Aging Well in a Digital World: Developing Inclusive Community-Based Technology Programs for the Mental Wellbeing of Older Adults

by

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Abstract

The onset of the COVID-19 pandemic has highlighted the urgent necessity to close the digital divide among diverse Canadian older adult populations, to access services necessary to better their mental health. As society increasingly relies on digital platforms for various services and activities that impact mental wellbeing, including healthcare consultations, social interactions, and learning opportunities, older adults are at risk of being marginalized due to barriers related to digital access and proficiency. This PhD thesis focuses on exploring digital mental health interventions for older adults, with a primary emphasis on improving digital literacy to ensure equitable access to services that impact mental wellbeing. The project centers on three research objectives: 1) Identifying existing digital mental health interventions for older adults, 2) Understanding the factors that impact the mental wellbeing of community-dwelling older adults, and 3) Developing strategies to advance digital literacy and improve mental wellbeing. The initial phase emphasized equity, diversity, and inclusion in digital accessibility, and the need to focus on the social determinants of health and the specific needs of community-dwelling older adults in the heart of service creation. The second phase identified four themes contributing to the mental wellbeing of diverse community-dwelling older adults: stability, capability, positive impact on others, and a sense of belonging. These insights inform the development of interventions tailored to the mental health needs of diverse older adults. A framework was subsequently developed to provide equitable digital access for community-dwelling older adults, built on community needs and priorities. The findings and the operational framework from this research guide various Digital Literacy Programs across British Columbia, marking significant progress towards democratizing access to digital resources and education for older adults. Grounding the approach in community feedback and engagement validates older adults' lived experiences and empowers community organizations to develop tailored technology programs. The framework serves as a practical guide for managing digital literacy initiatives, offering a structured methodology for evaluating and ensuring the quality and effectiveness of digital literacy programs, promoting accountability and transparency, and ensuring programs deliver tangible outcomes that enhance digital inclusion and wellbeing among older adults.

Keywords: mental health; digital literacy; community-dwelling older adults; marginalised populations; community-based service development

Dedication

To those seeking solace in community, one day we will make a world where we are all accepted. We will never have to walk alone again.

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Table of Contents

List of Tables

List of Figures

List of Acronyms

BC	British Columbia
CBSS	Community-Based Senior Serving
CDOA	Community-Dwelling Older Adults
DMHI	Digital Mental Health Intervention
DSM-V	Diagnostic and Statistical Manual of Mental Disorders Version 5
DTWE	Downtown West End (Vancouver, BC, Canada)
GAD-7	Generalised Anxiety Disorder 7-item
GIS	Guaranteed Income Supplement
iCBT	Internet-delivered Cognitive Behavioural Therapy
LGBTQ2S+	Lesbian, Gay, Bisexual, Trans, Queer, 2-Spirit (plus sign represents the inclusion of additional identities not represented in the initialism)
nCCR	neuroplasticity-based computerized cognitive remediation
PHQ-9	Patient Health Questionnaire 9-item
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PROSPERO	Prospective Register of Systematic reviews
RCT	Randomized Controlled Trial
RoB	Risk of Bias
SOPT	Speed of Processing Training
WHO	World Health Organisation

Glossary

Mental Wellbeing based on Social Determinants of Health	Mental health in the context of social determinants of health involves looking at how various aspects of a person's environment and society impact their well-being. This includes factors such as economic stability, access to good education, the support of their community, availability of healthcare, and the safety of their neighborhood. For example, someone with a steady job, good schooling, supportive friends and family, proper healthcare, and a safe place to live is likely to have better mental health. On the other hand, financial struggles, lack of educational opportunities, social isolation, poor access to healthcare, and living in unsafe areas can all contribute to stress and mental health issues. This perspective emphasizes the importance of systemic changes and preventive measures to enhance mental well-being on a broader scale (Marmot & Wilkinson, 2005).
Pathological Mental Health	Pathological mental health deals with specific mental disorders or illnesses that are diagnosed based on clinical criteria. Resources like the Diagnostic and Statistical Manual of Mental Disorders (DSM) provide guidelines for these diagnoses. Examples include conditions like major depressive disorder, bipolar disorder, anxiety disorders, schizophrenia, personality disorders, and neurodevelopmental disorders like autism and ADHD (Kessler et al., 2005). These conditions involve significant disruptions in thinking, emotion, or behavior that led to distress or problems in functioning. Treating these conditions typically involves medication, therapy, or other specialized interventions (APA, 2013).

Chapter 1.

Introduction

1.1. Background

This dissertation focuses on community-dwelling older adults (CDOA) in Vancouver, British Columbia (BC). The population of CDOA in Vancouver is highly diverse, with large proportions of immigrant, ethnic minority, low-income, socially-isolated older adults, and the constellation of lesbian, gay, bisexual, trans, two-spirit, and queer (LGBTQ2S+) older adults. The number of low-income older adults continues to increase as the percentage claiming Guaranteed Income Supplement (GIS) has grown by 6% from 2020 to 2022 (OSABC, 2022). This population and community chosen because I am well embedded in the community, for the collection of valuable data and insight from the research participants due to the trust that has been built prior to data collection. CDOA were also chosen as the target population because over 90% of adults over 65 years old in BC live in the community (OSABC, 2022) and their experiences differ from those living in assisted living facilities and long-term care homes. Additionally, in this project, I have focused on exploring perceived mental health as opposed to pathological mental illness, exploring social issues for mental wellbeing. The main difference between these approaches of viewing mental health lies in their focus and methods of intervention. Looking at mental health through the lens of social determinants emphasizes external factors and collective well-being, aiming to prevent issues through systemic changes (WHO, 2014). Conversely, the pathological approach focuses on individual disorders, requiring personalized medical or therapeutic treatment (WHO, 2014).

1.2. The Mental Wellbeing of Older Adults

There are many social causes or determinants of mental health challenges in the world including childhood trauma, social isolation, poverty, discrimination, and marginalisation. These determinants impact the conditions that shape a person's life, determining the interactions with the health care sector, including access to mental health services (Park, Jang, & Chiriboga, 2016).

Lack of access to mental health support for older adults further reduces the help-seeking behaviors of this population (Teo et al., 2022). Support can be both formal and informal. Formal social support denotes the physical and emotional aid provided by official entities in adherence to established regulations, policies, and laws. This type of support is marked by consistency and reliability, illustrating the supportive dynamic between organizations and recipients. Informal social support entails assistance offered by unofficial groups or individuals, often characterized by unpredictability. Examples of formal support are those provided by government agencies, institutions, workplaces, communities, and other structured social bodies, while informal support encompasses assistance from family, relatives, neighbors, and friends (Lu, Wu, Mao, & Liang, 2020).

With regards to formal support, having a good rapport with healthcare professionals encouraged people to seek help. For instance, holding favourable opinions about both the healthcare system and mental health interventions raised the probability of utilising these services (Begum et al., 2012; Gur-Yaish et al., 2016). On the contrary, having significant informal support from friends and family reduces this help-seeking behaviour because the older adults' concerns and problems are alleviated by those around them (Hohls et al., 2021). When social support allowed opportunities to exchange health information, disclose, and receive endorsements/recommendations for treatments, decisions for the older adult were made on their behalf by others. This shows that there is a need for efforts to push independence and understanding of one's understanding of mental health and mental health needs.

Furthermore, the intersection of mental health stigma and ageism presents significant obstacles for older adults in accessing mental health services. Stigma surrounding mental health contributes to feelings of shame and embarrassment, while ageist attitudes from care and service providers perpetuate discriminatory assumptions about the mental health needs of older individuals (Benjenk et al., 2018). Consequently, many older adults may be reluctant to acknowledge or discuss their mental health concerns, leading to underutilization of mental health services and exacerbation of mental health issues. (Pepin, Segal, & Coolidge, 2009). The stigma, which is associated with a lack of awareness of mental health, has led many older adults to believe that depressive and anxious feelings are normal side effects of growing old, which left many of these adverse feelings to be ignored and unaddressed (Hadas & Midlarsky, 2000).

Due to the heterogeneity of the population of older adults, it is improper to assume that all members of the population share the exact needs and require the same standardised mental health services. Because of Canada's diversity, it is pertinent to understand the different mental health needs of the population (Blazer et al., 2013). In this project, I will be focusing on three underserved groups that can be found in the older population in the Downtown West End of Vancouver to push the need for an understanding in need before a creation of a resource: ethnic minority and immigrant older adults, low-income older adults, and LGBTQ2S+ older adults.

Ethnic Minority and Immigrant Populations

Older immigrants are vulnerable to social isolation and loneliness due to language barriers, cultural differences, discrimination, and evolving familial caregiving dynamics (de Jong Gierveld, Van der Pas, & Keating, 2015). Immigrant Canadians experience greater loneliness than native-born Canadians and are vulnerable to psychosocial challenges such as emotional distress, depression, and anxiety (Gierveld, Pas, & Keating, 2015; Toselli et al., 2014). These Canadian findings are consistent with findings from the United States and Europe in which challenges related to adaptation, access to services, lack of community participation, language and cultural barriers, and sense of exclusion were reported in older immigrants (Ali et al., 2021; Victor, Dobbs, Gilhooly, & Burholt, 2021). Compared to White Canadians, ethnic minority populations are less likely to report depression or major depressive episodes, mental distress, and suicidal thoughts (Forte et al., 2017). Factors such as language barriers or lack of access to culturally appropriate mental health services that prevent individuals from seeking or receiving proper support. Socioeconomic factors such as income inequality, discrimination, and access to healthcare may also contribute to disparities in mental health reporting among different ethnic groups (Ohtani, Suzuki, Takeuchi, & Uchida, 2015). Little progress was made in reducing disparities in access to mental health care for Black, Hispanic, and Asian older adults compared with Caucasian older adults between 2004 and 2012. This includes access to any type of mental health care including outpatient mental health visits and psychotropic medication use. In the case of Black and Hispanic older adults, disparities in rates of access to any mental health care and any psychotropic medication were exacerbated over this period in absolute and relative terms. Asian older adults had persistently lower rates of access to care across this period (Cook et al., 2017). The disparities evident in mental health care access

among older Black, Latino, and Asian populations stem from profound cultural variations in their perceptions of mental illness causation (Jimenez et al., 2012). Within these communities, deeply rooted beliefs about the origins of mental health challenges often diverge from mainstream perspectives, influencing individuals' attitudes towards seeking professional help. Moreover, the available mental health treatments frequently fail to align with the nuanced preferences, values, and cultural beliefs held by older members of racial and ethnic minorities. Consequently, there exists a pronounced reluctance among these populations to engage with mental health services, resulting in significant underutilization and exacerbation of mental health issues (Jimenez, Cook, Bartels, & Alegría, 2013). Immigrant older adults have felt a lack of sense of belonging, or feeling like an “outsider”, and these beliefs have been known to be associated with higher levels of depression and overall poorer mental health (Zemba & Mehrotra, 2023). Many also face issues around language barriers, which prevents access to services that are mainly provided in English (Ponce, Hays, & Cunningham, 2006). Addressing these disparities requires a comprehensive understanding of the diverse cultural contexts shaping individuals' perceptions of mental illness and a concerted effort to develop culturally competent interventions that respect and incorporate the unique values and beliefs of older racial and ethnic minorities.

LGBTQ2S+ Older Adults

LGBTQ2S+ older adults have faced a lifetime of criminalized queer identities and a lack of social support associated with marginalization. Romantic partnerships among LGBTQ2S+ individuals are twice as likely to dissolve compared to heterosexual marriages, potentially because of stressors, including societal discrimination and lack of support systems (McCann & Brown, 2019). A study in 2015 found that LGBTQ2S+ older adults access mental health treatment at elevated rates for reasons beyond the burden of general medical, mental, and behavioural health concerns (Stanley & Duong, 2015). One older research that utilized a sample of younger and midlife adults demonstrated that despite not having a current psychiatric disorder, nearly one in five LGBTQ2S+ adults utilized psychiatric services, for reasons that included coping with a stigmatized identity and more normative beliefs in the LGBTQ2S+ community about seeking mental health treatment (Grella et al., 2009). The minority stress model (Meyer, 2003) posits that social forces; including discrimination, stigma, and prejudice, create an adverse environment for individuals in sexual minority groups, conferring increased risk for stress

responses such as alcohol abuse, psychological distress, or poor perceived health. This model could possibly explain increased service use by conceptualizing counselling and psychiatric medication as coping responses to having a stigmatized identity, regardless of level of current or recent psychiatric functioning or general medical health (Stanley & Duong, 2015). This evidence points to the need to understand the mental health needs of LGBTQ2S+ older adults and to develop tailored, accessible, and welcoming interventions to better the mental wellbeing of this population before the creation of interventions that promise to serve all populations of older adults.

Low-Income Older Adults

Finally, the effects of income and economic hardship is highly associated with mental wellbeing (Gresenz, Sturm, & Tang, 2001). Older adults who understand the need for mental health treatment may also experience various adversities in obtaining care, including having limited knowledge regarding available services, financial burdens, and lack of access to transportation (Palinkas et al., 2007). Financial constraints may restrict older adults from affording mental health treatments, including therapy sessions, medications, or other forms of intervention. Without adequate financial resources or insurance coverage, many older adults may perceive mental health services as unattainable or financially prohibitive, an issue that has been exacerbated since the COVID-19 pandemic where many families and individuals experience employment hardships (Witteveen & Velthorst, 2020). Moreover, the lack of reliable transportation options poses a considerable challenge, especially for those residing in rural areas or without access to private transportation. Limited mobility due to age-related health issues further exacerbates this barrier, as older adults may struggle to travel to mental health facilities or appointments (Bocker et al., 2012).

Understanding the needs of underserved populations is indispensable before crafting any intervention or service as it forms the cornerstone of effective and empathetic support systems. Members of these communities often face unique challenges stemming from socioeconomic disparities, cultural differences, or systemic inequalities. Without a deep comprehension of their specific circumstances, any intervention risks being ineffective or even detrimental. By delving into their needs, preferences, and constraints, we can tailor interventions that resonate with their realities, ensuring relevance, accessibility, and sustainability. Such an approach not only

promotes inclusivity but also fosters trust and empowerment within these communities, paving the way for meaningful and lasting positive change. Ultimately, understanding their needs is not just a matter of social responsibility but a strategic imperative for creating impactful interventions that can make a difference.

1.3. Technology and Mental Health

With the rapid technological change that has happened world-wide, the popularity and availability of digital mental health interventions (DMHIs) have grown of interest over the past several years. In particular, the development of DMHIs such as smartphone applications, remote monitoring and tracking devices, and wearable computers such as smartwatches and virtual/augmented reality headsets have skyrocketed (Hollis et al., 2017; Sixsmith, 2021). Smartphone, desktop, and tablet applications have recently been described by the World Health Organization (WHO) as well as many health researchers and scholars as reliable, cost-effective, and useful methods in providing accessible mental health treatments for the community (Chandrasekar, 2018; Fortuna et al., 2019). Mobile apps, websites, and digital platforms can offer self-help resources, guided meditation sessions, cognitive behavioural therapy programs, and mood tracking tools tailored to the specific needs and preferences of older users (Denecke, Schmid, & Nüssli, 2022; Wasil, Palermo, Lorenzo-Luaces, & DeRubeis, 2022). These resources empower older adults to take an active role in managing their mental health, promoting feelings of control and autonomy. Technology can also enable older adults to access therapy and counselling remotely, overcoming barriers such as transportation issues or mobility limitations, and ensuring timely support for mental health concerns (Gorenko et al., 2021).

The COVID-19 pandemic has served as a catalyst for the rapid growth and adoption of digital healthcare. One notable aspect is the expansion of online healthcare services, driven by social distancing measures and lockdowns, which prompted a surge in demand for virtual consultations (Jiménez-Rodríguez et al., 2020). Providers quickly adapted to conducting appointments via video calls or phone consultations, ensuring continuity of care while minimising the risk of virus transmission. Remote patient monitoring technologies also saw increased adoption during the pandemic, enabling healthcare providers to track patients' vital signs and health metrics from a distance. Wearable devices, such as smartwatches or fitness trackers, allowed for continuous

monitoring of patients with chronic conditions or those recovering from COVID-19, providing valuable data for early intervention and personalised care (Whitelaw, Mamas, Topol, & Van Spall, 2020). In addition to telemedicine and remote monitoring, the pandemic spurred the development and utilisation of various digital health tools and applications. These tools served multiple purposes, including symptom tracking, contact tracing, and COVID-19 testing scheduling (Menni et al., 2020). Mobile apps became instrumental in disseminating public health information, facilitating self-assessment, and connecting individuals with testing centres or vaccination sites (Singh, Couch, & Yap, 2020). Furthermore, healthcare organisations implemented digital solutions to enable remote work for non-clinical staff. Cloud-based collaboration platforms, teleconferencing tools, and electronic health record systems allowed employees to work from home efficiently, ensuring business continuity amidst the pandemic (Klonek et al., 2022). The urgency of the pandemic also drove innovation in digital healthcare technologies. Advancements in artificial intelligence, data analytics, and remote diagnostics led to the development of new solutions for disease detection, treatment, and prevention. This period of innovation and adaptation has not only addressed the immediate challenges posed by COVID-19 but also reshaped the future of healthcare delivery, driving continued evolution and advancement in the field of digital health (Bohr & Memarzadeh, 2020).

Beyond clinical opportunities, digital platforms and applications can offer social connection and engagement, which are vital for combating loneliness and isolation, common issues among older adults. Technology can mitigate social isolation and loneliness among older adults by facilitating connections with friends, family, and communities without the barriers of distance. Through video calling platforms, older adults can engage in face-to-face virtual conversations, fostering a sense of presence and closeness more powerful than voice-calling (Smith, Steinman, & Casey, 2020). Additionally, social media platforms can enable older adults to stay connected and updated on the lives of their loved ones, as well as participate in online communities based on shared interests (Zhang et al., 2021).

Despite the limited research conducted on older adults and the use of DMHIs, there is potential for further gerontological breakthroughs in mental health interventions for hard-to-reach populations. For the ageing population specifically, using DMHIs can expand the boundaries of the types of services available, and overcome geographic

barriers through delivery of services and programs to remote areas (Fortuna et al., 2017). However, there are risks that emerge from the digital divide. Many older adults may feel uncomfortable with utilising emerging technologies, which may in turn intensify their feelings of inequitable healthcare, aggravate patterns of aid avoidance, or even cause feelings of self-deprecation (Kim et al., 2009; Jokisch et al., 2020).

The fundamental advantage of DMHI is the opportunity it brings to blur the lines of inequality when it comes to the accessibility of mental health resources. However, currently, there are very few studies looking at the effects of DMHIs in populations that specifically face significant social and physical challenges. Within the older adult population, there exists a subpopulation of vulnerable older adults such as, but not limited to, racial minorities, immigrants, and gender/sexual minorities. Schueller et al (2019) have written extensively about how digital interventions can provide opportunities to alleviate mental health disparities among marginalised populations, stating that technology can be tailored to be culturally sensitive and low cost, and can also overcome barriers of time, place, and language.

1.4. Older Adults, Technology, and the Digital Divide

As many services and programs transition to virtual modes of delivery during the pandemic, low-income older adults' mental wellbeing is particularly at risk as they may not be able to afford access to digital technology and high-speed internet. Data from Statistics Canada (2019) shows only a little over half of low-income Canadians use the internet creating a "digital divide". The digital divide refers to the gap between those who have access to digital technologies and those who do not (Cullen, 2001). In a book on the digital divide by Van Dijk published in 2020, he mentioned 2 phases of the divide. The first phase refers to technology access, which is impacted by one's socio-economic status – so whether they can afford technology or not. The second phase refers to technology skill. Once you have attained the device, can you use it? This is impacted by education, language, having people around to teach you, and age because it is harder to learn technology when you have not used it all your life. Additionally, COVID-19 exacerbated the need for technology but did not close the divide (Cosco et al., 2021).

However, older adults should not be viewed as incompetent, difficult, or unable to adopt technology. In fact, older adults are highly motivated to learn. According to

Statistics Canada (2023), in terms of age category, the largest increase of technology adoption was among older Canadians, with over 8 in 10 (82.6%) of older adults aged 65 years and older using the Internet in 2022, up 6.3% from 2020. For those aged 75 years and older, the increase was even larger: up by 10% to 72%. About half (50.9%) of older adults sent messages using an instant messaging app in 2022, while 43.5% used social networking websites or apps. Over one-third (37.8%) of older adults made online voice calls or video calls in 2022, virtually unchanged from 2020 (37.2%).

There was a push from the COVID-19 pandemic for older adults to stay in touch by online means. Digital means of social connection, such as through social media platforms, messaging apps, and video calls, offer a distinct mode of interaction compared to in-person social connections. In-person interactions involve physical presence, enabling face-to-face engagement, the observation of body language, and the interpretation of non-verbal cues. This physical proximity often fosters deeper, more meaningful interactions, as individuals can engage all their senses and pick up on subtle nuances in communication. Digital connections lack this important physical presence part of socializing and rely solely on digital communication tools. While they offer convenience and accessibility, allowing individuals to communicate across long distances and at any time, they may lack the depth of interaction found in face-to-face encounters (Sherman, Michikyan, & Greenfield, 2013). Digital interactions typically occur through a screen, which may limit the depth of emotional connection and the richness of face-to-face communication. Digital connections provide individuals with a degree of privacy and control over their communication, allowing users to curate their online persona and choose what information to share. In contrast, in-person interactions may feel more vulnerable in terms of personal information and communication boundaries, especially when it's between strangers (Sherman, Michikyan, & Greenfield, 2013).

As for whether one form of connection is better than the other, it largely depends on individual preferences, context, and the nature of the relationship. Compared to digital communication like email and text messages, people perceive face-to-face interactions as more meaningful, of higher quality and more useful in building social connections and emotional closeness (Schiffrin et al., 2010). Past research has shown that video calls have been considered more capable of creating co-presence than voice calls, and the ability of voice and video capabilities to elicit human presence through synchronous verbal and non-verbal cues above just text-based digital communication is

evident (Oh et al., 2018). The literature suggests that different types of digital communication can facilitate social connectedness in many ways. Under usual circumstances (conditions when face-to-face human communication is not limited, unlike during the COVID-19 pandemic), people use digital methods intertwined with face-to-face communication, but rarely as a complete replacement of in-person interactions (Baym et al., 2004; Gonzales, 2014). In-person social connections are often valued for their depth and intimacy, while digital connections offer unique benefits such as convenience, accessibility, and the ability to connect with a broader network of people, especially across distances (Nguyen et al., 2022).

Email usage was the most common means of digital communication for older adults. About 74.7% of those aged 65 years and older sent and received emails in 2022, up 7.7% from 2020. 50.9% of older adults sent messages using an instant messaging app in 2022, while 43.5% used social networking websites or apps. 37.8% of older adults made online voice calls or video calls in 2022, virtually unchanged from 2020 (37.2%). Additionally, there was a significant uptake in banking and booking appointments. 40.7% older adults used online banking and financial apps in 2022, up 10.9% from two years earlier. Around half (55.4%) of older adults used government online services in 2022 which includes taxes, vaccinations, financial aid, and accessing health information. With regards to leisure and entertainment, 44.5% of older adults watched video streaming services and 42.7% older adults listened to music online. Additionally, 2.3% of older adults used dating websites or apps in the year 2022 (StatsCan, 2023).

With the data suggesting that the population can, in fact, learn and use technology at a rapid pace, having equitable access to technology can empower all older adults to use technology, thereby fostering social inclusion, improving access to essential services, and enhancing mental wellbeing. Currently, there has been a growth of effort to have community0based resources in place for seniors who want to be more technology-literate.

In Vancouver, BC, public libraries, including the Vancouver Public Library (VPL), offer various digital literacy programs to help community members, including older adults, enhance their technology skills. VPL provides Tech Basics Workshops, which cover essential technology skills such as using computers, navigating the internet,

setting up email accounts, and understanding basic software applications. The library also offers one-on-one help sessions, allowing patrons to book personalized sessions with staff or volunteers to address specific technology-related questions; these sessions are ideal for individuals requiring targeted assistance with their devices or online tasks (Julien et al., 2022). VPL offers specialty technology classes focused on more specific topics such as using social media platforms, managing digital photos, and understanding online privacy and security best practices. During the COVID-19 pandemic, the library expanded their digital outreach by offering online classes and resources to help patrons access digital services and information remotely. These programs are designed to be accessible and user-friendly, which caters to individuals with varying levels of comfort and experience with technology.

In New York City and Denver, Older Adults Technology Services, through its Senior Planet initiative, offers technology training programs specifically designed for seniors (OATS, nd.). They provide both in-person and online courses covering various topics, ranging from basic computer skills to social media and online safety. Another initiative, the Cyber-Seniors Program, offers its services across North America. This program connects tech-savvy youth with seniors to provide one-on-one technology tutoring. The initiative gained popularity after the release of the "Cyber-Seniors" documentary, which showcased how teenagers patiently taught seniors to use technology.

In the UK, the Tech to Connect Challenge was launched to explore how technology can combat social isolation among older adults (Gearing et al., 2021). This initiative is a collaboration between technological innovators, care providers, and third-sector organizations to create new digital solutions for aging communities. Throughout the development of this initiative, they advocated that the key to bridging the tech gap include intentional collaboration among industry, education, and community (Gearing et al., 2021). These initiatives reflect a growing awareness and commitment to ensuring that older adults are not left behind in the digital age, providing them with the skills and confidence to take full advantage of technology.

1.5. Community-Based Research

Community-based research (CBR) is a collaborative approach that is used to engage researchers, academics, and, most importantly; community members and organizations in a partnership that addresses the community's specific challenges and needs (Strand et al., 2003). At the heart of CBR is the active involvement of community members throughout the research process, ensuring that the research addresses the needs of the community members that it serves, and that the outcome can be beneficial to those it aims to serve. Researchers and community members must be working as equal partners and this relationship must be built on mutual respect and trust, allowing for genuine engagement and input from the community throughout all research stages, from the initial stages of formulating the research questions to disseminating the findings (Seifer & Greene-Moton, 2007). The community's participation is pivotal, ensuring that their perspectives, insights, and local knowledge significantly influence the research agenda, design, and outcomes.

The foundation of CBR is to provide tangible and beneficial outcomes for the community. The outcomes of the research should directly contribute to addressing the community's needs, whether through enhancing knowledge, evaluating specific interventions, or influencing policy changes that affect the community. Furthermore, CBR projects often incorporate elements of capacity building, empowering community members by enhancing their skills and knowledge, which they can utilize even beyond the scope of the research project (Wallerstein et al., 2017).

CBR is uniquely tailored to the specific context of the community involved, taking into account the social, cultural, and economic factors that influence their lives. This contextual sensitivity ensures that the research is applicable and respectful of the community's circumstances (Minkler, 2005). The entirety of the process is iterative and reflexive, meaning that it remains flexible and responsive to the evolving needs and circumstances of the community

In the case of this research project, the CBR process began with building partnerships with community-based senior serving organisations (CBSS), establishing trust and mutual respect as foundational elements. Through my involvement with a CBSS organtion in my community, I explained the research questions that arrived from

the gaps that exist in the literature as it relates to digital interventions and the mental wellbeing of CDOA. We reflected the community's priorities and collaboratively design the study. This collaborative approach ensured that the methodologies (semi-structured interviews) are culturally appropriate and considerate of local resources and constraints. The CBSS organisations that I was collaborating with were actively involved in the recruitment of community-dwelling older adults in the community.

After the data analysis was completed, communicating the findings back to the community was crucial; thus, results were shared in accessible formats, in local newsletters and free webinars. This transparency fostered further dialogue and action for community members based on the findings. Finally, the impact of the research was evaluated with regards to my experience working and providing services to community members, allowing an opportunity for reflection and improvement, and enhancing the effectiveness of future research efforts.

This approach underscores empowerment by strengthening community capacity and ensuring that research is aligned with real-world issues pertinent to the community. By embedding research initiatives within the context of the community's social and cultural environment, CBR promotes sustainable change. At the core, it builds trust between researchers and communities, thereby continuously facilitating more ethical and effective research practices. CBR is especially beneficial in tackling complex social issues as it leverages the unique knowledge and resources of local communities, leading to solutions that are both effective and sustainable.

1.6. Paving The Road to Inclusive Interventions

Like many doctoral projects across disciplines, this project initially intended to go one way, but very quickly pivoted to something that was unexpected. At first, the idea was for innovation, the creation of a novel digital product aimed towards the betterment of mental wellbeing of older adults. The progression of this project was meant to look like the following: 1) exploring existing digital mental health products for older adults (the target population), 2) creating a working group with older adults to create a prototype product, and 3) piloting said product. As I began my preliminary research, conducting the systematic review, I started to notice the gaps that existed. The target demographic of many digital health products for older adults were restricted to those who were

advantaged, namely; the rich, the educated, the ones with close intergenerational relationships, and those who speak English. These restrictions were not intentional, but the disparity existed nonetheless. Many older adults lacked the access and skill to even begin to use necessary online services such as government aids, medical appointments, transportation, and food access; let alone the ability to accept innovations beyond that such as smartphone apps, e-gaming, social media, virtual reality, augmented reality, and more. I concluded that equitable access was always the key to laying a good foundation for future innovations. I decided to shift my doctoral research to find ways to achieve digital equity for the older adult population, including those who are marginalised, under-represented in research, and under-serviced in community.

The initial idea of this project was to create a novel digital mental health intervention that can be equitable and addresses the needs of all the populations of older adults. However, in order to create an equitable digital intervention, the population must be able to use said technology. The project has been organised into 3 different objectives. The first two objectives were determined before the start of the project and the third objective was developed after understanding what needed to be created. The initial two objectives were: 1) To identify existing digital mental health interventions for older adults and 2) To identify the factors that affect mental health of the diverse population of CDOA.

From speaking to community members about their mental health needs, digital programs, and accessing services, it was determined that the third objective should be focused on ensuring that all members of the population can get access to digital mental health services/programs as well as other resources that tackle the social determinants of mental health. With these considerations in mind, the body of this dissertation (chapters 3-5) will be arranged as follows:

1.6.1. Chapter 3: Existing Digital Mental Health Interventions for Older adults

Objective 1: Identifying existing digital mental health interventions for older adults. This objective seeks to gain insight into the various designs and aspects of DMHIs for older adults, specifically, the aspects/features of existing DMHI that have been shown to improve the mental health of the older adult population.

Research Question 1: What aspects/features of existing DMHI have been shown to improve the mental health of the older adult population?

Digital interventions are promising in their ability to provide researchers, mental health professionals, clinicians, and patients with personalised tools for assessing their behaviour, and seeking consultation, treatment, and peer support. The research-to-practice gap for digital mental health interventions is increasingly being recognized, and leaders in the field have proposed strategies to routinely incorporate implementation methods into the study of digital mental health interventions for specific populations or communities (Lord et al., 2021). Practitioners in the mental health field as well as caregivers of older adults can use the advantages of digital tools to provide older adults with a helpful instrument to aid their mental health (Petrovic & Gaggioli, 2020).

In chapter 3, I conducted a systematic review to gather evidence of current DMHIs for older adults. This review was the first to summarise recent findings of current literature to inform practice today and benefit future intervention creation.

1.6.2. Chapter 4: Understanding the mental wellbeing of community-dwelling older adults

Objective 2: Identifying the factors that affect mental health of the diverse population of CDOA. This objective intends to pinpoint the important factors that contribute to the mental health of diverse older adults to allow community-based and health organisations to build interventions or services that mashed on the needs of the population.

Research Question 2: What factors impact the mental wellbeing of diverse CDOAs?

With population ageing, there is a growing urgency to improve the mental wellbeing of the older adult population in Canada. It is important to understand the factors that affect the mental wellbeing of the diverse population of older adults to create interventions or services that will best address their unique needs.

Due to the under-recognition of poor mental health among older adults, it's vital to adopt a community-oriented approach in comprehending the factors influencing older

adults' perceived mental well-being. This approach supports the exploration of essential mental health resources and services required by this demographic. This chapter explores perceived mental health, a subjective gauge of overall mental well-being, which doesn't directly correlate with diagnosed mental disorders but significantly still impacts one's quality of life.

Furthermore, the aim of this chapter was to grasp the mental health priorities of older adults residing in communities, including their definition of good mental health and how community-based services can bolster their mental well-being. It's erroneous to assume uniform mental health needs among the older adult population. Canada's older demographic is diverse, encompassing variations in age, gender, culture, religion, language, socio-economic status, and sexual orientation. Thus, an expanded understanding of this domain is imperative for the health system to adequately cater to Canada's diverse ageing population. Given the scarcity of mental health research on diverse community-dwelling older adults, this study seeks to address a literature gap and inform future community-based mental health interventions or services.

Chapter 4 captured themes that can allow community-based and health organisations to build interventions or services that target the mental health concerns of diverse CDOA in Canada and beyond. Additionally, the results can be used to aid future researchers in developing interventions and services that put the mental health needs of older adults at the centre of creation and design.

1.6.3. Chapter 5: Creating Inclusive Community-Based Digital Learning Programs to Achieve Digital Equity

Objective 3: Creating Inclusive Community-Based Digital Learning Programs to Achieve Digital Equity. This objective aims to discover the steps needed for community-based seniors serving organisations to create programs and services that can improve the digital literacy of CDOAs.

Research question 3: What are the steps needed to create inclusive community-based programs to improve the digital literacy of CDOAs?

Health equity refers to the absence of systematic health disparities among different social groups with varying levels of advantage or disadvantage. Digital equity,

essential for the entire population's well-being, necessitates bridging the digital divide by addressing barriers to technology uptake, access, and usage. Older adults often encounter challenges in adopting and using technology due to factors such as device costs, trust in and familiarity with technology, willingness to seek assistance, privacy concerns, and user interface design issues. Studies indicate that a significant portion of older individuals may be unprepared for digital health visits due to technological inexperience or physical impairments. These challenges may be exacerbated in low- and middle-income countries where socioeconomic disparities, knowledge gaps, limited technology access, and language barriers widen the digital divide.

Efforts worldwide have focused on leveraging technology for educational purposes, but much of the research predominantly targets the general or younger population and centres on developing new digital tools without adequately involving older adults in the process. Failing to address digital inequity risks restricting technology usage to privileged individuals with higher education and income. Recognizing the diverse identities within older adult populations is crucial, moving away from viewing them as a homogeneous marginalised group and acknowledging intersecting identities such as socioeconomic status, social isolation, and race. Understanding individual needs is essential for ensuring equitable access to knowledge.

Chapter 5 employed a community-based approach to gather insights on achieving digital equity among diverse community-dwelling older adults (CDOA). The study focused on the population of Downtown West End (DTWE) of Vancouver, known for its high diversity and dense older adult population. Acknowledging that community needs vary across Canada and beyond, this chapter aims to provide recommendations tailored to diverse populations, offering insights for implementing community-based initiatives to promote digital equity.

1.7. Summary

Digital literacy improves the mental health of older adults by facilitating access to online resources, social connections, and telehealth services, thereby reducing isolation, providing support, and increasing access to mental health care. This dissertation aims to provide strategies to advance digital literacy and improve the mental wellbeing of the diverse population of CDOA. By addressing these three research objectives, this

dissertation aims to make a significant contribution to the field of digital literacy and mental health, providing insights into issues that older adults in the community face and offering practical implications for senior-serving community organisations and researchers; and awareness for funders, policymakers, and academics.

Chapter 2.

Theoretical Framework

To investigate the mental health challenges of under-represented CDOA populations, we must first examine current theoretical frameworks that can be applied to aid this investigation. The lack of research catering to the needs of minority older adults stems from systemic inequalities, underrepresentation in studies, and cultural biases within the research community. Many CDOA face unique health and social challenges, including disparities in mental healthcare and service access due to factors such as language barriers, physical barriers, financial barriers, cultural inconsideration of services, and discrimination. Incorporating the social determinants of health (Raphael, 2009) and an intersectionality framework (Crenshaw, 1989) is essential when conducting this research, as it allows for a more nuanced understanding of how factors such as race, ethnicity, gender, socioeconomic status, and other intersecting identities impact service needs to improve mental wellbeing. Without considering these intersecting factors, research runs the risk of oversimplifying complex issues and overlooking critical insights necessary for developing inclusive and effective policies and interventions. While I understand that the term “marginalised populations” is an umbrella term for people that experience social disparity, I will mainly focus on those socially affected by their ethnic, cultural, gender, socio-economic disparity, and sexual minority statuses. Within this dissertation, the terms “under-represented populations”, “underserved populations” and “marginalised populations” will be used interchangeably.

As we are currently in the digital/modern age, we have seen the sociocultural rejection of other frameworks (such as the successful ageing theory (Rowe & Kahn, 1997) and disengagement theory (Hochschild, 1975), whether it be from the lack of cultural awareness, lack of inclusivity, or underlying ageist perspectives, among others (Dillaway & Byrnes, 2009; Mabry & Bengtson, 2005). This chapter summarises the Social Determinants of Health (SDoH) and Intersectionality Framework, dissecting and understanding the background or historical context of each framework fully. The elements of the theories and their applicability to the topic of mental health of under-represented older adults and digital equity will be discussed. While both theories address how systems of power and environment affect people, intersectionality focuses

and centres on individual identity and experiences whereas social determinants of health centers on the broader societal conditions and health outcomes. The field of mental health and technology is at its infancy. To progress further, the application of theoretical frameworks to this research will have to be inclusive and be able to withstand the test of time.

2.1. Social Determinants of Health

This study was grounded in the social determinants of health (Raphael, 2016a). It is vital to recognize the context within which older adults live in order to understand their mental health and well-being, as well as determining services and resources that they need (Bunjun & Morris, 2007). Having low social status in a society hinders peoples' possibilities of achieving better health (Raphael, 2016a). The Canadian Medical Association (2013) has suggested that only 15% of population health is determined by biology and genetics. They note how much of a person's health is determined by factors outside their bodies: 10% by physical environments, 25% by the health care system, and 50% by one's social and economic environment. To improve the health of Canadians, attention must be drawn to factors affecting health inequities such as social determinants of health and how they impact Canadians throughout their lives (Canadian Medical Association).

SDoH focuses on understanding the circumstances in which people live, work, and age (Marmot, 2005). These circumstances, or social determinants, are all related to the many deep-rooted health inequalities in the world. Lower life expectancy, higher rates of mortality, and greater burden of disease among disadvantaged populations resulted from the unequal distribution of money, power, and resources (Bell & Marmot, 2022). The circumstances and environment of the individual play fundamental roles in their ability to achieve good mental health. These circumstances include the geographical location in which someone lives, household income, nutrition, education, immigration status, and their experience with social exclusion or "other-ness" (Allen, Balfour, Bell, & Marmot, 2014). Individuals with lower social status have greater health risks and lower life expectancy than those with higher status, and the impact of these social positions can accumulate over time (Bell & Marmot, 2022). Ultimately, having access to healthcare and technology is a beacon of economic power.

Despite Canada being recognised as the leader in health promotion for their population, there is still a lack of policies that support many Canadians (Raphael, Curry-Stevens, & Bryant, 2008). Underserved Canadians, such as members of the LGBTQ2S+ community, immigrants and refugees, racialized groups (visible minorities), and low-income population still encounter higher power inequalities that impact their access to healthcare and their understanding and perception of mental health (Castañeda et al., 2015; Raphael, 2016). The SDoH framework encourages a deeper understanding of the created inequities within the Canadian mental health and social care system. SDoH allows a deeper analysis of how Eurocentric assumptions in the Canadian health care system have created inequalities across gender and different cultural groups (Armstrong & Pederson, 2015; Raphael, 2016a). Additionally, this framework challenges the Canadian health care system due to institutionalised racism in the social service and health care system, which is seen in language barriers, lack of cultural sensitivity, absence of cultural competencies, barriers to access health service utilisation, and inadequate funding for community health services (Peng & Cassie, 2015; Raphael, 2016a). All of these factors impact the health status and service access of under-represented groups who are living in Canada in various forms (Peng & Cassie, 2015; Raphael, 2016a).

Braveman (2022) emphasised that upstream social determinants act as fundamental causes and can influence health through downstream social determinants (e.g. economic opportunities impact living conditions). This work also highlights the impact of racism and of pervasive, daily stress (Braveman, 2022). Wiley and colleagues (2022) similarly characterised the impact of chronic stress on mental health outcomes through biological pathways. For example, they explained how low socioeconomic status impacts mental health for those at the lower end of the social gradient, including stress from navigating everyday circumstances, anxiety about financial insecurity (and therefore unpredictable living conditions), and perceived lack of control (Wiley et al., 2022).

Discrimination, whether related to race/ethnicity, immigrant status, sexual orientation, and/or occupational status, has repeatedly been associated with adverse mental health outcomes in the USA and Canada (Emmer, Dorn, & Mata, 2024). In addition, Franco, Durkee, & McElroy-Heltzel (2021) argue that discrimination based on multiple minority identities can be viewed as a “fundamental cause” of depression and a

predictor of anxiety. It is vital to explore cultural factors that are held within ethnic groups. For instance, culture greatly shapes the understanding of topics such as mental health in that there are philosophies that imply that openly displaying emotion is a result of weakness (Kramer, Kwong, Lee, & Chung, 2002). Admitting to mental health problems is taboo and could threaten the reputation of one's family. For example, Asian societies tend to be communal, resulting in repressing any stigmatizing characteristics, and are typically hidden from the public view (Chaudhry, 2016; Choudhry, 2001; Hossen, 2012; Jhangiani, 2011). The fear of losing respect or becoming an outcast in the Asian community has been shown to be a valid concern in addressing any mental health problems (Chaudhry, 2016). Similarly, holding an honourable reputation is very important in these respective communities because the person can become the subject of gossip or the recipient of pity.

Familial relationships can also strongly impact mental health. Many marginalised individuals carry various degrees of familial burdens and responsibilities (Calderón & Tennstedt, 2021). Living with family, satisfaction with family relationships, and family connectedness have all been associated with fewer depressive symptoms (Wong et al., 2017). In contrast, a history of abuse and neglect from a family member has been associated with symptoms of PTSD, anxiety, and aggression (Cecil et al., 2017). Social support and participation may be particularly important for ethnic and LGBTQ2S+ populations (Pflum et al., 2015; Hynie, 2018). However, it is critical to note that there is still limited knowledge on the mental wellbeing of underrepresented populations in mental health research.

Focusing on the social determinants of mental health for the senior population (considering culture, education, income, gender, sexuality, social support, and immigration) allows for a deeper understanding of how CDOA view their mental health and well-being and communicate it to others. Rooted in SDoH, this research allowed space for participants with varying lived experiences to share their stories in-depth and determine factors that interact with individuals' mental health experiences and outcomes. I was required to examine how various social, economic, and environmental factors influence the health outcomes of the community. I began by understanding the key social determinants of health, such as income, education, employment, social support networks, neighborhood environments, and access to healthcare. These factors shape the conditions in which people live, grow, work, and age, and significantly impact mental

health. These determinants were incorporated by formulating the research questions that explored how these factors affect mental wellbeing within the community. In the interview guide, I allowed the opportunity for the participants to investigate how their experiences with economic challenges or access to social support systems had an influence on their mental health experiences. Throughout this research, especially during data analysis, I maintained a holistic perspective by considering how multiple determinants interact simultaneously rather than in isolation, which aided in understanding the complex, multifaceted influences on mental wellbeing. I explored themes and patterns that emerge regarding the impact of social determinants on mental health within the specific cultural, social, and economic contexts of the population under study. Using SDoH will allow a greater understanding to be gained to help support and educate policy-makers, reduce health inequities in the health care system, as well as decrease institutionalised racism many marginalised populations experience.

2.2. Intersectionality

First termed “intersectionality” by African-American feminist legal scholar Kimberlé Crenshaw (1989), intersectionality theory sought to complicate understandings of race and sex/gender-based scholarship. The theory argues that multiple marginalisation, such as those experienced by African-American women, are mutually constituted and could not be understood or ameliorated by approaches that treated race and sex/gender as distinct subjects of inquiry. Though developed as a response to second-wave feminist ideals that were implicitly white and middle-class, and to antiracist organising that was covertly male in its issues and objectives, intersectionality has the potential to improve research not only on sex/gender and race/ethnicity, but on all other domains of social position, including socio-economic status, background, or age cohort.

An intersectionality lens analyses the experiences of those who are marginalised in society, which varies from the different forms of social stratification such as class, race, sexual orientation, age, religion, disability, cultural groups, and gender (Carastathis, 2014; Deckha, 2004). An intersectionality framework focuses on understanding how the various forms of social stratification are interwoven together and results in systems of oppression (Carastathis, 2014). For example, women from particular cultural groups are socialised to carry out their gendered roles throughout their lives (Carastathis, 2014; Deckha, 2004). However, women’s intersecting identities or

social positions also result in potentially unique experiences for them. For instance, gender, age, and socioeconomic status intersect with each other. The experience of a young, low-income woman from Afghanistan can be quite different from the experience of an older, middle-class, Canadian woman. Religious backgrounds, education level, and physical and mental disabilities may further contribute to differences among these two subjects. The intersectional approach assumes that an individual's experience and health are not simply the sum of their parts and prove that, in this example, gender can be constituted (and health affected) through cultural meanings and processes, including those that are potentially positive, such as being in a higher social class, but also negative, such as through gendered aspects of trauma that includes both sexism and racism (Bauer, 2014).

Through this lens, a deeper understanding can be formed when analysing how factors such as race, culture, language, education, gender, sexual orientation, and class shape CDOA's lived experiences and how they interact and access services (Carastathis, 2014; Deckha, 2004). These experiences affect different groups of CDOA in society in various forms at micro, meso, and macro levels (Bastia, 2014; Calasanti & Giles, 2018; Koehn et al., 2013). By including the intersectionality framework, the social determinants can attempt to identify how each determinant impacts those who are marginalised in society (Koehn et al.) while challenging principles of social justice, anti-racism, and anti-oppression. The intersectionality framework draws attention to social inequality based on intersecting social relations that are manifested on an individual and population level, and a greater understanding can be achieved by studying how those relationships act as social determinants of health disparities (Bauer, 2014). Intersectionality has the potential to enrich population health research through improved validity. In fact, it provides greater attention to both heterogeneities of effects and causal processes that result in health inequalities.

When looking at the mental health and service needs of older adults in the DTWE, I needed to consider the multiple marginalised intersections of identities of the population. Aside from being older adults in a growing urban area, many of the populations are in the LGBTQ2S+ community, are immigrants, racialized people, homebound, and are low-income. One example on how this theory has been applied in previous research was a study done at two urban Aboriginal health centres in Vancouver by Browne, Varcoe, & Fridkin (2011). They revealed how intersectionality widens the

scope of what is conventionally identified as a ‘problem’ in health services delivery. They explain that when stigmatised diseases are decontextualized from their underlying causes, people who are HIV-positive are blamed or held responsible for their status, including their problematic behaviours (e.g., unprotected sex and injection drug use). In comparison, intersectionality moves beyond this type of individual focus. The framework was used to consider multi-level root causes of HIV including historical trauma, poverty, unemployment, abuse, racism and medical involvement such as prescribing practices, global economics, ideologies of racial superiority, capitalist priorities, and ongoing clawbacks to social welfare systems (Browne, Varcoe, & Fridkin, 2011). As a result, Browne et al. (2011) demonstrate the relevance of intersectionality when researching the health of underrepresented groups in society. This type of reframing is essential in mental health research in order to create mental health services that address the underlying problems so that treatment interventions are more finely attuned to different population groups.

Incorporating intersectionality theory into this research on CDOA’s mental wellbeing required a deep understanding of the core principles of intersectionality, recognising how overlapping social identities such as race, gender, and socioeconomic status affect each CDOA’s experiences. As a researcher, I needed to ensure that there was a diverse representation in the study by including participants from varied backgrounds and identities to capture a wide range of perspectives. Consistent with the requirements of a CBR approach, incorporating intersectionality in the research methods required me to engage community members actively, and allowing them to help develop the research questions. Additionally, the theory supported the qualitative approach that was used for data collection. This research utilized semi-structured interviews to delve into the complex, nuanced effects of intersecting identities on mental wellbeing and digital literacy. Reflexivity notes was created after each interviews, with consideration of my own biases as a researcher, and analysis of how different identities combine created unique experiences and influenced the way the participants answered or approched the questions. With regards to knowledge mobilization strategies, this theory was further incorporated in the way findings were disseminated by aiming for accessibility and cultural sensitivity, providing recommendations that respect the diversity of the community. Findings were presented in seminars and webinars hosted by CBSS

organizations, and were laid out in interactive and simplified way in community newsletters.

In summary, focusing on the social determinants of culture, education, gender, sexual orientation, social support, socio-economic status, and immigration and an intersectionality framework allows for a deeper understanding of how older CDOAs view their mental health and well-being and services that they need. With these frameworks, a greater understanding can be gained to help support and educate main players in the community-based senior-serving (CBSS) sector and policy-makers to reduce inequities in the health care and social services system, as well as decrease institutionalised discrimination and service barriers that many marginalised populations experience. Both frameworks could help researchers, practitioners, and others working to create inclusive, community-based services for CDOA in Vancouver and beyond.

Chapter 3.

Existing Digital Mental Health Interventions for Older adults

Technology has increasingly been seen as a solution not just for younger people but also older adults' health needs (Hollis et al., 2017; Chandrashekar, 2018). For example, technology has been highlighted during the COVID-19 pandemic, as older people and family caregivers have struggled to cope with physical distancing and restrictions on face-to-face contact (Sixsmith, 2021. The role of recent research has shown increased levels of technology adoption amongst older people to deal with social isolation and to access vital health and community services (Fortuna et al., 2019; Horst et al., 2021; Cosco et al., 2022). There is evidence that suggests that digital mental health interventions (DMHIs), such as computer-assisted therapy, smartphone apps and wearable technologies, are effective for the treatment, diagnosis, and alleviation of depression and anxiety symptoms among the younger population (Marengoni et al., 2011; Bocker, Glasser, Nielsen, & Weidenbacher-Hoper, 2012; Andrews et al., 2018; Fleming et al., 2018; Lattie et al., 2019). Previous systematic reviews have determined that internet-delivered CBT can be considered as low-intensity psychological intervention that can aid older adults with mild-to-moderate mental health problems (Xiang et al., 2020; Cremers, Taylor, Hodge, & Quigley, 2022). Nevertheless, research and innovation within the digital mental health intervention field is still limited for the older adult population in comparison to the younger population (Hollis et al., 2015).

This systematic review aims to investigate the evidence supporting the use of DMHIs for treating and preventing symptoms of depression and anxiety in adults older than 50 years. This review aims to 1) gain insight into the various designs and aspects of DMHIs for older adults, and 2) synthesize methodological findings from RCTs with older adult participants to extract important information to conduct future RCTs for this population.

3.1. Research in context

Evidence before this study:

Technology has increasingly been seen as a solution not just for younger people but also older adults' health needs. We searched SCOPUS, PsycINFO, AgeLine (EBSCO), and Medline (PubMed) for publications published from January 2010 to November 2021 for randomized controlled trials of DMHI on the older adult population (ages 50+). We found that there is an increasing number of trials that emerged within the last three years, which reflects the increasing interest in this field of research, and the urgency to utilize DMHI for the older adult population. We found no other systematic reviews that looked at RCTs of DMHIs for the older adult population. We found six systematic reviews of DMHIs, but they mainly reported the effectiveness of DMHIs among younger populations.

Added value of this study:

This review is the first to compare RCTs of DMHIs for depression and anxiety among the older adult population. The findings from this systematic review include the aspects of existing interventions that were successful in alleviating depressive and anxiety symptoms, including the characteristics of the DMHI, factors that are involved in the implementation of interventions, and aspects involved in conducting a RCT to evaluate DMHI for the older adult population. This can provide future DMHI researchers, mental health professionals, clinicians, and patients with the tools to design, develop, and utilize successful interventions for older adult users. We have also included four methodological considerations for future DMHI researchers to consider when conducting RCTs of DMHIs with the older adult population.

Implications of all the available evidence:

RCTs of DMHIs for depression and anxiety are needed to measure its impact on the mental wellbeing of the older adult population. This review supports existing reviews on DMHIs to create a regulated international gold-standard design of successful DMHI RCT for the older adult population.

3.2. Methods

3.2.1. Registration and Protocol

This systematic review has been registered with the international Prospective Register of Systematic reviews (PROSPERO) CRD42020192532. The protocol for this systematic review has been described and published in December 2020 (Riadi et al., 2020).

3.2.2. Search Strategy

The academic databases SCOPUS, PsycINFO, AgeLine (EBSCO), and Medline (PubMed) were searched in November 2021 for publications published from January 2010 to November 2021. DMHIs for treating depression and anxiety in older adults have existed prior to 2010 (Page et al., 2021). The reason behind this cut-off is that this review is focused on a modern and fast-paced topic; studies using decades-old technologies are unlikely to maintain relevance with the current production rate of new technologies. The database searches were conducted using a combination of search terms relating to mental health problems (i.e., depression and anxiety), the means of intervention delivery (via the internet, using smartphones, tablets, etc.), population age (older adults), and the study design (RCT). Reference lists of included articles have also been screened for potentially relevant studies.

3.2.3. Screening and Selection Process

All search results were downloaded into Clarivate EndNote, a reference management software, where duplicates were identified and removed. First, two reviewers (IR & LK) independently reviewed all article titles and abstracts based on the inclusion and exclusion criteria. Then, full texts were examined by the same reviewers. Any disagreements between the two reviewers in the title and abstract stage or the full-text stage were resolved through consensus-based discussion with a third reviewer (TDC).

3.2.4. Eligibility Criteria

This systematic review includes RCTs of DMHIs for adults older than 50 years for their depressive or anxiety symptoms. The reason for this younger age cut-off for this population is because there are limited studies that include the older population when looking at digital or technology-based health interventions. By lowering the age eligibility criteria, we hope to gather as much evidence as possible for the older population. We have included interventions using smartphones, enterprise digital assistants, personal digital assistants, portable media players, video game consoles (including virtual/augmented reality headsets), computers, laptops, tablets, and e-readers. Studies were included if the sample population completed pre-intervention and post-intervention anxiety or depression questionnaires. Only RCT studies were included to minimize bias and confounding factors and provide statistical reliability (Sterne et al., 2019). Peer-reviewed papers in all languages and from all countries were included. The exclusion criteria included non–peer-reviewed articles, conference proceedings, case reports, editorials, opinion papers, and letters, as well as studies that focus on children or young adults. Additionally, we will also include studies in which depression and anxiety are measured as secondary outcomes to ensure that all evidence of DMHIs for depression and anxiety for this population are included.

3.2.5. Risk of Bias Assessment

The risk of bias (ROB) of each study was assessed using the revised Cochrane risk-of-bias tool for randomized trials, version 2 (RoB 2) (Hariton & Locascio, 2018). ROB was evaluated for each bias domain listed in the RoB 2 assessment tool, which covers: (1) bias arising from the randomization process, (2) bias due to deviations from intended interventions, (3) bias due to missing outcome data, (4) bias in the measurement of the outcome, and (5) bias in the selection of the reported result.

3.2.6. Narrative Synthesis

A systematic narrative framework was used to synthesize the data (Siddaway, Wood, & Hedges, 2019). Due to the high degree of heterogeneity in outcomes and measurement in the studies, a meta-analytic approach was not appropriate; therefore, the results of included studies were narratively synthesized rather than meta-analyzed.

The results were organized by types of DMHI that were commonly found in all the eligible articles (iCBT, online courses, physical activity programs, etc.). Within each type of DMHI, characteristics of the interventions and their effectiveness in alleviating depressive/anxiety symptoms were discussed.

3.3. Findings

3.3.1. Included studies

A total of 1022 article titles and abstracts were reviewed, and 58 full-text articles were reviewed for inclusion. All full-text studies were written in English. Among these, 17 studies were included in the review for data extraction (Figure 1).

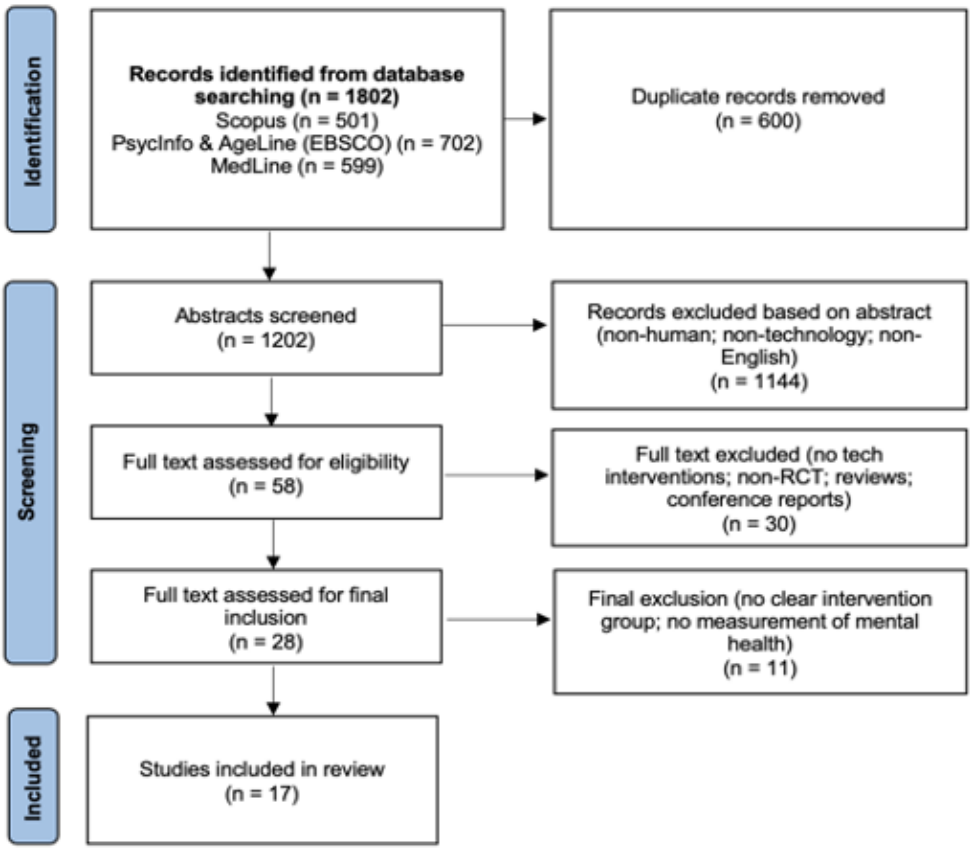

Figure 3.1. PRISMA flow chart of study selection for systematic review

3.3.2. Study Characteristics

All 17 studies that were included are randomized controlled studies. Out of all the studies, seven were conducted in the United States (Egede et al., 2015; Morimoto et al., 2020; Moore et al., 2018; Rendon et al., 2012; Smith et al., 2019; Sparrow, Gottlieb, DeMolles, & Fielding, 2011; Linder et al., 2015), three in Sweden (Thorén et al., 2011; Thorén et al., 2014; Malmberg, Lunner, Kähäri, & Andersson, 2017), two in Australia (Dear et al., 2015; Morton el., 2018), and the remainder took place in Germany (Knaevelsrud et al., 2017), the Netherlands (Vloothuis et al., 2019), China (Lee et al., 2013), Brazil (Ferraz et al., 2018), and Russia (Kotov, Isakova, & Sheregeshev, 2020). Two of the studies are pilot studies (Lee et al., 2013; Ferraz et al., 2018). Many of the studies [n=12] had completed at least one follow-up study within 12 months after the completion of the initial study (Egede et al., 2015; Rendon et al., 2015; Smith et al., 2019; Sparrow et al., 2011; Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014; Knaevelsrud et al., 2017; Vloothuis et al., 2019; Lee et al., 2013; Kotov, Isakova, & Sheregeshev, 2020).

Three of the studies utilized internet-delivered cognitive behavioral therapy (iCBT) (Egede et al., 2015; O'Moore et al., 2018; Knaevelsrud et al., 2017), while others investigated online courses/computer lessons (Dear et al., 2015; Morton et al., 2018), internet-delivered exercise courses to promote physical activity (exer-gaming) (Rendon et al., 2012; Sparrow et al., 2011; Linder et al., 2015; Vloothuis et al., 2019; Kotov, Isakova, & Sheregeshev, 2020), neuroplasticity-based computerized cognitive remediation (nCCR) (Sterne et al., 2019), online speed of processing training (SOPT) (Smith et al., 2019; Sparrow et al., 2011), and technology-based rehabilitation programs ("telerehabilitation") (Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014). A few of the studies considered mental health measures as secondary outcomes, with the primary being improvement of physical activity (Rendon et al., 2012; Sparrow et al., 2011; Linder et al., 2015; Vloothuis et al., 2019; Ferraz et al., 2018; Kotov et al., 2020), sensory impairment rehabilitation (Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014), or cognitive functional performance (Morimoto et al., 2020; Smith et al., 2019; Lee et al., 2013). Study characteristics are summarised in the tables (Table 1 and table 2)

Table 3.1. Participant demographics for the 17 included studies

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Dear, 2015	65·39, 65·51	35, 37	67, 54	33, 46	Over 60 years of age and assessed by General Practitioner or specialist to rule out any physical cause for anxiety
Egede, 2015	63·5, 64·2	120, 121	3, 2	97, 98	Over 60 years of age, male and female veterans who meet DSM-IV criteria for major depressive disorder
Ferraz, 2018	NR	22, 25	50, 27·3	50, 72·7	Over 60 years of age, diagnosed with Parkinson's Disease (PD), and using medication for PD. Modified Hoehn and Yahr stages 2, 2.5, or 3
Knaevelsrud, 2017	70·91, 71·91	47,47	74·5, 55·3	25·5, 44·7	Experienced a traumatic event as a child or adolescent during World War II that met the criterion A for PTSD as specified in DSM-IV. Must report at least a subsyndromal level of PTSD symptoms
Kotov, 2020	65·02, 64·8	50, 50	40, 38	60, 62	Individuals with ischemic stroke of hemispheric location that has been confirmed by computer tomography

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Lee, 2013	78, 78	7, 6	85·7, 66·7	14·3, 33·3	Over 60 years of age and experiencing early dementia (score of 1 on screening with the Chinese Dementia Rating Scale). Participants must be mentally stable, capable of following instructions, and have an attention span of 30–45 minutes

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Linder, 2015	55·5,59·4	48,51	31·2, 39·2	68·8, 60·8	Individual who experienced unilateral ischemic or hemorrhagic stroke within the previous 6 months with some voluntary movement as indicated by a score of 11–55 on the Fugl-Meyer Assessment. Must have limited access to an organized stroke rehabilitation program. Must have preserved cognitive function

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Malmberg, 2017	71·1, 69·6	20, 21	53·1, 45·9 (based on both older and younger groups combined)	46·9, 54·1 (based on both older and younger groups combined)	Individuals who had conductive or sensorineural binaural hearing loss of 20–60 Decibel Hearing Level. Must have completed a hearing aid fitting 3 months before the study began. Must have a Hearing Handicap Inventory for the Elderly score ≥20, indicative of some residual hearing problems.

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Morimoto, 2020	74·7, 72·2	18, 18	63·6 (based on both treatment and control groups)	33·4 (based on both treatment and control groups)	Older adults ages 60−89 with major depression who failed to achieve remission (Montgomery-Asberg Depression Rating Scale >15) after treatment with therapeutic dosages of an SSRI or SNRI antidepressant for at least 8 weeks.

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Morton, 2018	80·71 (based on both treatment and control groups)	53, 44	64·5(based on both treatment and control groups)	35·5 (based on both treatment and control groups)	Must have the space and infrastructure for Internet use (i.e., a phone connection and a table that could accommodate the computer package), and sufficient cognitive ability to engage with the training
O'Moore, 2018	63·16, 59·68	44, 25	86·4, 68	13·6, 32	Over 50 years of age and had a self-reported diagnosis of symptomatic knee based on radiographic criteria and knee pain on most days. Must have major depressive disorder and had access to a computer with internet.
Rendon, 2012	85·7, 83·3	20, 20	100,100	0, 0	Community-dwelling adults between 60 and 95 years of age

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Smith, 2019	80·6 (based on both treatment and control groups)	173, 178	72·7 (overall)	27·3 (overall)	Over 55 years of age and living in supported living facility. Must have sufficient vision and dexterity to use a monitor, keyboard, and mouse.
Sparrow, 201	70·3,71·7	52,51	NR	NR	Community-dwelling men in the Boston area.
Thoren, 2011	63·5 (based on both treatment and control groups)	29,30	49 (overall)	51 (overall)	Have a hearing impairment with subjective, significant communication difficulties, and have been using hearing aids for at least 1 year

First Author, year	Mean Age (control; treatment), years	Number of participants (control; treatment)	Percentage of female participants (control; treatment)	Percentage of male participants (control; treatment	Inclusion criteria
Thoren, 2014	69·4,69·2	38,38	42, 42	58, 58	Have a hearing impairment with subjective, significant communication difficulties, and have been using hearing aids for at least 1 year
Vloothuis, 2019	Patient: 60·53,59·26; Caregiver: 53·91, 54	Patient: 32,34; Caregiver: 9,13	Patient: 34·4, 41·2; Caregiver: 23, 21	Patient: 65·6, 58·8; Caregiver: 77, 79	Have a score of <11 on the domain 'depression' on the HADS

NR=not reported.

Table 3.2. Digital Mental Health Intervention characteristics and outcomes of the included studies

First Author, year	Psychological outcome measured	Depression or anxiety scale used	Intervention	Control	Presence of support	Mode of delivery	Duration of the intervention	Follow-up	Psychological outcomes	% Participant completion rate (treatment, control)

Dear, 2015	Anxiety	PHQ-9, GAD-7	Online course - The Managing Stress and Anxiety Course allows participants to learn and practice psychological skills. The course is comprised of the following components: five online lessons, five lesson summaries and homework assignments, regular automatic reminder and notification emails, secure email-type messaging with the therapist and several detailed case stories, which	Performed the course in self-guided format	Weekly contact with therapist	Web-delivered	8 weeks	3 and 12 months	Reliable improvement and reliable recovery on the GAD-7 and the PHQ-9 in the treatment group compared to the waitlist control group. At 3-month and 12-month follow-up, over 75% of the treatment group reported reliable improvement on the GAD-7 and the PHQ-9	87, 86

			participants can follow throughout the course							

Egede, 2015	Depression	GDS, BDS	iCBT - Behavioural activation for depression via video-conferencing technology with a therapist. Behavioural activation is based on the idea that what a patient does plays a part in how they feel. Behavioral activation is a CBT skill.	Same-room treatment	CBT performed with a therapist	Videoconferencing technology	8 weeks	4-week, 8-week, 3-month, 12-month	Tele-conference method is feasible and produces outcomes that are no worse than in-person delivery 12 months after treatment. Participants in both groups tolerated and clinically benefitted from behavioural activation for depression	83, 86

Ferraz, 2018	Depression	GDS	Physical activity program - Xbox 360 video game with Kinect. These games use full-body motion to allow the player to engage in a variety of mini-games, all of which feature jump-in, jump-out multiplayer play.	Physical exercises without the use of a gaming console	Under the supervision of a physiotherapist	Gaming console	8 weeks	NR	All groups showed significant improvement in depressive symptoms. No significant differences were found between treatment and control groups.	91, 88

Knaevelsrud, 2017	Depression and Anxiety	BSI-18	iCBT - The intervention comprise of structured writing assignments that were facilitated through a secured Web-based platform. Study participants write and upload their texts within a secure Web portal and study therapists provide feedback subsequently within 24 hours. Therapy delivery instructions were based on a disorder-specific CBT manual that was	Waitlist control group	Therapist feedback	Web-delivered	6 weeks	3, 6, and 12-month	No statistically significant improvement. Participants reported feeling valued and motivated by the therapist, found it easier to disclose their problems due to visual anonymity, i.e. due to not seeing the therapist face- to-face, and felt that the therapist understood their problems.	87.2, 95.6

			developed for the purpose of the study.							

Kotov, 2020	Depression and Anxiety	BDS, BAS	Physical activity program - Daily robot mechanotherapy using a MOTOmed bedside trainer in “passive training” and “active training” mode for legs with reversal of the forward and backward directions every 5 minutes.	Standard face-to-face therapy	First sessions were run by a doctor in-person and the patients worked independently afterwards	Robot-assisted & Computer-delivered	14 days	5-day, 21-day, 3-month and 6-month	There was a decrease in the mean depression and anxiety level. Follow ups showed continuous decrease in depression and anxiety	NR

Lee, 2013	Depression	GDS	Cognitive training - Training with a computer-assisted errorless learning program (CELP). The training programs were implemented on an individual basis, approximately twice a week, with a total of 12 30-minute training sessions, which were completed in around six weeks. The CELP was run using a touch-screen notebook computer with a touch-pen input device. Therapists	Waitlist control group	Guidance by therapist	Web-delivered	6 weeks	3 month	GDS showed a statistically significant difference	100, 100

			provided guidance if the subjects had difficulty using the computer input device or had literacy problems.							

Linder, 2015	Depression	CES-D	Physical activity program - A robot-assisted intervention coupled with a home exercise program and a home exercise program done alone. A physical or occupational therapist completed a home visit to educate participants and their caregivers if indicated in their assigned intervention. To facilitate compliance, participants signed a behavior contract and were instructed to complete a daily exercise log. Each	Physical activity program without technology	A physical or occupational therapist completed a home visit to educate participants and their caregivers	Robot-assisted & Computer-delivered	8 weeks	NR	Both treatment and control group showed improvements in depression scores, but treatment showed more improvements	88.2,83.3

			participant was asked to complete 3 hour of study-related interventions 5 days/week for 8 weeks total within a 12-week period, thus allowing for life events such as illness or vacation that may have prevented study completion							

Malmberg, 2017	Depression and Anxiety	HADS	Aural rehabilitation - The internet-based intervention programme is based on four elements: reading, home training, interaction with an audiologist and interaction with peers in an internet-based discussion forum. The reading element is divided into five modules, one module for each of the 5 weeks. The participants were instructed to read specific content each week based on the various	Reading activity with no assignment and no supervision	Direct responses were provided online by an audiologist	Web-delivered	4 weeks	6 months	Intervention group and the control group improved their total scores over time. No significant changes in follow up	89, 81

			chapters of the book. The weekly home assignments were accessible to facilitate an understanding of the contents of the book and the compendium. The weekly home assignments were handed in on the internet by the participants (weeks 1–5), and direct responses were provided online by an audiologist. Weeks 1–4 ended with quiz questions on the content of the past weeks' readings.							

Morimoto, 2020	Depression	MADRS	Cognitive training - Neuroplasticity-based computerized cognitive remediation (nCCR) for 4 weeks. Three "Bottom Up" training exercises were used: one low level auditory tone sweep, one phonemic discrimination task, and one low level visual discrimination training exercise. Two "Top Down" training exercises were used: "Catch the Ball" (individually titrated training in visual	Same audio-visual presentation, length, contact with study staff, engagement of participants' attention and learning, but not to target cognitive control functions specifically.	Access to the supervising psychologist and research assistants for questions. After the initial program set up, participants worked on their own without intervention	Computer-delivered	4 weeks	NR	Intervention improved both depressive symptoms and cognitive control deficits more than an active control condition	83, 83

			attention, inhibition of pre- potent responses, working memory, cognitive flexibility and dual task performance) and “Semantic Strategy” (rearranging multiple, increasingly complex word lists into categories with individually titrated decreases in allotted processing time)							

Morton, 2018	Depression and Anxiety	CES-D, GAI-SF	Social networking - The training group received a customized computer platform with a simplified touch-screen interface ("EasyPC") and any necessary broadband infrastructure (i.e., modem, cables, etc.) for social networking activities. Three qualified carers administered the training. The training schedule was manualized, and participants were also provided with a user manual	Care-as-usual	Administration of computer training by technologists	Computer-delivered	3 months	NR	Trainees experienced slightly better mental health than control participants. However, these effects were independent of time of measurement and therefore hard to attribute to the training.	83, 72

			to support their training, including homework tasks to consolidate learning in between sessions. Training was stepped-down across 3 months.							

O'Moore, 2018	Depression	PHQ-9, K-10, SF-12 MCS	iCBT - The iCBT Sadness Program consists of 6 online lessons representing best practice CBT, as well as regular homework assignments and access to supplementary resources. Each lesson comprises a cartoon narrative in which a character gains mastery over MDD symptoms by learning and implementing CBT skills. Patient queries throughout the program were primarily addressed by e-mail contact.	Treatment as usual	Email contact with researchers and therapists	Web-delivered	10 weeks	1 week, 3 months	The proportion of recovered patients in the iCBT group was significantly higher than control	NR

Rendon, 2012	Depression	GDS	Physical activity program – The program consists of 8-min cardiovascular warm up on a stationary bicycle and an 8-min cool-down. Each participant used three different balance games from the Wii Fit software package. Participants were instructed to follow the onscreen visual displays.	Care-as-usual	The intervention group was under supervision of a physical therapist and was pre-post tested by two additional physical therapists	Virtual Reality Gaming	6 weeks	NR	Both groups scored in the 'normal' classification of depression scoring by the GDS	80, 90

Smith, 2019	Depression	PHQ-9	Cognitive training - The participants were tasked to complete a traditional puzzle format on the monitor. Unlike a paper and pencil puzzle, the participants used the mouse and keyboard to enter their answers to the row and column clues.	Computerized crossword puzzles	Research assistants available on-site	Computer-delivered	6 weeks	5-8 weeks, 6 month, 12 month	Intervention significantly increased, rather than decreased, the burden of depressive symptoms among participants residing in assisted living	82,75

Sparrow, 2011	Depression	BDI-II	Physical activity program - This intervention is a telephone-Linked Computer-based Long-term Interactive Fitness Trainer (TLC-LIFT) system provides real-time guidance, meaning that the system provides instructions on what exercises to do and how to do them, guiding the participants through the exercises as they perform them in their homes. It is fully automated and administered	Received general health education	Researchers conducted periodic home visits in the first 3 months. The rest was fully automated	Telephone-linked computer-delivered	6 months	3, 6, and 12 month	Lower levels of depressive symptoms were observed in the intervention group than in control group	81,92

			by telephone in the participant's own home.							

Thoren, 2011	Depression and Anxiety	HADS	Rehabilitation program - online education program and forum for adult hearing aid users. The program includes a professional guidance by an audiologist	Referred to an online discussion forum without any audiologist contact.	Contact with audiologist	Web-delivered	5 weeks	6 month	The results showed that the participants in the intervention group showed reduced symptoms of depression and anxiety immediately and at the 6 months after the intervention.	83,80

Thoren, 2014	Depression and Anxiety	HADS	Rehabilitation program - A five-week online intervention program that included weekly assessments and interaction with an audiologist as well as with peers. The online intervention program included self-studies, training and professional coaching in hearing physiology, hearing aids, and communication strategies	Asked to read reading materials related to the history of hearing aids	Weekly assessments and interaction with an audiologist as well as with peers	Web-delivered	5 weeks	3 month	Significant improvements in the domain of psychosocial wellbeing were found at the follow-up	100, 100

Vloothuis, 2019	Depression and Anxiety	HADS	Physical activity program - an 8-week caregiver-mediated exercise program with e-health support after stroke in addition to usual care. Exercises were combined into a patient-tailored, progressive training regimen, related to the patient goals. Patient-caregiver couples were encouraged to contact the coordinating therapist using tele-rehabilitation services like telephone,	Care-as-usual	Caregiver-mediated, contact with researcher every week	Videoconferencing technology, web-delivered	8 weeks	8 week, 12 week	No significant improvements	100, 100

			video conferencing or email when appropriate in between the weekly exercise sessions. The patients and their care-givers were instructed to perform the selected set of exercises at least five times a week for 30 minutes. This meant that patients received 20 hours of caregiver-mediated exercises in addition to usual care during the 8-week intervention period.							

NR=not reported

3.3.3. Measurement

Twelve studies determined that the DMHI was beneficial in their primary psychological outcome variables (Egede et al., 2015; Morimoto et al., 2020; O'Moore et al., 2018; Sparrow et al., 2011; Linder et al., 2015; Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014; Dear et al., 2015; Lee et al., 2013; Ferraz et al., 2018; Kotov et al., 2020). Out of the 12 studies, one study investigated symptoms of anxiety (Dear et al., 2015), seven investigated symptoms of depression (Egede et al., 2015; Morimoto et al., 2020; O'Moore et al., 2018; Sparrow et al., 2011; Linder et al., 2015; Lee et al., 2013; Ferraz et al., 2018), and four investigated symptoms of both anxiety and depression (Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014; Kotov et al., 2020). The effectiveness of each study was not measured solely by the difference between intervention and control groups. Due to the novelty of the subject and the scarcity of RCT research that has been conducted, the measurement of effectiveness varies by the specific depression/anxiety scales used and by each study's research questions/objectives (Table 2).

3.3.4. iCBT

Three studies evaluated the use of iCBT amongst older adults. One study looked at the use of iCBT to treat older adults with Major Depressive Disorder (MDD) and used a control group that underwent in-person CBT (Egede et al., 2015). Egede et al. have found that the technology-based method resulted in outcomes similar to in-person delivery. Another study used a treatment-as-usual control group and found that 84.6% of the intervention group participants no longer met the criteria for MDD versus only 50% in the control group (O'Moore et al., 2018). The third study focused on online writing assignments in their iCBT program on veterans with Posttraumatic Stress Disorder (PTSD) (Knaevelsrud et al., 2017). They compared the intervention group against a waitlist control group and found no significant improvement of BSI-18 scores after the follow-up. However, the participants stated that the visual anonymity provided by iCBT allowed them to talk about their mental health concerns freely (Knaevelsrud et al., 2017). These results have determined that iCBT treatments can provide the same information and teach the same skills as traditional face-to-face CBT for participants without mental health multimorbidity (Egede et al., 2015; O'Moore et al., 2018).

3.3.5. Online Courses and Computer Lessons

Two studies looked at or created online courses for older adults[33, 34]. One study provided a course that focused on managing stress and anxiety and used an active control group (received the course in a self-guided format)[33]. Their analysis indicated greater proportions of reliable improvement and recovery on the GAD-7 and the PHQ-9 in the treatment group than in the control group[33]. Another study administered a customized computer platform with a simplified touch-screen interface and accompanying broadband infrastructures to older adults with sufficient cognitive ability to engage in computer training[34]. They found that participants in the intervention group (trained for the social network) experienced slightly better mental health than the care-as-usual control participants[34].

The social media training also yielded positive changes in depression and anxiety scales. However, the authors determined that the change in depression and anxiety scales were contributed from other variables (such as the participants' competence with technology and previous social networking activity) and, therefore, hard to attribute to the training[34].

3.3.6. Physical Activity Interventions

Six studies looked at using physical activity interventions to alleviate depressive and/or anxiety symptoms. Two studies (Rendon et al., 2012; Ferraz et al., 2018) used video game consoles as means to deliver their physical activity interventions. Two physical activity interventions were delivered via robot assistance (Linder et al., 2015; Kotov, Isakova, & Sheregeshev, 2020), and another two were computer-delivered (Sparrow et al., 2011; Vloothuis et al., 2019). The control groups included active control groups and waitlist control groups. Five out of the six physical activity DMHI studies found that intervention groups showed improvement in depressive symptoms and only slight differences were found between treatment and active control groups (Sparrow et al., 2011; Linder et al., 2015; Vloothuis et al., 2019; Ferraz et al., 2018; Kotov, Isakova, & Sheregeshev, 2020). These results indicate that physical activity can alleviate depressive and anxiety symptoms. However, delivering these programs via gaming consoles, robots, and computers does not yield better psychological outcomes than face-to-face/in-person physical activities (Linder et al., 2015; Ferraz et al., 2018; Kotov,

Isakova, & Sheregeshev, 2020). One unsuccessful DMHI utilized VR hardware to deliver a physical activity intervention to their participants (Rendon et al., 2012). They found that there were safety concerns that their participants expressed due to the novelty of the device and lack of supervision during the intervention.

3.3.7. Online Cognitive Training

Three studies looked at alleviating depressive and/or anxiety symptoms as outcomes of digitally-delivered cognitive training activities (Morimoto et al., 2020; Smith et al., 2019; Lee et al., 2013). Two studies used an online Speed of Processing Training (SOPT) program on two different populations of older adults (Smith et al., 2019; Lee at al., 2013). Lee et al. examined the effects of SOPT on early Alzheimer's Disease patients. Their findings indicated that GDS showed statistically significant improvements in participants who received computer-delivered and therapist-delivered cognitive training compared to those in the waitlist group (Lee et al., 2013). Smith et al. investigated the effects of SOPT in depressive symptoms among older adults who lived in supported senior living settings (Smith et al., 2019). Their results differ from the study by Lee et al., finding that the program significantly increased, rather than decreased, the burden of depressive symptoms among participants residing in assisted living.

A study conducted by Morimoto et al. looked at a different cognitive training DMHI, recognized as a neuroplasticity-based computerized cognitive remediation (nCCR), designed to target the cognitive control functions of older adults with late-life depression (Morimoto et al., 2020). They used an active control group matched for the duration, engagement, reward, computer presentation, and contact with study staff. Morimoto's results showed that nCCR induced remission in an additional 58% of participants versus 8% in the control condition (Morimoto et al., 2020).

3.3.8. Rehabilitation Programs

Three studies included in this review explored digitally-delivered rehabilitation programs (Malmberg et al., 2017; Thoren et al., 2014) and support through online forums (Thoren et al., 2011). The studies suggest that a combination of online professionals, supervised education, and informal online discussions could be a

promising rehabilitation tool (Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014). Additionally, Thoren et al. established that telerehabilitation and online support groups may yield positive results in alleviating symptoms of anxiety and depression and psychosocial wellbeing (Thoren et al., 2011).

3.3.9. Risk of Bias

The risk of bias assessment of the included studies is summarized in Table 3. While all studies were not characterized by significant missing data and implemented depression/anxiety score measurements, blinding for most of the studies was not possible or reported. In addition, many of the studies had significant drop-out rates, which contributed to much of the missing data. Three of the 17 (17.6%) included studies were deemed to be at high-risk of bias, and seven of the 17 (41%) included studies were deemed to be at some risk of bias.

Table 3.3. Risk of Bias of included studies in the systematic review.

First Author, year	Randomization process	Deviations from intended intervention	Missing outcome data	Measurement of the outcome	Selection of reported result	Overall
Dear, 2015	+	+	+	+	+	+
Egede, 2015	+	+	+	+	+	+
Ferraz, 2018	-	+	?	+	+	-
Knaevelsrud, 2017	+	+	?	?	+	?
Kotov, 2020	?	+	+	+	+	?
Lee, 2013	-	+	+	+	+	-

Linder, 2015	?	+	+	?	+	?
Malmberg, 2017	+	+	+	+	+	+
Morimoto, 2020	+	+	+	+	+	+
Morton, 2018	+	+	?	+	+	?
O'Moore, 2018	-	+	+	?	+	-
Rendon, 2012	?	+	?	+	+	?
Smith, 2019	+	+	+	+	+	+
Sparrow, 2011	?	+	+	?	+	?
Thoren, 2011	+	+	+	+	+	+
Thoren, 2014	+	+	+	+	+	+
Vloothuis, 2019	?	+	+	+	+	?

Grading system: +=high rish of bias; ?=unclear risk of bias; -=low risk of bias

3.4. Discussion

3.4.1. Principal Findings

This systematic review aims to collate all existing literature on DMHIs for the older adult population. Many DMHIs are neglectful of the mental health needs of the older adult population in the digital age (Pywell et al., 2020). It is essential to understand the types of technology-based interventions that have been introduced and their effectiveness in the older population in order to design future interventions that are user-friendly, practical, effective, and meet their mental health needs.

3.4.2. Successful DMHI

Novice-Friendly

In this review, we found that interventions involving learning or attending a course have done well with the older adult population who do not have severe mental health diagnoses (Dear et al., 2015; Morton et al., 2018). In existing literature, learning activities have been identified as successful because the participants do not have to rely on their existing knowledge of technology to participate in the intervention. This may have lessened the burden or the expectation to “perform” well in these studies (Fisk et al., 2020). Additionally, successful interventions have utilized simpler technologies as a means of delivery, such as a computer or tablet (Egede et al., 2015; Dear et al., 2015; Lee et al., 2013), instead of using more advanced hardware like virtual reality headsets (Rendon et al. 2012). This important aspect of DMHI can be said to be unique to the older adult population as this population has been known to have generally lower digital literacy and higher computer anxiety than the younger population (Oh et al., 2021). A previous systematic review that talks about barriers and facilitators of DMHI has stated that a participant’s digital health literacy influences the extent to which they are able to adapt and engage with DMHIs (Borghouts et al., 2021). A population with low levels of digital literacy therefore requires novice-friendly interventions.

Social Interaction

A critical implication was whether a DMHI facilitated social connectedness and enabled the user to interact with other people. Social support through social networks not only increases engagement but may also have a positive effect on depressive and anxiety symptoms (Domènech-Abella et al., 2019). However, in the studies included in this review, social interactions were not included as a part of the interventions and its impact on depression/anxiety symptoms were not discussed. Nevertheless, from the results, we have found that DMHIs with social components tend to show clear improvements in mental health outcomes. For example, one study assessed participants who were part of a physical activity program where they were given the option to complete some of the activities in a group setting. Those who were part of the group activity fostered greater social interaction, resulting in clear improvements in mental health (Kotov et al., 2020). However, it must be noted that the mental health outcomes

were not exclusively the results of the social components of the intervention. It has been known that the effect that an intervention had on participants' sense of social connectedness (e.g. being able to connect to peers, having regular contact with a personal therapist) was found to facilitate user engagement (Domènech-Abella et al., 2019) This aspect of successful DMHI is not unique to older adult users.

Presence of support

All successful DMHIs have provided their participants with in-person supports at the very least in the initial moments of DMHI administration. There were five types of support provided to the participants during interventions: the presence of a therapist, a health professional (including physicians and nurses), researchers or research assistants, a physical activity coach, or a combination of supports. We could not determine the difference between each type of support provided to the participants and whether they influence the mental health outcomes of the DMHI. One iCBT study included in this review claimed iCBT can only be impactful for alleviating depressive/anxiety symptoms solely when therapists are present (and not delivered in a self-guided format) (Egede et al., 2015). Another study that looked at an online rehabilitation program has found that the intervention was only successful in the treatment group that had direct support from a medical professional. The group who had to do it in a self-guided format showed no psychological improvements (Thoren et al., 2011). Previous studies of completely self-guided DMHIs Have found that users of any age had difficulty engaging with the DMHI and, at times, neglected to use the intervention completely (Harjumaa et al., 2015; Donkin & Glozier, 2012) Additionally, a systematic review of unguided DMHI has found that trial settings have a large impact on user engagement with unguided interventions and, consequently, on the generalizability of the findings to the real world (Baumel, Edan, & Kane, 2019).

Tailored to Participants' Needs

Many of the successful DMHIs included in this review have targeted populations or groups of older adults that share a specific malady. Therefore, the interventions themselves have been designed to alleviate a common problem that their target population shares. For example, some studies looked at using technologies to deliver rehabilitation programs for older adults with hearing impairments, including programs to

improve hearing and hearing-related issues (Malmberg et al., 2017; Thoren et al., 2011; Thoren et al., 2014). Others examined DMHIs for stroke survivors (Linder et al., 2015; Kotov et al., 2020), older adults with Parkinson's Disease (Ferraz et al., 2018), and individuals with MDD (Egede et al., 2015). Ultimately, each intervention was tailored to a specific problem that participants shared due to their disability/disease. This could mean that creating specific and tailored interventions with clear objectives/outcomes is key to its success.

3.4.3. Interventions with Limited Mental Health Outcomes

We have found four studies where the DMHI was not associated with reductions in depression and/or anxiety symptoms (Rendon et al., 2012; Smith et al., 2019; Knaevelsrud et al., 2017; Vloothuis et al., 2019), and one study that was inconclusive (Morton et al., 2018). The unsuccessful DMHIs share a common aspect in the fact that they include components that are difficult to understand or to use. Unsuccessful DMHIs can involve tasks that are overly challenging to complete, whether it be physically or cognitively. One study that examined a physical activity intervention stated that the participants could not complete the entire exercise routine without the use of assistive devices (Rendon et al., 2012). This caused some concerns about potential injuries that may occur due to the lack of supervision for the DMHI (Rendon et al., 2012). Another study found that their intervention exacerbated the depressive and anxiety symptoms of their participants due to the excessive mental difficulty of the task that was introduced (Smith et al., 2019). Some studies have also found that their sample populations require more advanced mental health care due to their existing mental illnesses (Morton et al., 2018; Knaevelsrud et al., 2017). This could mean that DMHIs can be successful only to alleviate minor depressive/anxiety symptoms or those in the lower end of major disorders. In other words, severe mental health concerns may need to involve direct contact and care from mental health professionals, a service that current DMHI cannot yet provide.

Additionally, from the included studies on cognitive training, we can determine that the effects of SOPT differ for various populations of older adults (Smith et al., 2019; Lee et al., 2013). Moreover, nCCR has been proven to be effective to induce remission in older adults who suffer from late-life depression (Morimoto et al., 2020), but no evidence on populations without a diagnosis of depression or those with psychological

multimorbidity. These results therefore indicate that there are too many variables to consider on cognitive training DMHIs to conclude its effectiveness.

3.4.4. Limitations

Due to the novelty of the topic of DMHI in the older adult population, we were only able to include 17 studies in this review, two of which being pilot studies. We were not able to conduct a meta-analysis due to the heterogeneity of the population, measures, and results of the papers included. Additionally, all the studies included in this review did not have qualitative components, which prevents the ability to analyse the fundamental aspects that has made each intervention successful or unsuccessful from the perspectives of the end-users. Scholars have critiqued that RCT research has ignored the full advantage of the insights that might be gained through the inclusion of interpretive qualitative approaches because they tend to undervalue and underuse interpretive approaches in practice (Giddings, 2006).

Future RCT studies looking at DMHI with the older populations should consider the following methodological recommendations: (a) having a healthy control group and an intervention group with clinical diagnoses of mental illness, (b) collecting data on the support given throughout the duration of the interventions, (c) obtaining qualitative and quantitative data to measure the success of the interventions (i.e. mental health questionnaires, post-intervention interviews), as well as (d) conducting follow-up interviews and surveys up to one year post-intervention to determine the long-term outcome of the DMHI.

Bias primarily emerged due to unreported blinding during the RCT as well as the selection of reported results. DMHI research on older adults is especially difficult to interpret because of the number of variables that need to be considered during data analysis. Furthermore, a meta-analysis was not possible due to the heterogeneity of existing research on DMHI, including the types of interventions, data analysis methods, variations in control groups, and different measurements of depression/anxiety symptoms. Our results further confirm that a substantial amount of research needs to be done on this topic to make DMHI a reality for the older population.

3.5. Conclusion and Future Directions

Digital mental health research is still in its infancy. There is yet to be a regulated gold-standard design of successful DMHI for the older adult population. Despite the apparent potential of digital technology supporting mental health, insufficient evidence suggests that this potential is not being fully realised, with uptake being limited and outcomes being largely anecdotal and unpublished. The results of recent DMHI literature suggest that: 1) end-users and the population of interest are at the center of DMHI creation and design; 2) DMHIs need to be malleable and able adapt to different life circumstances, education level, and physical and psychological abilities of the population, and 3) DMHI creation must be accompanied by (human) support available for all users.

Chapter 4.

Factors contributing to the mental wellbeing of community-dwelling older adults

4.1. Introduction

Most Global North countries, including Canada, are experiencing population aging triggered by low fertility rates and rising life expectancy (Statistics Canada, 2022). Recent data from Statistics Canada found that In 2021, the number of persons aged 65 and older rose to 7 million, an 18.3% increase from the population in 2016. In 2021, the 65+ population represents almost 1 in 5 Canadians (Statistics Canada, 2022).

Late-life mental health concerns are often overshadowed by physical health in older populations. However, mental health challenges are commonly experienced in older adult populations, with estimates suggesting that depression is more common than dementia in later life (Allan, Valkanova, & Ebmeier, 2014). Late-life mental illness has been associated with impaired independent and community-based functioning, impaired cognition, poor medical and health outcomes, increased comorbidity, compromised quality of life, and increased rates of disability and mortality (Laborde-Lahoz et al., 2015). Poor mental health among older adults has also been correlated with increased rates of health care utilization, placement in long-term care homes, burden on medical care providers, and higher annual health care costs (Aschbrenner et al., 2011; Zivin, Wharton, & Rostant, 2013). Despite the high prevalence of late-life mental health concerns and evidence for the efficacy of interventions to ameliorate these concerns, poor mental health is underrecognized and undertreated in this population. Older adults are prone to vastly under-report mental health disorders (Lyness et al., 1995) and are less likely to be referred to mental health practitioners than the younger population (Pettit et al., 2017). Additionally, older adults are unlikely to use traditional clinic-based mental health services for a variety of reasons, including physical frailty, transportation difficulties, isolation, and stigma (Stewart, Jameson, & Curtin, 2015). Finally, the presence of mental health challenges in older adults is associated with increased health care costs, even after accounting for mental health-specific treatment costs (Unützer et al., 2009).

Because poor mental health in the older adult population is under-recognised, it is important to use a community-based approach to understand the factors that impact the perceived mental health of older adults to support the investigation of crucial mental health resources and services that this population needs. Perceived mental health is a subjective measure of overall mental health status and does not directly correspond with diagnosed mental disorders, which is important and immensely affects quality of life (Mawani & Gilmour, 2010).

Additionally, we sought to understand the mental health priorities of community-dwelling older adults (CDOA), namely, how they define good mental health and how community-based services can support the mental wellbeing of this population. It is limiting to assume that all members of the older adult population share the exact same needs and require the same standardized mental health services. Canada has a diverse older population with substantial variation in terms of age, gender, culture, religion, language, socio-economic status, and sexual orientation (Statistics Canada, 2021). An expanded understanding of this field is necessary if the health system is to effectively serve the diverse aging Canadian population. As there is currently a paucity of mental health research on diverse CDOA (Garrido et al., 2009), this investigation aims to fill a gap in the literature and guide future community-based mental health interventions or services.

4.2. Methods

In-depth semi-structured interviews were used to understand the participants' mental health priorities. The interviews explored four main topics: (a) perceived (self-reported) mental health, (b) contributors to good mental health, (c) access to mental health services, and (d) digital mental healthcare delivery. The interview guide included questions such as "what are some of the mental health services that you have used?", "what are the barriers or difficulties you face when accessing mental health services", "in your life, what has been the biggest contributor to your mental health (positive/negative)?", and "describe your mental health in the past month".

The semi-structured interview process was chosen to encourage the interviewees to openly discuss their own feelings and experiences of mental health while maintaining some structure to the interviews. Semi-structured interviews are neither free

conversations nor highly structured questionnaires (Galetta, 2013). This approach allows researchers to regulate the order of the questions to match the flow of the conversation and enables respondents to expand their ideas and speak in detail rather than relying only on pre-defined concepts and questions. This is especially important when speaking about stigmatised and difficult topics, such as mental health, as the participants will have control over the flow of the conversation (Magaldi & Berler, 2020). Additionally, in-depth semi-structured interviews are inclusive in allowing participants with low levels of literacy to participate, as completing surveys or questionnaires may be difficult (Guion et al., 2011). Qualitative methods have recently gained recognition for its ability to offer further understanding of under-represented populations' mental health experience compared to only using quantitative methods (Palinkas et al., 2015). Marginalized populations, such as ethnic minorities and Lebian, Gay, Bisexual, Transgender, and Queer (LGBTQ+) older adults can express their mental health experiences and share the adversities that they have faced fully and without the limitation of a selection of pre-determined answers (Lu & Gatua, 2014).

4.2.1. Recruitment

Older adults from the Downtown West End (DTWE) of Vancouver were recruited to participate in semi-structured interviews to understand the beliefs, experiences, attitudes, and underlying feelings about mental health of CDOA. We received support from a local senior-serving not-for-profit organisation in the DTWE. A column in the agency's newsletter was purchased to disseminate the recruitment poster. The staff also aided with the recruitment strategies by informing members of the study. The DTWE senior population is highly diverse, with various sub-populations that experience marginalization and discrimination due to their race, ethnicity, socio-economic status, and gender/sexual orientation (Frank et al., 2010, p. 8). We therefore focused on these sub-populations during recruitment by informing the senior center staff to spread the word of the study to our target population. The inclusion criteria for recruitment included: older adults over the age of 65, living in the DTWE at the time of recruitment, living in the community (i.e., not an assisted living facility or other care homes), able to speak and understand English, and able to understand and consent to this study.

4.2.2. Data Collection

A semi-structured interview guide was used for the interviews. This guide was developed by three of the authors (IR, LK, and SD) to understand and capture the unique factors that impact the mental health of CDOA. All the interviews were conducted by one researcher (IR) and the questions asked were open-ended and designed to encourage participants to provide rich descriptive data. The data collection was conducted in October and November of 2022. Interviews were no longer than 60-minutes and were conducted through the interviewee's preferred video-communication platform (e.g.., Zoom) (N=12), or in-person (N=3) following COVID-19 social distancing protocols. Interviews were audio-recorded, and memos of participant information and any non-verbal cues that emerged during the interviews were created. Honoraria of $25 in the form of a gift-card were provided for participants.

4.2.3. Analysis

Following Braun, Clarke, & Hayfield's (2015) approach to thematic analysis, we began with transcription of the interview recordings and performing line-by-line coding using NVivo 12, a data analysis software. Notes were created for each interview by the researcher to keep track of the basic characteristics of each participant and any relevant field notes, aiding with the creation of initial codes. The initial codes were then read, reread, and organized into higher order codes. The higher order codes, along with relevant quotes from the transcript, were migrated into a Microsoft Excel sheet where themes were developed. Exemplar quotes were reviewed by three authors (IR, LK, and SD) to ensure consensus on the content and nature of the themes. IR has been an active member of the DTWE community and was able to provide unique and personal input on the analysis and interpretation of the data.

4.3. Findings

The participant sample consisted of 15 CDOA over the age of 65 who volunteered to participate after reading the study description and consent form. CDOA were initially recruited through our community partner, a senior-serving non-profit organisation in the DTWE. Seven of the 15 older adults recruited identified themselves as members of the LGBTQ+ community and the majority (10 out of 15 participants) are

ethnic minority older adults. The characteristics of the study participants are presented in Table 1.

Demographic Factors	Category	Number of participants	Percent
Age	65-70	7	46.6
	71-75	5	33.3
	76-80	2	13.3
	80+	1	6.6
Gender	Male	5	33.3
	Female	10	66.6
Household Status	Living alone	14	93.3
	Living with other family members	1	6.6
Highest Education Attainment	Grade School	1	6.6
	High School	4	26.6
	College diploma	4	26.6
	Undergraduate	3	20
	Master's	2	13.3
	Doctorate	1	6.6
Identify as low-income*	Yes	12	80
	No	3	20
Ethnicity	Caucasian	5	33.3

	South Asian	3	20
	East/Southeast Asian	4	26.6
	Persian	3	20
Identify as LGBTQ+	Yes	7	46.6
	No	8	53.3

Table 4.1. Demographic table of participants
LICO cutoff <$26,620/year Based on poverty line in urban areas of Canada, with a population of 500,000 or more

Based on our thematic analysis, four themes were derived from the interview data demonstrating the factors that most significantly impact the mental wellbeing of CDOA in the Downtown West End of Vancouver. These include:

1. Sense of stability over personal circumstances
2. Having the ability to do
3. Creating a positive impact on other peoples' lives
4. Feeling a sense of belonging

4.3.1. Sense of stability

All participants expressed that, as they age, their mental health has been affected because they feel that they are losing control over their life at an old age, an age where they are supposed to feel the most stable. This includes control over their bodies, their judgements, their time, and their independence. One participant (F, 78) referred to "stability" as being "in control, even when everything is spiraling down". The two senses of stability that participants mentioned most often were financial and relationship stability.

Financial stability was mentioned by majority of the participants as an important factor that impacts their mental wellbeing. Many of the participants who reside in the DTWE are low-income older adults. A lack of financial security was identified as a factor that participants felt contributed to having a good quality of life, including having access to healthy diets, proper housing, transportation, and adequate health services (i.e., dental, vision, and mental health services). One participant (M, 67) said:

> Every now and then, I can certainly feel that I should be saving [money] and that I should have saved. I certainly worry about money more than most seniors, and this really gives me anxiety. I'd like to see some counseling services provided for free or for low cost to those seniors who can't afford it. Because mental health is just as important as physical health, and seniors have made an enormous contribution to our society. They deserve the respect and consideration and help if they need it.

Participants identified that factors impacting one's sense of stability also included relationship stability (the ability to rely on others). Many of the participants find comfort and unwavering support in a good network of family or friends as they age, as well as the routine that they have built, such as one participant (F, 74) who said:

> I have very good friends who are around my age and who live near me. So, and we've all – I wouldn't call it a family relationship, but we're very good friends, and we're there to support and help each other and just to [have] social action, just to get together for a drink every week. It makes me look forward to it.

On the contrary, social isolation — especially during and after the COVID-19 pandemic, where social restrictions have prevented people from communicating face-to-face — had a detrimental effect on the mental health of CDOA. One participant (F, 72) mentioned the fear and anxiety that they experience living in isolation:

> I fear of something happening to me and having no one around. Like, my husband was sick for several years and then I took care of him until he passed. And… but now, there's nobody for me.

Additionally, when the COVID-19 pandemic occurred, many older adults found difficulties with maintaining their interpersonal relationships. This is especially true with those who had limited access to technology. One participant (M, 82) explained the difficulties with activity continuation using technology:

> I used to go down to [a community center] for a physical meeting with my choir. It's sort of a seniors' choir and songwriting class. Since the pandemic, it's all virtual and online, so we're doing zoom meetings, but

> there's always some kind of technical issues with some people or me not being able to join or start the video… And I had troubles, because I had a really old computer and then I had to buy a new computer.

4.3.2. Having the ability to "do"

Many participants mentioned that dealing with their ongoing health issues and experiencing physical decline has been the most significant barrier to performing hobbies and activities that they used to do, which in turn negatively impacts their mental wellbeing. One participant (F, 70) explained:

> When you're aging, you're dealing with more health issues. For example, I suffer from high blood pressure, so I take high blood pressure pills. I also suffer from osteoporosis, so I take medication for that. You know, you're finding that you can't really do some of the things that you used to do in your youth. You can't walk as far without feeling some pain. You know, your mental facilities, although I try to keep myself as engaged as possible, your mental facilities sort of declined.

"Doing" is more than just participating in current activities, it is also about the loss of one's ability to do an activity and finding joy in compensating. With declining physical health, some have taken an interest in less physically involved activities. Many older adults have gained newfound enjoyment in art-based activities such as music or painting, hobbies that were not in their repertoire in their younger days. One older adult (F, 73) took up a new activity and reported:

> When I retired when I was 71, I took up singing lessons. I had never sung in choirs, but I decided – I'd never done singing lessons, so now I'm taking singing lessons, and they bring me huge joy, I have to say, I get to sing whatever I want! So, right now, I'm singing Bach, who could believe that? I can do whatever.

However, for participants who feel that they are still physically able and active, often their biggest barrier to pursuing activities is their safety. As racially-motivated crimes in the DTWE have increased after the COVID-19 pandemic, particularly towards the Asian/Pacific Islander population in Canada, some participants found that their daily walks around the neighbourhood, which once brought them joy, have become burdensome. Two Asian-Canadian participants (F, 68; F, 68) said:

> I was attacked by a white man, about a month ago. I was taking a photo of a tree and then I turned to take a selfie, and I heard a man's voice saying, "hey, I want to ask you a question!". And I knew, with the tone and the loudness of where it was coming from, behind me, I knew that

> something bad was going to happen, but I had to look to see who it was. I turned around and that's when he just, boom! Pushed me to the ground.
>
> Someone said to me: "you know, it's Kung flu!" and blaming [COVID-19] on China, you know, and those people think that way. a lot of times, like a LOT of times, I even forgot that I was Asian, until I got attacked. Then I [remember] oh yeah! I have to be careful now, you know, because I look Asian to people. But in my mind, I'm Canadian. I love going for a walk, I walk around the Seawall, walk around Stanley Park, and usually, I would go by myself. But now, after the attack, it's… different.

4.3.3. Creating a positive impact on other peoples' lives

Helping others has allowed members in the community to feel empowered. For participants with the skills and capacity to volunteer, it was said that it is "one of the greatest gifts that I can leave behind for the community." The idea of changing other peoples' lives for the better has been reported by one participant (F, 71) as a major contributor to her mental health:

> I work as a volunteer peer support person. So, I have four clients right now and I talk to them once a week or more than once a week. One of them I'm going to start with Zoom next week. So, it keeps me in contact with other people, how are they doing. I'd like to think I contribute somewhat to their mental health, their good mental health, so that in turn helps with mine.

Teaching is one of the many ways that some of the participants can positively contribute to the community. One participant (M, 67) mentioned that teaching gave him a "sense of purpose" and positively impacted their mental wellbeing.

> I still contribute to my community in whatever way I can. I teach yoga because that gives me a great deal of pleasure. I also have education, which is not a professional degree but a diploma. At some point, when I got more out of my shell, I found that I really liked to teach. I like to help people turn their light bulbs on and partially that was because I learned so much, I learned more than my students ever learned.

4.3.4. Feeling a sense of belonging

As many of the older adult residents of the DTWE belong to under-represented groups, the feeling of belonging to and acceptance within their community has been a life-long objective. LGBTQ+ participants specifically spoke about breaking away from

social labels, which allowed them to live authentically, start thinking of their own goals in life, and do what makes them happy. One participant (M, 67) stated:

> Part about mental health, I think, was the fact that we were encouraged to be who you are. One can be a doctor, the other can be a cashier in a grocery store, and both can be happy, and neither is elevated, and I think having the opportunity to challenge that within yourself is part of the ongoing condition of mental health.

Breaking away from stereotypes can feel uncomfortable, but it begins the path to self-acceptance. Part of feeling a sense of belonging is accepting oneself and creating a sense of purpose. As one participant (M, 70) described:

> Satisfaction with yourself, and I don't mean a self-satisfied image, I mean a true acceptance of who you are and what you've done is everything. And I suppose there's also a component there that you still have a place in the world. A very big one, that what you can do could still matter in the world.

Aside from self-acceptance and individuality, most participants mentioned that feeling a sense of belonging ultimately stems from being part of a community. Whether it is a spiritual or religious community, communities based on identity (e.g. queer communities, communities based on ethnic backgrounds), or geographical-based community such as the DTWE, they ultimately allow people to feel like they belong. One participant (F, 74) stated:

> "I'm on the board of a community of an organization that's just reinventing itself. And I've been part of it for five years, it's trying to have an impact on the condition of LGBT seniors in Vancouver. I feel like it's where I'm supposed to be, considering my own identity and what I have been through."

To further this point, another participant (F, 68) explained that belonging to an online community allowed them to gain support and initiate conversations around the hate crimes, which helps them cope and not feel alone in dealing with a traumatic experience:

> I've joined an Asian-Canadian Writers [Facebook] Group and I started to post things about Asian hate crime rising, because I've seen things on the news. And so, no sooner after I posted something like that, other people were talking about it in the group. So, it had so many responses from people I don't even know, and all supporting me! So, it does help.

4.4. Discussion

This study identifies key factors in the lives of CDOA that improve or worsen their mental wellbeing. These factors highlight actionable items for community-based senior-serving organisations to improve the mental wellbeing of members of their community.

Previous studies have examined the mental health needs of older adults who live outside of the community (i.e., in assisted living facilities and in long-term care homes) as they adapted their everyday health behaviors during the COVID-19 pandemic (Bhome et al., 2021; Vahia, Jeste, & Reynolds, 2020). One study that focused on CDOA recommended that increasing social contact and engaging in adaptive coping behaviors were the two most prevalent needs of the population (Scott, Yun, & Qualls, 2021). This supports our findings in the need of the population for more active engagement in the community, as well as individualised coping strategies such as volunteerism and participation in hobbies. The themes identified in this study can add insight into the needs of diverse CDOA, a population that is under-represented in the field of gerontology and mental health research.

Having a sense of stability, including financial stability, was one of the major points discussed by all participants, as many older adults who live independently in the west end community are low-income. The topic of money was not part of the interview guide, but participants were quick to speak on their financial situation when asked about the biggest contributor to their mental health as an older adult. In the ethnically diverse neighbourhood of DTWE, lack of financial stability has caused CDOA to worry about housing, food, and preventative medical treatments (such as dental, vision, and mental health services). Consistent with our results, previous studies have shown that stress over money is the main cause of mental illness in ethnically diverse neighbourhoods due to lower education and generational poverty that are prevalent in racialised communities (Jimenez et al., 2012).

CDOA in the DTWE have always relied on activities in the neighbourhood to fulfill their social and physical needs. DTWE falls in the “Sweet-spot” neighbourhood (relatively high walkability/low environmental pollution) of Metro Vancouver, which attracted many older adults to age in place in this community (Frank et al., 2010, p. 8). Walking to the grocery store, bank, and community centre for seniors’ activities have always been achievable by those who are not homebound. However, the COVID-19

pandemic has halted many activities and events that older adults usually attend (Lebrasseur et al., 2021). In a population who rely on mostly in-person community events to create and maintain social relationships and perform physical activities, the circumstances of the COVID-19 pandemic were debilitating. The pandemic has also affected the community members' feeling of belonging as it hindered face-to-face communication, which distanced community members from one another. This was especially difficult for marginalised members of the community as the pandemic restrictions prevented cultural-based or LGBTQ-based activities that foster feelings of belonging. This study highlights those with marginalized intersections of identities, including those within gender and ethnic minorities, found that having a sense of belonging, specifically having chosen families, is one of the main factors that contribute to good mental health. The shared adversity and feelings of "otherness" that many marginalized groups face, lead to feelings of isolation and loneliness (Shankar et al., 2017). Participants have mentioned that being with others who can relate to their stories and treat them with kindness is ultimately the main factor that can alleviate their isolation and improve their mental health.

Based on the results, senior-serving organisations should incorporate programs and services that foster stability (independence), leisure, positive actions, and social connectedness. Programs such as social prescribing, an initiative that enables healthcare providers to refer community members to community and social services (Drinkwater, Wildman, & Moffatt, 2019), volunteering opportunities, artistic clubs, language classes already exist in-person and have been shown to have had a positive impact on older adults' mental health. However, one major area of improvements that still needs to be done is in the area of digitally-delivered programs and digital literacy. With the COVID-19 pandemic and lack of access to mental health services for CDOA, there is a push towards the creation and popularisation of digital-based mental health services and interventions (Cosco et al., 2021). The four themes identified in this study can be used as a framework to create a digital curriculum that can allow older adults to tackle these factors that impact their mental wellbeing using technology. This can particularly be useful for homebound or isolated older adults who may not have the opportunities to attend existing in-person social programs or services.

Additionally, the themes identified in this study can be used by senior-serving organisations to see the shortage of important services within their neighbourhood or

organisations. For example, this study has highlighted the importance of financial stability on the feeling of independence and the mental wellbeing of CDOA. Therefore, there is a need for a financial education program for older adults or leisure activities that are free of charge within communities.

4.4.1. Limitations

The findings of this study must, however, be interpreted within the context of its limitations. Firstly, the overall demographic profile of older adults in the DTWE is not known. Purposeful sampling was done by IR, who is an active member of the DTWE community and a volunteer at the senior serving organisation located in the neighbourhood. The purposeful sampling of LGBTQ+ and ethnic minority older adults was based on the demographic of the active members in the senior organisation and may not accurately represent the demographics of the neighbourhood.

Additionally, as the study was conducted during the height of the COVID-19 pandemic, the researchers were unable to conduct interviews within the homes of older adults, which may have caused us to miss important cues and information stemming from interacting with this population within their personal environment. Further, as recruitment was completed through physical posters within the community organization and through social media, our study is unable to account for the experiences of homebound older adults who do not use technology.

Finally, the topic of mental health can be quite sensitive, particularly within the older adult population. Confidentiality was emphasized when speaking to the participants. However, some individuals may still have felt uncomfortable speaking about their personal struggles with mental health and well-being due to the sentiment that it is a private matter. For some participants, especially those who are of Asian descent, mental health was generally viewed as having a successful life (career, family, finances), and they may have been brought up in life with that mentality (Kudva et al., 2020). Due to the interviewer's positionality as an Asian woman, these participants may have had difficulty speaking openly about any distress they were experiencing because it may be embarrassing to "admit failure." In contrast, Gill and Maclean (2002) suggested that when the researcher and participant are of same gender and culture, the communication can be more genuine as there is a mutual aspect of gender and culture, which leads to

more accurate data. There is therefore a possibility that participants outside of the interviewer's gender and culture may have withheld vulnerable values and information regarding the topic of mental health.

4.5. Conclusion and Future Directions

Our study has pinpointed strengths and limitations with using a community-based approach, specifically in using semi-structured interviews to discuss mental health with marginalised populations. Future research on this topic should consider the positionality of the interviewers when conducting semi-structured interviews with community members. Additionally, interviews regarding this topic should be conducted in-person whenever possible to capture any non-verbal cues. In-person interviews are also important to make the opportunity to speak about this topic more accessible to those without access to technology and those who are homebound.

This study has expanded the conversation on late-life mental health and pinpointed important factors that contribute to the mental health of diverse older adults. We found four overarching themes that contribute to the mental wellbeing of CDOA: 1) Having a sense of stability over personal circumstances, 2) being able to do, 3) positively impacting others, and 4) feeling a sense of belonging. The themes that were captured in this study can allow community-based and health organisations to build interventions or services that target the mental health concerns of diverse CDOA in Canada and beyond.

Chapter 5.

Towards Digital Equity for Community-Dwelling Older Adults: Creating Inclusive Community-Based Digital Learning Programs

5.1. Introduction

With population ageing, there is a push towards the creation of digital health services and interventions for the older adult population. Many digital services are inaccessible for older adults because of the baseline requirements to operate and use devices, navigating the internet, and other basic skills that many older adults do not have. There is a need to ensure that all members of the population have the baseline skills to utilise digital services.

Canada is experiencing an increase of the older adult population, driven by declining birth rates and increased life expectancy (Statistics Canada, 2022). The baby-boomer generation began to turn 65 in 2011. However, the most significant negative effects on social and health care services were generally not expected until this generation began to turn 75 in 2021, an age where the gradient of dependency on age-related social and health services increases dramatically (CIHI, 2021). With this rise in demand, effective policy and planning are needed to address these challenges and determine ways to improve the social and health care system.

In the past decade, and particularly since the COVID-19 pandemic, technology, including internet access, wearable devices, and personal health monitoring equipments, has become a way to alleviate the burden of healthcare and community-based service delivery. It was the hope that technology can be used to enable the streamlining of participation, data collection, and transcends the barriers of distance, all in all, a step forward towards health equity (Cosco et al., 2021; Horst et al., 2021).

Equity in health is defined as the absence of systematic disparities in health (or in the major social determinants of health) between groups with different levels of underlying social advantage/disadvantage (Braveman & Gruskin, 2003)). For all members of the population of all ages to benefit, digital equity is required, which includes

closing the gap of the digital divide by tackling barriers to uptake, access, and usage of these technologies (Gell et al., 2015).

Older adults can face difficulties in technology uptake and usage due to the cost of devices, trust of and familiarity with technology, willingness to ask for help, concerns about privacy, and user interface design (Cosco et al., 2021; Martínez-Alcalá et al., 2018; Riadi et al., 2020). A US study, done in response to expansion of digital health access during the pandemic, suggested that 13 million (38%) older people would be unprepared for video visits, because of inexperience with technology, and that 20% would be unprepared for telephone visits, owing to hearing or communication difficulties or dementia (Lam et al., 2020).

Such issues could be amplified in low-income and middle-income countries, where pre-existing socioeconomic disparities, gaps in knowledge, reduced access to technology, and language barriers can create larger digital divides (Mathrani, Sarvesh, & Umer, 2021)

The majority of research done on the topic of digital equity has focused on the general population or the younger population as it relates to education equity or on the creation of new apps, softwares, and hardwares (such as AI, VR, etc.) (Resta et al., 2018; Hollis et al., 2015). Often, there was the missing component of having older adults at the centre of development and creations of digital products and interactions (Riadi et al., 2020). Without tackling digital inequity, the use of technology will only be limited to those who are privileged in society, such as those with high education and income.

When looking into highly diverse populations of older adults, it is important to treat the population as not one homogenous “marginalised” group, but understand the multiple intersections of marginalised identities that make up the population (Bauer, 2014). Understanding the individual needs is necessary for accessing knowledge (Kelly et al., 2021). A focus on the current research on this topic through the lens of under-serviced members of the population such as low income, socially isolated, and racialised community-dwelling older adults (CDOA) is timely.

This research utilised a community-based approach to capture recommendations on what is needed to achieve digital equity in diverse CDOA. This paper will focus on the CDOA populations of the Downtown West End (DTWE) of Vancouver, a highly diverse

community with a dense population of older adult residents. This paper will use a segment of a diverse population to create a list of recommendations that can be utilised by communities across Canada and beyond, to adopt community-based programs or services to achieve digital equity for its population.

5.2. Methods

5.2.1. Recruitment

The participants were recruited until theoretical saturation was reached and no new information was obtained. In our study, deliberate emphasis was placed on fostering diversity during the recruitment of participants, ensuring representation of the demographic of older adults in Vancouver. CDOA (N=10), community-based senior service (CBSS) organisation staff (N=6), and volunteer technology coaches (N=4) from the DTWE of Vancouver were recruited to participate in semi-structured interviews. We received support from a local CBSS organisation in the DTWE. A column in the agency's newsletter was purchased to disseminate the recruitment poster for the CDOA participants. The staff and Technology Coaches were recruited through word of mouth through the author's connections with the agency. The DTWE senior population is highly diverse, with various sub-populations that experience marginalisation and discrimination due to their race, ethnicity, socio-economic status, and gender/sexual orientation (Frank et al., 2010, p. 8). We therefore focused on these sub-populations during recruitment by informing the senior centre staff to spread the word of the study to our target population. The inclusion criteria for CDOA recruitment included: 1) older adults over the age of 65, 2) living in the DTWE at the time of recruitment, 3) living in the community (i.e., not an assisted living facility or other care homes), 4) able to speak and understand English, and 5) able to understand and consent to this study. The inclusion criteria for community centre staff included: 1) Working in a community organisation that mainly serves the senior population, 2) able to speak and understand English, 3) able to understand and consent to this study, and 4) have had direct contact with older adults as a part of their role in the organisation. The inclusion criteria for technology coaches included: 1) being a volunteer in a community organisation that mainly serves the senior population, 2) have taught at least 2 older adult participants since starting the volunteer position, 3)

able to speak and understand English, and 4) able to understand and consent to this study.

5.2.2. Data Collection

Semi-structured interviews are effective for obtaining qualitative data due to their flexibility, allowing researchers to ask follow-up questions and explore topics in depth. These interviews provide in-depth insights by encouraging participants to express themselves in their own words (Lu & Gatua, 2014). The interviews explored four main topics: (a) understanding of digital equity and why it is needed, (b) existing efforts (services/programs) to create digital equity, (c) limitations of current programs/services for CDOA to learn technology, and (d) future directions to create an inclusive digital landscape for the population. The interview guide included questions such as “what are some of the existing technology programs and services available in the community for CDOA?”, “what are the barriers or difficulties that older adults face when trying to learn technology”, and “describe an ideal program and resource for you/an older adult to learn new technology”.

Semi-structured interviews are neither free conversations nor highly structured questionnaires (Galetta, 2013). This is especially important when speaking about difficult topics, such as digital literacy, as the participants will have control over the flow of the conversation (Magaldi & Berler, 2020). Additionally, in-depth semi-structured interviews are inclusive in allowing participants with low levels of literacy to participate, as completing surveys or questionnaires may present some barriers (Guion et al., 2011). Qualitative methods have recently gained recognition for its ability to offer further understanding of under-represented populations’ experience compared to only using quantitative methods (Palinkas et al., 2015).

All the interviews were conducted by one author (IR) and the questions asked were open-ended and designed to encourage participants to provide rich descriptive data. The data collection was conducted in October and November of 2023. Interviews were between 30 to 60-minutes long and were conducted through the interviewee’s preferred video-communication platform (e.g.., Zoom) (N=4) , or in-person (N=16). Interviews were audio-recorded, and memos of participant information and any non-

verbal cues that emerged during the interviews were created. Honoraria of $25 in the form of a gift-card were provided for all participants.

5.2.3. Analysis

Following Braun, Clarke, & Hayfield's (2015) approach to thematic analysis, we began with transcription of the interview recordings and performing line-by-line coding using NVivo 12, a data analysis software. Notes were created for each interview by the researcher to keep track of the basic characteristics of each participant and any relevant field notes, aiding with the creation of initial codes. The initial codes were then read, reread, and organised into higher order codes. The higher order codes, along with relevant quotes from the transcript, were migrated into a Microsoft Excel sheet where themes were developed. Exemplar quotes were selected based on the content and nature of the themes. IR has been an active member of the DTWE community for the past 4 years and was able to provide unique and personal input on the analysis and interpretation of the data.

5.3. Findings

The participant sample consisted of 10 CDOA over the age of 65, six community-based senior-serving (CBSS) organisation staff, and four senior volunteer technology coaches. CDOA, staff, and volunteers were recruited through our community partner, a senior-serving non-profit organisation in the DTWE. The characteristics of the study participants are presented in Tables 1, 2, and 3.

Demographic Factors	Category	Number of participants	Percent
Age	65-70	6	60
	71-75	1	10
	76-80	2	20
	80+	1	10
Gender	Male	4	40
	Female	6	60
Household Status	Living alone	10	100

	Living with other family members	0	0
Highest Education Attainment	Grade School	0	0
	High School	1	10
	College diploma	3	40
	Undergraduate	4	4
	Master's	1	10
	Doctorate	1	10
Identify as low-income*	Yes	8	80
	No	2	20
Ethnicity	Caucasian	3	30
	Hispanic	1	10
	East/Southeast Asian	3	30
	Persian	3	30
Identify as LGBTQ+	Yes	4	40
	No	6	60

Table 5.1. Demographic table of community-dwelling older adult participants

Note: LICO cutoff <$26,620/year Based on poverty line in urban areas of Canada, with a population of 500,000 or more

Demographic Factors	*Category*	*Number of participants*	*Percent*
Age	Under 30	3	50
	30-50	2	33.3
	Over 50	1	16.6
Gender	Male	2	33.3
	Female	4	66.6

Years of experience in CBSS	Over 5 years	2	33.3
	Under 5 years	4	66.6
Highest Education Attainment	Undergraduate	2	33.3
	Master's	4	66.6

Table 5.2. Demographic table of CBSS staff participants

Demographic Factors	*Category*	*Number of participants*	*Percent*
Age	Under 30	0	0
	30-50	0	0
	Over 50	4	100
Gender	Male	4	100
	Female	0	0
Years of experience in CBSS	Over 5 years	1	25
	Under 5 years	3	75
Highest Education Attainment	Undergraduate	1	25
	Master's	3	75

Table 5.3. Demographic table of volunteer technology coach participants

From the interviews with community-dwelling older adults, senior-serving community organisation staff members, and volunteer technology coaches, four overarching themes that are derived from second level codes were created. These themes represent the steps that are needed to tackle the issue of digital literacy were identified:

1. Collaboration with community-based senior serving organisations
2. Determining the needs and drive of the individual
3. Tackling the issues of digital access
4. Tackling the issues of digital literacy

Collaboration with community-based senior serving organisations

The involvement of senior-serving organisations was seen as an important step to reach members of the community with low digital literacy. For older adults who have a

low baseline of technology use, awareness of community-based services, including digital literacy programs, that are advertised via social media is low. The only way to know if technology help and services exist is from word-of -mouth or other non-technological means. As one senior centre staff member (30, F, South Asian) stated:

> In our printed newsletters, we do, from time to time, advertise that services do exist if seniors are looking for ways to learn how to use the computer for a cell phone or tablet.

Additionally, older adults value the aspect of learning when it is a familiar or friendly environment, surrounded by community members, friends, and neighbours. This "friendliness" of a community organisation is what encourages older adults to attend classes that are geared to improve their digital literacy. As one older adult (68, F, East Asian) stated:

> For seniors, to go to programs to draw their interests, it has to be in a friendly environment. And, well, it's to make them feel interested to come.

Hosting such programs in community organisations also allows a sense of camaraderie and support from others who are experiencing the same frustrations or issues. One technology coach (61, M, Caucasian) stated:

> I see value in the one-on-one. I could almost see like a support group, eight or 10 seniors, you can get together for eight or 10 week period. With that, they can kind of talk through the lesson and they can complain about it! But they also can help each other and have facilitators, a few who work with them to help them get a little bit more updated

One senior (76, F, Caucasian) supported this social aspect of tech learning:

> We need to have more structured time in the organisation that people can come together, talk with a person, or in a group, about what's going on in their in their lives

Determining the needs and drive of the individual

Many participants mentioned that older adults have various needs when it comes to learning technology. This need or drive is what encourages them to learn skills to improve their digital literacy. One older adult (65, M, South Asian) explained:

> I think the question is: what's the outcome we're looking for here? Is it to become socially engaged? You know, to see your grandkids, their facial expressions on a screen, that's what I want. For other people, is it to learn something? Is it to express something?

Homebound older adults are especially driven to improve their digital literacy to continue to be connected to the outside world, as, physically, they are unable to. One staff member (40, F, Caucasian) recalled a moment with a homebound senior:

> She was matched with a check-in volunteer. So the two of them were talking for months, and he got her set up. She's got an iPhone, and he helped her set it up for voice activation, and got her to listen to podcasts. So, it was awesome. She was thrilled because she was getting bored to tears!

Once their needs are determined, older adults are more likely to be interested and less resistant to learning. One tech coach (60, M, Caucasian) stated:

> It helps people be more independent, stay connected with family and friends. I think this eases their resistance [to technology] a bit.

Tackling the issue on digital access

It is important to address the access to technology before learning how to operate it. Access can include affordability, as many low-income seniors cannot obtain the device to start their digital literacy journey. Two older adults (68, F, South Asian; 88, M, Caucasian) stated:

> Financial support has to be given, you know, because I think, especially with issues around this insane rental situation and housing, that really draws on your resources.

> I don't think a lot of seniors can afford to pay for tech stuff. Yeah, I would say the financial issue is the largest issue.

One staff member (63, M, Caucasian) stated:

> Some people don't have the money for a computer. Not just a computer, but some people don't have the money for the cable or the bills that are associated with having a computer

There is also the need to own devices that are compatible with specific accessibility issues. Many seniors experience trouble with their eyesight and hearing,

which exacerbates their frustration when learning the operations of new devices. One staff member (30, F, South Asian) explained:

> It could either be the size of the font, or the colours, you know, all the minute details that we don't think about, ever. All those things do play a role in making them hesitate [to learn]. We need to teach them how to adjust these details first

One older adult (67, F, East Asian) explained their positive experience:

> I don't really see that well, with the iPad. But I learned that I can somehow connect it to a monitor. You can plug it in now so it's bigger. It's better to learn anything if you know how to adjust technology, so, even if your eyesight is not good, you can connect it to a bigger monitor.

Finally, language is seen as a barrier for those trying to learn technology. Many older adults in the city have a primary language other than English, but the devices obtained in Canada require many users to speak one of the two primary languages (English or French). One older adult (67, F, East Asian) expressed:

> I'm grateful there's lots of Chinese [people] here. Basically, most of the time, my friends are helping me around language in computers.

One tech coach (61, M, Caucasian) also supported this and calls for a need to have more services offered in other languages:

> We have a bunch of tech coaching and all these services to help seniors learn. Not much, but there are some, but none of them are offered in languages other than English. So that's a huge thing. I know that's something that we need to work on, I guess, as a society.

Tackling the issue on digital literacy

Many older adults do not know where to begin when learning new digital skills. Initially, it is important to understand what the basic skills are required to operate and use technology for their specific needs. One senior (65, M, South Asian) calls for better instructions when obtaining new tech:

> Certain platforms haven't done a great job for people that aren't particularly savvy on the computer. I don't think it has to be very complicated, as long as it can be really intuitive for people that are just learning how to use a computer. Currently, instructions [for new devices] don't go through steps. It doesn't say click on this and this and

> this. It just assumes that everybody has a fair knowledge of how to operate things, which is which is false

There is also the need to distinguish different baseline skills when teaching technology to seniors and indicate progression. One senior (88, M, Hispanic) stated:

> Programs or lessons need to have elementary, intermediate, and advanced. So, start from the beginning. Well you see, I would attend from one lesson to the next, and then I can progress.

However, many programs must go back to basics, and allow those to learn from the beginning. One staff member (40, F, Caucasian) stated:

> I think it goes back to that simplicity. Technology can be challenging, but, you know, for me, sitting with a volunteer and realising and knowing all those little steps of what was either what caused the challenge, or that has the potential to cause challenges… it's really important.

Finally, literacy can be built when fear towards technology is tackled. Many older adults distrust technology due to misunderstanding. One tech coach (66, M, South Asian) stated:

> I had people telling me that they could never use Zoom because the government is spying on them.

However, when trust is built between coach and participants, and that they are able to alleviate the technology distrust, then older adults can begin steps towards digital literacy. One tech coach (60, M, Caucasian) shared their method:

> A lot of seniors I've coached have expressed their distrust with technology, and I think a lot of it comes down to resistance to change. I try to help them overcome this by building confidence in their abilities, sometimes they are just looking for validation that they are doing it correctly.

5.4. Discussion

This study identifies key components on how communities can work to achieve digital equity for its older adult populations. These components highlight actionable steps that policymakers, funders, and community-based organisations can take to achieve digital equity for all older adults in Canada and beyond.

Previous studies have defined the digital divide in the older adult population and determined the two steps needed to close the divide, namely, tackling access and usage (Gell et al., 2015). This coincides well with the two themes that were found in this study, tackling the issues on digital access and on digital literacy. What was lacking in the range of literature on this topic was looking at closing this divide through an equity lens that accounts for a diverse range of circumstances, especially for underserved members of the population.

The involvement of CBSS organisations was seen as a crucial step to encourage those who experience hesitation to learn technology, which many low-income and those with low level of formal education experience. Through having digital literacy programs in community organisations, it lessens the fear that some older adults may have when it comes to learning technology as it is hosted in a familiar, friendly space. Additionally, being in a group of learners who are at the same skill level can make the experience much more supportive, less intimidating, and avoid feelings of incompetence. Consistent with our results, a supportive learning environment can accelerate the uptake of new skills (Routarinne, 2009) and retention (Alan & Clarke, 2007). Additionally, many ethnic minority older adults have spent the majority of their lives with a collectivist mindset, where the involvement of community members, friends, and family, is important when pursuing an activity (Baretto et al., 2021).

Past research has looked at motivational factors for learning a new skill in the older adult population, and have shown that there is no single motivator that can be applied to a whole group of individuals (Fisk et al., 2020; Wister, Malloy-Weir, Rootman, & Desjardins, 2010). With highly heterogeneous populations such as CDOA in a large urban area, it is important to know that not everyone will have the same needs and drive to learn. To achieve digital literacy, it is therefore crucial to know the end goal of the individual, just as teaching any other important skills (Bereiter & Scardamalia, 2018). For example, many of the participants wanted to learn to use technology to alleviate social isolation and connect with family and friends, an issue that has been talked about in many studies of the elderly population following the COVID-19 pandemic (Smith, Steinman, & Casey, 2020). In this case, the introductory lessons should be tailored to understanding features of the device to achieve this goal, such as obtaining video-call compatible devices, finding methods and and social media applications to use, and learning how to troubleshoot issues related to communication.

CDOA cannot be analysed as one homogenous marginalised group and understanding the individual needs and being able to address each intersection of marginalised identity is therefore necessary when looking at how people can access knowledge (Tefera, Powers, & Fischman, 2018). “Access” or obtaining the technology and having a chance to use it differs from “literacy”, which relates more towards mastery of a knowledge, continuum of learning, and proficiency in skills (Keefe & Copeland, 2011).

Past research have determined five dimensions of digital equity: 1) Access to hardware, software, and connectivity to the Internet, 2) Access to meaningful, high quality, and culturally relevant content in local languages, 3) Access to creating, sharing, and exchanging digital content, 4) Access to educators who know how to use digital tools and resources, and 5) Access to high-quality research on the application of digital technologies to enhance learning (Resta et al., 2018). The focus on access has therefore been discussed, but there was a missing component of viewing the digital equity issue from a CDOA lens. Access was also not identified as a crucial first step before literacy can be achieved.

In the case of digital access, we have identified challenges such as language, accessibility, and financial needs as crucial in this population of CDOA. These issues have been mentioned in existing research on digital divide (Gell et al., 2015). Efforts such as translation services, lessons taught in different languages, learning about accessibility features in devices, and having access to affordable or free tech devices and services can be made to tackle challenges on access.

Like other skills in life, many CDOA mentioned needing the basic elementary understanding of technology, and being able to know essential terminologies to be able to navigate the device accordingly. Many have mentioned needing to go to basics of device operation, namely turning things on and off, typing, changing language, accessibility functions such as font size and brightness, and accessories such as mouse, speakers, and tablets. Past studies have found that the lack of crucial, foundational understanding was a barrier for technology adoption as older adults felt humiliation and shame for not having such basic understanding of a new concept (Kuerbis et al., 2017). If these foundational knowledge can be made to the same calibre of priority as higher

level concepts of technology, then every individual, regardless of skill level, can have the ability to work towards having high digital literacy as other members of the population.

Solving the digital divide and achieving digital equity in the CDOA population requires a comprehensive and collaborative approach involving efforts by CBSS organisations, involvement of community members, bottom-up approach to learning, and consistent and reliable flow of resources to the community. By prioritising digital inclusion and investing in these strategies, communities can take significant steps toward reducing disparities and ensuring that all members of the population have equal opportunities in the digital era.

5.4.1. Limitations

The findings of this study must be interpreted within the context of its limitations. Firstly, the overall demographic profile of older adults in the DTWE is not known. Purposeful sampling was done by IR, who is an active member of the DTWE community and a volunteer at the senior serving organisation located in the neighbourhood. The purposeful sampling of LGBTQ+ and ethnic minority older adults was based on the demographic of the active members in the senior organisation and may not accurately represent the demographics of the neighbourhood.

Additionally, the study was conducted with the consideration of the COVID-19 pandemic. In some instances, the researchers were unable to conduct interviews in person, which may have caused some missed opportunities to interview homebound older adults without access to technology.

The inclusion of people in different positions in the community has allowed for a more rounded perspective of the topic. However, the individual experiences of the staff and tech coaches were not able to be explored in-depth as the focus of the interviews were on the needs and values of the older adult population that they served. Personal biases of staff and tech coaches could have impacted their understanding and beliefs of what CDOAs need in terms of digital equity.

Our study has pinpointed strengths and limitations with using a community-based approach, specifically in using semi-structured interviews to discuss digital literacy and equity with older adult populations with different intersections of marginalised identities.

Future research on this topic should consider conducting interviews in-person whenever possible to capture any non-verbal cues and allow those without access to video-calling capabilities to inform their needs as members of the population with low digital access/literacy. Additionally, there is a need to conduct research on this topic on other intersections of marginalised older adults that were not included in this study, including but not limited to: indigenous populations, marginalised individuals in rural/remote areas, and individuals who do not speak English.

5.4.2. Conclusion

This study has gathered recommendations for communities to achieve digital equity and close the digital divide in the CDOA population. From the interviews with community-dwelling older adults, senior-serving community organisation staff members, and volunteer technology coaches, 4 steps that are needed to tackle the issue of digital literacy were identified: 1) Collaboration with community-based senior serving organisations, 2) Determining the needs and drive of the individual, 3) Tackling the issues of digital access, and 4) Tackling the issues of digital literacy. The themes that were captured in this study can allow community-based and health organisations to build interventions or services that target the mental health concerns of diverse CDOA in Canada and beyond.

Chapter 6.

General Discussion

6.1. Synthesis

With advances in healthcare and improved living conditions, Canadians are living longer lives, resulting in a growing proportion of older adults in the population. This demographic shift brings with it a set of unique challenges and opportunities, particularly concerning the digital landscape and the mental health of older adults. However, amidst this trend, there remains a notable gap in understanding and addressing the digital literacy needs of CDOA. As mentioned throughout this dissertation, the onset of the COVID-19 pandemic has brought this issue into sharper focus, highlighting the pressing need to bridge the digital divide among older adults. As society increasingly relies on digital platforms for various services and activities, from healthcare consultations, social interactions, and learning opportunities, older adults risk being left behind due to barriers related to access and proficiency (Tappen, Cooley, Luckmann, & Panday, 2022). Therefore, concerted efforts to develop accessible, inclusive, and community-driven initiatives centred around the social determinants of health are essential not only for promoting digital literacy but also for enhancing the mental wellbeing and overall quality of life for older adults across diverse communities in Canada.

The current digital intervention landscape for older adults is not as accessible or inclusive as it needs to be. The population of older adults in Canada is highly diverse, with many people experiencing various adversities related to service access due to their different intersections of marginalised identities and economic adversities (Bryant, Raphael, Schrecker, & Labonte, 2011). Chapter 3 examined current DMHI and concluded that there is yet to be a regulated gold-standard design of successful DMHI for the older adult population. The review suggested that efforts still needed to be made to create inclusive innovations. These suggestions were identified as: 1) end-users and the population of interest are at the centre of DMHI creation and design; 2) DMHIs need to be malleable and able adapt to different life circumstances, education level, and physical and psychological abilities of the population, and 3) DMHI creation must be accompanied by (human) support available for all users. The second suggestion brought

forth the conversation about equity, diversity, and inclusion in digital accessibility. Equitable access to services needs to be addressed. The redirection was made and focus was shifted to reflect the social determinants of health and its role in digital access. It was then determined that the project needed to be centred on the community-dwelling population of older adults. Since over 90% of older adults live in the community, it felt appropriate to understand the needs of this population. These populations' needs also differ from other older adults who live in assisted living facilities or long-term care homes, as they are generally more frail, and have the support of healthcare providers and other caregivers (Kanwar et al., 2013). We cannot assume that all members of the heterogeneous older adult population share the exact same needs and require the same mental health services.

Canada possesses a heterogeneous older adult demographic characterised by significant diversity in age, gender, culture, religion, language, socio-economic status, and sexual orientation (Statistics Canada, 2021). An enhanced comprehension of this demographic is essential for the healthcare system to adequately meet the needs of Canada's diverse ageing population. In 2009, Garrido et al. found that only half of older adults with mental health needs use mental health services, and little is known about the causes of perceived need for mental health care. This statement is still applicable today and has an added barrier due to the COVID-19 pandemic and health services being pivoted online (Daly et al., 2021). Chapter four aimed to address this gap in the literature and provide direction for future community-based mental health interventions or services. This study has expanded the conversation on late-life mental health and pinpointed important factors that contribute to the mental health of diverse older adults. Four overarching themes were found that contribute to the mental wellbeing of CDOA: 1) Having a sense of stability over personal circumstances, 2) being able to do, 3) positively impacting others, and 4) feeling a sense of belonging. The findings extracted from this study offer insights that enable community-based and healthcare organisations to develop interventions or services tailored to address the mental health needs of diverse older adults.

After the determination of needs, it was found that the development of a framework was the appropriate step into providing equitable digital access for CDOA. The framework was meant to be built from the needs and priorities of community members and service providers. The involvement of CBSS organisations was seen as a

crucial step to encourage those who experience hesitation to learn technology, which many low-income and those with low level of formal education experience. By prioritising digital inclusion and investing in these strategies, communities can take significant steps toward reducing disparities and ensuring that all older adults can have equal opportunities in the digital era. The interviews that I conducted captured the voices of CDOA, volunteers, and senior centre staff, found the following recommendations for the creation of an inclusive community-based program: 1) Collaboration with community-based senior serving organisations, 2) Determining the needs and drive of the individual, 3) Tackling the issues of digital access, and 4) Tackling the issues of digital literacy.

The recommendations found in this chapter were further created into a community-based framework for digital equity - a practical approach for CBSS organisations (see figure 6.1.). This framework will allow organisations who cater to seniors in their own community to adapt and build equity-centered digital learning practices based on their population. In developing a framework for digital equity specifically tailored for CDOA, the process commenced with the collection of rich qualitative data through interviews with community members. These interviews were pivotal in capturing the lived experiences, challenges, and aspirations of older adults as they navigate the digital world. By employing a semi-structured interview format, participants were encouraged to share their personal narratives and insights, which provided a comprehensive understanding of the barriers and enablers they encounter in adopting digital technology.

Building upon the emergent themes from paper three (chapter five), the framework was constructed to address the specific needs identified through participants' narratives. Each component of the framework was designed to target a particular aspect of digital equity, ensuring a holistic approach that not only considers technical skills but also the social and motivational dimensions critical to achieve literacy for community members.

The framework emphasizes the importance of having community partners (CBSS organisations) involved as the initial phases of the learning journey. This early stage of the framework is emphasized for those outside of the community, which includes health organizations, private industries, funding bodies, and academic/research groups. By grounding the framework in community involvement as the crucial first step, it ensures

that the strategies proposed are responsive to the actual needs and preferences expressed by older adults, thus enhancing its potential effectiveness and sustainability in real-world applications. This approach underscores the value of CBR in developing pragmatic solutions that foster digital inclusion for CDOA.

Understanding the drives and motivators of older adults is essential for effective technology learning, as it aligns the educational process with their specific interests and needs, thus increasing engagement and adoption. By identifying what motivates them—whether it's connecting with family, managing health, or pursuing personal interests—educators, coaches, volunteers, and caregivers can tailor learning experiences that highlight these benefits, making technology more relevant and interesting to the learner. This approach also helps in overcoming common barriers like fear or lack of confidence by fostering supportive learning environments that build self-assurance and reduce anxiety.

Lastly, a key component of the framework is to tackle the issue of accessing technology prior to learning, which arose from the recognition that many older adults still struggle with obtaining or using devices. Ensuring access to technology is a critical step before embarking on technology literacy education, as it lays the foundation for effective learning and usage as without access to the necessary devices and internet connectivity, efforts to teach digital skills can be impractical and ineffective. Access to technology provides older adults with the opportunity to apply and practice newly acquired skills in real-life contexts, reinforcing learning through hands-on experience. Having access to technology creates an equitable learning environment as many older adults face barriers to technology access, such as through financial constraints, geographical limitations, or physical disabilities. Addressing these barriers is essential to ensure that all individuals can enhance their digital skills, thereby reducing the digital divide and promoting inclusivity. When access is guaranteed, learners are more likely to stay motivated, as they can immediately see the benefits and utilities of the technology in their daily lives, whether it be for communication, health management, or accessing information and services.

Once an older adult becomes literate in technology, their skills and confidence can have a ripple effect that benefits other community members, including motivating peers to engage with technology and teaching others. As a tech-savvy individual, they

can serve as a role model, demonstrating the practical benefits and enhancing the appeal of technology adoption to other seniors. Their personal success stories can inspire others who may be hesitant to learn, reducing the fear and anxiety associated with new technologies. They can play a crucial role in peer-to-peer teaching and support. They may volunteer in local tech workshops or group classes, offering insights and assistance from a relatable perspective. This form of peer mentoring is often more effective because it involves shared experiences and an understanding of common challenges faced by seniors. Community members can feel more comfortable asking questions and voicing concerns to peers who have undergone similar learning journeys. Their involvement in technology can also contribute to broader community development by facilitating access to digital resources that address local needs, such as health information, social services, and community events. As more seniors become digitally literate, they collectively strengthen the community's resilience in an increasingly digital world.

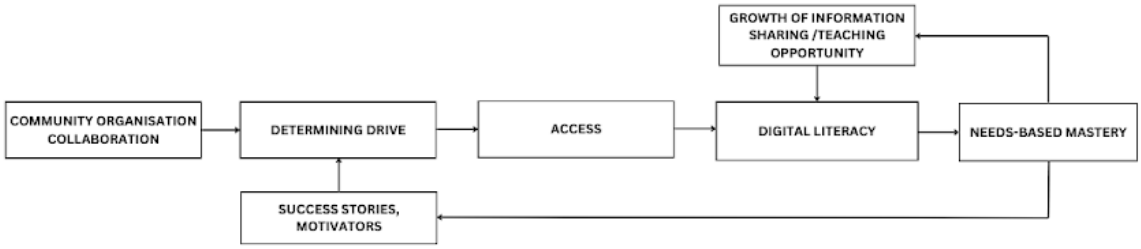

Figure 6.1. A community based framework for digital equity based on the needs and priorities of community members and service providers.

6.2. Strengths and Limitations

6.2.1. Research Approach

Reflecting on the use of a broad focus featuring general mental health outcomes across multiple populations versus a more specific approach involves evaluating both the breadth of insights gained and the depth of understanding achieved. Employing an understanding of mental health through the social determinants lens while including data collection from a very heterogeneous yet small population allowed for the identification of

commonalities and universal trends across diverse groups, while being within the scope of a doctoral project. This understanding allowed for the increase of the generalizability of my findings since the results are not confined to a specific group, enabling the adaptation of digital mental health interventions across various settings and demographics.

With regards to its limitations, one significant drawback is the potential lack of specificity, which might result in interventions that are not adequately tailored to the distinct needs of particular subgroups. This lack of depth in understanding specific issues can make implementing broad findings challenging when applying results to specific contexts. Without focusing on populations or outcomes, important nuances that could inform more targeted and effective interventions might be overlooked.

The choice between a broad and specific focus impacted how digital mental health interventions/resources were conceptualized, developed, and implemented. A broad approach contributed to the creation of adaptable, versatile framework that can be modified to fit different contexts, which makes it an asset during the early stages of innovation as it provided essential foundational insights. In contrast, a specific approach, while initially limiting applicability, allows for the creation of deeply resonant interventions tailored for targeted groups (Minkler, 2005). This depth of understanding is particularly beneficial for practical implementation, guiding the development of highly customized interventions that enhance user engagement and effectiveness.

This research uniquely employs a community-based approach in creating a digital equity framework, marking it as the first of its kind. Given the innovative nature of this method, the process had to start with a small group to ensure manageability and to facilitate a detailed, focused analysis that respects the community's input from the outset. Balancing these methods (utilizing broad research for foundational insights and specific research for targeted implementation) can optimize the development and practical application of digital mental health interventions, ensuring they are both widely applicable and deeply effective within populations.

6.2.2. Sampling

This current thesis utilised two participant groups sampled from community-dwelling older adults from the Downtown West End of Vancouver. Purposeful sampling, a method frequently employed in qualitative studies focusing on the mental health of older adults (Grundberg et al., 2012; Kenbubpha et al., 2018), offered several strengths. Firstly, it ensured relevance by allowing me to select participants with firsthand experience or knowledge pertinent to the research topic, thus enriching the collected data. Secondly, purposeful sampling allowed for diversity in participant selection, as I was able to intentionally include individuals from varied backgrounds, experiences, and perspectives, offering a comprehensive understanding of mental health experiences within the older adult population (Badu, O'Brien, & Mitchell, 2019). Additionally, this sampling method was immensely efficient in terms of time taken and resources needed to conduct this research project. With the help of a CBSS organisation, I was able to target specific individuals or groups likely to provide valuable insights, rather than recruiting a larger and potentially homogenous or less diverse sample. Lastly, purposeful sampling allowed me to reach a depth of understanding by focusing on individuals who possessed specific characteristics or experiences related to the topic of mental health and digital equity, and enabled a nuanced exploration of themes and experiences for underserved and under-researched populations.

The recruitment of participants from a small, urban, and diverse area for a study on the mental health and digital equity of older adults in Canada had its strengths and limitations. Focusing on a small area allowed for a recruitment process that was manageable for a doctoral project as it facilitated easier access to potential participants. It allowed a deeper exploration of participants' experiences and perspectives, fostering richer insights and nuanced understandings within the time and logistical considerations of a PhD project, given the intensive and rigorous nature of qualitative data collection and analysis methods. Additionally, recruiting and conducting the project in a small area fostered a sense of community and trust between the interviewer (myself) and the participants, which increased their desire to share their experiences openly, allowing for the collection of deeply valuable data that could only be captured after trust and rapport was built between interviewer and interviewee (DeJonckheere & Vaughn, 2019).

Purposeful sampling also presented some limitations. One concern was the risk of selection bias, as I may inadvertently overlooked certain perspectives or experiences by focusing on specific groups or characteristics, potentially limiting the generalizability of findings. Moreover, my subjective judgement involved in the selection process may have introduced bias or have allowed me to overlook important perspectives that do not align with preconceived notions of relevance. As interviewers and researchers, we simultaneously hold multiple identities and positionalities that are variably salient across contexts. Positionality is always present and relational, a quality of interactions shaped by how varied physical and social aspects of the self take on meaning within contexts over time (Glas, 2021). I began to reflect more deeply on the experience beyond the written page. Specifically, I asked myself questions about the experience:

> What role did my positionality as a young, able-bodied, queer, woman of colour with a high level of formal education studying issues of digital literacy and mental health of the older adult population play?
>
> How did I use my positionality in different parts of my research?
>
> Did my positionality influence the interactions that I had with my participants?

On one hand, my positionality helped many of my participants who were immigrants, people of colour, and LGBTQ2S+ older adults feel more comfortable. I saw a lack of hesitancy or struggle from them when engaging in conversations about mental health needs and inequality of access due to their marginalised identities. On the other hand, considering my age and level of formal education, I had to be careful that I did not attempt to speak for my older research participants, that I did not attempt to work on their behalf to help them rise. This prevented me from probing participants further when speaking about their struggles with learning digital literacy because I believed that such efforts on my part would be counter-libratory, as my position would have situated me as an oppressor.

Despite efforts to ensure diversity, the purposeful sampling efforts still resulted in the exclusion of many marginalised groups, particularly if when subgroups within the older adult population were excluded from the sampling frame (for example, not many African-Canadian older adults reside in the DTWE of Vancouver, so no African-Canadian older adults were recruited in the studies).

Additionally, despite allowing for greater efficiency in data collection, purposeful sampling required significant time and resources to identify participants who met the specific criteria. The time constraints of a PhD program-imposed limitations on the scope and diversity of participant recruitment. Ideally, a more extensive and diverse sample would have included participants from a broader range of backgrounds, such as different cultural, socio-economic, and geographical contexts. This would have enriched the study by providing a more comprehensive understanding of the digital literacy and mental health needs of older adults across various demographics. However, due to the limited timeframe inherent to the PhD process, it was not feasible to engage a larger and more varied cohort. Future research should aim to include a wider array of participants to enhance the generalizability and depth of the findings.

There were also limitations associated with recruiting participants from a small, urban, and diverse area. The findings have shown to lack generalizability to older adult populations residing in other geographic locations, particularly suburban and rural areas, as well as to those living in different regions of Canada with distinct demographic and cultural characteristics. For example, transportation access was seldom mentioned as a limitation to accessing services because public transportation can be mostly accessible in urban areas, despite it being a major limitation to service access for rural populations (Parsons, Gaudine, & Swab, 2021). Recruiting from a small area also resulted in a relatively limited pool of potential participants, which had an impact on the sample size and the diversity of perspectives represented in the study. Furthermore, while a dense urban area like the DTWE of Vancouver is highly diverse, it also presented challenges in terms of ensuring adequate representation of all demographic groups, as previously mentioned. “Hard-to-reach populations” are generally floating populations and socially invisible thus gaining access to them poses major barriers for their recruitment (Faugier, & Sargeant, 1997). Hard-to-reach populations may also actively try to conceal their group identity due to fear of confrontation with legal authorities (e.g. active drug users) or simply because of social pressure they feel from other members of the broader community, especially when asked to talk about a stigmatised topic such as mental health (Shaghaghi, Bhopal, & Sheikh, 2011). It is suggested that faith-based communities, people experiencing housing insecurities, and newly arrived immigrants are among the hard-to-reach populations (Shaghaghi, Bhopal, & Sheikh, 2011). While recruiting participants from a small, urban, and diverse area offers strengths such as

manageability, community engagement, and diversity of perspectives, future research efforts should be mindful of the limitations regarding generalizability, sample size, and representation.

6.2.3. Qualitative Methods

The entirety of this doctoral project relied on the use of qualitative methods to capture the experiences, views, learnings, and suggestions from community members with regards to the topic of their mental health needs and digital equity. Utilising semi-structured interviews allowed for flexibility and adaptability in the interview process, which enabled in-depth exploration of complex and nuanced topics such as mental health, digital literacy, and health equity. This method also allowed participants to elaborate on their experiences and perspectives without limiting it to a choice from a set of predetermined answers like in a survey. Additionally, this approach allowed for collaborative and participatory dynamics between myself and participants, which promoted trust, increased rapport, and encouraged open communication. Qualitative interviews offered rich and detailed data as it captured the subjective experiences, meanings, and interpretations of participants, which provided valuable insights for understanding the complexity of mental health needs among older adults from diverse backgrounds.

Investigating the digital literacy of older adults and gathering recommendations for future digital literacy programs required the use of semi-structured interviews for data collection as the study relied on capturing the lived experience of the target population. Semi-structured interviews allow for flexibility in exploring participants' experiences, perceptions, and attitudes towards digital technology without the need for a specific level of understanding of the topic. The language of the interview guide was able to be utilised and shaped depending on the participant. More or less technology jargon could be used accordingly, which allowed those with more understanding of digital literacy to dive deeper into the topic, and those with low literacy to feel welcomed to talk about their struggles. This approach allowed for a participatory and collaborative dynamic between researchers and participants, enabling the co-construction of knowledge and the generation of actionable recommendations tailored to the specific needs and preferences of the participants.

Line-by-line coding was utilized when analyzing the data because it required me to deeply engage with the data, ensuring a comprehensive understanding of every part of the interview. It encouraged thorough exploration, which lead to deeper insights and a richer interpretation of my participants' responses. By analyzing the data line by line, I was able to minimize the risk of overlooking subtle yet significant details. This approach gave room to identify themes and patterns that could otherwise be missed by other broader coding methods such as thematic coding (Terry et al., 2017). It is important to note the flexibility of line-by-line coding, as it allows themes to emerge organically from the data rather than imposing preconceived categories. Additionally, this flexibility and refinement that line-by-line coding offers allowed for the continuous refinement of codes as new insights emerge. Line-by-line coding provided a rigorous and transparent process as every line of the transcripts were analysed. Despite the time-consuming nature of this analysis method, the depth and detail it provided greatly enhanced the analysis of my interview data.

The limitations associated with qualitative semi-structured interviews include the subjective nature of qualitative data collection that introduced bias, as the interpretation of participants' responses was always influenced by my perspectives, assumptions, and preconceptions, as the researcher. Semi-structured interviews may not capture the full range of older adults' experiences and perspectives on digital literacy, as participants' responses may be shaped by social desirability biases or limited by their own awareness or articulation of digital literacy issues. Semi-structured interviews also required building rapport and trust to ask probing questions and navigate sensitive topics. As I was a member of the community, it was advantageous as trust had been built prior to data collection. However, the power dynamic between research and participants when conducting community-based research must be acknowledged. Power dynamics are inherent in qualitative interviews, as they involve individuals with distinct agendas, perspectives, and narratives (Bengtsson & Fynbo, 2018). These dynamics significantly influence the atmosphere and interactions within qualitative interviews (Karnieli-Miller et al., 2009), shaping both the process and outcomes of knowledge acquisition in qualitative research (Ben-Ari & Enosh, 2012). Interviewers typically hold a position of authority, initiating questioning and directing the study, thus establishing an initial imbalance, but interviewees also possess agency and can refuse questions, withhold information, or challenge interpretations (Kvale, 2006). Additionally, when interviewers

and interviewees occupy different social positions, the power dynamics become more complex, as social structures intersect with the interview process (Griffin, 2016; Vähäsantanen & Saarinen, 2013). The intersecting identities of both parties significantly influence rapport-building, data generation, and analysis, especially in qualitative interviews that span diverse social positions (Khan & MacEachen, 2022).

Qualitative semi-structured interviews are valued for their adaptability, depth of exploration, and ability to engage participants effectively. However, we must remain attentive to certain drawbacks, including the potential for bias, the varying skill levels of interviewers, and the limited scope of participant viewpoints. To mitigate these limitations, researchers should employ rigorous methodological techniques, practice reflexivity to acknowledge and address our own biases and assumptions, and supplement interview data with multiple sources through triangulation. By doing so, we can bolster the trustworthiness, consistency, and persuasiveness of their findings and suggestions for the development of digital literacy programs tailored to older adults. Expanding on this, it's crucial for researchers to continuously reflect on our own perspectives and biases that might influence the interview process and analysis. Employing a variety of data collection methods beyond interviews, such as observations or surveys, can provide a more comprehensive understanding of the topic. This multifaceted approach not only enriches the study but also strengthens the validity of the conclusions drawn and the recommendations made.

6.3. Future Directions

6.3.1. Further Research Opportunities

In light of the current era's increasing digitalization and its profound impact on various aspects of daily life, it is imperative to underscore the importance of digital literacy, particularly for older adults, within the CBSS sector. As technology continues to evolve and become increasingly integrated into essential services, including healthcare, social engagement, and information access, the ability to navigate digital platforms becomes indispensable for maintaining overall well-being, including mental health, among older adults. Recognizing this pressing need, this PhD work emphasises the significance of incorporating digital literacy initiatives tailored specifically for older adults into CBSS organisations' existing efforts. By empowering older adults with the necessary

digital skills and resources, we aim to enhance their ability to access vital services, connect with their communities, and mitigate feelings of isolation or exclusion exacerbated by technological advancements and the potentially growing digital divide. Through the collaborative implementation of the framework within the CBSS sector, I strive not only to bridge the digital divide but also to promote mental health and well-being among older adults in today's rapidly evolving digital landscape. In considering the implications of my findings, it is evident that further exploration is necessary when applying the recommendations and framework developed in this study. Specifically, there is a need to delve into the practical implementation of these strategies within the CBSS sector. My hope involves introducing this framework to organisations already engaged in digital literacy programs within this sector first, as they have identified the digital literacy of their community. By collaborating with these organisations, which possess a nuanced understanding of their community members' needs, I will aim to assess how effectively the framework can be integrated into existing programs. Through this collaborative effort, I hope to not only refine the model but also address any existing gaps in digital literacy initiatives within these communities. This iterative process of implementation and evaluation will be crucial in ensuring the relevance and effectiveness of this framework in fostering digital inclusion and empowerment within the CBSS sector.

As we move forward with the implementation of the digital equity framework within the CBSS sector, it is imperative to establish robust mechanisms for data collection to assess both the successes and shortcomings of its utilisation within the community. Future research endeavours must focus on systematically investigating the effectiveness of this framework in addressing the digital literacy needs of older adults. This necessitates a multifaceted approach that combines qualitative methods to understand the nuanced experiences, challenges, and successes encountered by participants, as well as quantitative data collection to measure key metrics such as participant demographics, length of program involvement, improvements in digital skills, and uptake of technology. Qualitative methodologies, such as interviews or focus groups, will offer valuable insights into the specific gaps and successes of the model, providing a rich understanding of the contextual factors influencing its implementation and impact. Additionally, quantitative data will provide empirical evidence regarding the program's efficacy, allowing for the identification of areas of improvement and informing

future iterations of the framework. By employing a comprehensive mixed-methods approach, we can gain a holistic understanding of the framework's effectiveness and tailor interventions to better meet the evolving needs of older adults in the digital age within community-based settings.

Moreover, an intriguing avenue for future inquiry involves examining the applicability of the digital equity framework within marginalised groups not directly represented in the current study. Specifically, exploring the feasibility and efficacy of implementing our framework within organisations catering to underserved populations, such as deaf or hard of hearing seniors, visually impaired seniors, seniors with chronic illnesses, and those experiencing housing insecurities, presents a compelling opportunity for research. By extending the scope of the investigation to encompass these marginalised groups, we can assess the adaptability of the framework to diverse contexts and identify potential modifications or enhancements needed to cater to the unique needs and challenges faced by these populations. For instance, considerations for accessibility, including the provision of alternative communication methods, adaptive technologies, and accommodations for mobility limitations, may be paramount in ensuring the inclusivity and effectiveness of the framework for individuals with sensory impairments or chronic illnesses. Additionally, addressing socioeconomic disparities and housing insecurities may require tailored interventions aimed at improving access to digital resources and support services within marginalised communities. Through collaborative partnerships with organisations serving these populations and engaging in participatory approaches, we can co-design and refine the framework to better meet the diverse needs of marginalised older adults, thereby fostering digital inclusion and empowerment across a broader spectrum of society.

Furthermore, it is critical to acknowledge the existence of older adults who remain unserved due to various barriers, including being homebound, isolated, and lacking access to information about available programs. This segment of the population, despite potentially having a pressing need for digital literacy services, may face significant challenges in accessing and participating in such programs. To address this gap and ensure inclusivity, proactive community outreach initiatives are essential. Outreach efforts should be tailored to reach homebound and isolated older adults through diverse channels, including but not limited to social service agencies, healthcare providers, senior centres, and faith-based organisations. These initiatives can involve

the dissemination of informational materials through mailings, phone calls, or community events, as well as leveraging digital communication platforms accessible to older adults, such as email or social media. Additionally, partnerships with local volunteers or community leaders can facilitate direct outreach to vulnerable populations, offering personalised support and assistance in navigating available resources. By prioritising outreach efforts to engage high-needs participants who may otherwise be overlooked, we can work towards ensuring equitable access to technology programs and addressing the digital divide among older adults.

6.3.2. Practical Implication and Application

Community involvement and implementation are pivotal aspects of this project, epitomising my commitment to ensuring that digital literacy initiatives are not only developed but also effectively integrated within the fabric of diverse communities. The findings gleaned from this research and the operational framework established are currently serving as guiding lights for numerous Digital Literacy Programs funded across British Columbia. This signifies a significant stride towards democratising access to digital resources and education among older adults. By anchoring our approach in community feedback and engagement, we not only validate the lived experiences of older adults but also empower community organisations to craft bespoke technology programs that resonate with the unique needs and aspirations of their constituents. Moreover, the emphasis on community involvement underscores a broader ethos of inclusivity and co-creation, fostering a sense of ownership and investment among stakeholders in the collective pursuit of digital literacy and empowerment.

The created framework serves as a practical compass for funding bodies navigating the complex landscape of digital literacy initiatives. In an era where resources are finite and the demand for digital literacy interventions is burgeoning, the framework offers a structured methodology for evaluating, assuring quality, and assessing the efficacy of funded programs. By providing a standardised framework for program evaluation, our approach facilitates informed decision-making, enabling funding bodies to optimise resource allocation and maximise the impact of their investments. Furthermore, by establishing clear metrics and benchmarks for success, our framework promotes accountability and transparency, ensuring that funded programs deliver tangible outcomes that resonate with the overarching goals of promoting digital inclusion

and wellbeing among older adults. In essence, our framework serves as a linchpin for fostering a culture of evidence-based practice and continuous improvement within the realm of digital literacy programming.

Collaboration with health authorities can represent a transformative opportunity to scale the impact and establish a gold standard for digital literacy programming nationwide. By forging strategic partnerships with health authorities, we can collaborate and share expertise, resources, and reach to develop comprehensive solutions that address the digital divide and promote mental health equity among older adults. From co-designing evidence-based interventions to implementing scalable strategies for community engagement, collaborative efforts hold the promise of driving systemic change and advancing the agenda of digital inclusion and wellbeing on a national scale. By leveraging the collective strengths of community organisations and health authorities, we can build resilient ecosystems where older adults have the knowledge, skills, and support they need to thrive in an increasingly digital world.

6.3.3. Contribution to the field

This research represents a significant milestone in advancing discussions around digital health equity for community-dwelling older adults, particularly through an intersectional lens. By recognizing and addressing the unique challenges faced by individuals with multiple marginalised identities, I advocate for the creation of inclusive digital health programs that prioritise equity and accessibility. This research underscores the importance of considering factors such as socioeconomic status, race, ethnicity, gender identity, and disability when designing interventions, thereby ensuring that no segment of the population is left behind in the digital revolution. By centering the experiences and needs of marginalised older adults, I hope to foster a more inclusive and equitable digital landscape that empowers individuals to access and benefit from digital health resources and services.

This research fills a critical gap in the realm of digital mental health research, providing a foundation for future innovation and intervention. By shedding light on the digital divide and its implications for mental wellbeing among older adults, this project paves the way for the development of targeted strategies to address these disparities. The findings highlighted the urgent need for interventions that can bridge the gap

between theory and practice, leveraging digital technologies to enhance mental health outcomes and promote overall wellbeing among CDOA. By identifying key areas for intervention and innovation, this project lays the groundwork for future research endeavours aimed at advancing digital mental health initiatives and improving the quality of life for older adults across the country.

At the heart of this research is a commitment to level the playing field when it comes to digital access, ensuring that the digital divide does not widen but rather narrows over time. By emphasising the principle of "nothing for us without us" in the realm of digital health innovation, I advocate for the active involvement of older adults in the co-creation and implementation of digital health solutions. This community-driven approach not only empowers older adults to take ownership of their health and wellbeing but also fosters a sense of agency and belonging within the broader digital health ecosystem. Through collaborative partnerships with community organisations and other stakeholders, we can together develop innovative solutions that reflect the diverse needs and experiences of older adults, ultimately leading to more equitable and inclusive digital health outcomes.

Beyond the realm of digital literacy, this project endeavours to catalyse a paradigm shift in the discourse surrounding mental health within communities. Recognizing the intertwined nature of digital literacy and mental wellbeing, this project seeks to destigmatize conversations about mental health and promote holistic approaches to wellness. By creating safe spaces for open dialogue and exploration, my aim was to empower individuals to candidly discuss their mental health experiences, challenges, and aspirations. In doing so, I hope to foster a sense of solidarity and mutual support within communities, transcending barriers of age, gender, and background. The efforts are anchored in the belief that by nurturing a culture of empathy and understanding, that we can cultivate resilient communities where individuals feel empowered to seek support, access resources, and embark on their journey towards mental wellbeing. Through a community-driven lens, I hope to empower older adults to prioritise their mental wellbeing and access the resources and support they need to thrive in their communities. By bridging the gap between theory and practice, this project hopes that this framework is not only evidence-based but also grounded in the lived experiences and needs of older adults, ultimately leading to more effective and sustainable outcomes in the realm of digital health and wellbeing

6.4. Reflection

Like many doctoral projects across disciplines, this project initially intended to go one way, but very quickly pivoted to something that was unexpected. At first, the idea was for innovation, the creation of a novel digital product aimed towards the betterment of mental wellbeing of older adults. The progression of this project was meant to look like the following: 1) exploring existing digital mental health products for older adults (the target population), 2) creating a working group with older adults to create a prototype product, and 3) piloting said product.

The plan was simple and straightforward. I always planned to go into this project with diversity, equity, and inclusion in mind, but never would have thought that such disparity existed in the world of digital health. I started this project in the spring of 2020, the beginning of the COVID-19 pandemic, a time where many services had to pivot to online means. I planned to ride the wave of digital health research and thought: I am sure that the issue on equity and access had been researched and resolved, otherwise, why would there be so many proposals for new digital products for this population?

As I began my preliminary research, conducting the systematic review, I started to notice the gaps that existed. The target demographic of many digital health products for older adults were restricted to those who were advantaged, namely; the rich, the educated, the ones with close intergenerational relationships, and those who speak English. These restrictions were not intentional, but the disparity existed nonetheless. Many older adults lacked the access and skill to even begin to use necessary online services such as government aids, medical appointments, transportation, and food access; let alone the ability to accept innovations beyond that such as smartphone apps, e-gaming, social media, virtual reality, augmented reality, and more.

I came to the conclusion that the digital health research realm sat on a porous and crumbling surface. That the further we, as digital health researchers, aim to go leaps and bounds to create new innovation, many members of the population would be left behind, further increasing the research-to-practice gap. Equitable access was always the key to laying a good foundation for future innovations. I decided to shift my doctoral research to find ways to achieve digital equity for the older adult population, including

those who are marginalised, under-represented in research, and under-serviced in community.

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Appendix A.

PRISMA-P 2015 Checklist

This checklist has been adapted for use with systematic review protocol submissions to BioMed Central journals from Table 3 in Moher D et al: Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews 2015 4:1

An Editorial from the Editors-in-Chief of Systematic Reviews details why this checklist was adapted - Moher D, Stewart L & Shekelle P: Implementing PRISMA-P: recommendations for prospective authors. Systematic Reviews 2016 5:15

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
ADMINISTRATIVE INFORMATION					
Title					
Identification	1a	Identify the report as a protocol of a systematic review	☒	☐	Pg1, Ln1-2
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	☐	☒	N/A
Registration	2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number in the Abstract	☒	☐	Pg2, Ln13
Authors					
Contact	3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author	☒	☐	Pg1. Ln6-18
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	☒	☐	Pg6, Ln22-26
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	☐	☒	N/A
Support					
Sources	5a	Indicate sources of financial or other support for the review	☒	☐	Pg6, Ln29

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
Sponsor	5b	Provide name for the review funder and/or sponsor	☒	☐	Pg6, Ln29
Role of sponsor/funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	☐	☒	N/A
INTRODUCTION					
Rationale	6	Describe the rationale for the review in the context of what is already known	☒	☐	Pg2, Ln19-45; Pg3, Ln1-19
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	☒	☐	Pg3, Ln21-25
METHODS					
Eligibility criteria	8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review	☒	☐	Pg3, 29-39
Information sources	9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage	☒	☐	Pg3, 39-41
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	☒	☐	Pg3, 39-46,; Table1
STUDY RECORDS					
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	☒	☐	Pg4, 14-15, 36-42
Selection process	11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis)	☒	☐	Pg4, 15-18
Data collection process	11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	☒	☐	Pg4, 36-37
Data items	12	List and define all variables for which data will be sought (e.g., PICO items,	☒	☐	Pg4, Ln38-42

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
		funding sources), any pre-planned data assumptions and simplifications			
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	☒	☐	Pg5, Ln14-20
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	☒	☐	Pg5, Ln1-9
DATA					
Synthesis	15a	Describe criteria under which study data will be quantitatively synthesized	☒	☐	Pg5, 22-24
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (e.g., I^2, Kendall's tau)	☒	☐	Pg5, 24-29
	15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression)	☒	☐	Pg5, 29-31
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	☒	☐	Pg5, Ln14-20
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies)	☒	☐	Pg5, 31-34
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE)	☒	☐	Pg5, 34-36

Appendix B.

Systematic Review Search Strategy

Database	Scopus
Date cutoff	January 2010 - November 2021
Search Query	(TITLE-ABS-KEY (older AND adults OR seniors OR elderly OR elder OR aged OR 50) AND TITLE-ABS-KEY (intervention OR treatment OR therapy) AND TITLE-ABS-KEY (mental AND health OR mental AND illness OR mental AND disorder OR psychiatric AND illness OR depress OR anxiety OR anxious) AND TITLE-ABS-KEY (technology OR digital OR online OR internet OR mobile OR electronic OR "social media" OR smartphone OR web OR mobile OR vr OR ar OR "virtual reality" OR "augmented reality" OR wearable OR computer OR laptop OR e-reader)) AND PUBYEAR > 2009 AND (LIMIT-TO (DOCTYPE , "ar"))
Limits	Search within: Title, Abstract, Keywords; Scopus applies word stemming to fields containing text;
Number of hits	301

Database	PsycInfo and AgeLine (EBSCO)
Date cutoff	January 2010 - November 2021
Search Query	(“older adult$” OR “senior$” OR “elderly” OR “elder$”) AND ("intervention$" OR "treatment$" OR "therapy") AND ("mental health" OR "mental illness" OR "mental disorder$" OR "psychiatric illness*" OR "depress*" OR "anxiety") AND ("technol*" OR "digital" OR "online" OR "internet" OR "mobile" OR "electronic*" OR "social media" OR "smartphone$" OR "web*" OR "mobile app*" OR "smartphone app*" OR “VR” OR “AR” OR “virtual reality” OR “augmented reality” OR “wearable tech*” OR “wearable$” OR “computer*” OR “personal digital assistant$” OR “PDA$” OR “laptop$” OR “e-reader$” OR “Enterprise digital assistant$” OR “EDA$”)
Limits	Source types: Academic Journals, journals; Age: 65+
Number of hits	502

Database	MedLine

Date cutoff	January 2010 - November 2021
Search Query	((("older adult$" OR "senior$" OR "elderly" OR "elder$") AND ("intervention$" OR "treatment$" OR "therapy")) AND ("mental health" OR "mental illness" OR "mental disorder$" OR "psychiatric illness*" OR "depress*" OR "anxiety" OR)) AND ("technol*" OR "digital" OR "online" OR "internet" OR "mobile" OR "electronic*" OR "social media" OR "smartphone$" OR "web*" OR "mobile app*" OR "smartphone app*" OR "VR" OR "AR" OR "virtual reality" OR "augmented reality" OR "wearable tech*" OR "wearable$" OR "computer*" OR "personal digital assistant$" OR "PDA$" OR "laptop$" OR "e-reader$" OR "Enterprise digital assistant$" OR "EDA$")
Limits	Article type: randomized controlled trial; Age: 50+;
Number of hits	399

Appendix C.

Informed Consent for Research Objective 2

TITLE OF STUDY
Factors contributing to the mental wellbeing of community-dwelling older adults

PURPOSE OF STUDY
You are being asked to take part in a research project. Before you decide to participate in this study, it is important that you understand why the research is being done, what is involved and any foreseeable risks and benefits of participating in this study. Please read the following information carefully. If you have any further questions, please do not hesitate to ask the researcher if there is anything that is not clear or if you need more information.
The purpose of this study is to investigate factors that impact seniors' mental wellbeing. Specifically, we are interested in learning about your ideas, what needs to be done to address seniors' and mental wellbeing during the pandemic and beyond.

STUDY PROCEDURES
As a participant in this study you will be asked to take part in a semi-structured interview. If you agree to being interviewed, you will be asked questions concerning your mental health and any factors in your life that impact your mental wellbeing. Questions will cover topics such as the health and social services, social needs, leisure, and what is (or is not) currently working to foster better mental health. With your permission, the interview will be audio recorded. Your participation will require approximately 45-60 minutes of your time. You may withdraw from the study at any point in time. Any identifiable personal information will be replaced with unique participant identifiers (e.g. P1, P2,..) to help ensure confidentiality of your participation. If you choose to withdraw from the study at any point, all data will be deleted immediately. Any research materials or information that may be used to identify you, such as the signed consent form and interview audio recording, will be stored securely in a folder in SFU vault, a secured cloud storage service supported by Simon Fraser University. All files uploaded into this system will be protected under the BC Freedom of Information and Privacy Act (FIPPA). The folder will only be
accessible to the research team members through completion of an identification process. Once the study is complete, all identifiable personal information will be deleted. Your contact information will only be kept by the Principal Investigator in the event that you agree to being contacted in the future in follow-up to your interview or to request participation in future studies and will remain stored securely in SFU Vault.

RISKS
The topic of mental health may be sensitive to certain individuals. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose. You may also ask for a break at any time during the interview. In the case you

experience any mental distress, please visit https://www.healthlinkbc.ca/mental-health-covid-19 for mental health resources or contact toll-free 310-Mental Health (310-6789 - no area code needed) to access emotional support, information, and resources for mental health and substance use issues throughout British Columbia. This service is available 24 hours a day.

COVID-19

The interviewer as well as everyone else in the research team have received at least 2 doses of the COVID-19 vaccination. The interview will be conducted online or in-person following social distancing protocols. KN95 masks will be distributed to all participants for the in-person interviews.

BENEFITS

This study is part of a larger project that aims to develop innovative ways to improve the mental health of marginalized older adults. The information provided through your participation in this study will be used to identify strengths and weaknesses in how social connectedness is being fostered in the context of the pandemic, with particular attention to gaps in knowledge.

WILL YOU BE PAID FOR TAKING PART IN THIS STUDY?

For participating in this study, you will be given an honorarium by way of a gift card of approximately $25 in value via mail. All personal information regarding mailing addresses or emails will be kept in a
confidential folder in SFU Vault, as described above, and will only be accessible to the research team members. In particular, mailing addresses will be deleted once the gift cards have been mailed.
Your receipt of this honorarium will not be contingent on your remaining in the study until project completion. You may withdraw from the study at any time and will still receive payment of the honorarium in full.

CONFIDENTIALITY

Only the study investigators will have access to information in which you are identified, and all records of your participation will be held confidential, except in cases where the researcher is legally obligated to report specific incidents. These include, but may not be limited to, incidents of abuse and suicide risk.
With your permission, the interview will be audio recorded and later transcribed into writing. Audio recordings will be deleted immediately after transcription. At your request, you will be provided a copy of the transcript via email where you will be invited to make changes to the transcript as you wish (e.g., if you would like to withdraw a particular statement you made during the interview). Transcripts sent via email will be password protected to ensure confidentiality.
All identifying information, including signed consent forms and participant contact information, will be stored securely in SFU Vault. De-identified materials, including interview transcripts with all identifying information removed, will be stored on a password-protected computer. All or part of the content of your interview may be used in academic papers, policy papers, or news articles, on the investigators' website and in

other media that the study's investigators and collaborators may produce such as spoken presentations, and in an archive of the project.

CONFLICT OF INTEREST

The principal investigator and the student lead do not receive any compensation from WESN to conduct this study. The student lead is currently an active volunteer at the WESN and will not be receiving any compensation, financial or otherwise, for conducting this study. If you require further information regarding the arrangements described in this paragraph, please refer to the *concerns and complaints* section of this form

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher or West End Seniors' Network. Please note that your participation in this study is not mandatory as a result of your affiliation with WESN. You have the right to refuse to participate in this study or withdraw from the study at any time, for any reason, without explanation, and without any negative consequences to your employment, your relationship with your employer, or any services to which you are entitled or are presently receiving. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

FURTHER CONTACT

If you are agreeable to being contacted in follow-up to your interview if additional questions arise and regarding future opportunities to participate in research, please provide consent below. If you give your consent for future contact, you are agreeing to allow the study investigators to collect your name and contact information and to contact you via telephone or email in follow up to your interview and/or to request participation in future research studies. You are under no obligation to participate in any studies that you are contacted about, and may withdraw permission at any time

☐ Please tick this box if you consent to being contacted for a follow up to your interview.

☐ Please tick this box if you give the researchers permission to contact you regarding future studies

COCERNS OR COMPLAINTS

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, you may contact the Director, Office of Research Ethics

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a
reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.
Participant's signature _____ Date
_____

Investigator's signature _____ Date
_____

Appendix D.

Interview Guide for Research Objective 2

Opening Statement

Thank you for taking the time to speak with me today. As we discussed in our earlier communication, I am a PhD student the supervision of Dr. Theodore Cosco as part of the Precision Mental Health Project at Simon Fraser University. We are conducting this study in order to gain insight about seniors' mental health and factors that impact your mental wellbeing.

The topic of mental health may be sensitive to certain individuals. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose. You may also ask for a break at any time during the interview. In the case you experience any mental distress, please visit the mental health resources we have provided in the written informed consent form.

I'd like to take a moment to briefly go over the consent form which you signed and returned to me the date of _____. Any information obtained during this interview will be kept confidential. This interview will be audio recorded for the purposes of creating a transcript for ease of data analysis. The recording will be destroyed following completion of the study. Again, you may withdraw your participation at any time and are not required to answer any questions today that you do not wish to. Do you have any questions regarding this? Do you consent to participating in this interview?

There are no right or wrong answers to the questions I will be asking; you are the expert, and I am looking for your genuine opinion. The interview will last approximately 30 to 60 minutes. Please stop me at any time if you need a break.

1. Please state your name and age for this interview.
    a. What is the highest level of education you have received?
    b. Can you describe your positionality:
        i. What is your race/ethnicity?
        ii. What is your household income?
        iii. What is your gender identity?
        iv. And sexual orientation?
        v. Is English your first language? What other languages do you speak?
        vi. Please describe to me your familial/kinship and household status? Who do you live with right now?
        vii. Who are the people you are closest to you, and how would you describe your relationships with them right now?

2. How would you define mental health?
    a. What is your understanding of good mental health?

b. What are your experiences with mental health? Has this been diagnosed by a physician?

3. What are some of the factors in your life that impact your mental health the most (positive and negative)?
    a. What do you think is the most important factor and why?
    b. Did these factors change as you age?
        i. What are some of the challenges that you face [as an older adult]?
        ii. (If they mentioned vulnerable positionality such as being a member of a religious, ethnic, racial, or gender minority in the demographic question) How does [your positionality] play a role on the state of your mental wellbeing?
        iii. Do you think your experiences differ from other older adults in the community? If so, how?

4. Can you tell me about the importance of social connections in your life?
    a. How does your social life and the quality and frequency of your social connections affect your mental health?

5. How has COVID-19 affected your mental health?
    a. What are some of the challenges that you face that you didn't face before?
    b. Could you describe a specific experience? (If unclear: can you describe what your day looked like pre and post COVID-19? Can you expand on that?)

6. What are the steps that you have taken to maintain good mental health?
    a. Have you used any seniors' programs/services/initiatives that helped improve your mental health? If so, please describe your experience

7. What are your thoughts on using technology to improve the mental wellbeing of seniors?
    a. Can technology help alleviate the social disconnectedness that seniors face during COVID-19?
    b. What are some of the challenges that seniors face when using technology?
    c. What are some of the ways that you think these challenges can be minimised?

8. Moving forward, what would you like to see change in the community that can help improve the mental wellbeing of seniors?

Closing Statement

Thank you, you've provided some invaluable insight into this topic. It's very important to hear the perspectives of _____. We've now gone over all of the questions that I have prepared. I'd now like to take some time to open the conversation to any relevant topics you would like to discuss or any additional information you would like to share with me.
What do you think I should have asked you about this topic that I didn't?
Are there any further thoughts you would like to share?
If there are any aspects of our discussion today that I am unclear on, do I have your permission to contact you via phone or email to request clarification?
If there are any questions or concerns that you have after the interview has ended, please feel free to contact myself or Dr. Cosco by telephone or email so that we may address them.

Appendix F.

Informed Consent for Research Objective 3

TITLE OF STUDY
Digital interventions to improve social connectedness and mental wellbeing of vulnerable older adults during COVID-19 and beyond

PURPOSE OF STUDY
You are being asked to take part in a research project. Before you decide to participate in this study, it is important that you understand why the research is being done, what is involved and any foreseeable risks and benefits of participating in this study. Please read the following information carefully. If you have any further questions, please do not hesitate to ask the researcher if there is anything that is not clear or if you need more information.
The purpose of this study is to gain insight about digital literacy, learning technology, and tech-related services to improve the quality of life and mental wellbeing from the perspectives of marginalized community-dwelling older adults, the staff members of the West End Seniors Network (WESN), and volunteer technology coaches at WESN. Specifically, we are interested in learning about what's currently being done, what works, and what still needs to be done to address seniors' digital literacy and foster social connectedness, engagement, and mental wellbeing.

STUDY PROCEDURES
As a participant in this study you will be asked to take part in a semi-structured interview. In light of the current COVID-19 pandemic, interviews are planned to be conducted virtually via Zoom in keeping with safety guidelines and recommendations. If you agree to being interviewed, you will be asked questions concerning the impact of the COVID-19 pandemic on social connectedness and mental health of the marginalized population of older Canadians. Questions will cover topics such as the health and social service needs within the context of the pandemic, whether these needs are being met, and what is (or is not) currently working to foster better mental health for this population. With your permission, the interview will be audio recorded via the video conferencing platform Zoom. Your participation will require approximately 45-60 minutes of your time. You may withdraw from the study at any point in time. Any identifiable personal information will be replaced with pseudonyms to help ensure confidentiality of your participation. If you choose to withdraw from the study at any point, all data will be deleted immediately. Any research materials or information that may be used to identify you, such as the signed consent form and interview audio recording, will be stored securely in a folder in SFU vault, a secured cloud storage service supported by Simon Fraser University. The folder will only be accessible to the research team members through completion of an identification process. Once the study is complete,

all identifiable personal information will be deleted. Your contact information will only be kept by the Principal Investigator in the event that you agree to being contacted in the future in follow-up to your interview or to request participation in future studies and will remain stored securely in SFU Vault. Please see the further contact section of this form for more detail.

RISKS

The topic of mental health may be sensitive to certain individuals. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose. You may also ask for a break at any time during the interview. In the case you experience any mental distress, please visit https://www.healthlinkbc.ca/mental-health-covid-19 for mental health resources or contact toll-free 310-Mental Health (310-6789 - no area code needed) to access emotional support, information, and resources for mental health and substance use issues throughout British Columbia. This service is available 24 hours a day.

You will also be asked to disclose sensitive information such as your sexual orientation, gender identity, your relationship with family members, and your socio-economic status. Once again, any identifiable personal information will be replaced with pseudonyms to help ensure confidentiality of your participation. Please see the section on *confidentiality* below for further information.

The interview will be hosted by Zoom, a US company, and as such, is subject to the USA Patriot Act and CLOUD Act. These laws allow government authorities to access the records of host services and internet service providers. By choosing to participate, you understand that your participation in this study may become known to US federal agencies.

BENEFITS

This study is part of a larger project that aims to develop innovative ways to improve the mental health of marginalized older adults. The information provided through your participation in this study will be used to identify strengths and weaknesses in how social connectedness is being fostered in the context of the pandemic, with particular attention to gaps in knowledge.

WILL YOU BE PAID FOR TAKING PART IN THIS STUDY?

For participating in this study, you will be given an honorarium by way of a gift card of approximately $25 in value via mail. All personal information regarding mailing addresses or emails will be kept in a confidential folder in SFU Vault, as described above, and will only be accessible to the research team members. In particular, mailing addresses will be deleted once the gift cards have been mailed.

Your receipt of this honorarium will not be contingent on your remaining in the study until project completion. You may withdraw from the study at any time and will still receive payment of the honorarium in full.

CONFIDENTIALITY

Only the study investigators will have access to information in which you are identified, and all records of your participation will be held confidential, except in cases where the

researcher is legally obligated to report specific incidents. These include, but may not be limited to, incidents of abuse and suicide risk.
With your permission, the interview will be audio recorded and later transcribed into writing. Audio recordings will be deleted immediately after transcription. At your request, you will be provided a copy of the transcript via email where you will be invited to make changes to the transcript as you wish (e.g., if you would like to withdraw a particular statement you made during the interview). Transcripts sent via email will be password protected to ensure confidentiality.
All identifying information, including signed consent forms and participant contact information, will be stored securely in SFU Vault. De-identified materials, including interview transcripts with all identifying information removed, will be stored on a password-protected computer. All or part of the content of your interview may be used in academic papers, policy papers, or news articles, on the investigators' website and in other media that the study's investigators and collaborators may produce such as spoken presentations, and in an archive of the project.

CONFLICT OF INTEREST
The principal investigator and the student lead do not receive any compensation from WESN to conduct this study. The student lead is currently an active volunteer at the WESN and will not be receiving any compensation, financial or otherwise, for conducting this study. If you require further information regarding the arrangements described in this paragraph, please refer to the *concerns and complaints* section of this form

VOLUNTARY PARTICIPATION
Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you are an employee of
Or are in some way affiliated with one of the organizations supporting recruitment for this project (West End Seniors' Network), please note that your participation in this study <u>is not mandatory</u> as a result of this affiliation. You have the right to refuse to participate in this study or withdraw from the study at any time, for any reason, without explanation, and without any negative consequences to your employment, your relationship with your employer, or any services to which you are entitled or are presently receiving. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

FURTHER CONTACT
If you are agreeable to being contacted in follow-up to your interview if additional questions arise and regarding future opportunities to participate in research, please provide consent below. If you give your consent for future contact, you are agreeing to allow the study investigators to collect your name and contact information and to contact you via telephone or email in follow up to your interview and/or to request participation

in future research studies. You are under no obligation to participate in any studies that you are contacted about, and may withdraw permission at any time be contacting Indira Riadi, indira_riadi@sfu.ca

☐ Please tick this box if you consent to being contacted for a follow up to your interview.

☐ Please tick this box if you give the researchers permission to contact you regarding future studies

CONCERNS OR COMPLAINTS

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, you may contact the Director, Office of Research Ethics

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Appendix G.

Interview Guide for Research Objective 3

Opening Statement

Thank you for taking the time to speak with me today. As we discussed in our earlier communication, I am a PhD student the supervision of Dr. Theodore Cosco as part of the Precision Mental Health Project at Simon Fraser University. I want to thank you for taking the time to join me today to discuss ways to improve or create new technology-based programs, activities, and interventions to help community-dwelling seniors combat social isolation and improve their mental wellbeing.

b. Consent Process

I'd like to take a moment to briefly go over the consent form which you signed and returned to me the date of _____. Any information obtained during this interview will be kept confidential. This interview will be audio recorded for the purposes of creating a transcript for ease of data analysis. The recording will be destroyed following completion of the study. Again, you may withdraw your participation at any time and are not required to answer any questions today that you do not wish to. Do you have any questions regarding this? Do you consent to participating in this interview?

There are no right or wrong answers to the questions I will be asking; you are the expert, and I am looking for your genuine opinion. The interview will last approximately 30 to 60 minutes. Please stop me at any time if you need a break.

<u>Initial Questions</u>

1. Tell me about what the seniors in the community have shared with you [for seniors: Tell me about your experience] with regards to social isolation and disconnectedness during COVID-19.
    a. What has changed since before the pandemic?
    b. What do you think is the ideal social situation right now?
    c. What has helped them maintain social relationships throughout COVID-19?

2. [For volunteers] You are all volunteers at WESN who have helped seniors with technology-based problems. Generally, how comfortable are seniors with using technology?
    a. What is the most frustrating part about using technology?
    b. What do you think is the easiest/best feature to have in a device?
    c. Can you tell me about an experience that you've had when helping seniors using technology to connect with others?

3. [For staff] You are all staff at WESN who have helped seniors with technology-based problems. Generally, how comfortable are seniors with using technology?
    a. What is the most frustrating part about using technology?

b. What do you think is the easiest/best feature to have in a device?
c. Can you tell me about an experience that you've had when helping seniors using technology to connect with others?

4. [For seniors] Generally, how comfortable are you with using technology?
    a. What is the most frustrating part about using technology?
    b. What do you think is the easiest/best feature to have in a device?
    c. Can you tell me about an experience that you've had when someone has helped you with technology? What worked and what didn't?

<u>Learning Technology</u>

5. What can we do to make the learning technology experience easier for this population?
    a. What can we do to ease the financial burdens that come from owning and using technology?
        i. Probe: obtaining devices, internet connections
    b. What can we do to aid individuals with specific needs to learn and use technology?
        i. Probe: Physical disability
        ii. Psychological disabilities
        iii. Language barriers

6. After everything that we have discussed, can you think of a tech-based program during and beyond COVID-19 that you think can help seniors with their mental wellbeing and social connectedness.
    a. What does that program look like?
    b. How will it specifically help seniors in this community?
    c. How can we get started with the creation of this program?

<u>Future Directions</u>

7. What you would like to see happen in the near future?
    a. What other services that relate to technology social connections, and mental health will you be interested in providing to seniors in the community? [for seniors: what other services that relate to technology and social connections and mental health are you interested in seeing?]
    b. What devices and/or applications do you want to see be developed in the future? (be specific, think about how it looks like, is it accessible? Is it easy to use?)

Is there anything further you would like to discuss that we did not ask you regarding the development of technology-based programs or interventions for mental wellbeing and social connectedness?

Appendix H.

Request for organizational support in research recruitment

Dear West End Seniors Network,

Our research group at Simon Fraser University is conducting a study seeking to gain insight about digital-based programs/interventions for marginalized seniors' social (dis)connectedness and mental health within the context of the COVID-19 pandemic. We are writing to request your support in our efforts to recruit individuals who may speak knowledgeably on this topic. As part of this project, we are seeking to conduct interviews, surveys, and a focus group with marginalized community-dwelling older adults in the Vancouver West End as well as WESN organizational staff to attain in-depth, relevant, and diverse perspectives as to the impact of COVID-19 on social connectedness as wellbeing among older Canadians.

As an organization whose initiatives align closely with the directive of enhancing the mental, physical, and social wellbeing of Canadian seniors, your support in this project will be invaluable. We believe that your connections with community-dwelling older adults will enable recruitment of individuals who may provide critical insight about what's currently being done, what works, and what still needs to be done to address seniors' social isolation and foster social connectedness and mental wellbeing during the pandemic.

Your support in this aspect of the project may involve facilitating introductory communication between research team members and potential participants. Please note that given current pandemic restrictions, all study activities are planned to be conducted virtually.

We are available to answer any questions you may have about this study and the potential role of your organization in the recruitment process.

Thank you for your time and we look forward to connecting in the future.