Assistive Technology for Older Adults: A Literature Review

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Overview

The World Health Organisation (WHO, 2002) defines an older person as an individual that is over the age of 60. The fastest growing segment of the global population is older adults; it is estimated that by 2050 there will be 2.1 billion older people, comprising one in five individuals across the world. Much of this demographic resides in developing countries in Asia and Africa making up 36% of their population (WHO, 2019). In Ireland, it is estimated that by 2050, approximately 1.6 million citizens will be aged 65 or over (Central Statistics Office [CSO], 2020). This unprecedented rapid increase in population requires governments and other stakeholders to promote the development and maintenance of frameworks, policies and supports that allow for healthy and productive ageing. Assistive technology has been put forward as one such avenue to facilitate positive ageing for older adults and promote independence and autonomy.

This literature review provides insight into the role of assistive technology in supporting ageing in place and provides information on the characteristics of older adult users. It details the governmental policies and frameworks that have been developed to enable the introduction and promotion of assistive technologies for ageing populations, the benefits and challenges of implementing these technologies, and the evidence on their effectiveness.

Ageing in Place

With a rapid increase in the ageing population, there has been a movement to de-institutionalise society and support an integrated social and health care system that allows older adults to age in place (Wiles et al., 2011). Wiles and colleagues (2011) describe *ageing in place* as an older adults' ability to age safely and independently in their own homes and communities. This concept recognises the importance of maintaining social connections, autonomy, dignity, and a sense of belonging and inclusion for older adults. Research has

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indicated that older adults prefer to continue ageing in their own homes and communities irrespective of their physical capacity to do so. The transition to institutionalised care is neither wanted nor desirable to older adults and residential care is often viewed as a last resort (Stones & Gullifer, 2014). Lebrusan and Gomez (2022) note that this preference to age in place depends on several key variables including an older adult's housing characteristics, financial standing, and social support. Additionally, they identified that the predilection to age in place can be linked to place attachment. This refers to the emotional attachment that an individual has to a place and can be defined as having two dimensions; attachment to an individual's own home (their private space) and to the local community. Lebrusan and Gomez (2022) also highlight the importance that family ties have in the development of place attachment through the immaterial memories that are associated with the household and community; this is further reinforced by projecting past experiences onto the present moment. These researchers found that place attachment could be associated with a sense of security and safety that can comfort older adults as they age and as their sense of identity evolves as their role in society changes.

Ageing in place is an important concept for older adults and there are several methods and initiatives that have been put forward to enable older adults to achieve safe and healthy ageing in their homes and communities. For example, the Irish government plan to introduce a Universal Healthcare System that will improve older adults' access to healthcare by prioritising care in residential and community settings and developing the support to enable this. This will allow older adults to age independently in the comfort and safety of their own homes, and it will reduce the cost and the length of hospital visits (Department of Health, 2013). One such support is the implementation of assistive technologies, which is further described in the next section.

Defining Assistive Technology

The term assistive technology is used to describe a system or service that facilitates and creates opportunities for individuals to live independently despite chronic illness, disability, and/or declining health (Borg et al., 2011; WHO, 2018). Edyburn (2004) further defines assistive technologies as having two distinct aspects: assistive technology devices and assistive technology services. *Assistive technology devices* refer to any equipment or product that enables the improvement and maintenance of an individual's functional capability. On the other hand, *assistive technology services* are any that directly enable an individual to acquire an assistive device. The WHO (2022) stated that the concept of assistive technology is often used as an umbrella term for assistive products and the systems and services that relate to them. Additionally, they describe assistive technology as including both physical and digital devices and that the definition of assistive technology changes depending on the context of the research or situation. The varied definitions and the interchangeable use of different terminology to describe the same technologies and devices can be confusing and act as a barrier to older peoples' understanding of these devices.

There are a considerable number of devices that fall under the purview of assistive technology. Types of assistive technology for older adults include intelligent robots, wearables (i.e., any kind of electronic device designed to be worn on the user's body), health monitors, phones, tablets, hearing aids and speech-to-text applications (Song & van der Cammen, 2019). Electronic assistive technology (EAT) is considered a subgroup of assistive technology, and is the term used to describe an item, product, or system that is electronically powered. EAT includes telecare, telehealth, and ambient assisted living devices (i.e., includes smart devices, wireless networks, software application, computer, and medical sensors). Some EATs have been developed as product-service systems, such as the personal

emergency response system (PERS), where a service can be triggered by an older adult in case of emergency, such as a fall (Song & van der Cammen, 2019).

Moreover, the use of mobile health (mHealth) as a form of assistive technology has increased rapidly in recent years, with several applications (apps), such as digital management apps and electric calendars being particularly useful in aiding older adults with cognitive impairments such as dementia (Yousaf et al., 2020). A number of apps have also been identified to enable older adults to age positively at home including amplification apps such as Pocket Talker - a listening device for individuals who are hard of hearing - and Dragon Diction - a speech-to-text voice recognition app that can assist older adults who may have mobility and dexterity issues (Lesner & Klingler, 2011). Smartphones and tablets are particularly useful assistive devices that provide access to the aforementioned apps and aids to support older adults in various aspects of their lives. These devices enable easier communication with a variety of options (i.e., phone calls, texting, skype, facetime, etc.) and allow older adults to stay in contact with their family and friends. Additionally, smartphones provide an alternative means for patient contact with healthcare services and ensure older people with functional difficulties have access to health and wellbeing services (WHO, 2022).

In recent years there has also been a notable increase in the utilisation of wearable technologies as health monitors. These wearables have several different functions including a global positioning system (GPS), human activity recognition (i.e., track an individual's daily activities by monitoring raw data gathered by wearable sensors), and vital sign monitoring (i.e., a tool that helps provide information about the physiologic condition of the user). The information that these devices provide can be used to monitor older adults' social and environmental interactions and to enhance their quality of life (Pramod, 2023). Smart

watches are one such device and can be used as a health monitoring device. Research has shown that they are particularly useful for monitoring older adults living with dementia or other cognitive impairments who may struggle to reliably report their health status. Smart watches provide insight into the wearers' daily activities, which can be interpreted depending on their health, habits, and characteristics. While these watches are not an adequate replacement for home-based care, the measurements that they provide can improve the care and safety of the older adults (Boletsis et al., 2015). Pendant alarms are another form of health monitoring that have been designed to enable older people to live safely and independently in their own homes. They were developed to be utilised in specific situations but remain inactive for most of the time, and act as a communication device between a wearer and third parties, should assistance be required. There are also pendant alarms that function as constant monitors for older people with specific chronic health conditions. These monitor health outputs of the wearer and alert if there is an incident (Lynch et al., 2022). It is clear that wearable technology has massive potential in enabling independent ageing for older people; however, there is a low adoption rate of these devices and further education and integration schemes for older people would be beneficial (Ma et al., 2022).

Of note, assistive technology encompasses a broad spectrum of technology and there is some overlap with digital technologies. Many of the devices that are considered to the electronic assistive technologies also fall under the purview of digital technologies (Dixon & Michaud, 2018; Yousaf et al., 2020). However, digital technology is more concerned with the provision of healthcare rather than the technologies themselves (Varri, 2020).

Characteristics of Users

There are a range of frameworks for understanding the use and adoption of technology. Adoption of technology models highlight the perceived benefits-cost analysis that potential users complete before adopting the use of a technological device. The most

widely regarded model, the Technology Acceptance Model (TAM), was introduced by Fred Davis in 1986: it is an information systems theory that describes how an individual's willingness to accept technology is determined. TAM suggests that when an individual is introduced to a new technology that the perceived usefulness and perceived ease of use should be used as determinants of an individual's willingness to accept assistive technology (Silva, 2015).

Additionally, Chen and Chan (2014) developed and tested a senior technology acceptance model (STAM), based on the acceptance of assistive technology by older adults in Hong Kong. The STAM further augmented previous technology acceptance models by factoring in the influence that age-related health abilities and characteristics of older adults may have on their willingness to accept and adopt new technologies. Chen and Chan (2014) found that the STAM could explain up to 68% of the variance observed in the older adults' use of technology. Moreover, they identified that age, gender, level of education, self-efficacy, anxiety, health status, and ability (i.e., the functional physical, emotional, and mental capacity of an individual) were characteristics that influenced the acceptance of technology. Additionally, it was noted that these factors were more reliable predictors of technology usage than the commonly utilised attitudinal factors that previous acceptance models tend to use, such as usefulness and ease of use. This indicates that it may be beneficial to consider both demographic and attitudinal factors when evaluating older adults' willingness to implement assistive technology and when developing promotions and guidelines for the provision of these devices.

Tsertsidis and colleagues (2019) also identified six factors that influence an older person's likelihood of successfully integrating assistive technology into their life:(i) older adults' concerns and problems regarding technology, (ii) their previous positive experience

with characteristics of technology, (iii) their experience of the benefits of technology, (iv) their willingness to use technology, (v) social influences (friends, family, and organisations), and (vi) the characteristics of the older adults (i.e., past experiences/attitudes, physical environment, etc.). Additionally, social influence, hedonic motivation (potential pleasure that can be derived from the technology), cost, habit, and trust have been identified as important factors to consider when promoting technology to older adults (Charness & Boot, 2022).

Shin and colleagues (2023) further identified a gap in the need for assistive technology and older adults' adoption of these assistive devices. They found low adoption of technology can be influenced by health status and age. Their study investigated the willingness of frail, prefrail, and robust groups of South Korean older adults to utilise assistive technology. They found that similar factors (social influence, habit/familiarity, cost etc.) to previous research influenced older adults' willingness to implement assistive technologies in their lives. However, they identified that frailty impacted the acceptance of assistive technology, indicating that this should be considered when developing interventions and guidelines for the provision of assistive technology to ensure that all older adults (indiscriminate of their level of frailty) have access to the required assistive technology and education on the use of this technology.

Other research has indicated that the inclusion and involvement of older adults in the development of assistive technology devices and services can decrease the challenge of integrating this support into the lives of older adults. Ageism and negative stereotypes often limit older adults' inclusion in the design of assistive devices that are developed to support them and improve their quality of life. This can create a disconnect with the needs of older adults not being fully met, which can be a barrier to the use of assistive technology to enable independent living (Mannheim et al., 2019).

Assistive Technology Policy, Programmes and Services

There is no singular, universal policy or programme that regulates and supports access to assistive technology, and there are considerable differences in the design and support of policies and programmes that support and promote the use and development of assistive technologies (MacLachlan et al., 2018). The 71st World Health Assembly highlighted that assistive technology is a pillar of the development of universal health coverage which resulted in the passing of *Resolution 71.8* to improve access to assistive technology (May 2018). This resolution provided a guideline for the WHO and member states to help them to meet their commitments to improving assistive technology and the provision of assistive technology. Layton and colleagues (2020) subsequently carried out a systematic analysis on the response of members and non-member states to this resolution to better understand how global actors can contribute to strengthening a systems-thinking discourse in the field of assistive technology. They reported countries' responses to the resolution offered a number of different multi-stakeholder views, but that all ultimately represented a clear common goal regarding access to assistive technology, in spite of differences in priority, in perspectives and in progress.

The WHO (2022) later published a global report on assistive technology where they advised that countries should develop dedicated integrated national policies regarding the implementation of assistive technology. They further suggested that countries utilise the policy brief on assistive technology that the WHO developed alongside the countries own relevant policy briefs. This WHO (2020) policy brief highlights the importance of assistive technology for older people and people living with disabilities. It outlines the benefits and barriers to accessing assistive devices, systems, and services, and emphasises the need for a coordinated and integrated approach to the development, promotion, and provision of assistive technology. The brief outlines a set of recommendations that governments and

relevant stakeholders can use to regulate and maintain a high standard of access to assistive technology, and to continue the investment into research and development of these technologies.

Additionally, the WHO (2022) advised the establishment of permanent implementation structures that are committed to the promotion and development of assistive technology and access to assistive technologies. They recommend establishing a national assistive technology agency that would be dedicated to the development of access to assistive technology, co-ordination platforms that support well-designed information systems that facilitate the development and maintenance of co-ordinated networks to reduce duplication of services, and regulatory bodies and mechanisms that enforce continued access to affordable, safe, and effective assistive technologies.

Specifically for older adults, the WHO (2017) has endorsed the development of assistive technologies for clinical and home settings to foster older adults' autonomy and allow them to retain their independence and control of their living situation, despite any reduction in capacity. They advocate for the provision of assistive technologies by implementing policies and programmes that provide technical and financial support to older adults and note assistive technologies should be compliant with accessibility standards. Nationally, the Irish government has identified assistive technology as a key support for ageing in place and to enable older adults maintain their autonomy and improve their quality of life without the need for institutional care (Department of Health, 2021). The National Positive Ageing Strategy (NPAS; 2013) emphasises the importance of a technological response to support the needs of older adults and outlines a commitment to developing innovative technologies, services, and products that improve the well-being of the ageing population.

Nationally, a range of funding schemes have been developed to support the implementation of assistive technology. For example, the HSE recently developed the Cooperative Real Engagement for Assistive Technology Enhancement 2021 (CREATE 2021) fund to provide grants and financing to digital and assistive technology to enable and enhance the provision of digital and assistive technology (DAT) for people living with a disability (HSE, 2021). In 2022, €2 million was allocated by the Irish government to fund 11 of the CREATE projects. These projects will support people of all age ranges across Ireland who live with sensory, cognitive, physical, and intellectual disabilities and will improve access to DAT for people with disabilities (Department of Health, 2022). Other funding schemes to support the implementation of assistive technology to older adults include the Housing Adaptation Grant for People with a Disability, which provides funding to older adults with disabilities that enables them to adapt their homes to meet their needs, whilst the Assistive Technology Grant Scheme previously provided funding for the provision of assistive technology devices to older adults (Department of Health, 2019).

In 2016 Enable Ireland and Disability Federation Ireland published a paper discussing assistive technology for people with disabilities and for older adults, and outlined there are too many gaps between the ambition of policy and the provision of assistive technology in Ireland. They highlighted fragmented service delivery as one barrier to the provision of assistive technology, noting there are three separate bodies (i.e.., HSE, Department of Education and Skills, and Department of Social Protection) funding various schemes to support the development and provision of assistive technology. Additionally, they reported there is supplementary funding from volunteer organisations, but no co-ordination across these funding schemes. Broadly, they argue the way that the distribution and support for assistive technology is managed is not effective, and obtaining consistent support through

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different life stages is difficult. In their paper, Enable Ireland and Disability Federation Ireland developed a funding protocol to measure an individual's eligibility or need for assistive technology. Their proposed model has four funding bands depending on level of complexity and risk. This allows for more flexible funding protocols and helps to regulate funding on a needs basis. Other research carried out in Ireland by Cullen and colleagues (2012) has also emphasised the lack of coordination in the provision of assistive technology, lack of service quality standards, and geographical variation in waiting times and access to assistive technology. It is worth noting that the HSE (2023) service plan aims to address and improve the provision of assistive technology. It references the Co-operative Real Engagement for Assistive Technology (CREATE) project which aims to improve the availability of these services and to transform the provision of assistive technology in Ireland. However, more broadly it is clear that the Irish government and relevant stakeholders must address infrastructural issues around the provision of assistive technology to ensure that the needs of older people are met, and acceptable standards are developed and enforced.

Benefits of Assistive Technology

Assistive technology has been highlighted in international and national policy as crucial in allowing older adults to age productively and positively. The WHO (2022) notes these technologies promote autonomy, independence and social participation in the ageing community, improving older adults' overall quality of life. Research has demonstrated that they enable older adults to perform their normal, daily activities and enable them to age healthily and live independently and safely, without having to relocate to assisted living facilities (Gitlin et al., 2013). Zager Kocjan and colleagues (2022) identified assistive technology as an important component in facilitating continued autonomy and a high quality

of life for older adults who prefer to age in their own homes and communities by supporting and promoting self-regulation.

Social isolation among older adults is a major concern for health and social policy as it is associated with a range of health problems, including cardiovascular disease, stroke, dementia, and mental health issues (Cotterell et al., 2018). Several interventions to reduce social isolation and to improve connectedness have been put forward, including assistive technology. Indeed, a study carried out by Sisay (2017) indicated that the integration of technology in older adults' daily living enhanced their quality of life, improved their social connectedness, and reduced their feelings of isolation. Assistive technologies have been shown to be particularly important in the aftermath of COVID-19 among older adults who continue to experience the social isolation of the pandemic (Jutai & Tuazon, 2022). There are numerous technology applications and devices that are believed to reduce social isolation among older adults. For example, the internet and smartphone technology provide opportunities to enable social connectedness among older adults using email, social media, and other such apps. Access to the internet by older adults has been shown to decrease loneliness and to increase social contact in assisted and independent living communities (Cotton et al., 2013). Additionally, monitoring technologies can identify changes in an individual's physical and social functioning as they monitor how frequently an individual leaves home or has social visitors and they can identify changes in social behaviours to alert an individual that they are at risk of social isolation and loneliness (Czaja, 2017). The internet and smartphone technology further provide opportunity to enable social connectedness among older adults using email, social media, and other such apps.

There are several other mental health benefits that are associated with the use of assistive technology (Walsh et al., 2020; Sorkin at al., 2021). There are a range of assistive

devices and services that support older adults with cognitive impairments and other mental health difficulties; mood-tracking apps, online supports, computer-mediated therapy, and online mediated support groups can all be beneficial and increase ease of access to people with functional difficulties (Strauss et al., 2022).

Additionally, several other benefits associated with assistive technology to support physical health have been identified. For example, Sisay (2017) identified that the implementation of assistive technologies in older adults' lives has a significant positive impact on rehabilitation and their physical independence. This study indicated that the use of these technologies may delay functional decline and has resulted in fewer difficulties for older adults who rely on personal assistance. The safety of older adults is another benefit of the use of assistive technology for older adults living independently. Monitoring systems, tracking devices, and safety alarms are all useful if an older person requires help or medical assistance (Sundgren et al., 2020). Assistive devices also reduce the impact that cognitive, mobility, hearing, and vision impairments may have on an individual (Borg et al., 2009). Research has further indicated that the use of assistive products helps to reduce the likelihood of developing secondary health conditions (weight gain, stress ulcers) in older adults living with functional difficulties (WHO, 2022).

Furthermore, assistive technology enables older adults to better access health care facilities and earlier interventions. In addition to benefits for older people, assistive technology can support caregivers and the healthcare system. Assistive technologies reduce the time, level of assistance, and energy needed for caregiving; the use of these devices especially support family carers who also have other responsibilities. Furthermore, assistive technologies have been found to reduce the length of hospital stays and health care costs (Bensi et al., 2011; Madara Marasinghe, 2016; WHO, 2015). Indeed, a scoping review of

economic evaluations of assistive technology globally reported assistive technology investment, access and/or usage impacted on formal and informal health care costs, although the authors note that evidence in this area is limited. They advocate for a wider use of robust alternative evaluation and appraisal methodologies to highlight assistive technology value and provide further evidence that may make governments more willing to invest in assistive technology (Albala et al., 2021). Mirroring this, the WHO (2022) report that enabling older adults to age in place for as long as possible has significant financial advantages for health and wellbeing service expenditure, further indicating that assistive technology use by older adults will lower health care costs and will reduce the strain on the health care system. Furthermore, they note the use of assistive products promotes better accessibility and increased availability of services (WHO, 2022).

Challenges of Assistive Technology

Although there are many benefits to the integration of assistive technologies into the homes and lives of older adults, some challenges and barriers have been identified. For example, there are several ethical issues related to the use of assistive technology. Privacy is one such issue that has been raised when discussing the use of monitoring devices and other surveillance technologies. Older adults have raised concerns about the loss of privacy that the implementation that these devices may cause. The technologies are sometimes regarded as an intrusion by older adults, and many are concerned about unknown individuals having access to their monitoring devices and being watched in their own homes. Others have raised concerns about the influence that these devices may have on the basic human rights of older adults; that is, their right to privacy and security/safety (Percival & Hanson, 2006; Robinson et al., 2007). A further ethical challenge that must be considered when discussing assistive technology is the autonomy of the user: as noted previously, research has indicated it is necessary that older adults are included in any decision-making surrounding the introduction

of technology into their homes. It is important that older adults are not pressured into implementing these technologies as this infringes on their autonomy and can impact on the older adult's willingness to utilise these devices and systems (Sundgren et al., 2020)

The effectiveness and likelihood of 'false alarms' is another challenge in the implementation of assistive technology devices. For example, Capetzuti and colleagues (2009) evaluated bed-exit alarms and the effectiveness of these devices. They found that the way in which a bed was exited impacted alarm function, and the variability in bed egress may cause false alarms to occur.

Linked to research on technology acceptance, Arthanat and colleagues (2019) identified that there were two different categories of barriers to the successful implementation of assistive technology in older adults' homes: (i) *internal* barriers which relate to the characteristics of an individual and their willingness to utilise assistive technology, and (ii) *external* barriers which relate to demographic and socio-contextual factors. In their research, older adults' own perceptions of technology were shown to be a challenge to the integration and optimal use of these assistive devices. They found that older adults often perceived assistive technology to be contradictory to their lifestyle and felt that it would not cater to their needs, and there was a lack of positive peer culture surrounding the use of these devices. Moreover, some of their identified worries about digital competency and anxiety regarding phishing and scams further reinforced older adults' reluctance to adapt assistive technology devices and services into their homes and everyday lives. External contributors often surrounded the older adults' career and family situations; for example, older adults who worked in fields that utilised technology were more comfortable in the implementation of technology. They also noted there was a reported disconnect between older adults and their younger family members with many reporting that their grandchildren were unsupportive in

their slow adoption to a rapidly changing industry, and this outlook further perpetuated the relative delay in older adults' adoption of assistive technology and technology in general.

Adding to this, Tsetsidis (2021) identified some structural issues with the implementation of assistive digital technology for older adults living with dementia. They established that there was insufficient information being provided to older adults living with dementia and their family members about the different technologies available to them and how to properly use these devices and systems. It was further noted that once a dementia diagnosis had occurred, health care practitioners typically focused on medicinal solutions overlooking assistive technologies that would assist and enable the older adults to age in place.

In their report on assistive technology, the WHO (2022) identified a range of challenges associated with the implementation of assistive technologies. These include lack of awareness, and the high cost of assistive devices, systems, and services. Indeed, a lack of awareness and understanding of assistive technology can be associated with lower levels of interaction and integration of these technologies into older peoples' lives. Inadequate knowledge alongside misconceptions and stigma about technology deter and discourage older adults from accessing these devices and systems (Pryor et al., 2018; Van Brakel, 2006). Other research carried out by Fotteler and colleagues (2021) investigating the popularity of assistive technology found that the most prominent issue facing the implementation of assistive technology was older adults' lack of knowledge on the subject. Further research by De San Miguel and colleagues (2015) examining the risk profiles of purchasers and non-purchasers of personal security alarms identified that most non-purchasers of these alarms felt they could benefit from them but could not afford to purchase one.

In their report, the WHO (2022) identified that information about assistive technology, how to use these devices, and cost is fragmented and difficult to access due to there being no centralised database or information source further discouraging the use of these resources (WHO, 2022).They note funding for assistive technology can be governmental or privatised, and there may be geographical disparities in funding levels especially if the provision of assistive technology was not fully integrated into public funding (Visagie et al., 2020). Policymakers and stakeholders must prioritise and promote the provision of information material and education surrounding the benefits and use of assistive technology.

Effectiveness of Assistive Technology

Alongside an increase in the development and implementation of assistive technologies for older adults, there has been a corresponding increase in research into the effectiveness of these devices and whether they significantly improve the safety and quality of life of the older adults who use them. Brims and Oliver (2019) carried out a systematic review and meta-analysis of the effectiveness of assistive technology in ensuring and enabling older adults living with dementia to age safely in place. The researchers utilised both published and unpublished literature stored in seven bibliographical databases between 2011 and 2016. They found that the data regarding the use of assistive technology to reduce the institutionalisation of older adults living with dementia was inconclusive. However, they did identify that implementation improved the safety of older people by reducing the risk of falls, accidents, and risky behaviour. In fact, Brims and Oliver found that the implementation of assistive technology reduced the probability of a fall occurring by 50%. However, there were some limitations with this review which limit the generalisability of the findings: for example, only literature written in English were used, all of the studies were carried out in high income countries, and there was limited demographic information available.

A second systematic review investigating the effects of assistive technology on the wellbeing of community-dwelling older adults living alone in single households found evidence that it can improve the physical and mental wellbeing of older adults. However, there was little evidence that assistive technology can improve social wellbeing. More recently, Fotteler and colleagues (2022) carried out a systematic review of 19 studies investigating the effectiveness of assistive technology for older adults and the influence of frailty. They found that in eight of these evaluations assistive technology was significantly effective in improving older adults' quality of life. Additionally, they noted that disease management devices (e.g., home intervention systems for heart failure, automated self-management monitors for blood glucose, medical alert protection systems) were the most effective of the technologies evaluated, with four of the five observed trials showing significant improvement in disease management with the introduction of these assistive devices. However, studies that investigated the influence of frailty on the effectiveness of assistive technology for older adults found that the use of such devices did not improve older adults' functioning or their quality of life. Fotteler and colleagues (2202) concluded that while there are some promising results for well-functioning older adults, there is still uncertainty and a lack of research on the topic that makes it difficult to clearly define the effectiveness of assistive technology for older adults.

Although there have been some individual cases where assistive technology has had a significant positive impact on older adults, there is still some discourse within the findings and overall, more research is required (Brims & Oliver, 2019; Fotteler et al., 2022). There is currently also no unified methodology to assess the effectiveness and acceptance of these technologies (Gabriella et al., 2023). Finally, research by Fleming and Sum (2019) highlighted that there are a few limitations that must be considered when evaluating the

effectiveness of assistive technology in future research. They identified small sample sizes, high drop-out rates, and inconsistently performing technology as constraints within their own investigation and note that these concerns should be considered and accounted for in research in the future.

Conclusion

Assistive technology is a broad topic that is not clearly defined, and its features overlap with other technology descriptors which can make investigating the topic arduous. Despite this, there is definite global support to utilise assistive technology in promoting ageing in place, helping older adults maintain independence, and improve their quality of life. This literature review highlights the potential benefits of assistive technology in addressing the challenges faced by older adults, such as physical limitations, cognitive decline, and social isolation. However, it also reveals some barriers to the adoption and use of assistive technology, including demographic characteristics, health status, attitudinal factors, fragmented funding and services and cost. It highlights gaps in research on the effectiveness of assistive technology. All of this must be taken into account to promote equitable and inclusive access to assistive technology for older adults, taking into account their unique and diverse needs, preferences and contexts.

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