et al., 2017).

Furthermore, applications for type 1 diabetes are strongly recommended to include features related to sentiment record and analysis, such as emoticons for mood identification, since maintaining good glycaemic control often generates feelings such as sadness, denial, anguish, and in some cases, revolt, making self-care practice difficult (Chaves et al., 2017).

Another feature used for sentiment record is coaching with the objective to identify barriers and motivate users for decision making and achievement of self-care goals.

The use of innovative electronic health technologies such as body sensors, as in the case of the DiaTrace system, has been demonstrated to be generally highly accepted by patients. This high acceptance may be due to the visualization of physical activity and food intake and the real-time display which can be used to monitor current activity (Schiel et al. 2011).

In the case of celiac disease, the only study we found outlined the importance for users to be trained before using applications. In the case of the MyHealthyGut mobile app (Dowd et al., 2018), participants in the study indicated that initially, they weren't aware of the full capabilities of the app and found the navigation of the app confusing and frustrating. Given that app use was not as intuitive as participants would like, they suggested having engaging and simple instructions (e.g., improved onboarding) to simplify using the app and accelerate their enjoyment of it. In sum, ease of use, nutritious gluten-free recipes, the possibility to retrieve health information (e.g., information about irritable bowel syndrome) and low cost were considered as the top factors in determining potential use of the app, along with the ability to track diet and symptoms, supplements to promote gut health, cooking tips for the gluten free diet and the ability to connect with others.

Barriers and obstacles related to the use of Assistive Technologies

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Limitations specifically referred to body sensors or to mobile apps integrating body sensors. The most relevant limitations include measurement inaccuracy, high susceptibility to artefact noise, considerable time delays for obtaining results, uncomfortableness and long-term reproducibility (Ling et al., 2016). Also, the cost of the strip and the boredom of making repeated measurements become the significant barriers for type 1 diabetic patients who frequently need to monitor their episodes of hypoglycaemia (Dowds et al., 2018).

In the case of app integrating body sensors, technical errors generally occur with wearables devices, such as unreliable measurements and missing data (Groat et al., 2018).

Unmet needs and suggestions for improvement

The literature review outlined the importance of using a user-centred approach when designing and developing technologies to support people with type 1 diabetes in adopting healthy habits (Chaves et al., 2017). Some authors stated that applications developed for self-care in diabetes should consider users' preferences in order to be efficient, useful and enjoyable. In addition, applications should have functionalities that are gender and opinion sensitive so as to improve usability and cater for more participants. Therefore, applications aimed at supporting behaviour changes should be user-centred to foster motivation and interest in using them (Chaves, 2017). Furthermore, applications should have resources to guide young people on how to properly administer insulin and monitor glycemic levels, reporting signs and symptoms of hypoglycemia or hyperglycemia, and forms of acting in each situation hence minimizing insecurities and collaborating in diabetes management. Also, some scholars proposed making up for the shortage of health professionals' time to educate users through the use of self-care mobile applications, which can provide decision support for self-care and optimize treatment for each individual.

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The study by Pulman et al. (2013) suggested the need to consider three factors before a new technology is actually developed: (1) considering young people's relationship to technology, (2) reflecting on how this might be able to effectively make a difference to them, and (3) considering when it might not be a suitable mechanism to use.

Prahalad et al. (2018) argued that, if, on the one side, medical device technology, digital health and big data have the great potential to decrease the burden of daily diabetes tasks and provide more personalized insights to improve clinical outcomes and quality of life, on the other side, the sheer volume of data may impose a burden on both patient and provider.

As regards celiac disease, participants in the study by Dowd et al. (2018) noticed as important the need to make more flexible the symptom tracking feature, as they felt that the three symptoms proposed by the app did not include symptoms that all participants experienced or wished to track. Therefore, it was suggested that adding additional symptoms (e.g., fatigue, hair loss), or keeping the label general (e.g., celiac related symptoms) with an open text box, would increase the applicability of the diet and symptom tracking feature. Furthermore, while the focus of MyHealthyGut on food types, rather than quantities was appreciated, it was felt that inputting the ingredients of a complicated recipe was tedious, thus proposing to enable the app to attach a file to one's diet tracker, such as an image of the recipe in question, such that all ingredients could be tracked and the time required for entry diminished.

Both for type 1 diabetes and celiac disease, the literature highlighted the potential of delivering education and decision support tools through mobile apps (Dowds et al., 2018; Groat et al., 2018; Prahald et al., 2018; Zahng et al., 2019). Specific education topics that were suggested for celiac disease were: signs that something still isn't right, information on common digestive issues, and diet changes recommended for those issues (Dowds et al., 2018).

- ***What is known about use of AT by people with visual impairment?***

The research yielded ten research articles. All studies were conducted outside Europe, but three were conducted in Denmark (1) and the UK (2).

Types of Assistive Technologies Investigated

Components of visual rehabilitation may include mobility training, training in adaptive strategies and modification of the environment, among other interventions.

Optical and electronic magnification devices, such as lenses, closed-circuit television and telescopic systems are among the most common forms of intervention in a low vision rehabilitation programme. Examples of technologies mentioned in the literature are:

- Portable head-mounted displays. They provide hands-free magnification and contrast enhancement at all distances, using optoelectronic and real-time video technology. This includes the eSight Eyewear, a neural network model to help more low vision patients receive a professional application of the device;
- Telescopic, prescriptive lenses, magnifiers;
- Large print or talking materials;
- InterWalk smartphone app;
- Computer assistance devices.

Benefits related to the use of Assistive Technologies

Assistive devices are crucial to improve the functioning and quality of life of people with visual impairments, enhancing their independence in daily life activities and improving their residual vision.

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In recent years, telerehabilitation has become of growing interest in healthcare because it allows individuals to remain at home while receiving rehabilitation services (Lorenzini & Wittich, 2019).

In a study by Rosner and Perlam conducted in 2018 assessing the effect of the usage of computer-based assistive devices, participants reported high satisfaction with their and indicate that the devices have improved their quality of life and leisure activities.

Facilitators of Technology usage

In low vision rehabilitation, visual aids using video systems (e.g., smart phones, tablets) are increasingly used by people with visual impairments. The pilot study of Lorenzini and Wittich (2019) indicated encouraging results confirming the feasibility and acceptability of training to optimise the use of manual magnifiers in 10 patients with low vision through telerehabilitation from their homes.

Barriers and obstacles related to the use of Assistive Technologies

The decision-making process around the (non)use of such devices has been identified as multifactorial. Important barriers have been found in the process of acquiring and incorporating enlarging low vision aids, for which training support would be useful (Lorenzini et Wittich, 2019).

Another barrier to the use of assistive technologies is represented by financial constraints. In fact, device coverage is not always covered by the healthcare system. More generally, denying access to assistive technologies is a welfare system that does not address this.

Unmet needs and suggestions for improvement

Studies show the importance of individualised attention focusing on the user during low vision rehabilitation (Lorenzini et al., 2019). Indeed, training experiments have shown that approximately 80% of the prediction accuracy help more low vision patients receive professional device fitting (Dai

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et al., 2020). Another issue found relates to the accessibility of technology use in relation to age and ethnicity. For example, older adults in the United States from racial/ethnic minority groups were less likely to report using low vision devices but not visual rehabilitation than white individuals (Choi et al., 2018).

One aspect that can still be worked on, however, relates to physical activity and physical limitations more generally. Increasing physical activity and decreasing physical limitations and addictions will improve the quality of life. The use of rehabilitation programmes, assistive devices and the instructive use of assistive devices can help improve the quality of life of the blind (Amini et al., 2018).

Coverage of low vision devices is not always guaranteed by the healthcare system. Some programmes, such as Medicare, can help address a significant health disparity in the use of this evidence-based intervention.

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▪ ***Summary of the findings***

What does research evidence tell us about what is the most effective health technology (in terms of products and service provision) to support people with disabilities to improve their sport participation and physical exercise, dietary behaviours and the adoption of healthier lifestyles?

The literature review has confirmed that health technology can successfully assist people with disabilities in engaging in healthy lifestyles. Technology has been demonstrated to have not only the potential to help compensate, at least in part, for physical limitations (if any) but also to effectively support patients in managing chronic diseases and their associated risks, thus increasing the degree of empowerment for self-care practices, as well as to enhance skills development and acquisition of knowledge for behaviour change.

What does research evidence tell us about the unmet needs of users in this regard?

Overall, unmet needs vary depending on the specificity of the disability. However, the point that emerged as particularly important to address, and that has been stressed in almost all the disabilities considered in the literature review, concerns the need to adopt a user-centred approach when designing technologies aimed at supporting behaviour change. That is, based on the evidence reported in this review, developers and designers should focus on and try to understand better what are the needs of the users of their products or services so that they could be able to create products that fit well with the users' motivation and interest in using them, that in turn would increase the users' satisfaction and the health outcomes related to the product's use.

Internet Search

The main findings resulting from the internet search are presented below, clustered by country and target group.

- ***Slovenia – Mental health disorders***

Available documents/information/other for assistive devices and technologies, especially aimed at people with mental health disorders and, above all, connected to the aim of better participation in sports, are quite scarce.

- ***Slovakia – Mental health disorders***

In Slovakia, people with depression or any people who want to improve their mental health can access the online platform https://pozitivnamysel.sk/ to get online counselling or set up a meeting with psychologists or coaches.

- ***Spain - Mental health disorders***

The website of the Spanish Society for the Study of Anxiety and Stress - S.E.A.S. – is a useful support for people with mental health disorders in Spain. S.E.A.S. is a national association of psychologists, doctors, pedagogues, researchers and professionals in general interested in the study of anxiety, stress and related areas. It promotes training and permanent updating of professionals, facilitates the exchange of information and knowledge on anxiety, stress, disseminates basic knowledge at a social level, guides people when searching for solutions, educates to preserve health and prevents problems related to anxiety and stress (https://webs.ucm.es/info/seas/)

The website of the Ministry of Health describes different concepts, as well as consequences, types, prevention and management, including explanatory videos. It offers information and advice to the

Spanish population, including information on positive emotions, anger, stress, anxiety and sadness (https://bemocion.sanidad.gob.es/emocionEstres/estres/home.htm).

Quiérete is a mobile application developed by the Spanish Red Cross. It helps users to take care of their health (diet, exercise and mind), providing them a series of basic recommendations to promote healthy habits in the personal area and modify the behaviours of harmful habits. The application brings together different sections: My plan (which collects profile data, health status and progress), Survey, Challenges, Recipes. It helps users to stay active and assess the progress of their own health (https://apps.apple.com/us/app/qui%C3%A9rete/id1359211727?l=es)

Health track (Localiza salud) is a simple computer application that makes visible resources and activities that contribute to health and well-being in the municipalities adhering to the Health Promotion and Prevention Strategy in the Health National System (EPSP). All municipalities are invited to participate and develop their resource map to improve the lifestyles of their population. Accessing the application, users can observe the healthy activities that are carried out around them (https://localizasalud.sanidad.gob.es/)

Siente - Mindfulness is a mobile application that creates a methodology of mindfulness sessions and positive psychology exercises adapted to users' needs. It helps users to initiate a change of habits in order to improve their well-being by learning to accept life situations, be flexible before the changes, share the pain with/of others, improve their confidence and relationships, find their purpose and be kind. It is rated 4.7 out of 5 on the app preview store (https://apps.apple.com/es/app/siente-mindfulness/id1135427078). More information can be retrieved here: https://crearsalud.org/siente/

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Finally, a news device for people with depression, anxiety, phobias, obsessive compulsive disorder, addictions and dementia and people who suffer from gambling, as well as for children with attention deficit and hyperactivity disorders has been described on Levante news portal. It measures the brain activity in real time when responding to certain image or sound stimulations. It is a reliable and safe diagnostic and therapeutic aid. (https://www.levante-emv.com/comunitat-valenciana/2019/01/17/nuevo-dispositivo-diagnosticar-depresion-hiperactividad-13907043.html)

- ***Other useful resources for mental health diseases***

Strava is a social network for athletes. The activities are recorded and users can share their own skills and training, give kudos to the best performances and leave comments on their activities.

Multiple activities are allowed: walking, hiking, running, cycling, kayaking, climbing, surfing, swimming, yoga, etc. Also, it shows the distance travelled, heart rate, moving time, calories, etc. It serves as motivation for self-improvement. Users can compete with the routes that other people have registered in their city. They earn medals and trophies when beat themselves.

Strava offers users monthly challenges and includes a premium plan (to offer a training plan and lessons to avoid injuries) (https://www.strava.com/?hl=es).

It provides guides to routes in many countries around the world with notes from local athletes. The countries whose routes are listed are: Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Hong Kong, Italy, Norway, New Zealand, Netherlands, United Kingdom, Singapore, Spain, USA, Sweden, Switzerland.

Moodpath is an app that allows users to manage anxiety, depression, and stress. It helps users to follow their progress and teach them skills.

(https://play.google.com/store/apps/details?id=de.moodpath.android)

(https://apps.apple.com/us/app/minddoc-your-companion/id1052216403)

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Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Moodpath (MindDoc: Your Companion)	Medical	4.7/5	Italian, Chinese Simplified, Chinese Traditional, Korean, French, German, Italian, Japanese, English, Dutch, Portuguese, Russian, Spanish	X	X	X	X

Data retrieved from https://apps.apple.com/us/app/minddoc-your-companion/id1052216403

HAPPIFY is an app aiming to shift users' mindset to a happier one using a variety of fun games and activities designed by a former successful video game creator. It uses a combination of mindfulness, positive psychology and cognitive behaviour techniques to gives users the tools to help them take control of their thoughts and feelings. (https://www.happify.com/)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Happify: for Stress & Worry	Health & Fitness	4.5/5	English, French, German, Italian, Japanese,	X	X	X	X

			Portuguese, Simplified Chinese, Spanish				

Data retrieved from https://apps.apple.com/us/app/happify-for-stress-worry/id730601963

PhysioTherapy eXercises is a free app to create exercise programs for people with injuries and disabilities. The Physiotherapy Exercises app contains more than 1,000 images illustrating 600 exercises suitable for those with spinal cord injury and neurological conditions. It is available in English for Android devices (https://www.physiotherapyexercises.com/).

FitMove is an app designed for children and young people with mental health issues that allows to do breathing exercises, muscle work, to improve eating habits and health care. The app combines theory and practice in its four sections so that children and young people can interact with their devices as if they were playing a video game. (https://apps.apple.com/es/app/fitmove/id1127315919)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
FitMove	Health and fitness	5.0/5	English, Spanish	X			X

Data retrieved from https://apps.apple.com/es/app/fitmove/id1127315919

Youper - Emotional Health Assistant allows users to monitor and improve their emotional health via talks based on therapy techniques or mindfulness.

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Youper	Medical	4.9/5	English	X	X	X	X

Data retrieved from https://play.google.com/store/apps/details?id=br.com.youper&hl=en&referrer=utm_source%3DYouperHomeFirstCTA

Mentegram is a mobile app to monitor people with depression. It helps PwD to set up an online meeting with a psychologist or even a psychiatrist and provides the status of the patiente. (https://mentegram.com/)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Mentegram	Health and fitness	3.0/5	English	X		X	X

Data retrieved from https://apps.apple.com/us/app/mentegram/id875026658

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- ***Belgium – Stress and Burnout***

Start to Run is a ‘podcast’ that users can listen to while running. This is an easy to use program that tries to get people to run. They provide novice runners with a schedule and a podcast/playlist. Their goal is to make users practice three times a week so that after 10 weeks they can run for 30 minutes without taking a break. It plays energetic music when users are supposed to be running and calm music when users are supposed to be on their walking break. This is specifically aimed at people that don’t have a lot of motivation like, for example, people with a burnout or a depression. But anyone can use the tool.

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Start 2 Run	Health and fitness	3.3/5	Dutch, German, English, French, Italian, Portuguese	X	X	X	X

Data retrieved from https://apps.apple.com/be/app/start-2-run/id698638896?l=nl

RouteYou is an app that allows users to map and rate their favourite walking/cycling/skate/etc. routes. Everyone, including people with a disability, can map a route. This way, people that use a wheelchair or another walking tool can easily find routes in their area that have been tested by other people with disabilities. This facilitates the inclusion of people with a disability. It also facilitates a playful exploration.

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
RouteYou	Health and fitness	2.5/5	Català Deutsch English Español Français Italiano Nederlands	X	X	X	

Data retrieved from https://play.google.com/store/apps/details?id=com.routeyou.www.twa

KeepMoving is a software that allows organizations, employers, brands, etc. to create gamified sport challenges for their employees/fans/volunteers/etc. The software keeps track of a variety of data from multiple people. Employers, brands, etc. can create challenges tailormade for people with disabilities. Due to the collection of data, the software can also be used to create sport challenges for charity (https://keepmoving.eu)

Languages: English, Dutch and French

- ***Turkey – Children with disabilities***

Migros sağlıklı yaşam yolculuğu (WellBeing Journey) is an app from the Turkish retailer Migros Ticaret. The initiative is led by Turkish retailer Migros Ticaret, who collaborated with 11 manufacturers, including global and local brands like Danone, Nestle, Lipton and Leroy. In the scope of this initiative, Migros aimed to create awareness and positive behaviour change in customers

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about healthy living and increase sales of the main food groups. The WellBeing Journey was first launched in April 2018. Migros was able to customise its own app in order to provide consistent messages, personalised wellbeing offers, calorie breakdowns and personalised shopping chart data. The app also helped promote physical activity and drinking enough water. More specifically, Migros was able to provide its customers with individual analysis of their nutritional habits, which were compared with the balanced nutrition distribution recommended by the Ministry of Health. Customised recommendations were then prepared for each customer and special discounts and offers were presented on the products each customer need.

- ***Denmark -People with type 2 diabetes***

Diabetes og Kulhydrattælling is a smartphone application to calculate portions of carbohydrates in a meal. There are more than 300 predefined foods and beverages, all of which are described with the amount of carbohydrate and other nutritional value. Users can add their food and beverages to the product overview to make it more personalized. It can be easily done by taking a photo of the product and add it into the app. The app is primarily developed for children and adolescents with type 1 diabetes, but the app can be used by anyone who needs to learn how to count carbohydrates (https://diabetes.dk/sundhed/mad/kulhydrat/kulhydrattaelling/app-til-kulhydrattaelling)

Accu-Check is the latest insulin pump from Roche Diabetes Care. Accu-Chek Insight manages the patient's diabetes 24/7. All the information is stored in Accu-Chek Mobile extension. The data can be automatically transferred to the "mySugr" management app. It is an all-in-one-blood glucose meter for people with diabetes who appreciate that everything is gathered in one solution (https://www.accu-chek.dk/mysugr)

- ***Albania – People/children with type 2 diabetes***

Continuous Glucose Monitoring Systems (CGMS) helps people with Type 1 Diabetes to better monitor their health and be more active. It is a user-friendly tool, multi functions available, promoting exercising and safe exercising as a way to bring multiple benefits to health.

These devices are now the state of the art to measure rapidly changing blood glucose values on an intermittent basis, and as such are extraordinarily helpful in judging glucose replacement and adjustment of insulin doses in relationship to sports. The information gathered during the measurement period is the template to reconfigure feeding, dose and training strategies to improve performance. More information can be retrieved here: http://www.runsweet.com/

DiaBits is a continuous glucose monitor (CGM) that tracks current blood sugar levels. Diabits connects to the CGM to estimate future blood sugar values using machine learning technology. It is a user friendly device, multi functions available, promoting exercising and safe exercising as a way to bring multiple benefits to health. More information can be retrieved here: https://www.diabits.com/

Glucose Buddy Diabetes Tracker is a very comprehensive diabetes management app.
This app lets log your blood glucose level, carb intake, medication doses, A1C results, exercise, and more. It's for people with type 1 and type 2 diabetes.
The app offers reminders to check your blood glucose and take your meds. If you use an Apple iPhone, you can register at glucosebuddy.com to sync your log to the website, input your glucose values, or print blood glucose and medication logs for a health care provider. Send reports to a health care provider via the app or website.
(https://play.google.com/store/apps/details?id=com.skyhealth.glucosebuddyfree&hl=en&gl=U)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Glucose Buddy	Medical	4.8/5	English, Arabic, Catalan, Czech,	X	X	X	X

Diabetes Tracker			Danish, Dutch, Finnish, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Malay, Norwegian Bokmål, Polish, Portuguese, Romanian, Russian, Simplified Chinese, Slovak, Spanish, Swedish, Thai, Traditional Chinese, Turkish, Ukrainian, Vietnamese				

Data retrieved from https://apps.apple.com/us/app/glucose-buddy-diabetes-tracker/id294754639

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Bant is an iPhone-based app designed primarily for young people with T1D that was developed by the University Health Network in collaboration with SickKids Hospital (Toronto, Canada) with input from patients, families, doctors, nurses and engineers. It tracks meals, blood glucose (via Bluetooth-enabled LifeScan OneTouch Mini blood glucose meter and Dexcom CGM via Apple Health), physical activity, and weight data and provides analytics, personalized feedback and data sharing options with HCPs.

(https://play.google.com/store/apps/details?id=org.ehealthinnovation.bant&hl=en&gl=US)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Bant	Health & Fitness	4.3/5	Arabic, Chinese, English, French, German, Italian, Korean, Portuguese, Russian, Spanish	X		X	X

Data retrieved from https://apps.apple.com/us/app/bant-simplifying-diabetes/id361257571

mySugr - Diabetes App & Blood Sugar Tracker is an app designed for people with T1D and type 2 diabetes that integrates with CGM systems The user is able to log blood glucose, carbohydrate

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intake, take food photos, log insulin use and gets personalized motivating feedback. The app also generates reports for the HCP.

(https://play.google.com/store/apps/details?id=com.mysugr.android.companion&hl=en&gl=US)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
mySugr	Medical	4.7/5	English, Bulgarian, Czech, Danish, Dutch, Estonian, Finnish, French, German, Greek, Italian, Latvian, Lithuanian, Norwegian Bokmål, Polish, Portuguese, Romanian, Russian, Slovak, Slovenian, Spanish, Swedish, Turkish	X	X	X	X

Data retrieved from https://apps.apple.com/us/app/mysugr-diabetes-tracker-log/id516509211

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GlucoseZone is a high quality digital designed exercise 'solution' primarily for people with T1D and type 2 diabetes. It provides exercise guidance taking factors like pre-exercise blood glucose levels, medications, and exercise type, into consideration. This app includes four main features: GlucoseZone Today (daily live and interactive workout videos, users can chat live with other online users as well as a workout coach); GlucoseZone Program (a guide to managing diabetes, including lowering HbA1c and weight loss); Live Replay (workouts to do at home, at the gym, or outdoors); and Diabetes Talk (prerecorded videos of certified diabetes professionals discussing topics like heart health, diabetes during the winter, preparing for a successful doctor's visit, and using technology). (https://play.google.com/store/apps/details?id=com.fitscript.glucosezone&hl=en&gl=US)

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
GlucoseZone	Medical	4.0/5	English	X	X	X	X

Data retrieved from https://apps.apple.com/us/app/glucosezone/id1140645765

ExCarb is a web platform available in English and Spanish that helps people with diabetes to plan their insulin, exercise safely, have fun and repeat the rewards. It is a user friendly tool, multi functions available, promoting exercising and safe exercising as a way to bring multiple benefits to health such as low risk for heart attacks and strokes, some cancers, arthritis, depression and anxiety, as well as many other serious medical conditions. More information can be retrieved here: https://excarbs.sansum.org/

- *Italy – Food Allergies, intolerances; type 1 diabetes; celiac disease*

CoreLifeStyle Intolleranze is a free mobile app for iOS devices that offers people with intolerances a practical guide to manage their diet in a healthy and safe way, providing them with information, practical advice and very tasty recipes ideal for those who are intolerant to nickel, lactose and gluten. Thanks to the cooperation with the Food Specialist Tiziana Colombo, President of the Association "The World of Intolerances", the app offers a free recipe per week dedicated to intolerant people. It also offers a list of over 800 dietary products that meet the needs of all intolerant people, and provides a section for intolerances to cosmetics for those who have a particular sensitivity to the components of cosmetics for daily use, to skin cleansers, to all those perfumes and fragrances that contain chemical additives hardly tolerated. (https://apps.apple.com/it/app/corelifestyle-intolleranze/id1136229145)

Indice e carico glicemico is a mobile app that helps to: recognize healthy foods, follow a low IG/CG diet and carbohydrates, weight control, prevent the onset of diseases, fight over-weight, controls blood pressure and hypertension, eat healthy, compute glycemic load, index and carbohydrates in food, control users' low carbohydrate diet. This is a free application that allows people to navigate easily, search, and visualize the glycemic index and glycemic load of various foods. The application also helps to maintain a body weight register and blood glucose level measurements. People can also access the glycemic load and carbohydrates in foods. There is also a glycemic load calculator for each individual portion. Knowing these values and following a low-carb diet help to avoid weight gain or obesity and reduce the risk of other related diseases.

https://play.google.com/store/apps/details?id=ig.Indice_lite&hl=it&gl=US

Name	Category	Rating	Languages	Free	Paid version	For Android devices	For Apple devices
Indice e carico glicemico	Medical	4.6/5	Italian, Chinese Simplified, Chinese Traditional, Finnish, French, Indonesian, English, Dutch, Polish, Portuguese, Russian, Spanish, German, Turkish, Hungarian	X	X	X	X

Data retrieved from https://apps.apple.com/it/app/indice-e-carico-glicemico-keto/id1087424868

Exercise Advisor is a prototypical exercise advisor app to reduce some of the burden associated with diabetes management during exercise. The app guides the user on carbohydrate feeding strategies and insulin management strategies before, during, and after exercise and provide targeted and individualized recommendations. As a basis for the recommendations, the decision trees for the app use various factors including the type of insulin regimen, time of activity, previous insulin boluses, and current glucose level. The app is designed to meet the various needs of people with T1D for different activities to promote safe exercise practices.

https://journals.sagepub.com/doi/full/10.1177/1932296820979811

My therapy is a free app whose major functions are:

- Reliable and powerful reminder for medication, measurements and activities
- Involvement of patients' family and friends to motivate them to manage their therapy
- Get on top of patients' symptoms and their wellbeing
- Support for a wide range of measurements such as blood pressure, weight, blood sugar, etc.
- Built-in health journal with monthly .pdf report

MyTherapy reminds patients to take their medication, to get active and to track their vitals and symptoms. At the same time MyTherapy's health journal summarises patients' medication intake and other health-related information. It is available in English, French, German, Italian, and Spanish and it is rated 4.8 out of 5 on the app store preview (https://apps.apple.com/gb/app/mytherapy-medication-reminder/id662170995).

▪ ***Sweden – Visual impairment or blindness***

In Sweden, there are several specialized websites, generally connected to associations or organizations working to promote leisure activities for people with a visual impairment, that offer helpful information for people with visual impairments to become more active (examples are: http://www.aktivasynskadade.org; https://www.parasport.se/).

Among the technologies that are intended to assist people with visual impairments with participation in sport, especially swimming, we found:

- IBM's Buddy, bluetooth beacons and haptic devices to help the blind swimmers. Sense Bluetooth doesn't work under water, they placed Bluetooth beacons on a steel wire that runs 4 to 5 feet above the water along the center of the lane (see here for further information: https://coolblindtech.com/ibms-buddy-for-the-blind-solution-helps-the-blind-swim/);
- Air bubbles, Audio in water, Indoor possion, Camera
- Samsung's Blind Cap, that is a vibrator in the cap with app on the phone (more information can be retrieved here: https://www.wareable.com/sport/samsungs-blind-cap-paralympic-swimmers).

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- *Summary of the findings*

***What evidence is available from grey literature and web-related resources in each country involved, and internationally*?**

Slovakia - Mental health disorders

Regarding people with depression and all those people who want to improve their mental health, in Slovakia, there do not seem to be many devices and supporting technologies. The only resource found is an online platform (https://pozitivnamysel.sk/) for obtaining online counselling or arranging a meeting with psychologists or coaches.

Spain - Mental health disorders

Looking at Spain, the internet search resulted in a number of websites and mobile apps that provide information, knowledge, solutions, recommendations regarding mental health. In particular, they deal with anxiety and stress (such as the website of the Spanish Society for the Study of Anxiety and Stress - S.E.A.S. - or the website of the Ministry of Health); promoting healthy habits and modifying harmful behaviours or mapping resources on the territory to improve the lifestyles of the population (as in the case of the Quiérete app or the Localiza salud app); promoting mindfulness sessions and positive psychology exercises with the aim of improving the well-being of users (this is the case of the Siente app). As can be seen, there are several initiatives coming from the top, at national level: Quiérete is a mobile application developed by the Spanish Red Cross; the Ministry of Health's website offering information on positive emotions, anger, stress, anxiety and sadness.

Turkey – Children with disabilities

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Regarding assistive technologies for children with disabilities in Turkey, the internet search has revealed only one app, Migros sağlıklı yaşam yolculuğu, from the Turkish retailer Migros Ticaret, which aims to create awareness and positive change in healthy behaviours and lifestyles. It also promotes physical activity.

Albania – People/children with type 2 diabetes

The internet search on assistive technologies aimed at people with type 2 diabetes in Albania are, in most cases, apps that help in insulin monitoring by promoting exercise as a way to bring multiple health benefits. GlucoseZone is perhaps the most diabetes and sports specific app. Designed specifically to promote exercise among people with type 1 and type 2 diabetes, it provides exercise guidance by taking into account factors such as pre-exercise blood glucose levels, medication and type of exercise.

All these apps have at least one free version and are translated into many languages.

Italy – Food allergies and intolerances; type 1 diabetes; celiac disease

With reference to Italy, from the internet search only one app was identified for food intolerances in general, one app aiming at recognising healthy foods in order to prevent the onset of diseases or to fight overweight or other problems that can derive from not having a healthy diet, and two apps for diabetes management.

Sweden – Visual impairment or blindness

Searching in the internet, there are several specialised websites in Sweden that work to promote leisure activities for people with a visual impairment, also moving in the direction of providing more information. In addition, a number of devices have been identified that enable people with a visual impairment to participate in sport.

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Survey of User Experience, Needs and Preferences

This explorative research offers additional insights concerning assistive technologies and people with chronic illness. A total of 154 respondents aged over 18 completed the user's survey. More specifically, 18.2% were from Denmark (28), 16.9% from Slovenia (26), 16.4% from Slovakia (27), 14.9% from Belgium (23), 11.7% from Italy (18), 9.7% from Albania (15), 5.8% from Sweden (9), and 5.2% from Spain (8).

Most of the sample was aged from 19 to 50 years old (77.1%); 61,8% were female. Thirty-eight per cent had a high school diploma, 46.4% had a bachelor's degree or a higher education title. As regards the employment status, half sample were employed (52%). More specifically, 25% were full-time employed, 17.1% were part-time employed, and 9.9% were self-employed; 15.1% were students, whereas 12.5% were unemployed. The remaining part of the sample was retired (9.2%) or had other employment status (11.2%; maternal leave, or were included in the social inclusion program, or were unemployable).

Respondents were asked to identify whether they had difficulties in any of the six general functional categories: mental health and neurological related disorders; digestive, metabolic, immunological, and endocrine systems related disorders; skin related disorders; seeing, hearing and vestibular related disorders; cardiovascular, haematological, and respiratory systems related disorders; neuromusculoskeletal and movement-related disorders. The impairments reported by participants are listed in Table 3.

Functional impairments	**N (%)**
Depression	27 (17.5%)
Migraine	28 (18.2%)

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Clinical stress disorder and anxiety	27 (17.5%)
Post-traumatic stress disorder	2 (1.3%)
Bipolar disorder/schizophrenia	13 (8.4%)
Developmental disabilities	6 (3.9%)
Type 1 Diabetes	27 (17.5%)
Type 2 Diabetes	37 (24%)
Obesity	21 (13.6%)
Food intolerances or allergies	35 (22.7%)
Psoriasis	9 (5.8%)
Blindness	6 (3.9%)
Low vision	37 (24%)
Hearing impairment	9 (5.8%)
Anemia	8 (5.2%)
Asthma	16 (10.4%)
Arthritis	9 (5.8%)
Blood pressure disorders (hypertension or hypotension)	24 (15.6%)
Locomotor with or without other limitations/disabilities	4 (2.6%)
Lower back pain	26 (16.9%)
Sciatica	5 (3.2%)

Table 3 Functional impairments reported by participants in the study.

On average, participants reported having three functional limitations/difficulties among those

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indicated. The figure below displays the frequency (in percentage) of co-occurrent impairments for each functional impairment considered in the study.

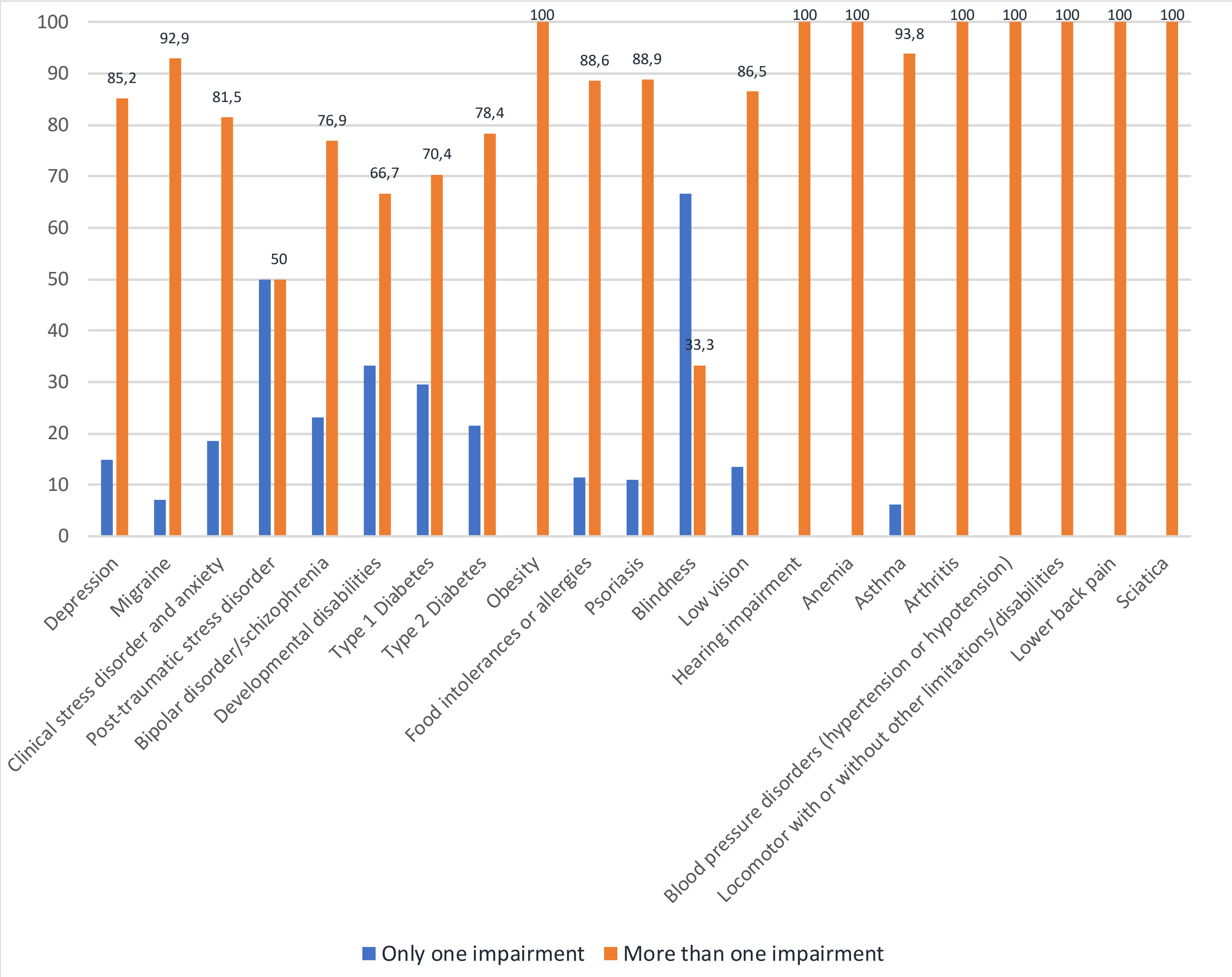

Figure 1 Percentages of comorbidities for each functional impairment.

- ***Frequency of use of general technologies and overall experience with technology***

Almost all the respondents reported a frequent usage of smartphones (90.9%), personal computer (desktop - 29.2% - or laptop – 47.4%), and television (55.8%). Smart watches were used by 27.3% of the sample, whereas 24% reported usage of internet-based programs, services or resources (e.g., online platforms, forums). Tablet was used by 17.5%; the use of game consoles and digital readers was reported by12.3% and 11% of the sample, respectively. Disability-related assistive technologies were indicated by 3.2% of the sample.

Overall, most of the sample found the experience with technology as satisfying (73.1%), whereas 24.1% reported a neutral opinion. Only 2.8% stated they found technologies as frustrating.

Furthermore, 41% of the respondents reported that technologies improve their creativity, whereas 48% expressed a neutral opinion and 10.1% thought that technologies interfere with their creativity. As regards the association of technologies with positive interpersonal relations, 52.8% of the sample found that technologies helped them to stay in touch with people; 9.2% said that technologies separate them from other people. The remaining part of the sample expressed a neutral opinion (38%).

Finally, 25.5% stated that technologies raise the opinion they have of themselves; 58.2% was neutral; 16.3% reported that technologies lower the opinion they have of themselves.

- ***Use of and experience with technologies for health, nutrition, and sport***

Twenty-two per cent of the respondents (N = 35) reported they had never used technologies for health, nutrition and sport. Of these, four people suffered only from mental health disorders (depression or clinical stress disorder and anxiety), two reported only type 1 and type 2 diabetes, whereas three others only reported low vision or blindness. Among those who indicated more than

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one functional impairment, non-use of technologies for health, nutrition and sport was frequently associated with depression (N = 6), migraine (N = 9), clinical stress disorder and anxiety (N = 5), type 1 (N = 5) and type 2 diabetes (N = 10), obesity (N = 9), and low vision (N = 6).

Among those who reported having used or actually being using technologies for health, nutrition and sport, 11% (N = 17) reported the use of devices that enable people with impaired vision or other disabilities to play sports and be physically active; 33.1% (N = 51) indicated devices or technology-based services that provide health information (e.g., nutrition and diets, physical activity); 31.8% (N = 49) reported devices or technology-based services for self-monitoring of nutrition and exercise; 16.9% (N = 26) said having used or using devices or technology-based services for monitoring hydration status, and metabolism (e.g., hydration, sodium, glucose, metabolites, various molecules, and proteins); 9.7% (N = 15) reported devices or technology-based services for monitoring physical and psychological stress; 10.4% have used or currently uses devices or technology-based services that provide physical biofeedback (e.g., muscle stimulation, haptic feedback, heart rate).

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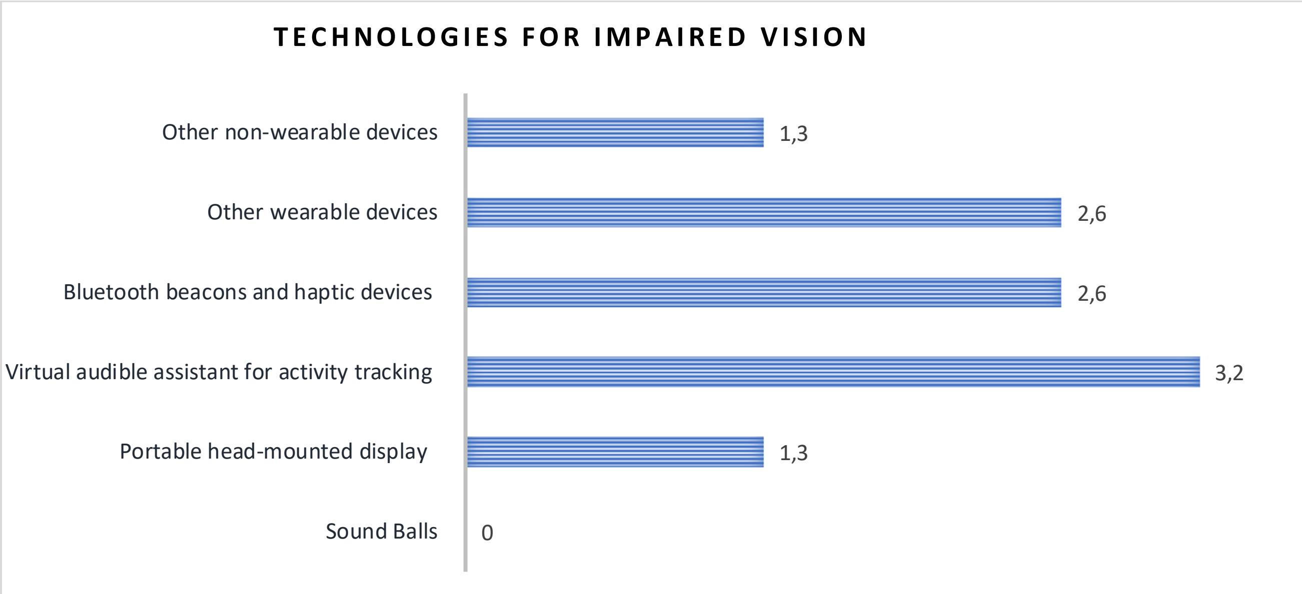

Figure 2 Percentages of participants using technologies for impaired vision.

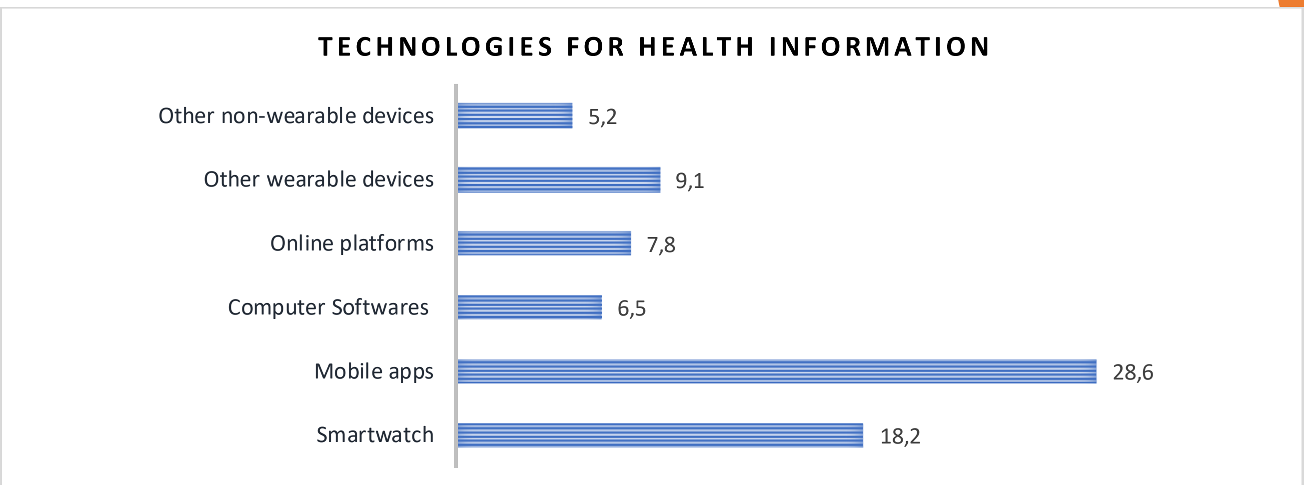

Figure 3 Percentages of participants using technologies for health information.

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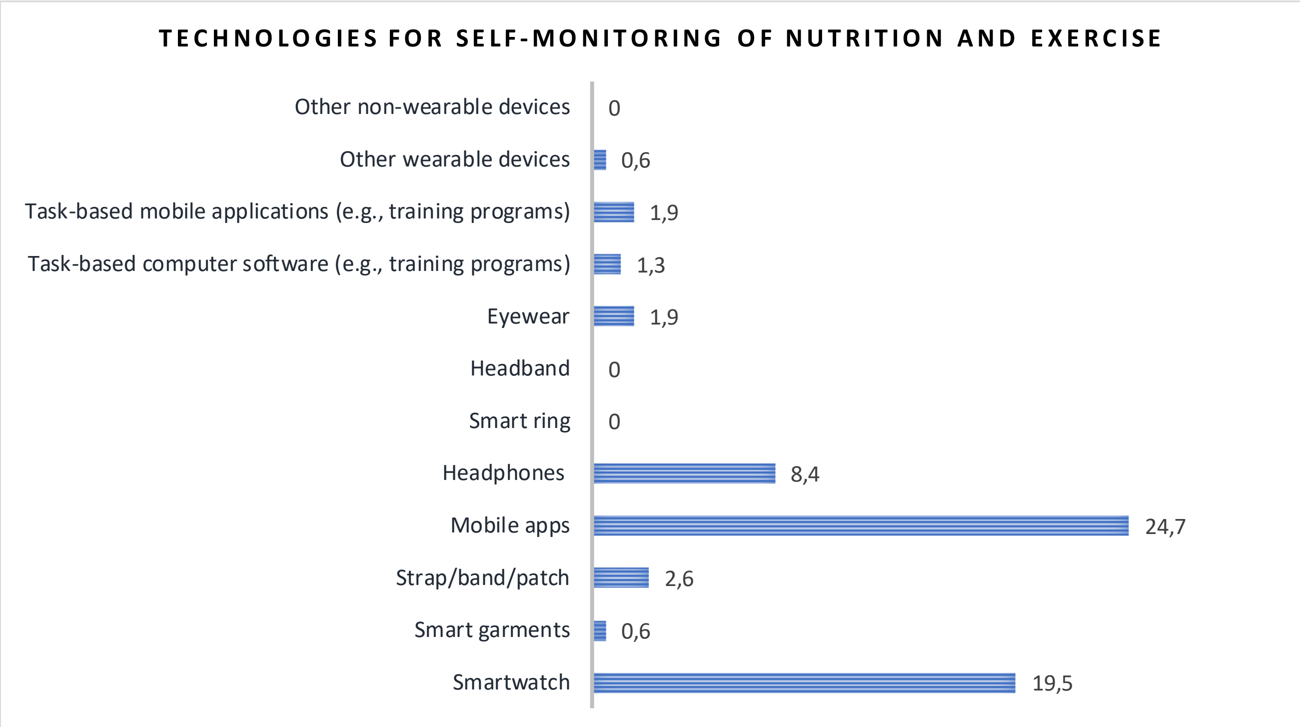

Figure 4 Percentages of participants using technologies for self-monitoring of nutrition and physical exercise.

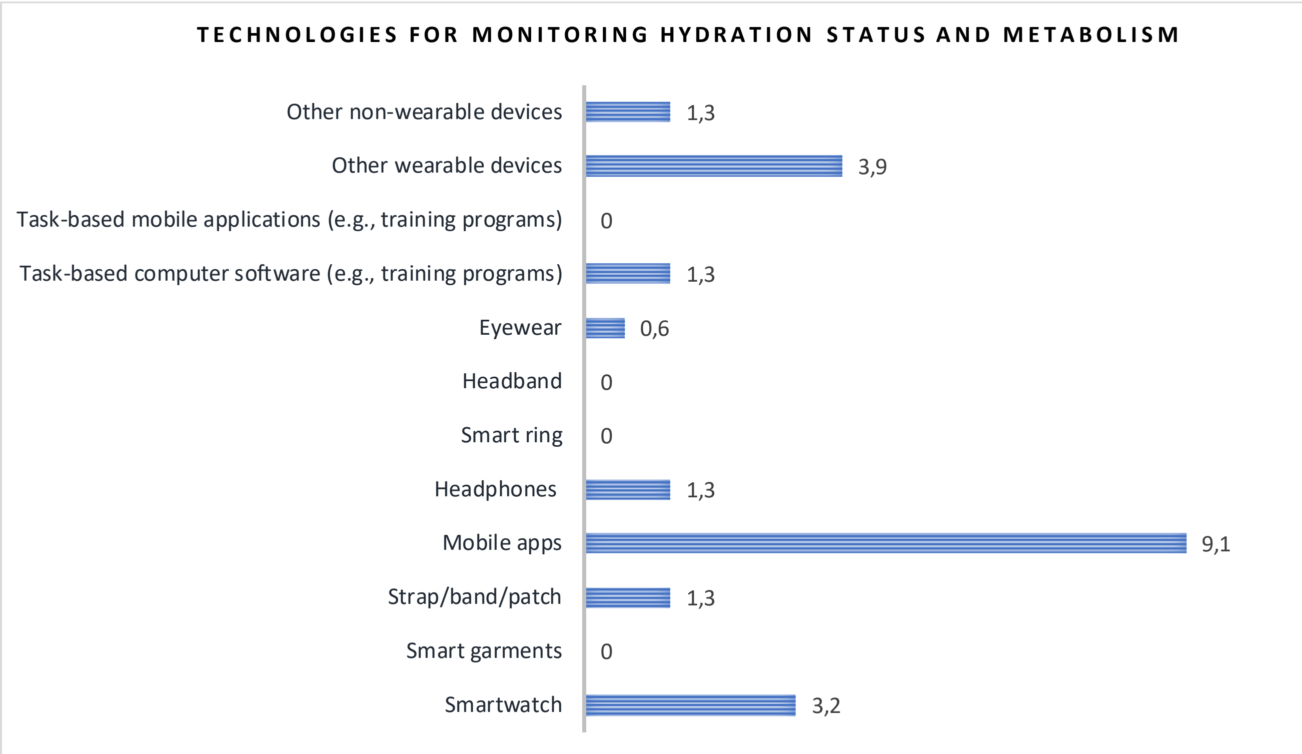

Figure 5 Percentages of participants using technologies for monitoring hydration and metabolism.

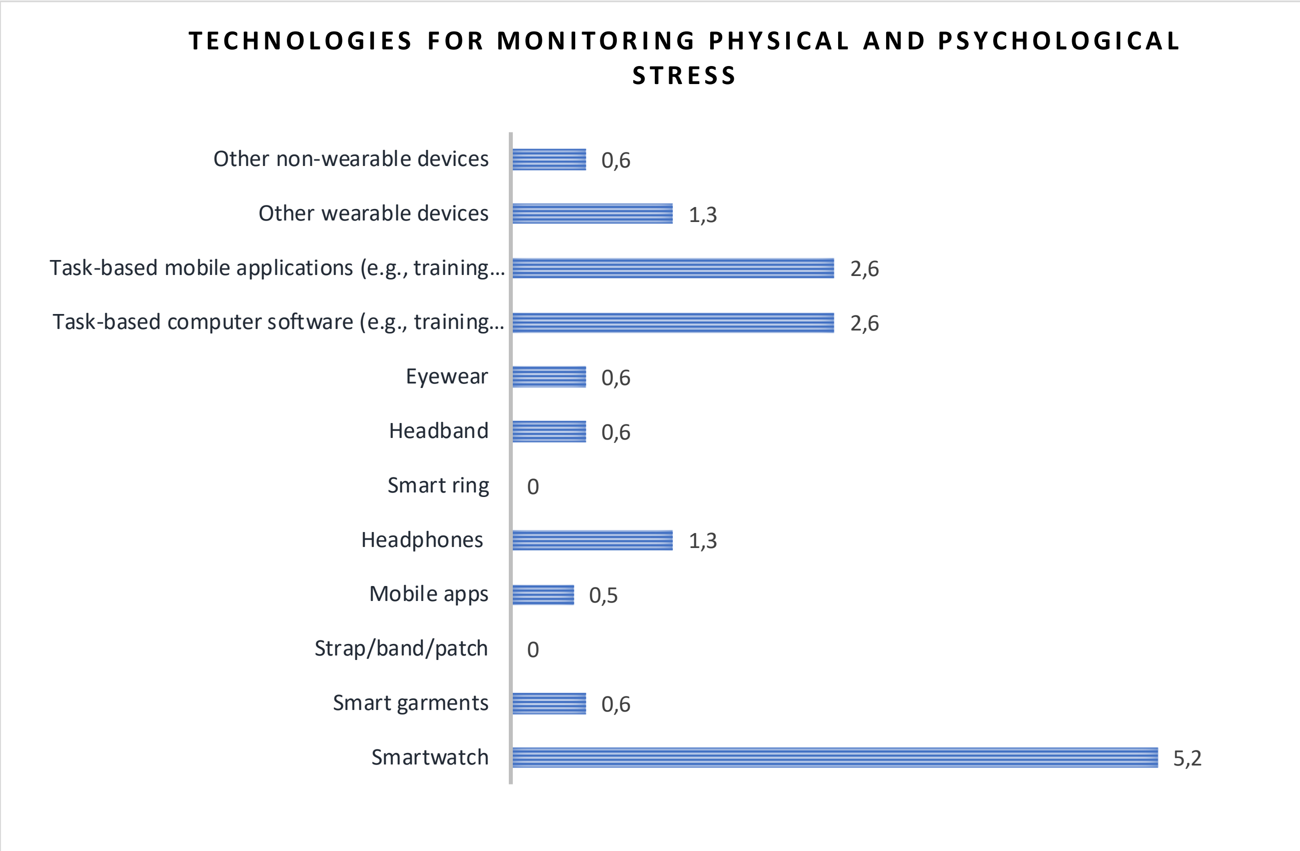

Figure 6 Percentages of participants using technologies for monitoring physical and psychological stress.

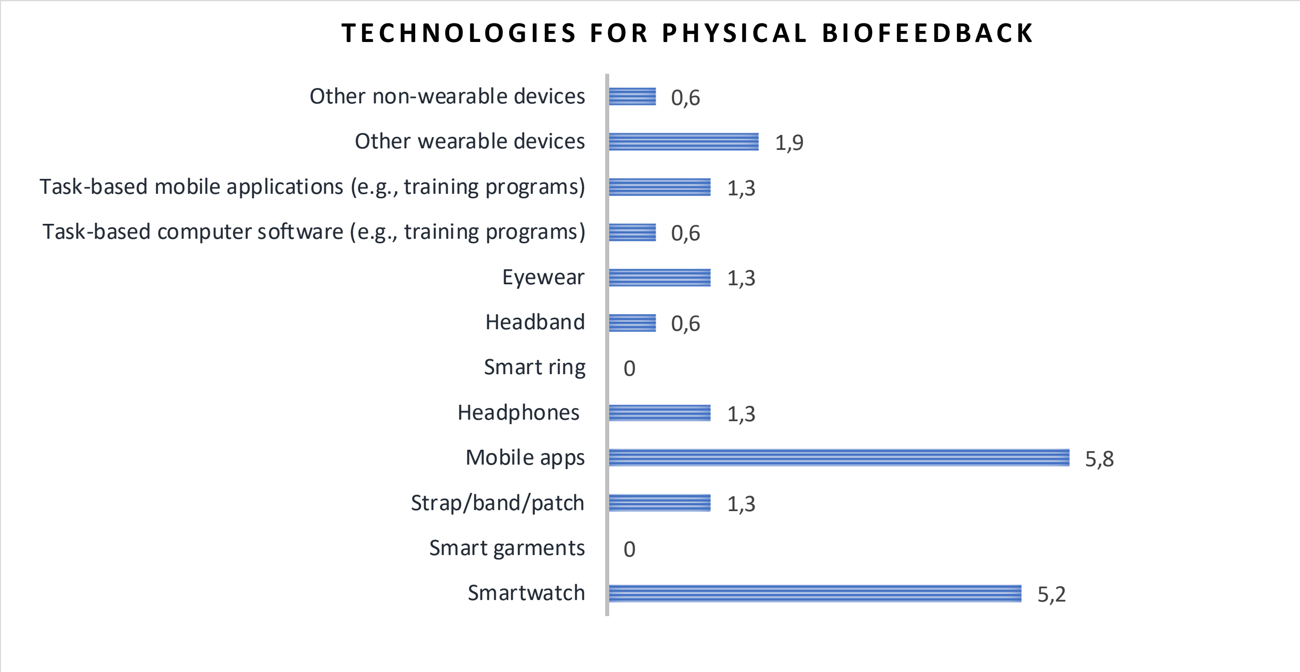

Figure 7 Percentages of participants using technologies for physical biofeedback.

As regards the frequency of use, 65.7% of respondents reported to use this kind of technology for one hour or less per day. On average, the daily usage frequency reported by participants is of approximately 5 hours per day.

Furthermore, participants were asked to indicate how often they needed someone's help with using this device/service (these devices/services) using a 5-point scale from "each time" to "never". Overall, 82.7% reported they do not need someone's help in using these technologies, whereas 17.3% indicated to need someone's help always (2.9%), almost always (4.8%) or about half of times (9.6%). The analysis of bivariate correlations (Pearson's r) showed that the need for someone's help was significantly associated with participants' reporting of depression (r =.25, p < .01) and clinical stress disorder and anxiety (r = .20, p < .05).

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- ***Perceived benefits related to the use of these technologies***

Participants were asked to answer a series of questions assessing their perception of benefits related to their use of technologies. More specifically, they were asked to indicate to what degree i) technologies improved their quality of life, ii) enhanced their comfort and wellbeing, and iii) help them to take care of their health. Responses were rated on a 5-point scale, ranging from "not at all" to "a great extent".

A relatively high percentage of respondents reported to be not at all or just a little bit satisfied about the degree these technologies improved their quality of life (30.1%), enhanced their comfort (27.2%) and wellbeing (25.2%), or helped them in taking care of their health (26.2%) and being more active (24.2%). Some respondents expressed a neutral opinion (percentages range from 13% to 22%).

Also, the bivariate correlation analysis indicated that higher was the number of impairments reported by respondents, higher was their satisfaction about technologies' efficacy in improving quality of life (r = .22, p < .05), wellbeing (r = .23, p < 05) and levels of activity (r = .22, p < .05).

- ***Healthy habits associated with using and experience with technologies for health, nutrition, and sport***

Participants were asked to report their healthy habits in terms of involvement in physical exercise (vigorous or moderate activity and walking) and attitudes towards healthy nutrition.

Involvement in physical exercise was assessed using two items adapted from the International Physical Activity Questionnaire (1998, retrieved from https://sites.google.com/site/theipaq/). Attitudes towards healthy nutrition were assessed using a series of items adapted from the Nutrition-Related Attitudes (Jeruszka-Bielak et al., 2018). The response options ranged from "strongly disagree" (1) to "strongly agree" (5).

Overall, the results showed that 64.4% of respondents did a vigorous or moderate physical activity at least one day in the last seven days, whereas 94.2% reported having walked at least one day for 10 minutes in the previous seven days. In terms of attitudes towards healthy nutrition, about 41% of the sample stated that the healthiness of food has a particular impact on their food choices. In contrast, the remaining part of the sample was neutral (19.9%) or said that it impacted their food choices (38.1%). Eighty-one per cent stated that it was important that their daily diet contains an adequate amount of various nutrients and that they were aware that eating plays a key role in their overall health condition. Almost half of the sample (47.7%) declared to follow a healthy and balanced diet.

The correlation analysis between healthy habits and use and experience with technologies for health, nutrition, and sport, revealed that being active was not significantly associated with technology's usage (*r*s = .08 and .03, p > .05, for vigorous/moderate activity and walking, respectively). On the contrary, more positive attitudes towards healthy nutrition, as a global score, were significantly associated with technology's usage and higher satisfaction with them, as it can be observed in the following table.

	Positive attitudes towards nutrition
Use of technologies	.25, $p < .001$
Improvement in quality of life	.30, $p < .01$
Improvement in comfort	.29, $p < .01$
Improvement in wellbeing	.25, $p < .05$
Help in taking care of one's health	.28, $p < .01$

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Help in being more active	.26, $p < .01$

Table 4 Associations of positive attitudes towards nutrition with use of technologies and perceived satisfaction with them.

- ***Current usage of technologies for sport, health and nutrition***

Participants who reported being currently using technologies for health, sport and nutrition were 94, which corresponded to 79% of respondents who previously reported to have had any experience with technology for health, sport and nutrition; 25 (21%) reported being not using any kind of technology for health, nutrition and sport, currently. The current usage of technology was significantly associated with perceived benefits from using technology for health, nutrition and sport, as it is reported in the table below.

	Current usage
Improvement in quality of life	.36, $p < .001$
Improvement in comfort	.36, $p < .001$
Improvement in wellbeing	.40, $p < .001$
Help in taking care of one's health	.21, $p < .05$
Help in being more active	.26, $p < .01$

Table 5 Correlations between current use of technologies and individuals' perceptions of benefits related to technology usage.

- ***Subjective wellbeing and psychosocial characteristics associated to use and experience with technologies for health, nutrition, and sport.***

Respondents were asked to report their level of satisfaction with respect to several dimensions of wellbeing and of their psychosocial functioning, identified according to the ICF model (2002).

In terms of personal wellbeing, they were asked to report their level of satisfaction using a 5-point scale ("1" for "Not Satisfied" through "5" for "Very Satisfied"). The results of the bivariate correlations showed that the adoption of technologies for health, nutrition and sport was significantly associated with higher satisfaction with interpersonal interactions and relationships, close and intimate relationships, educational attainment, work and employment status, feeling connected, emotional well-being, physical comfort, nutrition and healthy diets.

	Use of technologies
Self-care and domestic tasks	.13, $p > .05$
Interpersonal interactions and relationships	.17, $p < .05$
Close, intimate relationships	.17, $p < .05$
Educational attainment	.22, $p < .01$
Work and employment status/potential	.24, $p < .01$
Participation in desired community, social and civic activities	.12, $p > .05$
Autonomy and self-determination (making decisions)	.15, $p > .05$
Fitting in, belonging, feeling connected	.20, $p < .01$
Emotional well-being	.16, $p < .05$
Physical comfort & well-being	.22, $p < .01$
Overall health	.08, $p > .05$
Nutrition and healthy diets	.25, $p < .01$
Participation in sport or physical exercise	.14, $p > .05$

Table 6 Correlations between use of technologies and dimensions of personal wellbeing. Notes. Significant associations are in bold.

To investigate the psychosocial functioning of the individual, we asked respondents to indicate which aspects of the social functioning domain frequently or often apply to their condition. Findings revealed that the use of technology for health, nutrition and sport was significantly associated with feeling determined to meet personal goals ($r = .19$, $p < .05$), perceiving technology as interesting ($r = .19$, $p < .05$). Furthermore, feeling frustrated or overwhelmed ($r = .19$, $p < .05$), and feeling often angry or insecure ($r = -.17$, $p < .05$) were negatively associated with technology usage. Only marginal associations were found with perceived social support from friend ($r = .13$, $p = .09$), compliance with health professionals ($r = .14$, $p = .08$), and pleasure with having a challenge ($r = .15$, $p = .06$).

- ***Technology-related features that could serve as facilitators for continuing use of a specific technology.***

Participants were asked to rate technologies they were currently using with respect to some technology-related features selected from the Assistive Technology Device Predisposition Assessment (Scherer, 1998), a questionnaire that examines consumer's subjective satisfaction - with achievements in a variety of functional areas - when using assistive technology. The items cover three main categories:

- adaptability (e.g., help me to achieve my goals, benefit me and improve my quality of life, fit well with my accustomed routine, existence of supports, assistance and accommodations for successful use)
- fit to use (e.g., physically fit in all desired environments, feeling confident about the use)
- and socializing (e.g., feeling comfortable using the device around family, friends, school or work, community).

Sixty-seven participants in the study provided their feedback.

In terms of **adaptability** (Figure 8), most of the sample feel generally confident about using technologies without discomfort, stress and fatigue, think the device fits well with their daily routines and helps them to achieve their goals. The most critical aspect was related to the support and assistance for the successful use of the device.

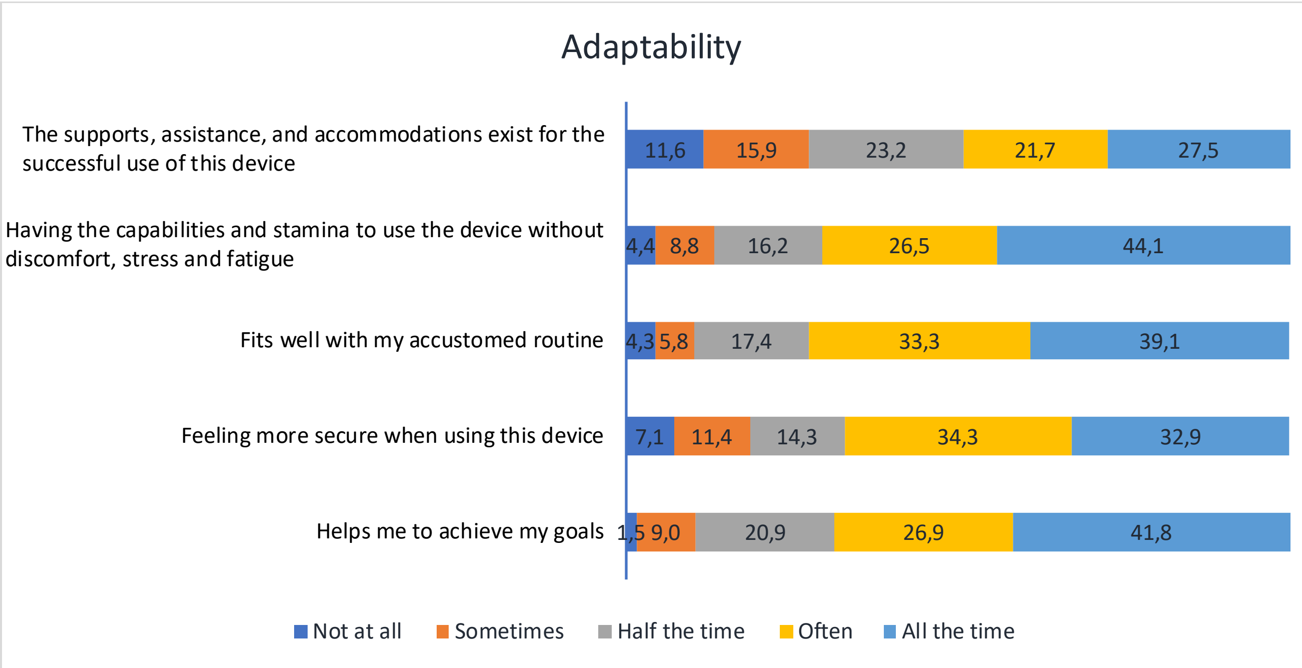

Figure 8 Users' ratings of technology adaptability features.

Regarding **fit to use**, respondents most rated this feature as occurring all the time or often (Figure 9).

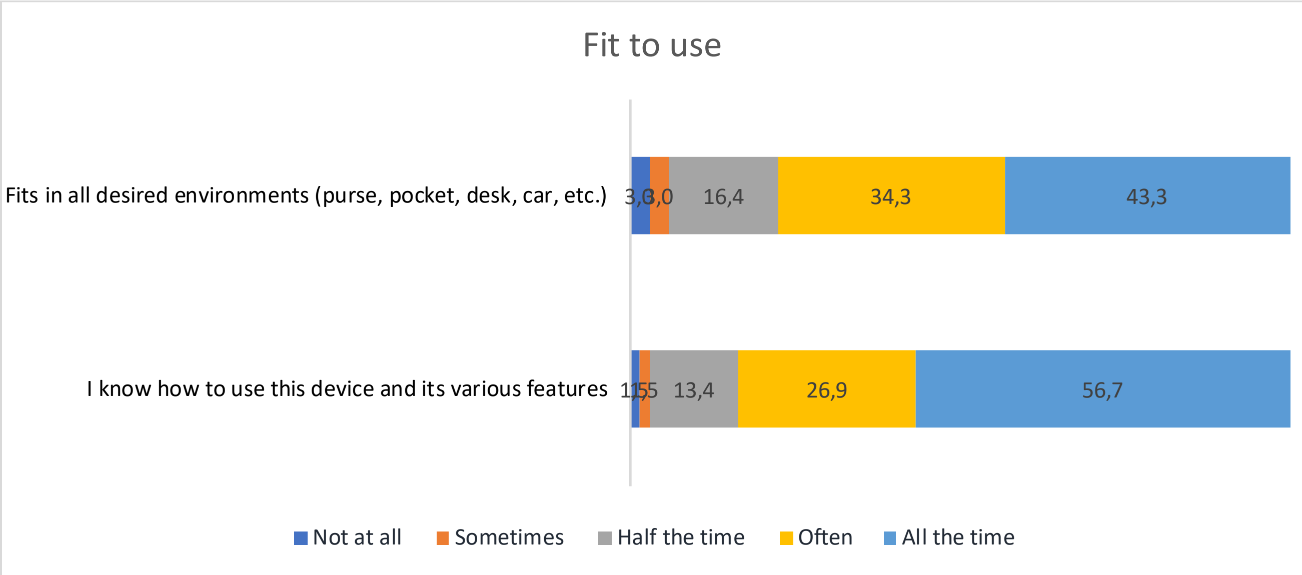

Figure 9 Users' ratings of technology fit to use.

Finally, in terms of socializing features (Figure 10), most of respondents reported that they generally (at least often) feel comfortable using their devices around family or friends. More critical is feeling comfortable at school or work and around the community, where almost 20% of the sample reported low frequency with which this happens (not at all or sometimes).

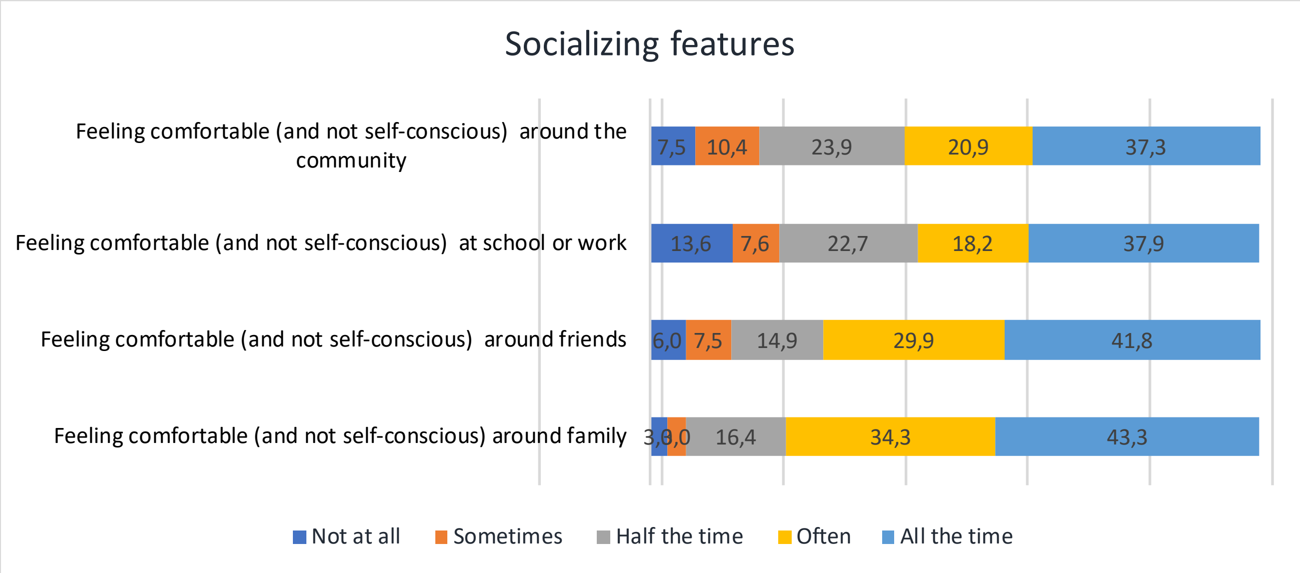

Figure 10 Users' ratings of technology socializing features.

When examining how the overall users' satisfaction with technology was associated with these specific technology-related features (overall adaptability, fit to use and socializing), the bivariate correlations suggested that only high adaptability was significantly associated with higher satisfaction overall, as can be observed in the table 7.

	Adaptability	Fit to use	Socializing
Improvement in quality of life	**.28, *p* < .05**	.03, *p* > *.10*	.19, *p* > *.10*
Improvement in comfort	**.23, *p* < .05**	.08, *p* > *.10*	.12, *p* > *.10*
Improvement in wellbeing	.21, *p* > *.10*	.06, *p* > *.10*	.15, *p* > *.10*
Help in taking care of one's health	**.29, *p* < .05**	-.03, *p* > *.10*	.14, *p* > *.10*
Help in being more active	**.29, *p* < .05**	.07, *p* > *.10*	-.06, *p* > *.10*

Table 7 Associations between user's satisfaction with technology and technology-related features. Notes: significant associations are in bold.

- ***Participants' rating of other technology-related features emerged from the peer-reviewed literature***

Based on the literature review illustrated above, a series of technology-related features were selected. Then, participants were asked to indicate, for each of these features, how much important they are for a user continuous usage of technologies. Responses were rated on a 5-point scale ranging from 1 (Not important) to 5 (Very important).

As can be observed in Figure 11, the multifunctionality of devices and the provision of clear instructions for use were rated as important or very important by respondents in the study. Other features perceived as relevant concern comfort to use, free or low cost, privacy and high-security levels, the flexibility of adaptation to the varying users' needs, and the adoption of a multidisciplinary approach (e.g., nutrition, physical exercise, psychological support, etc.).

The inclusion of interactive elements such as goal achievement score and competition were not rated as important, as well as the delivery of training, education, and decision support tools was considered relatively less important, with 29.4% of the sample rating them as not important or only somewhat important, and 41.2% as neutral. Provision of tangible rewards for goals achievements mainly was rated as neutral (32.1%) or important 25.2%; 28.6% reported that this feature was not important at all (28.6%) or somewhat important (10.7%). Provision of opportunities for chatting with live therapists/trainers mainly was rated as neutral (34.5%), followed by not important (29.8%) and important (23.8%). Provision of a real-time and visual display of feedback was mostly rated as important (34.9%) or very important (16.3%), followed by 40.7% of the sample rating this feature as neutral.

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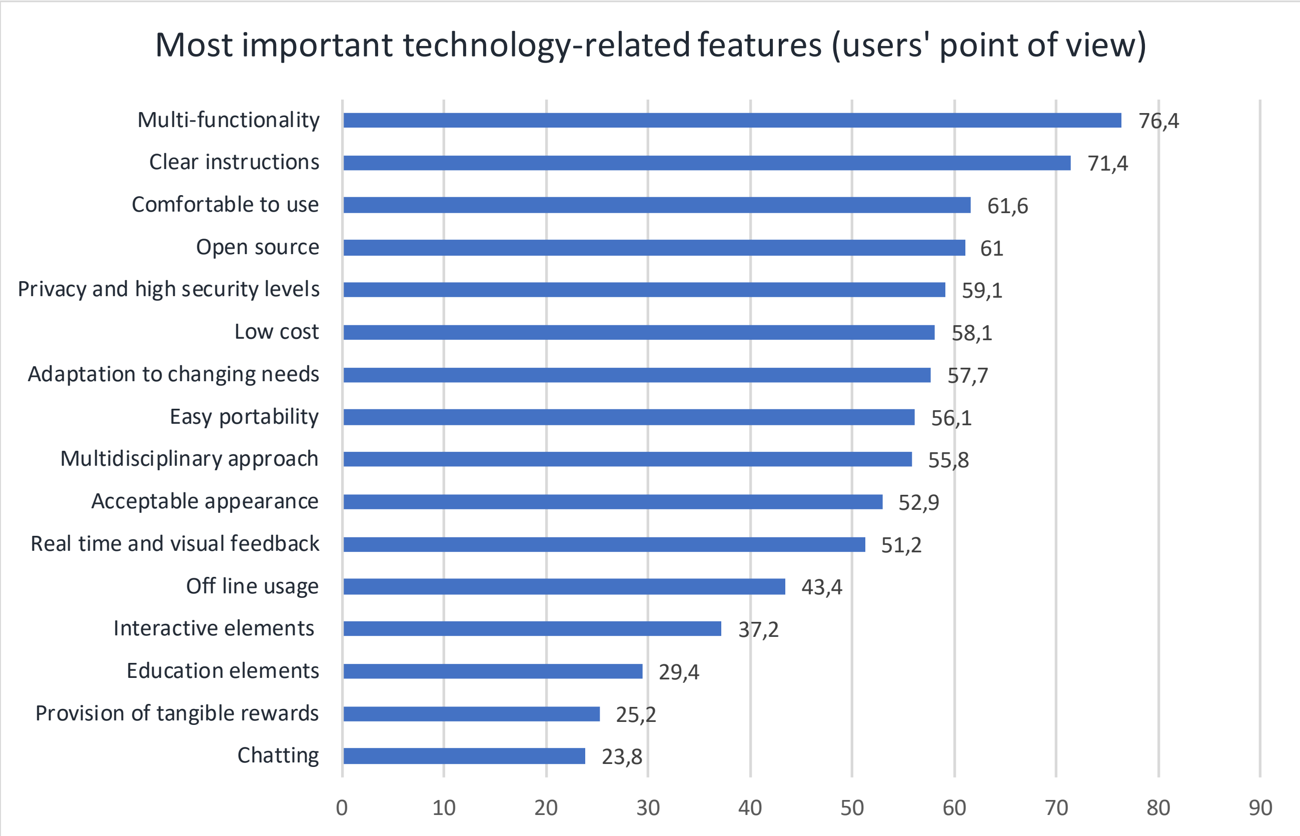

Figure 11 Percentages of users who rated as important or very important technology-related features.

- ***Reasons for non-use or stopping using technology***

Participants who reported to have used any device in the past but were not currently using it were asked to indicate what are the reasons they stopped using it. More specifically, they were asked to give a number between 0 (zero; not important at all) and 10 (ten; extremely important) to rate how important each reason was to their decision to stop using a device.

Personal factors

The most important factors that determined the user's decision to stop using the device were the need of someone's help, the worsening of users' health/physical condition, and users' forgetting to use the device. Feeling self-conscious using the device and having no one able to help them in using the device were rated as not important at all by the most part of the sample (see Figure 12).

Technology-related factors

Among the technology-related factors, the device limited fit with the user basic needs/preferences/expectations, the need for a better or a different device, and the fact that the device stopped working properly were rated as the most important factors leading users to stop using the device. The cost or the expiration of the lease were rated as not important by the most part of the sample (see Figure 13).

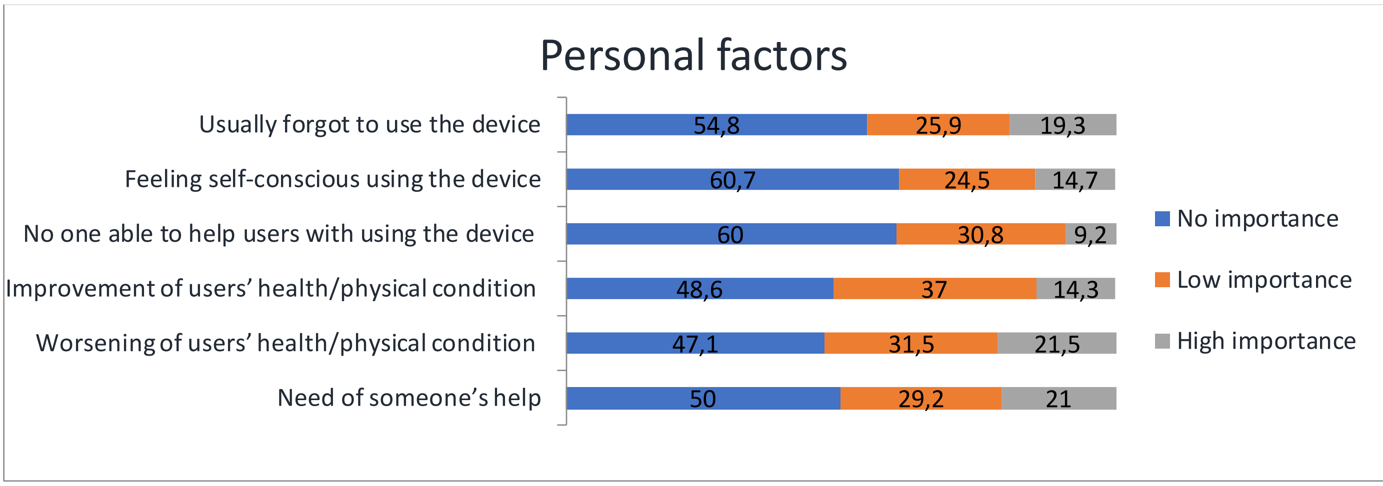

Figure 12 Personal factors determining users discard of technology (percentages of users' ratings).
Notes. Users' rates have been collapsed into three main categories: no importance (ratings from 0 to 5), low importance (ratings from 6 to 7) and high importance (ratings from 8 to 10) have been reported.

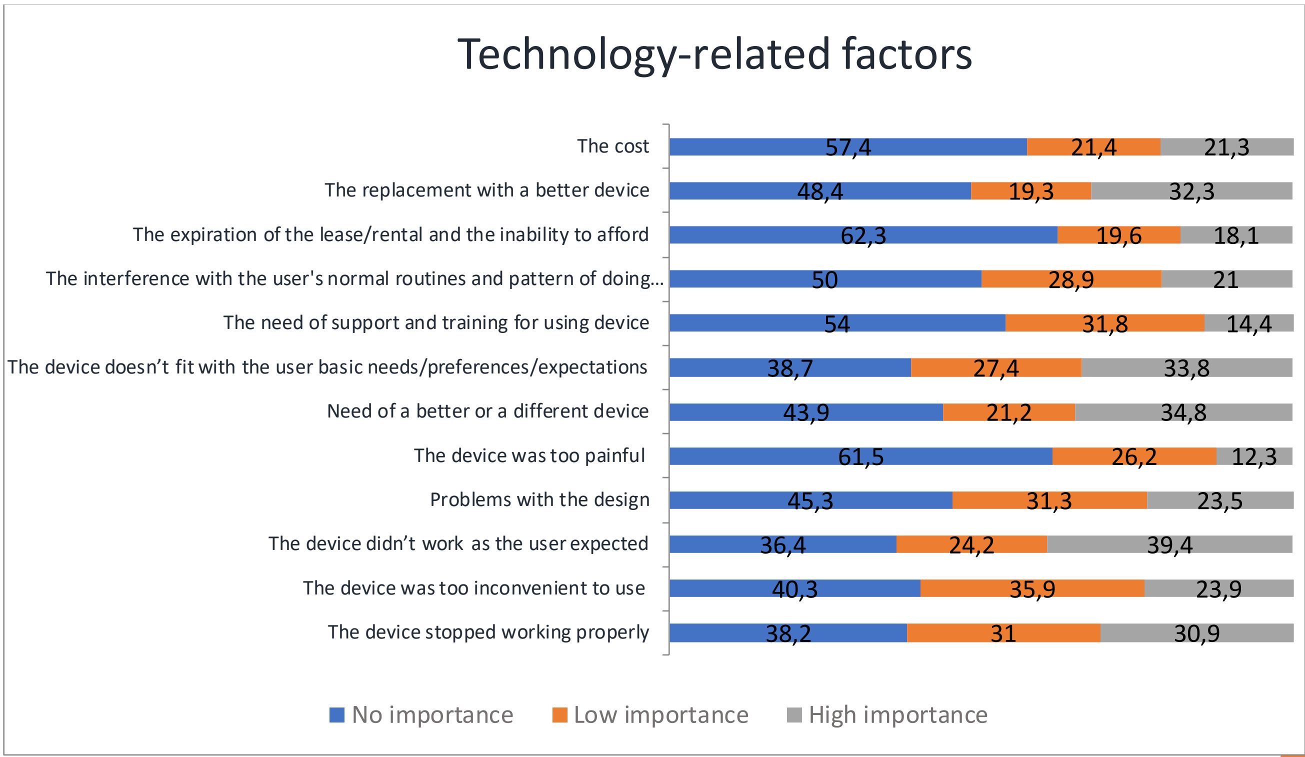

Figure 13 Technology-related factors determining users discard of technology (percentages of users' ratings). Notes. Users' rates have been collapsed into three main categories: no importance (ratings from 0 to 5), low importance (ratings from 6 to 7) and high importance (ratings from 8 to 10) have been reported.

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Survey of Experts about their patients/clients experience, needs and preferences

We interviewed 99 experts from Slovakia (19.7%), Albania (18.6%), Spain (13.5%), Denmark (11.4%), Slovenia (9.5%), Belgium (11.4%), Italy (9.4%), and Sweden (6.5%).

Of these, 64.6% were female, 32.3% were males, 3.1% preferred to not report their sex. Twenty-five per cent of the sample were aged from 19 to 30 years old; 33.3% from 31 to 40; 22.9% from 41 to 50; 17.1% were 51 years old and over.

Most of the sample had a bachelors' degree (36.1%) or a higher education attainment (47.4%). The remaining part had a high school diploma (16.5%). As regards the employment sector, 48.5% worked in healthcare, 10.1% worked in the area of nutrition and diet, 10.1% worked in the sector of sport and fitness, whereas 16.2% were employed in the area of social assistance and promotion of social inclusion.

- ***Recommendation of technology***

Professionals were firstly asked if they would suggest/recommend the use of technology-based devices or services to their patients/clients. Of the total sample, 75.8% answered yes, 13.1% stated that they would not suggest/recommend the use of technology, whereas 11.1% said they were not sure (Figure 14).

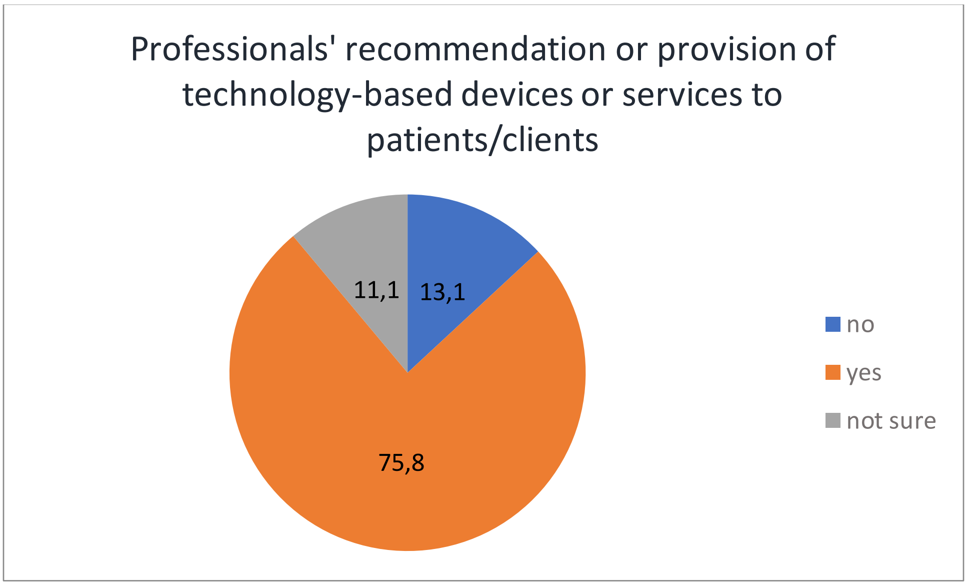

Figure 14 Percentages of professionals recommending use of or providing technology for people with disabilities.

- ***Factors that could influence the use (or disuse) of technology***

Professionals were introduced with a series of individual and psychosocial factors that could incentivize or disincentivize to technology-based devices and services usage. Then, they were asked to indicate to what degree each factor, in their opinion, could positively or negatively influence the use of technology-based devices and services for health, nutrition and sport practice/physical exercise by their patients/clients using a 4-point scale (no influence at all or does not apply; low influence; moderate influence; high influence). The results are reported in Figure 15.

Overall, the most important factor that serves as a facilitator for technology use is the user's desire to do it, which was rated as having at least a moderate influence by 93% of the respondents. Other important factors that are perceived as positively influencing the adoption of technologies for health, sport and nutrition were the desire for independence, cooperation with therapist and rehabilitation plan, whereas the view of barriers/limitations was rated as negatively influencing technology use.

Expectations held by family and attitude/outlook on life were generally rated as the factors that have a lower influence on the use of technology.

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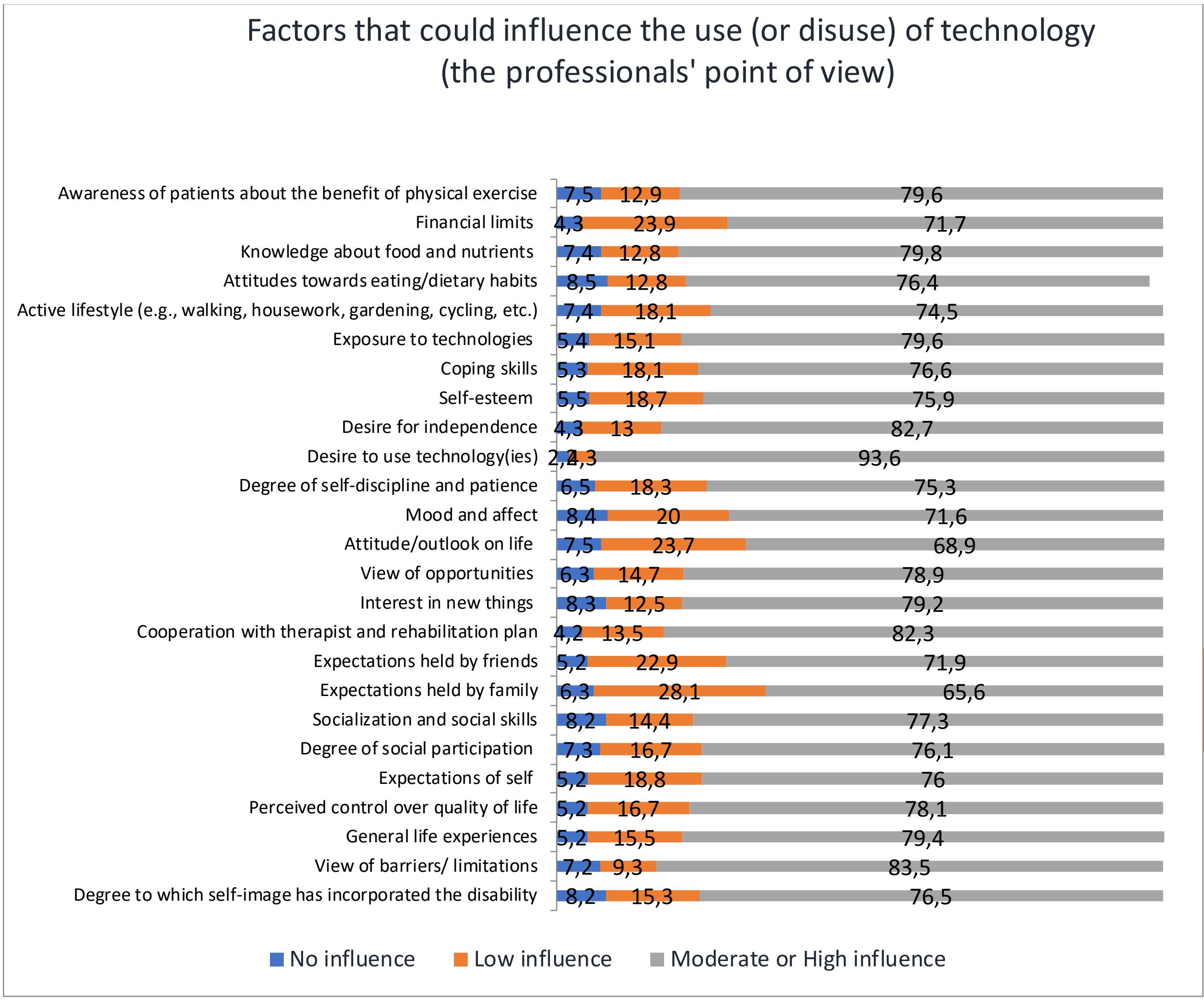

Figure 15 Factors contributing to technology use or disuse by people with disabilities. Professionals' ratings of importance.

- ***Factors that could influence professionals' recommendation of technology***

Professionals were asked to indicate the degree to which a series of factors could influence professionals in the provision/recommendation of technology-based devices and services for health, nutrition, and sport practice/physical exercise. Answers' options were: no influence at all (or does not apply), low influence, moderate influence and high influence. The results are reported in Figure 16.

As can be observed, over 90% of the sample reported that knowledge of technology-based devices and resources and passion for improving the outcomes for their patients/clients are important factors influencing professionals' provision or recommendation of technologies to their patients/clients. In addition, adequate training on technology-based devices and resources was also rated as highly affecting the provision or the recommendation of technology.

Low confidence in the skills of technology-based devices and resources and negative opinion about technology was mainly rated as not important for professionals recommendation of technology.

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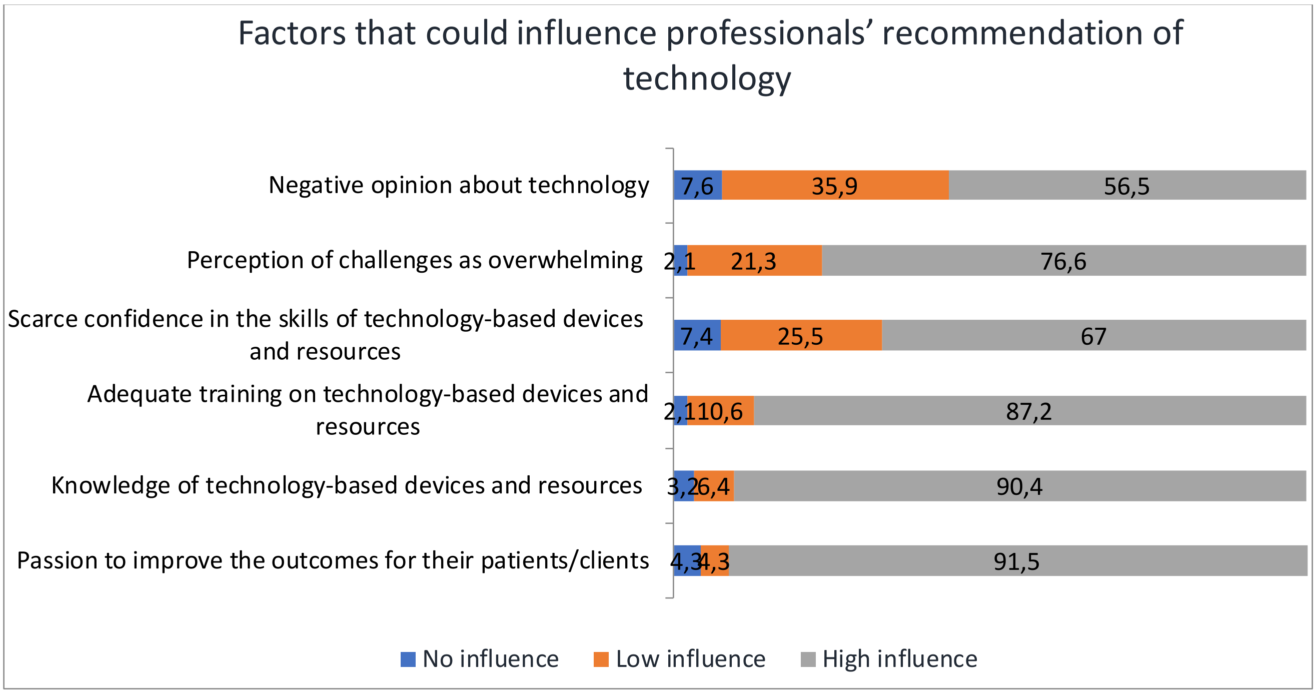

Figure 16 Factors contributing to professionals' recommendation or provision of technology for people with disabilities. Professionals' ratings of importance.

- ***Summary of the findings***

What are the views of users and professionals responsible for supporting the users in adopting healthy lifestyles?

The online survey of people with disabilities in the project's target groups revealed that nearly all respondents frequently used smartphones, personal computers, and television and that their experience with technology was satisfying. In addition, users say that technologies help them stay connected with people and increase their opinion of themselves.

Most users reported using technology-based devices or services that provide health information and technology-based devices or services for self-monitoring of nutrition and exercise. In addition, most of the sample said that using technology helped them achieve their goals all the time and that they feel more confident (secure, self-assured) when using technology.

The decision to stop using technology, where applicable, appeared to be overall associated with technology-related factors rather than with personal factors.

Health and sports professionals working in the field of identified disabilities were surveyed to measure their opinion, as professionals, on personal and psychosocial factors that might incentivize or disincentivize their patients or clients to use technology to maintain wellness-related routines, such as regular physical activity, sports, and good nutrition, as well as factors that might influence the provision of professionals and the recommendation of these types of technologies.

The majority of professionals stated they would suggest/recommend the use of technology-based devices or services to their patients/clients. Regarding factors that might influence the use (or disuse) of technology, professionals considered all individual and psychosocial factors that might incentivize or disincentivize the use of technology-based devices and services to be very influential.

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In terms of factors that might influence professionals' recommendation of technology, all of the listed factors were also considered influential in the provision/recommendation of technology-based devices and services.

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CONCLUSIONS

What lessons can be identified from the evidence arising from this research report?

Overall, technology seems to be an effective tool for supporting health-related behaviour change or maintenance. The main functions served by technology to assist people with the specific disabilities addressed in this research can be summarized as follows:

– Support for self-care (reminders, schedulers, task management, health information);

– Self-management of arousal, mood, and behaviour;

– Prompt for Health Behaviours such as healthy diets, engagement in physical activity;

– Passive symptom tracking (breathing, pulse, glucose).

Although assistive technology has numerous strengths and associated benefits, substantial improvements are still needed to effectively realise its maximum potential. Realising this potential requires the combined efforts of policymakers, developers, service providers, and researchers to examine the entire system of AT design, development and provision.

One of the main issues debated in the literature and that was also evident from the responses of participants in the survey regards users' abandonment of AT after a short period of use, that seems to depend on several factors, such as:

– Assistive technologies are designed in a way that does not reflect user's needs and preferences, as well as the overall environment;

– Users do not receive needed services such as evaluation check, training, support and assistance;

– Users functional capabilities change and assistive technologies usually reveal to not accommodate this change.

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These considerations suggest the adoption of a user-centred approach to the AT design, development and provision, whereby personal, social and technical issues are simultaneously addressed and information, training and support activities significantly improved.

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What are the implications arising from this research report?

The points above mentioned carries implications for both policy and practice levels. At the policy level, there is a need to acknowledge the key role of user involvement in all aspects of research, as well as in policy development, technology design and service provision. In addition, training and support activities need to be considered as integral components of the AT funding and delivery system.

At the level of practice, easy access to up-to-date information and training about AT and its benefits seems to be an essential need by both professionals and users. In addition, AT use needs to be supported and monitored on an ongoing basis to meet the changing needs of users flexibly.

Additional attention to professionals is critical because the lack of awareness about AT is a huge obstacle for people with disabilities to receive appropriate AT devices and services. Finally, there is an urgent need for ongoing data collection about AT use and research on measuring AT outcomes.

A lack of action and coordination in the form of policies, frameworks and supporting initiatives can either leave the benefits of technology underutilised or pushed out too far in time to help the healthcare systems to bridge the gaps that they are at risk of developing.

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