# Bridging the Digital Divide: Examining the Use and Access to E-Health Based Technologies by Millennials and Older Adults in Ontario, Canada

by

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An oral defense of this thesis took place on June 26, 2020 in front of the following examining committee:

**Examining Committee:**

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The above committee determined that the thesis is acceptable in form and content and that a satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate during an oral examination. A signed copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

**Abstract**

The digital divide is the *gap* between demographics and regions that have access to information communication technologies and those who do not. The older adult generation may not be familiar with e-Health usage, compared to generations such as millennials. A convenience non-random descriptive comparative study was conducted; Information was collected based on demographics; health information collection, usage and distribution; E-health and e-health technology usage; and digital literacy levels. Millennials (n=31) were undergraduate students recruited at Ontario Tech University; Older adults (n=28) were recruited from senior centres in the Durham region. Data was examined using sex and age cohort, to identify any statistically significant differences. Results showed that older adults had a decreased understanding of E-health based technologies, digital literacy, and accessed the internet less. These preliminary findings suggest that there are noted challenges facing older Canadians in terms of utilization of e-health technologies, in comparison to younger Canadians in Ontario.

**Keywords:** Digital divide, ICT, older adults, millennials, technology, E-health

## Author's Declaration

I hereby declare that this thesis consists of original work of which I have authored. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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The research work in this thesis that was performed in compliance with the regulations of Research Ethics Board/Animal Care Committee under **REB Certificate number 15340**

Delana Theiventhiran

## Statement of Contributions

Appendix M has been published as:

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## Dedication

I dedicate this thesis to my Amma and Appa. Without you, I would not be here today. You have worked so hard to give me a better life, and there is nothing more I appreciate. Getting to dedicate my thesis to you is my greatest honour. Thank you, from the bottom of my heart.

**தந்தை மகற்கு ஆற்றும் நன்றி அவையத்து**
**முந்தி இருப்பச் செயல (குறள் 67)**

***கற்றது கை மண் அளவு. கல்லாதது உலகளவு.***

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# Chapter I: Significance and Review of the Literature

## 1.1 Background and Rationale

The on-line world has the empowering potential for lay individuals and health care professionals alike to find health related information that is contextually relevant; to identify peers or experts related to various diseases or conditions; to locate local or on-line support groups, and to plan for and engage in various preventative actions for change and for health promotion (e.g., Eysenbach, 2008; Ferney & Marshall, 2006; Flicke, Maley and Ridgley, 2008; Kreps and Neuhasuer, 2010; Robinson and Robertson, 2010). In fact, Canadians are amongst the most active users of the Internet averaging 43.5 hours per week online, compared to the global daily average of only 23.1 hours (Canadian Broadcasting Corporation [CBC], 2011). Similarly, the number of broadband subscriptions globally has increased from 1.4 million in 2000 to over 3.6 billion in 2017 (ICT Data and Statistics Division, 2017).

Most individuals in developed nations such as Canada use mobile information and communication technologies (ICTs) as functional tools in everyday life (e.g., smartphones, tablets), and many could not imagine living in a world without daily access to the Internet for work, play, shopping, getting directions, and doing their banking. However, in a technologically advanced society, it is important to note that not everyone is familiar or comfortable with using these technologies (Becker, 2004; Levy, 2003; Morris, 2007; Stanley, 2010). Canadian Internet users for the ages of 34 and younger has increased substantially from 72.6 in 2005 to 82.9 in 2009. Similarly, Internet users aged 65 and older have also increased as well from 62.8% in 2005 to 65.9% in 2009 (Statistics Canada, 2013). This trend suggests an increasing acceptance, reliance and use of Internet based technologies by older Canadians. It is noteworthy that as of January 2018, 89% of Canadians surveyed reported using the Internet on a daily basis (Statistica, 2018). For example, Statistics Canada (2017) reports that E-commerce retail trade sales alone amounted

to over $ 1.8 billion (CDN); and revenue generated within the retail E-commerce market is expected to reach almost $29 billion by 2021, up from $18.3 billion in 2016. Hence, public health professionals and workers need to be cognizant of these trends and develop E-health based technologies and programs that target daily Internet users and trends related to Internet usage.

> "*Technology is only as powerful as it is accessible. Broader access brings education, information, and a sense of community that can help combat AIDS, malnutrition, ignorance and neglect. The power of a connected and enlighted world community is just the beginning*". Source: Hector Ruiz. Cited in Internet World Stats. Usage and Population Statistics (2018).

Public health services and their delivery can be significantly enhanced through the use of innovative and interactive E-health- and/or telehealth-based technologies and interventions that are specifically tailored to meet the client's health care needs (Bartfay & Bartfay, 2018). E-health is defined as "the use of telecommunications technologies and electronic information to exchange health care information and to provide and support services such as long-distance clinical health care to clients" (Hebdra and Czar, 2013, p. 505). Moreover, the development and employment of ICTs have had considerable effects on our daily lives affecting how we work, communicate, shop, do business globally, and socially interact on a daily basis. The term ICTs includes a variety of computer-based technology systems and applications for collecting, sending, retrieving and processing information, data and communications (Bartfay & Bartfay, 2018; Morris, 2007; Stanley, 2010).

## 1.2 The "Digital Divide"

Currently, there is a dearth of literature examining the use of E-health-based technologies to access health related information, especially from the uniquely Canadian context and perspective. The term digital divide is defined as "the gap between ICT 'haves' and 'have-nots', and serves as an umbrella term for many issues, including infrastructure and access to ICTs, use and impediments to use, and the crucial role of ICT literacy and skills to function in a digital information based society (Aviram & Eshet-Alkalai, 2006; Compaine, 2001; Hinrichsen & Coombs, 2014; Millward, 2003; Sciadas, 2000). This term also refers to the *gap* between demographics and regions that have access to modern information and communications technology, and those that don't or have restricted or limited access (Chinn et al., 2004; Norris, 2001). Access to technology and the Internet also plays a large part in the way that individuals are able to receive and use information. In fact, the Canadian Radio-Television and Telecommunications Commission has stated that broadband Internet is an essential service that should be delivered to all Canadians equally and adequately (CBC, 2017). Canada has many Internet "dead zones" where infrastructure for Internet connection has not been placed due to our unique geography and the rural/ urban divide. As a result, many rural and smaller towns have been introducing their own broadband infrastructures to help combat that situation and provide equal access to the Internet for all.

## 1.3 Systematic Review of the Literature

Despite the growth and the use of Internet based health related websites on various topics such as chronic and infectious disease, medications, nutrition and diets, there is currently a dearth of information related to who is actually accessing and how they are using these websites. Accordingly, a systematic review of the literature was undertaken to identify how E-based health

technologies are accessed and used by millennials in comparison to older adults, and to identify gaps in the literature and potential directions for future research.

## 1.4 Methods

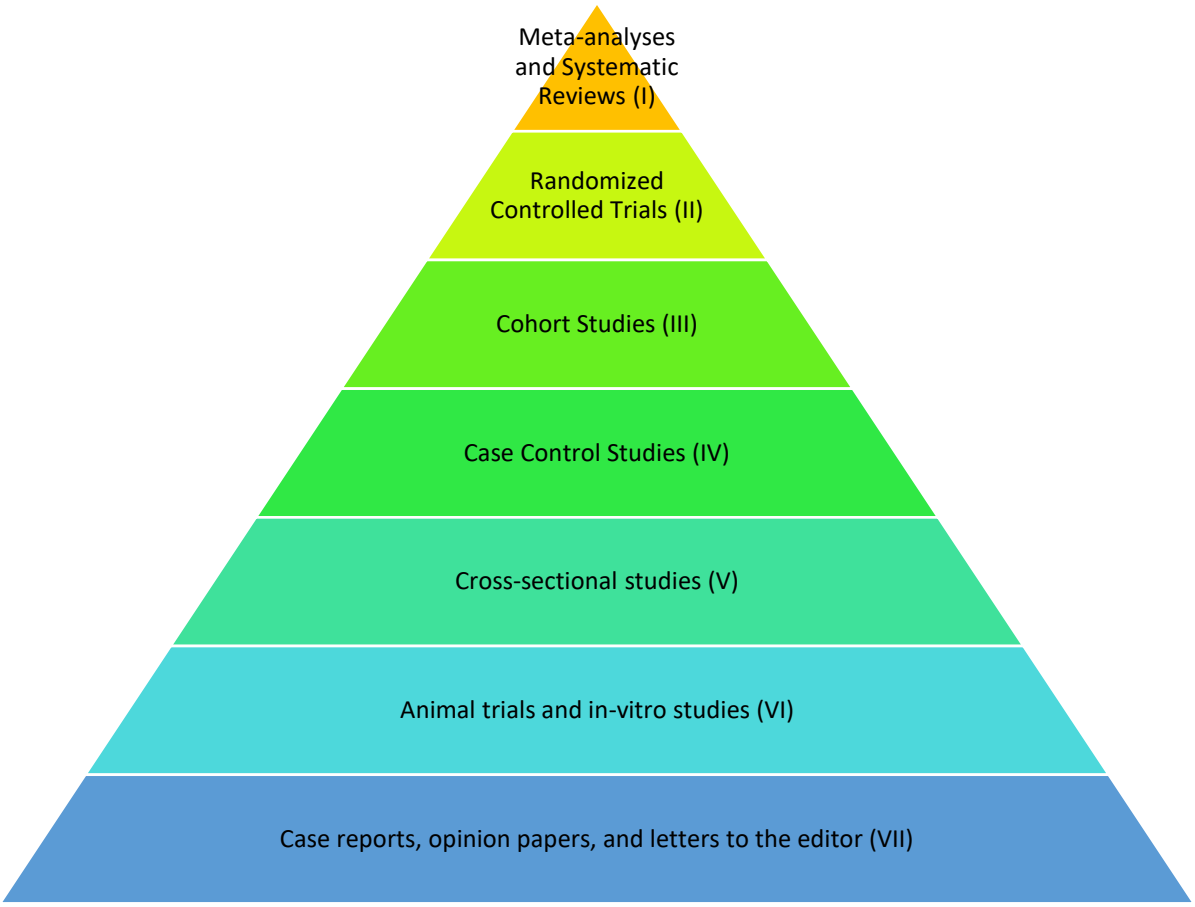
For the purpose of this systematic review of the literature, I examined the following three online computer databases: (i) PubMed; (ii) CINAHL, and (iii) ERIC. For further assistance, I consulted the University of Ontario Institute of Technology's reference librarian regarding search strategies. Preliminary searches consisted of the key terms "digital divide AND generations", and a combination of different search terms to outline "digital divide and older adults" (ie. Older adults, elderly, 65+) as well as for millennials (i.e., young adults, university students, college students). I also consulted with the university's reference librarian, to identify the best possible ways to locate my search results. Inclusion criteria included the following: (i) Published quantitative peer-reviewed articles published between the years January 2009 and May 2018; (ii) articles had to be published in English only, and (iii) studies had to focus on the target populations for the review compromised of older adults and millennials. Exclusion criteria for the systemic review included: (i) Letters to the editor (ii) theory-focused articles, (iii) non-English articles, and (iv) qualitative-based studies or reports.

A data abstraction template was employed to assess the suitability of the articles, and was compromised of the following information: (i) Type of article (research-based, quantitative, system review); (ii) ranking of article in the order listed in Flow Chart II (iii) name of author(s); (iv) year of publication; (v) country of origin, and (vi) main outcomes and/or conclusions reached. Once potential abstracts were located, articles were read and examined for their suitability. Examination followed a multi-level screening in which abstracts were first examined for suitability

and relevance, and then continued to screen the full-length article. Following the initial preliminary search, multiple follow-up searches were employed using terms such as “65+” such as “elderly”, and “senior”, to ensure all potential and relevant articles were identified. Lastly, the reference lists for all primary articles located that were deemed appropriate or suitable were also examined for potential secondary data sources.

The retrieved articles were also ranked, according to a seven-point hierarchical system as reported by Bartfay and Bartfay (2018, p. 202-204). This ranking system is based off of the Cochrane model, in which the studies are based on specific quality criteria (Cochrane Library, 2020). Specifically, Level I investigations were regarded as the strongest evidence and studies, and consisted of systematic reviews and multi-centred randomized clinical trials (RCTs) or non-randomized clinical trials. Level II studies consisted of a single RCT or a single non-randomized clinical trial. Level III investigations consisted of a single systematic review of an observational and/or correlational-type study. Level IV investigations consisted of a single observational or correlational study. Level V investigations consisted of a systematic review of some laboratory-based physiological study, descriptive study and/ or a qualitative investigation. Level VI studies comprised on a single laboratory-based physiological study, descriptive study or qualitative investigation. Lastly, Level VII investigations were regarded as the lowest ranking, and were comprised of opinions by single individuals in their noted field of expertise and/or expert panels or committees. The studies were documented by ranking for reference purposes.

**Figure 1.1 Hierarchical Chart of Study Ranks**

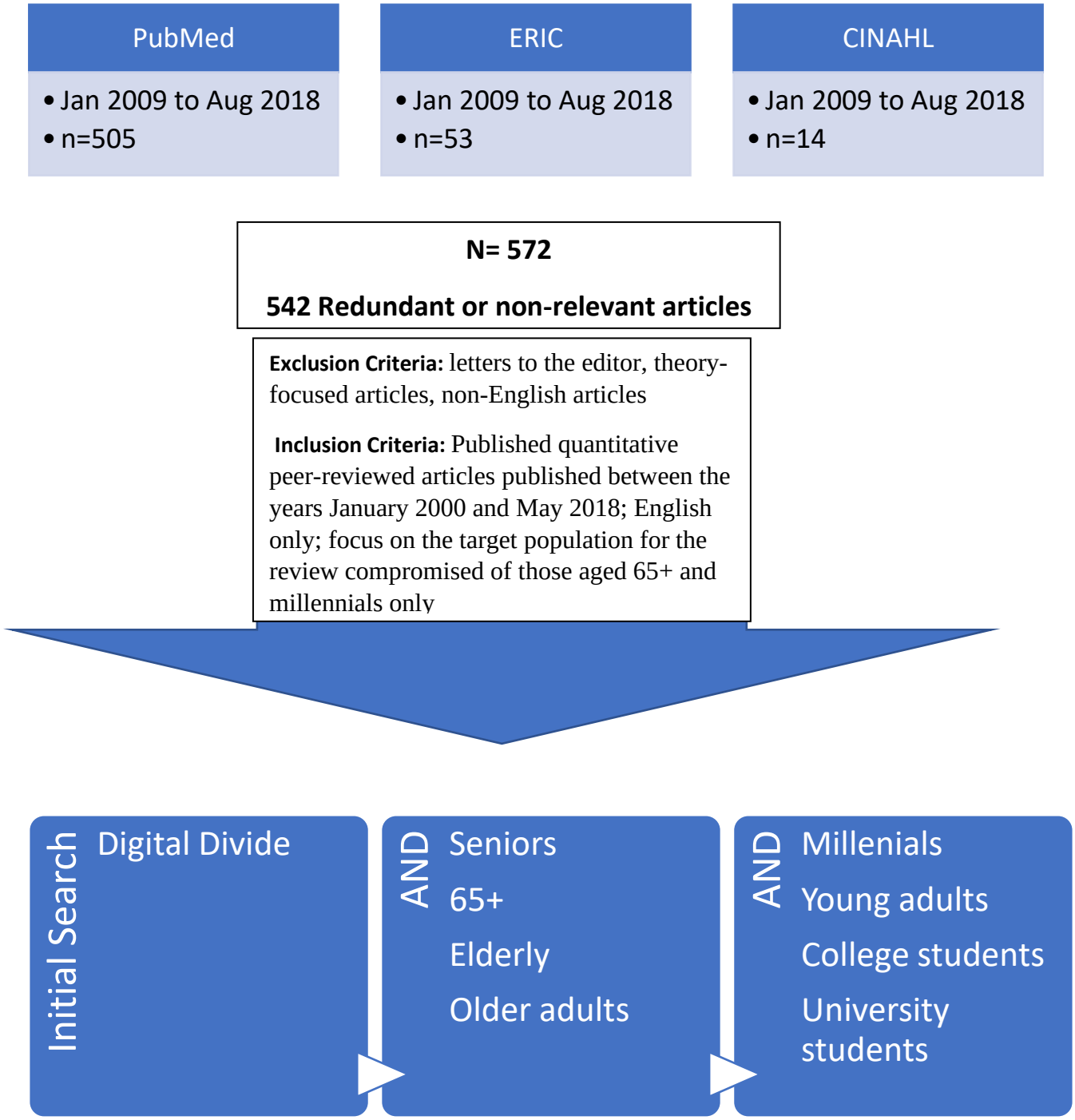



## Search Results

### PubMed

The initial search on PubMed retrieved 505 potential articles. Following that search, inclusion criteria was manually applied by clicking the boxes on the left of the screen, which brought down the list to 27 articles. After examining for suitability, 23 articles were selected and the data abstraction tool was then employed to extract data from the study.

**Figure 1.2 Flowchart of Systematic Review Search Methods**



**ERIC**

The initial search performed on ERIC provided 53 potential articles. Following the application of the inclusion criteria, that list was brought down to 11 potential articles. After examining for suitability, no articles were found to be suitable for the purpose of this study.

**CINAHL**

The initial search performed on CINAHL provided 14 potential articles. Following the application of the inclusion criteria, the list presented 12 hits. After examining for suitability, the list was brought down to eight hits, and had the data abstraction tool applied to extract relevant data from the study. The reader is referred to Table 1.1 below, which highlights key information regarding the studies including authors and country of origin, study design and methods, major outcomes and ranking. Studies that were excluded were due to a lack of suitability, did not address the topic, or were clinical in nature. Studies were also excluded if they did not meet the inclusion or exclusion criteria.

**Table 1.1: Summary of articles located from PubMed, ERIC, and CINAHL**

| Authors and Country of Origin | Design/Methods | Major Outcomes/Results | Ranking |
|---|---|---|---|
| **Bhuyan, Lu, Chandak, et al. (2016)- USA** | • Looked at mobile health applications for health behaviours.<br>• 36% of respondents had health apps<br>• 60% reported usefulness of health apps in health behaviour goals.<br>• 35% stated there was helpfulness in medical care section making<br>• 38% reported usefulness in asking physicians new questions. | • Mobile health apps can reduce the burden on primary care, reduce costs and improve quality on health care.<br>• There is also a privacy concern on who has access to information in the mobile health apps. | III |
| **Cresci, Yarandi, Morrell. (2010)- USA** | • Examined the health, demographic and social activities of urban older adults.<br>• Secondary analysis via 2001 Detroit citywide assessment of older adults. | • Computer users were younger, had a high level of employment and education, and were healthier and more active.<br>• Internet was used to connect with friends and family and playing | III |

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| | | games, and writing. | |
| **Delello, & McWhorter. (2016)- USA** | • Those 65+ are experiencing social isolation, loneliness, depression and decline in health.<br>• The study looks to find if ICTs (ipads) improved the lives of older adults | • Use of technology brought increased knowledge, closer gamily ties, and a greater connection to society. | III |
| **Duplaga (2017)- Poland** | • Examined looking at Internet usage with those who have disabilities on a nationwide study in 2013 in Poland | • 33.05% were Internet users<br>• 3556 respondents with disability 51.02% were females<br>• 25.19% were 65+ | III |
| **Gracia,&Herrero. (2009) – Spain** | • Aims to look at the association between Internet use and self-rated health in older individuals and see if there is an interaction when examining socioeconomic status.<br>• 709 individuals were examined in Spain, and were compared using two age groups (55-64 | • Relationship between Internet usage and poor self rated health, which supported the notion that Internet users have better self rated health then those who are non users.<br>• When applied using social class, the relationship was | III |

| | | | |
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| | and 65-74 years of age). | eliminated, which suggest that the Internet is not a significant determinant of health in older people. | |
| **Hong, Cho. (2016)- USA** | • 2003 to 2011 using the HINTS survey.<br>• Examined by 4 online behaviours: seeking health info, buying medicine, connecting with people who have similar health problems, and communicating with doctors. | • Digital health divide between different demographic groups is narrow but those who are older, do not have a HS education, and low income lagged | III |
| **Hong, et al., (2017)- China** | • Examine the current rates of access to mobile tools among Chinese individuals aged 45+.<br>• Used neighbourhood amenities and community level resources | • 18215 participants, 6.51% used Internet in the past month<br>• 83% owned a mobile phone<br>• Divide is present in china in an older population. Internet access is limited to people with higher SES. | V |
| **Hurme, Westerback, & Quadrello. (2010)- Finland** | • Sample of Finnish grandchildren and grandparents; | • The further the grandparent lives, the further the | I |

| | | | |
|---|---|---|---|
| | examining distance, age, gender, and education for grandparents. | face-to-face contact is, but more letters and cards.<br>• Grandchildren tend to use text messaging instead. | |
| **Kania-Lundholm, Torres. (2015)- Sweden** | • Research on older active ICT users looks at why those who are older age consider themselves as unable to use technology | • Interviews with 30 older adults (Aged 66-89).<br>• Positioning theory is used to shed light on how the older people interview positioned as active older issues. | III |
| **Levy, Janke, Langa. (2014)- USA** | • Health literacy and use of Internet for obtaining health info.<br>• Among Americans 65+.<br>• Sample size was 824 individuals and 1584 Internet users. | • Results showed only 9.7% of individuals with low health literacy used the Internet to obtain health information<br>• Above compared to 31.9% of individuals who have health literacy.<br>• Persistent result after controlling SES, health status and general cog. ability | III |

| | | | |
|---|---|---|---|
| **Levy, Janke, & Langa.(2014)- USA** | • Cross sectional survey using 225 adults to examine if HIT is able to improve quality of care and health outcomes. | • 76% of respondents had Internet access, users and nonusers of online health info differed.<br>• Those who used laptops, computers, and smartphones were more likely to be efficient in HIT. | V |
| **Luger, Hogan, Richardson, Cioffari-Baillif, Harvey, & Houston. (2015)- USA** | • Older adults have less access to Internet<br>• Data collected via mail survey with a sample of 266 veterans aged 65+.<br>• 50% reported having no Internet access but they reported feeling comfortable with help to access Internet. | • Older individuals are willing to access the Internet if they have technology support. | III |
| **Mackert, Mabry-Flynn, Champlin, Donovan, & Pounders (2016)- USA** | • 4974 American adults were looked at to examine if health literacy affected HIT use. | • Patients with low health literacy did not use HIT tools as much but they thought HIT use was private.<br>• It is important to examine | IV |

| | | | |
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| | | the way that HIT provides privacy and that individuals are able to use full benefits. | |
| **Nguyen, Mosadeghi, & Almario. (2017) United States of America** | • 81.5% of individuals reported using the Internet previously.<br>• 64.5% stated that they used the Internet within the past year. | • Individuals who lived in lower income households and rural areas were less likely to have access to use Internet for health information. | III |
| **Seifert, & Schelling (2016)- Switzerland** | • Examined those aged 65+ living in Switzerland via telephone survey. | • Those online found better positive aspects of the Internet compared to those who didn't. | III |
| **Van Deursen, & Van Dijk. (2011) – Netherlands** | • E-Health literacy is one of the bigger aspects that have been presented following the increase of technology in health care.<br>• 88 subjects participated in the study.<br>• Each subject had to work on assignments through the Internet and | • Unable to find out who is proficient in technology vs who is not.<br>• Subjects were able to complete 73% of the Internet tasks<br>• 73% of the formal tasks<br>• 50% of Internet tasks were completed<br>• 13% for informational skills | III |

| | | | |
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| | focused on areas such as operational, formal, informational and strategic. | • Age and education were crucial contributors in this area. | |

## 1.5 Discussion and Conclusion

This systematic review specifically targeted investigations with older adults aged 65+ and younger adults aged between 18-24 to examine and contrast the two assumed extremes of E-health technology usage. Based on my review, I conclude that there is currently a dearth of literature examining the digital divide for accessing and using E-health based technologies in general. Moreover, to my knowledge, no investigations to date have examined the digital divide for E-based health technologies between millennials and older adults, especially from the uniquely Canadian context and perspective. There were three major themes that emerged from this systematic review of the literature: (i) Age and the digital divide; (ii) privacy concerns, and (iii) digital literacy. I shall discuss each of these major themes in more detail below.

### (i)Age and the Digital Divide

Age was found to be one of the major contributing factors in regards to the digital divide in a total of 9 articles reviewed (e.g., Delello and McWhator, 2016; Duplaga, 2017; Gracia and Herrero, 2009; Hurme et al., 2010; Hong et al., 2017; Kania-Lundholm and Torres., 2015; Levy et al., 2014; Luger et al.,2015; Van Deursen et al., 2011). This finding is consistent with those previously reported in the literature (e.g., Hesse et al., 2005; Sciadas, 2000; Underhill & McKeown, 2008). For example, Sciadas (2000), reported that Internet access and usage in Canada declined dramatically with age, from over 90% for teenagers to less than 5% for adults aged 70 years and older. This can be attributed to the reasoning that millennials grew up with technology (Hurme et al, 2011; Layne & Nielsen, 2002; Opalinski, 2001), and tend to use technology such as social media as sources for communication, socializing and entertainment (Becker, 2004; Van Deursen and Van Dijk, 2010). Additionally, technology is largely used in the school and work setting to help support regular daily processes, applications and requirements.

In regards to those 65+, they were found to be not as familiar with technology (N=9), and only utilize technology when actually required (Cresci et al., 2010; Hong et al., 2017; Kania-Lundholm and Torres., 2015; Levy et al.,2014; Luger et al., 2015; Makoret et al., 2016; Nyugen et al., 2017; Seifet and Shelling., 2010; Van Deursen et al., 2011). Those aged 65+ were also found to need assistance and/ or guidance to access and use E-health based technologies (Becker, 2004; Luger et al, 2015; Millward, 2003; Opalinski, 2001).

A study by Loges and Jung (2001) examined the digital divide and the relationship it has it regards to age. The investigators hypothesized that age has a negative association with Internet access. The study found that older adults used less Internet-based applications, in comparison to younger adults. Similarly, Friemal (2014) reported that individuals aged 65 years and older were partially excluded from Internet usage. The studies by Korrupp and Szydlik (2008) and Loges and Jung (2011) further suggests that age and the instances of usage often correlate with the level of familiarity, fluency and knowledge an individual has with using the Internet.

(ii) **Privacy Concerns**

A total of 2 studies reviewed identified that privacy concerns were one of the main deterrents of technology usage for elderly individuals aged 65 and over (Bhuyan et al., 2016; Makkert et al., 2016). The older adult generation feels that privacy is one of their major concerns, especially in regards to how personal data may to collected, employed and/or sold to third party individuals by Internet and website developers. By contrast, it appears that younger adults are more willing to reveal personal information (e.g., age, sex, location), and are less concerned about privacy issues per se (Hinrichsen & Coombs, 2014; Morris, 2007; Stanley, 2010).

It is notable that the terms and conditions that were outlined in E-health related apps, for example, were often difficult to read (i.e., small font size), and technical terms were often employed. (Bartfay & Bartfay, 2018; Caldwell, Slatin & Vanderheiden, 2008; Eysenbach & Kohler, 2002). For example, Obar aand Oeldorf-Hirsch (2016) note that online users tend to agree to terms of services and privacy policies 93% and 97% of the time, respectively. This is a cause for concern as the privacy policy and the terms of service should have taken between 29 and 32 minutes to read, which did not happen with the majority of participants (N=543) in this investigation (Obar aand Oeldorf-Hirsch, 2016). Hence, it is not surprising that older adults often note that the terms and conditions are often long and technical in nature, which serve as deterrents from using E-health based apps (e.g., to measure their heart beat and steps per day taken) (Layne & Nielsen, 2002; Morris, 2007; Stanley, 2010).

**(iii) Digital Literacy**

Digital literacy is defined as the ability to find, evaluate, produce and communicate clear information through writing and other forms of communication on various digital platforms and devices such as smartphones, tablets, laptops and desktop PCs (Aviram & Eshet-Alkalai, 2006; Hinrichsen & Coombs, 2014). Digital literacy also showcases an individual's grammar, computer, writing, and typing skills on platforms, such as social media and blog sites. While digital literacy has historically focused on digital skills and stand-alone computers, its focus has shifted to network devices including the Internet and use of social media over the past few decades. For example, community-centres and libraries play an important role in helping older adults overcome their resistances to accessing and employing Internet-based technologies to achieve computer literacy; however, they are presently underutilized resources by older adults (Millward, 2003; Stanley, 2010). Morris (2007) reports that perceived barriers for E-literacy for older adults include lack of

interest, feeling too old, fear of new technology, lack of access to IT, lack of IT skills and experience, cost, concerns about security, and problems associated with disability (Morris, 2007; Statistics Canada, 2016).

## 1.6 Implications for Public Health

As the Internet is becoming the epitome of modern communications, there are many pragmatic reasons why the digital divide matters in terms of accessing and using E-health based technologies. Indeed, technology usage has widely been associated with those in the millennial generation, who are defined as individuals born between the years of 1981 to 2000 (Pew Research Center, 2018). Milestones of their generation include the rise of technology such as smartphones and tablets, social media, as well as entering the work force during the economic recession (Pew Research Center, 2018). Most millennials in today's day would be between the ages of 18 and 37. Conversely, older adults are here defined as those born between 1946 and 1965, and would be between the ages of 54 and 72.

With the rise of technology usage globally, those in the older adult generation may not be as familiar and comfortable with technology usage, and are thus put at a disadvantage compared to other generations such as millennials when examining and using E-health based platforms and technology (Eastman & Lyer, 2004; Hesse et al., 2005; Millward, 2003; Morris, 2007). Sciadas (2000), for example, reports that Internet access and usage in Canada declines dramatically with age, from over 90% for teenagers to less than 5% for adults aged 70 years and older. Indeed, older adults are not online as much and often prefer traditional methods such as pamphlets, booklets and/or face-to-face contact with their health care providers (e.g., physician, nurse practitioner, pharmacists) to obtain their health information. For example, Hesse et al., (2005) reported that although study participants viewed physicians as the most credible source for health information;

only 48.6% reported using the Internet first, while only 10.9% consulted with their physician first. Underhill and McKeown (2008) found that higher educated older women and those with higher incomes were more likely to search for health-related information online; whereas young adult men were the least likely to perform Internet-based searches.

Although these aforementioned methods and resources (e.g., pamphlets, booklets, primary health care provider) are valid ways to receive information, those who are 65+ are at a disadvantage when the online world provides them with significantly more up-to-date resources, such as Health Canada, Public Health Canada, government and not for profit NGO websites. These websites are able to provide a plethora of information for individuals who may be experiencing ailments that could be treated at home or over the counter. By accessing these online resources, these individuals are able to save time and health care expenses by potentially avoiding unnecessary trips to their health care provider or emergency room.

Practically speaking, identifying how newer E-health based technologies can be integrated into society and identifying why there is a gap with digital technology will help reduce the impact of the digital divide on generations and individuals who are not as familiar with technology and Internet usage. The largest concern of all is how to prepare older adults for new and emerging E-health technologies. Older adults are just at 65.9% of the population who use technology, whereas the millennials are almost fully integrated at 98% (Statistics Canada, 2016). With the increasing costs of healthcare, learning how to use technology can help support many older adults with their health care needs and also reduce associated costs. With the proper support, older adults can learn how to use technology to improve their quality of life and reduce health care spending costs at the same time.

Since older adults represent a large and growing sector of the Canadian population it is

disconcerting that a high proportion of older adults do not use the Internet and therefore lack E-literacy skills (Becker, 2004; Burwell, 2001; Eastman & Lyer, 2004; Layne & Nielsen, 2002). Although there is some evidence of the digital divide closing, the "silver surfer" is currently a rare breed, which is unfortunate given that, as a technology that can be accessed from inside the home or anywhere on the go, the Internet has enormous potential to benefit the lives of older adults and their health related quality of life (Morris, 2007; Opalinski, 2001). Indeed, we live in a society where information and knowledge is power. Hence those without Internet access are increasingly being recognized as the "health information poor" (Eastman & Lyer, 2004; Morris, 2007).

Taken together, the digital divide reflects a combination of factors; which including issues of access opportunities, skills, perceived needs, attitudes and overall lifestyle preferences. Nonetheless, one may argue that this is quite consistent with many technologies in their early stages of adoption. The importance of e-Health technologies can be seen during pandemics such as COVID-19, where many hospitals, clinics, and health care professionals are transitioning to using e-Health based technologies to assist their patients better. Accordingly, this thesis seeks to examine barriers to access and use of new E-health based technologies by millennials and older adults in Ontario, Canada.

Based on the systematic review of the literature, I have formulated 3 research questions and hypotheses that I will critically examine in my investigation, which are detailed below. The reader is referred to Chapter 3 for a detailed discussion on the specific design and methods that will be employed.

## 1.7 Research Questions

1. Is there a digital divide between millennials and older adults in the Durham Region of Ontario, Canada?

2. How do millennials prefer to get their health related information?

3. How do older adults prefer to get their health related information?

## 1.8 Research Hypotheses

1. Older adults will report decreased usage and preference for obtaining their health related information through Internet and E-health websites, in comparison to millennials.
2. Older adults will report increased levels of reluctance to use Internet and E-health websites, in comparison to millennials.
3. Older adults will report a preference for verbal (ie. Throughout a primary health care provider, pharmacist) and conventional (ie. Written) sources for obtaining their health related information, in comparison to millennials.

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# Chapter II: Study Design and Methods

## 2.1 Study Design and Methods

A convenience non-random descriptive comparative study was conducted to identify the digital divide between millennials and older adults in Ontario, Canada. Information was collected based on (i) age; (ii) health information collection, usage and distribution; (iii) E-health usage; (iv) digital literacy levels, and (v) use and access to E-based technologies (see Appendix H). Millennials were defined as individuals aged between 18 and 24 years; whereas old adults were defined as individuals aged 65 years and older. This study employed a questionnaire with various questions and a visual analog scale from 0 to 4 to examine respondents' familiarity to technology. This questionnaire was self-developed, and some questions were based off the MICTUHOS (Mobile Information and Communication Technologies (ICTs) Use and Health Outcomes Study) that is currently in progress at Ontario Tech University.

A descriptive study was employed to assist in analyzing trends, such as any increase or decrease in technology access and usage. Additionally, a descriptive study was chosen because it would assist with health care planning, which can further enhance the Canadian medical care system by providing various avenues for policy change (Grimes and Shulz, 2002). Some noted strengths of descriptive studies are that the data is often available and will be both efficient and inexpensive to utilize (Grimes and Shulz, 2002). There are also few, if any, ethical difficulties related to descriptive studies by convention (Grimes and Shulz, 2002). Some limitations of descriptive studies include temporal associations between causes and effects that could be unclear, as well as the risk of casual inferences being inferred when there could be none (Grimes and Shulz, 2002). Non-random convenience-type sampling was ideal for this study to obtain results from the two cohorts of interest (millennials and older adults) whilst maintaining the integrity of the study through application of the exclusion criteria.

The independent variables examined were age, digital literacy, level of education, and socioeconomic status (SES). Similarly, the dependent variables were the usage of E-health and age of E-users. In regards to the data collection instruments, there were seven questions based on demographics (ie. Age, sex, location of residence, etc), seven questions related to physical health, three questions related to mental health, four questions related to Internet usage, four questions related to digital literacy, and five questions related to E-health.

## 2.2 Recruitment of Participants

Millennials consisted of undergraduate students recruited from the University of Ontario Institute of Technology (Ontario Tech University) located in Oshawa, Ontario, Canada; Older adults were recruited from senior centres located and/or senior retirement facilities care facilities for older adults in Durham Region (see Appendix C). The older adult care centres that partook in the study were: St Andrews Friendship Centre, South Pickering Seniors Centre, Oshawa Senior Citizens Club, and Orchard Villa Retirement Residence. All consents from the seniors centres' can be seen in Appendix K. According to the Durham Region Health Department (2019), older adults currently consist of 142,619 people who reside in the area. The care facilities in Durham region were sent electronic posters that outlined the purpose of the study (see Appendix D & E). Potential subjects subsequently contacted the graduate student through emails, and arrangements for a date for visiting were formalized. Informed written consent was obtained from all study participants (see Appendix F), and this study received ethical approval from the University under REB File# 13540 (See Appendix K). Following completion of the data collection, the older adult care homes were sent thank you letters for their participation in the study (see Appendix I). This study also conformed to Tri-Council standards (See Appendix A). The initial timeline estimation for

completion of data collection, analysis and the writing of the formal thesis proposal was 8 to 12 months to complete, following approval by REB (see Appendix G for timeline).

## 2.3 Data Analysis

Data was coded and entered into a Microsoft Office Excel file™ for storage, quality assurance checks for data entry accuracy, and for data analysis. Data analysis consisted of both descriptive and inferential statistical analysis using R i386 Version 3.4.3. (R Core Team, 2013), and RStudio Version 1.2.5042 (RStudio Team, 2015). Both R and RStudio are open source software that are free to users. Description statistics included mean, standard deviation, frequency counts and/or percentages. The key dependent variables were internet usage, e-health and ICT usage, as well as digital literacy. The key independent variables in this study were age, sex, physical and mental health and access to technology. Inferential data analysis consisted of paired T-tests to determine if a significant difference between the sample means exists. A t-*test* is a type of inferential statistic which is used to determine if there is a significant difference between the means of two groups, which may be related in certain features (Norman and Streiner, 2014). Categorical data was analyzed using the Chi-square procedure. The Chi-square test is intended to test how likely it is that an observed distribution is due to chance. It is also called a "goodness of fit" statistic, because it measures how well the observed distribution of data fits with the distribution that is expected if the variables are independent (Norman and Streiner, 2014). A p-value of 0.5% was deemed significant *a priori* for all inferential data analysis. Post-hoc analysis used Bonferroni's. Bonferroni's post-hoc analysis corrects for multiple comparisons (Armstrong, 2014).

These tests are ideal for this study as I was examining two cohorts (millennials and older adults) in this study. Measures such as mean, SD, median, mode, and ranges were all calculated

for the independent variables. Demographic data such as income, education level, marital status, city of residence, and current working status were reported via descriptive statistics. Inferential statistics reported for this study were Student's Two-Sample t-tests, and Chi-squared test.

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# Chapter III: Results

## 3.1 Demographic Results

This chapter provides an overview of the demographics of the participants in the completed study. There was n=67 participants in total, with n=11 as millennial males, n=28 as millennial females, n=8 as older adult males, and n=20 as older adult females. Question 1 of the questionnaire examined the age of the participants, with the mean and standard deviation of the participants displayed in the Table below. The mean age for millennials was 21.2 (SD=1.8). The mean age for older adults was 70.3 (SD=11).

**Table 3.1 Mean and Standard Deviation of the Cohorts**

| | **Mean** | **Standard Deviation** |
|---|---|---|
| Millennials (M) | **21.2** | **1.8** |
| Older Adults (OA) | **70.3** | **11.0** |

Question 2 of the questionnaire examined the sex of the participants. Specifically, n=11 were millennial males, n=28 were millennial females, n=8 were older adult males, and n=20 were older adult females. Question 3 of the questionnaire examined the residence of the participants, which is portrayed in the figure below. According to the graph, the majority of the respondents were from Durham Region, with a larger number (n=48) of females than males.

**Figure 3.1 Location of Residence for Older Adults**

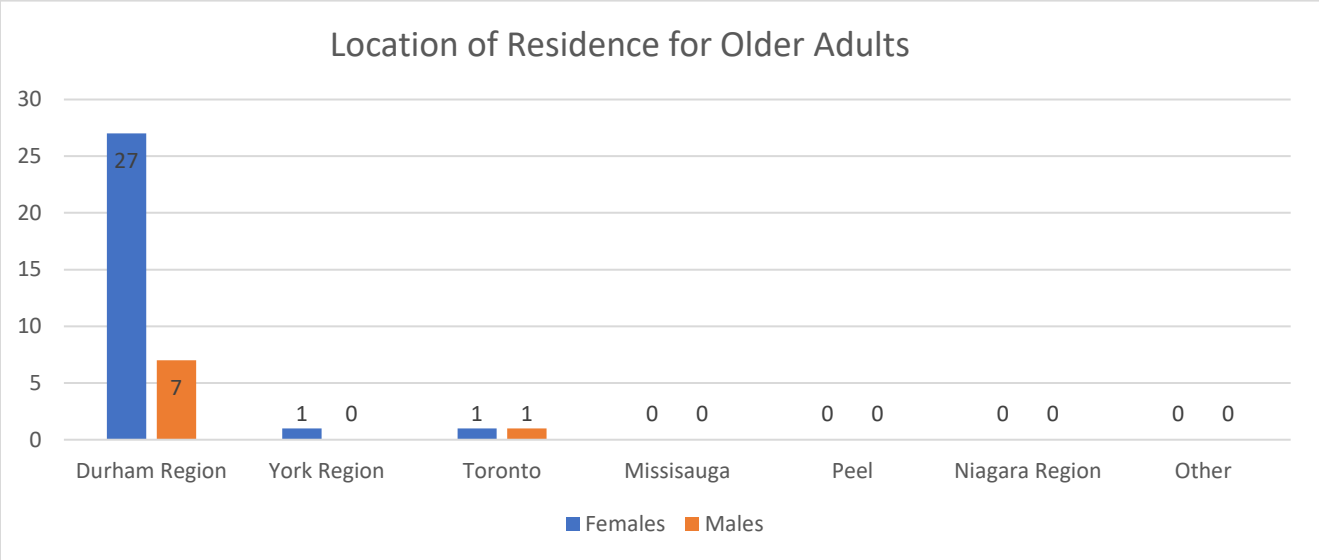
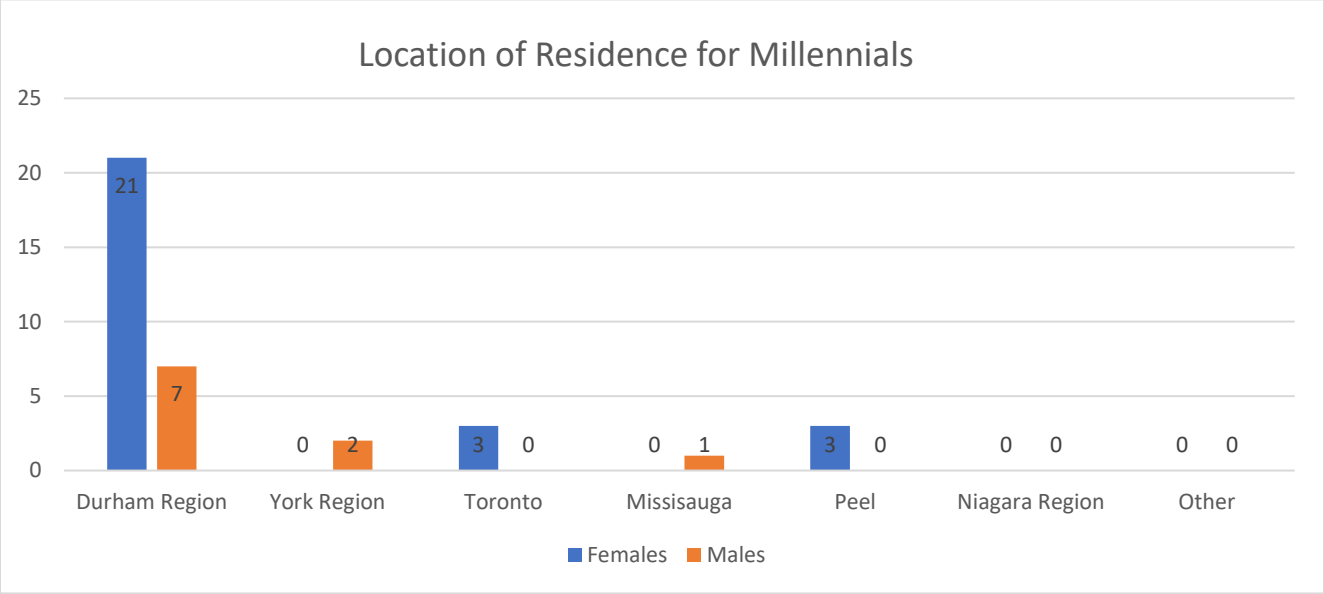



**Figure 3.2 Location of Residence for Millennials**




Question 4 of the questionnaire examines the marital status of the participants, which is portrayed in the figure below as a bar graph. The graphs below show that for older adults, there were an equal number of married individuals (n=7) for both males and females. N=7 females

were also widowed. For the millennial cohort, the majority of respondents were single (n=27, n=11), respectively. One individual was in a common law relationship.

**Figure 3.3 Marital Status for Older Adults**

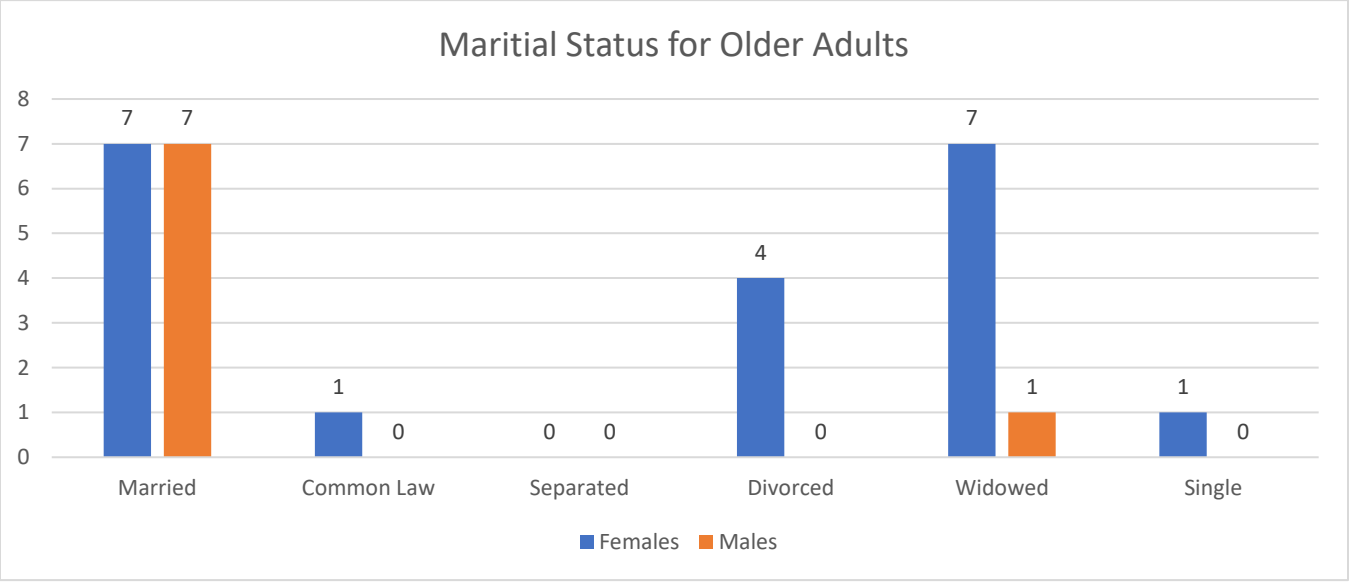
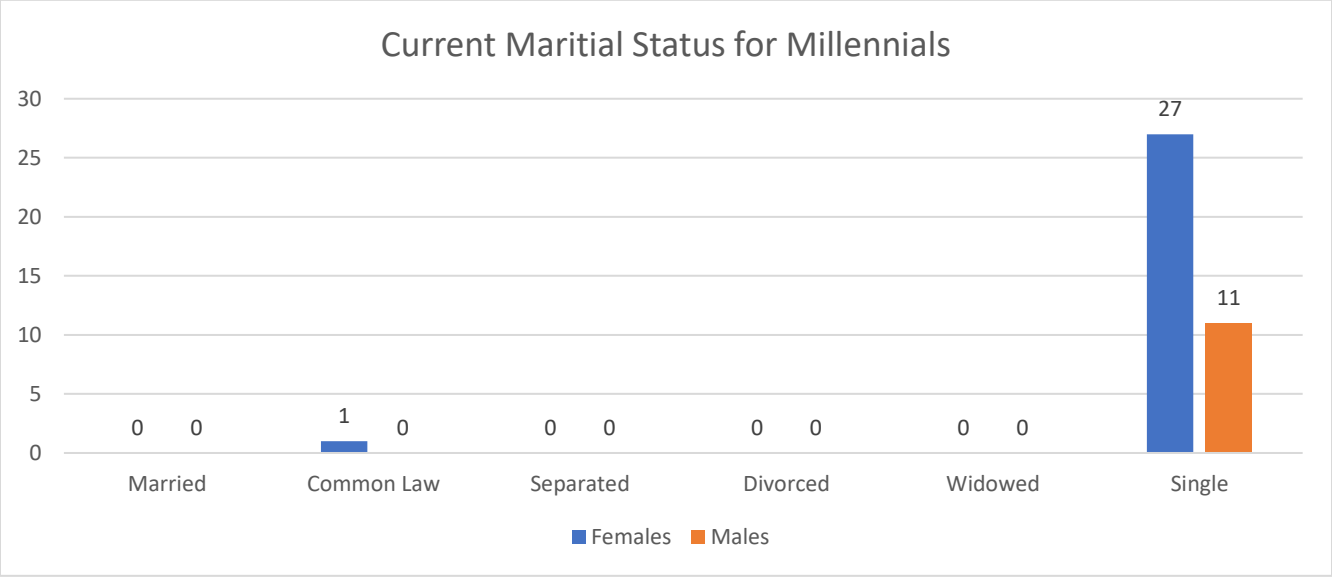



**Figure 3.4 Marital Status for Millennials**



Question 5 examined the formal education level obtained by the participants, which is portrayed in the figure below as a bar graph for easy visualization. For older adults, the majority of female respondents (n=11) had a high school diploma. However, more males (n=4) had a professional or graduate school degree. For millennials, N=16 females responded that they had a high school diploma. N=6 females responded that they had a university graduate degree. This was an expected outcome, especially given that millennial respondents were recruited from Ontario Tech University.

**Figure 3.5 Level of Education for Older Adults**

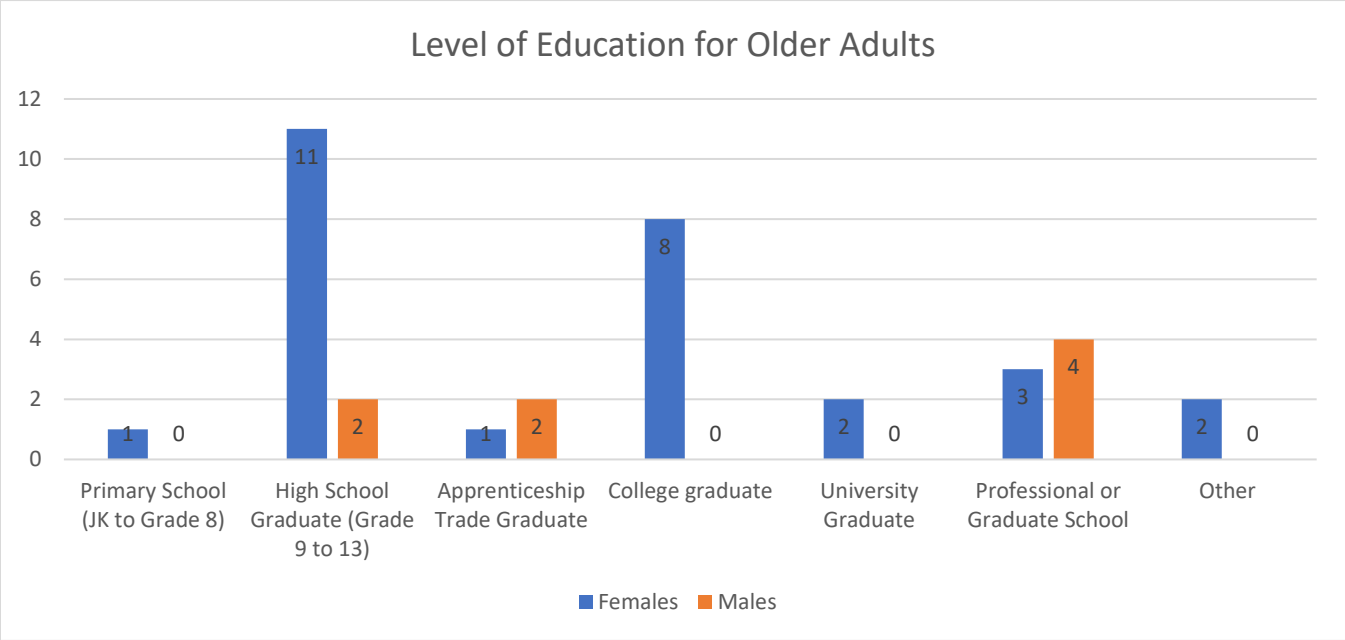
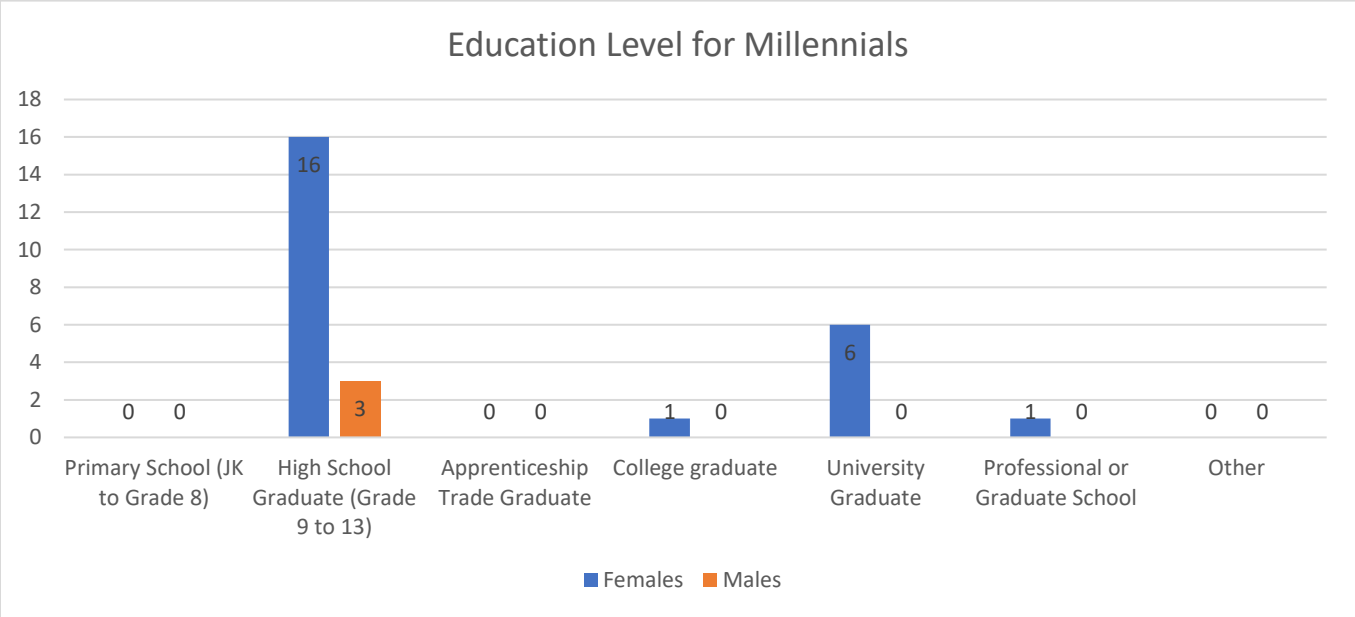


**Figure 3.6 Education Level for Millennials**




Question 6 examined the average household income, which is portrayed in the figure below as a bar graph for visualization. Older adult females (n=9) reported an average household income of $10,000-20,000. It is important to note that many older adult respondents refused to answer this question on the account that it was deemed “too personal” in nature to divulge.

The majority (N=7) of millennial female respondents reported that they have an average household income of $70,000+.

**Figure 3.7 Average Household Income for Older Adults**

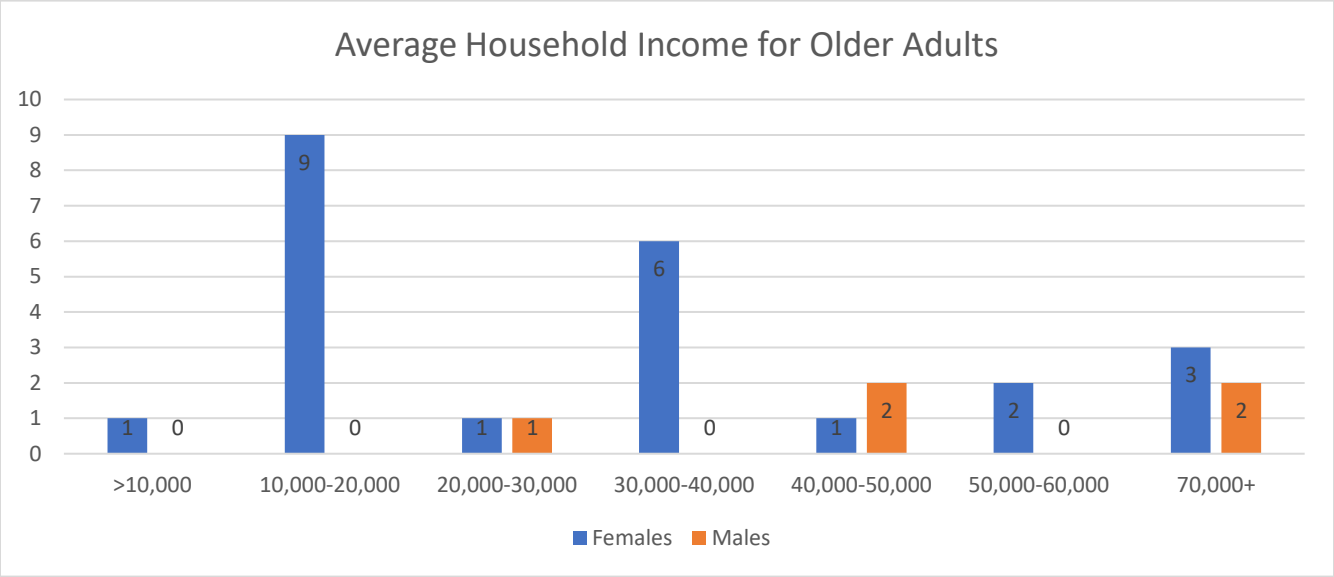
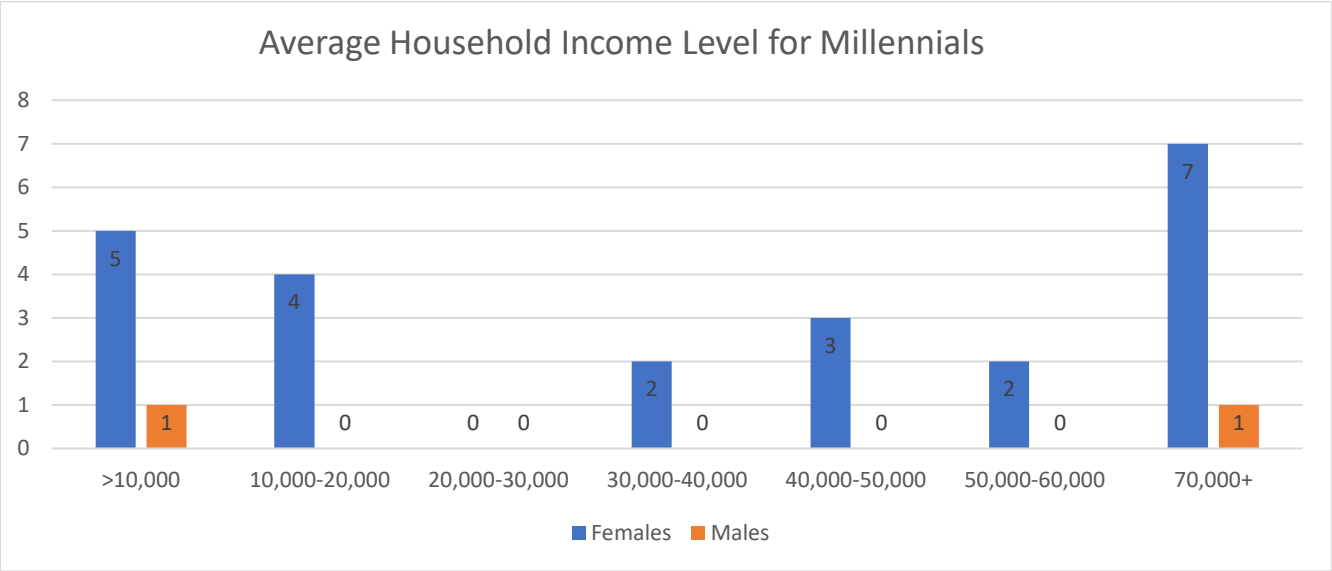



**Figure 3.8 Average Household Income Level for Millennials**




Question 7 examined the current working status, portrayed in the figure below as a bar graph for visualization.

**Figure 3.9 Current Employment Status for Older Adults**

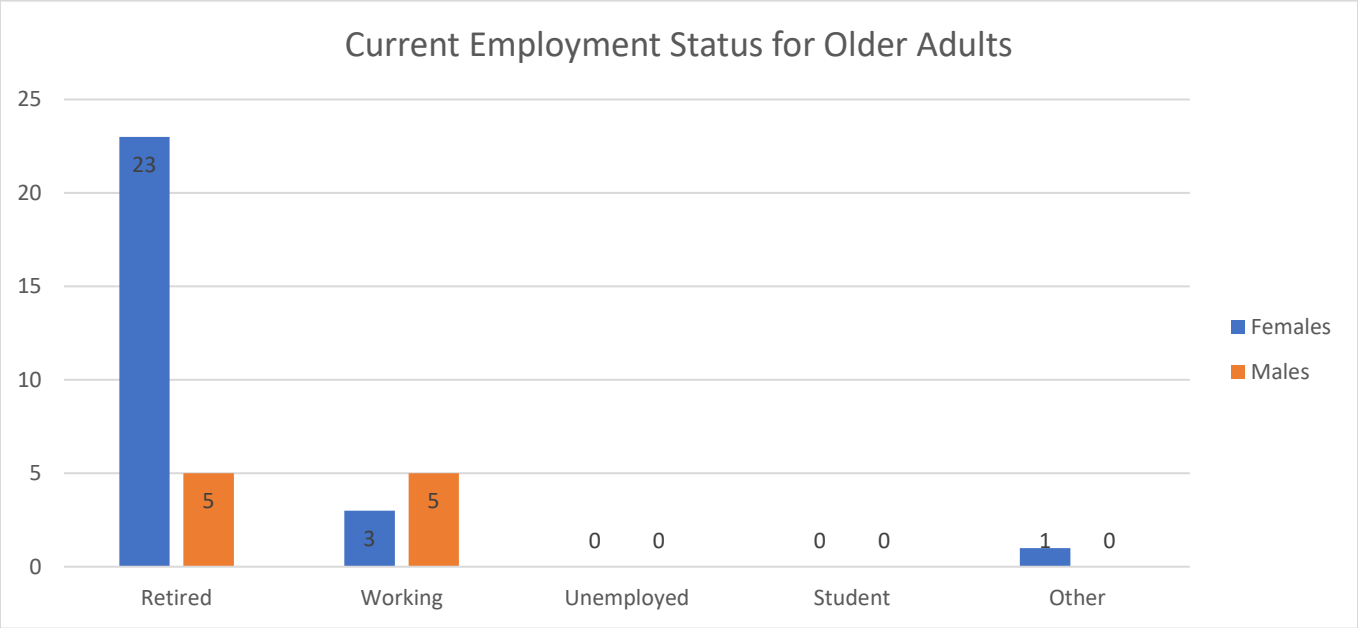
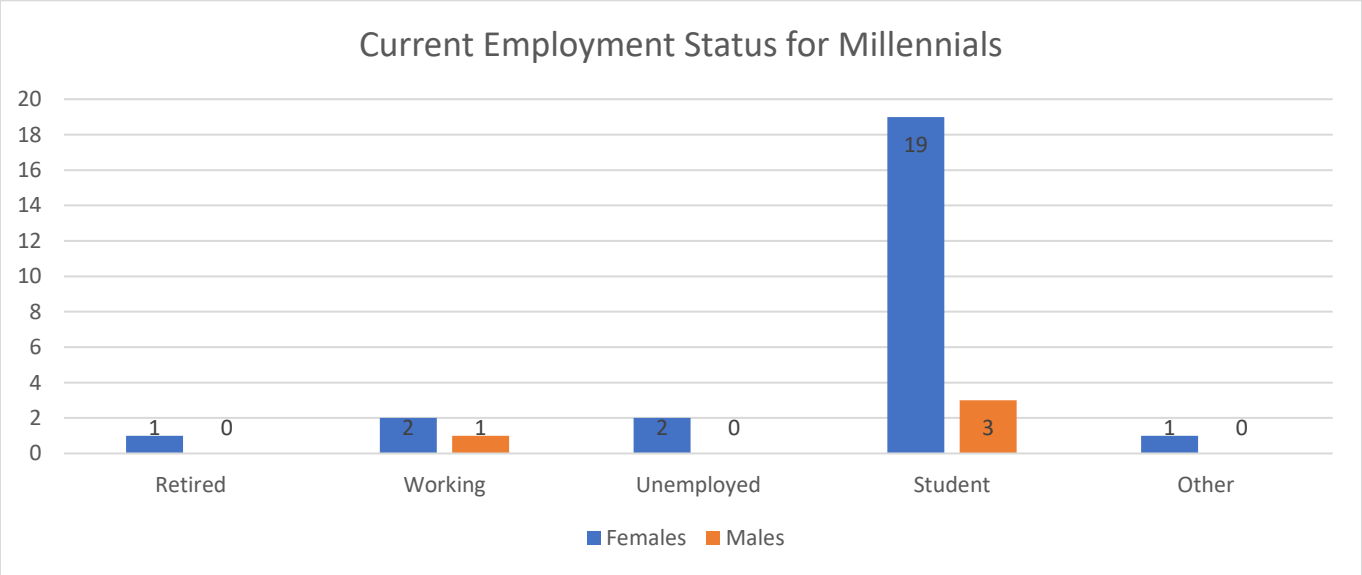



**Figure 3.10 Current Employment Status for Millennials**



## 3.2 Physical Health

This section examines the physical health of all the participants of the study. Question 8 examined the current perceptions of respondents overall physical health. The mean answer chosen for millennials was 2.6 out of 4, which ranks between satisfactory and very good, whereas the mean answer chosen for older adults was 2.5 out of 4, which also ranks between satisfactory and very good. It is interesting to note that females had a mean answer of 2.9 out of 4, and males had a mean answer of 2.5 out of 4; however, this was found to be statistically non-significant in nature ($p = 0.13$).

**Figure 3.11 Current Overall Physical Health for Older Adults**

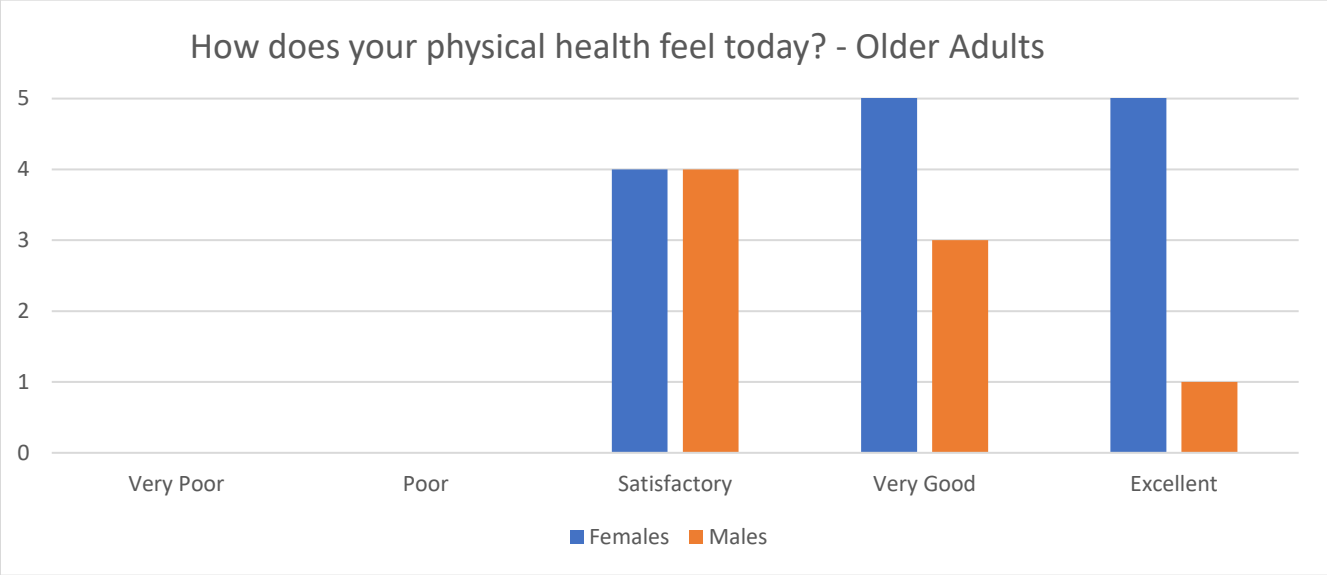
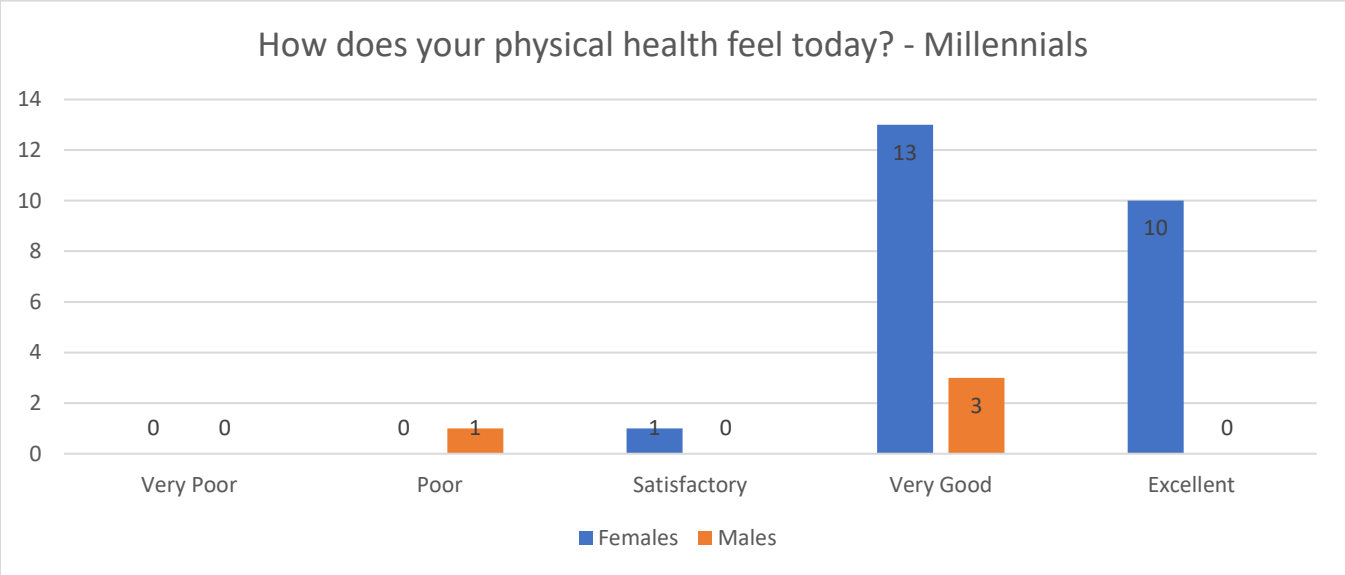


**Figure 3.12 Current Overall Physical Health for Millennials**




Question 9 of the questionnaire examined how many days per week participants participated in physical activity on average. The question was asked in a multiple-choice format, with options ranging from 0 days to 7 days. To evaluate this, the chi-square test was employed to compare the age of the participants with the answer they chose. The p-value was found to be 0.09, deeming the result as not significant. The sex of the individuals was also compared with the answer they chose, with a p-value of 0.38, deeming the result as non-significant.

**Table 3.2 Choices for Question 9 divided by age and sex**

| | A- 0 days | B-1 day | C-2 days | D-3 days | E-4 days | F- 5 days | G- 6 days | H- 7 days |
|---|---|---|---|---|---|---|---|---|
| Millennials | **1** | **2** | **8** | **9** | **11** | **6** | **0** | **2** |
| Older Adults | **4** | **4** | **2** | **4** | **6** | **2** | **1** | **5** |
| Males | **2** | **0** | **3** | **2** | **5** | **3** | **1** | **3** |
| Females | **3** | **6** | **7** | **11** | **12** | **5** | **0** | **4** |

Question 10 examined how long a participant engaged in regular physical activity per session. This question was asked in a multiple-choice format, with options ranging from 0-15 minutes to 1 hour or more. The p-value obtained was 0.02, and was thus deemed significant. Following the chi-square, a post hoc test was undertaken, and was found that option D (45-60 mins) and option E (60 mins+) were the most statistically significant option for both millennials and older adults with a p-value of 0.05. The test was examined again, this time using sex as an evaluating factor; however, it was not deemed statistically significant ($p = 0.21$).

**Table 3.3 Choices for Question 10 divided by Age and Sex**

| | A- 0 to 15 mins | B-15-30 mins | C-30-45 mins | D-45-60 mins | E-1 hr (60 mins) or more |
|---|---|---|---|---|---|
| Millennials | **3** | **5** | **9** | **14** | **8** |
| Older Adults | **4** | **9** | **7** | **4** | **1** |
| Males | **3** | **1** | **4** | **7** | **3** |
| Females | **4** | **13** | **12** | **11** | **6** |

Question 11 examined the overall health-related quality of life. To examine this question, a Likert-type scale was used, with options ranging from 0 to 4, 0 being very poor and 4 being excellent. To examine the data, a student's t-test was employed, which was not found to be not significant ($p = 0.81$). The same data set was then re-examined using sex as the independent variable, and was found to be significant ($p \leq 0.05$), deeming that females reported higher amounts of health-related quality of life compared to males.

Question 12 examined how long a participant was sedentary per day, with options ranging from 0 to more than 10 hours a day. To examine this, a chi square test was used. First comparing age with how often someone was sedentary, the p-value was found to be 0.24, which was not statistically significant. The same comparison was used with sex as the independent variable, and was found to be 0.19, which was also not significant in nature.

Question 13 examined how much sleep a participant was getting on average during the work or school week. The question used multiple choice with options ranging from 0 to 2 hours, to 10+ hours. When comparing age with how much sleep a participant was getting during the

week, the p-value was found to be 0.52 via chi-square analysis. Similarly, sex was also compared and the p-value was found to be 0.64, which is also not statistically significant.

**Table 3.4 Choices for Question 14 divided by Age and Sex**

| | Option 1<br>0 to 2 hours | Option 2<br>2-4 hours | Option 3<br>4-6 hours | Option 4<br>6-8 hours | Option 5<br>8-10 hours | Option 6<br>10+ hours |
|---|---|---|---|---|---|---|
| Millennials | **0** | **0** | **1** | **16** | **9** | **8** |
| Older Adults | **0** | **0** | **4** | **15** | **7** | **0** |
| Males | **0** | **0** | **1** | **5** | **5** | **7** |
| Females | **0** | **0** | **4** | **26** | **11** | **1** |

Question 14 examined how much sleep a participant was getting during the average weekend. This question also used multiple choice with options ranging from 0 to 2 hours to 10+ hours. When comparing age, the p-value obtained via chi-square analysis was 0.02, which was deemed statistically significant. Following this test, a post-hoc analysis (Bonferroni) was undertaken for multiple comparisons, and option 6 (10+ hours) was found to be the most significant at a value of 0.00. This means that millennials ranked that they got more sleep on weekends comparison to older adults. The question was then re-examined using sex as the independent variable, with a p-value of 0.00. This was deemed statistically significant, and was followed up with a post-hoc analysis (Bonferroni's). During the post-hoc, it was found that option 4- 6 to 8 hours ($p < 0.01$) and option 6- 10+ hours ($p < 0.001$) were statistically significant. Females were choosing option 4 more, in comparison to males who chose option 6 more.

## 3.3 Mental Health

Question 15 examined the current stress level that the participants were experiencing. This question utilized a Likert-type scale with options ranging from 0 as very poor to 4 as excellent. The student's t-test was utilized with a p-value of $\leq 0.05$ deemed as significant. When comparing age with the current stress level, the p-value was found to be 0.17. The same t-test was then undertaken using sex as the independent variable, where a p-value of 0.51, which was very close to reaching statistical significance.

Question 16 examines the stress reducing behaviours that the participants have been partaking in. This question was open-ended, so participants could answer with anything they saw fit. To examine the significance, a student's t-test was utilized with a p-value of 0.05 deemed as significant. When comparing age with the current stress level, the p-value was found to be 0.09, which was not statistically significant. The same t-test was then undertaken using sex as the independent variable, where a p-value of 0.57 was found. This was not statistically significant.

Question 17 examines how the overall mental health and well-being of the participants is for the day of the survey. The question was portrayed as a Likert scale with options ranging from 0 as very poor to 4 as excellent. To examine the significance, a student's t-test was utilized with a p-value of 0.05 deemed as significant. When comparing age with the overall mental health and well-being, the p-value was found to be 0.14, which was not statistically significant. The same t-test was then undertaken using sex as the independent variable, where a p-value of 0.10 was found. This was not statistically significant.

## 3.4 Internet Usage

Part IV examines the internet usage of the participants. As each question was examined separated through both age cohort and sex, the figure below will portray that, in addition to the choice of statistical test.

**Table 3.5 Tests and P-values on Questions 18 and 19**

| | **Statistical Test** | **Age Cohort (P-value)** | **Statistically significant?** | **Multiple Comparisons** | **Sex (P-value)** | **Statistically significant?** | **Multiple Comparisons** |
|---|---|---|---|---|---|---|---|
| **Q18: On average, how often do you access the internet in a week? Multiple choice answers** | Chi-Squared | 0.03 | Yes | Not testing- Question 1 (0.01) and 5 (0.01) | 0.52 | No | N/A |
| **Q 19: On average, how many hours do you use/ access the internet in a day? Multiple choice answers** | Chi-squared | 0.00 | Yes | Correcting - Question 1 (0.00) | 0.95 | No. | N/A |

**Figure 3.13 What do you use the Internet for?**

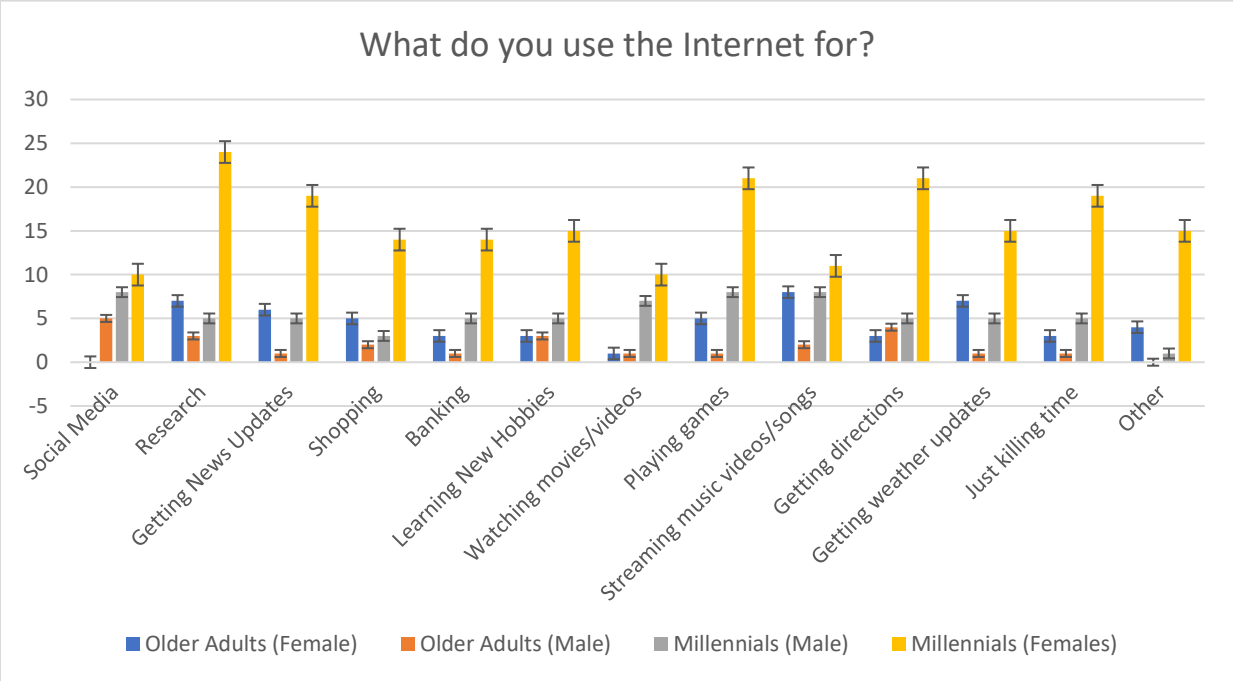



**Figure 3.14 What methods would you prefer to use to access the Internet?- Millennials**

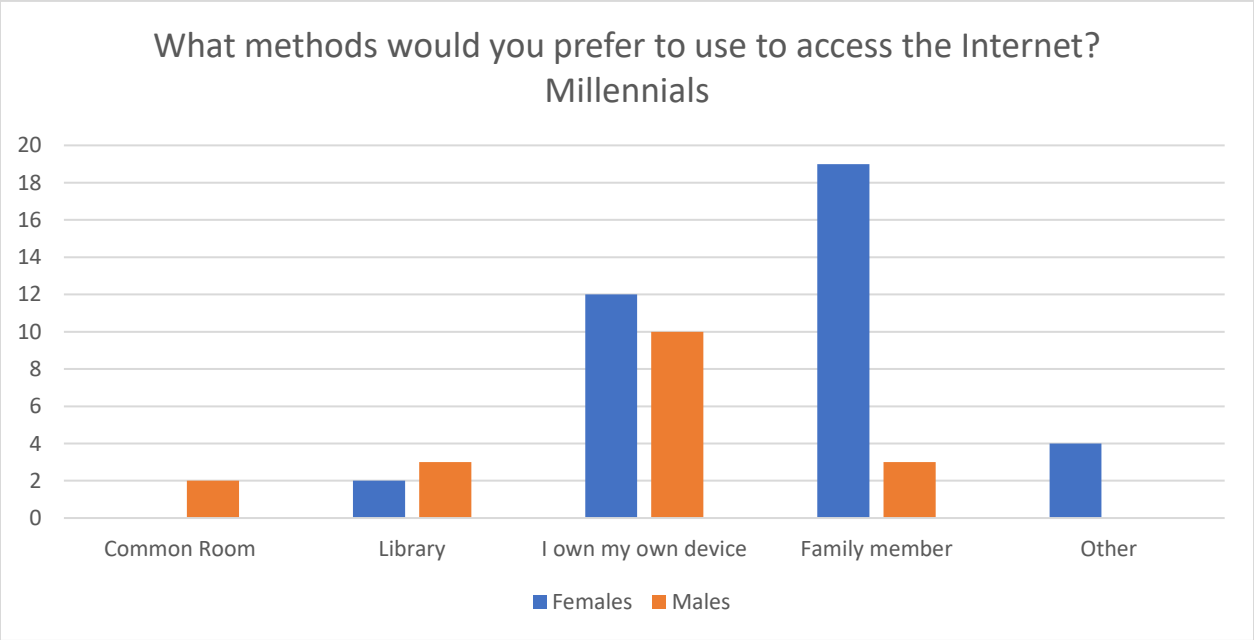
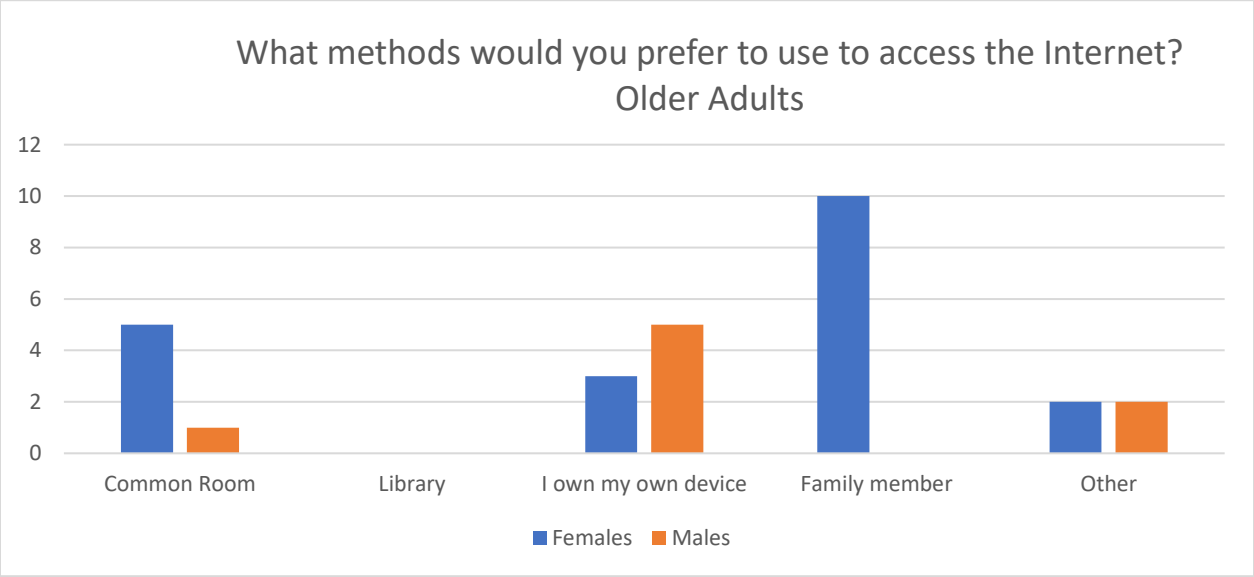


**Figure 3.15 What methods would you prefer to use to access the Internet?**

**Older Adults**




## 3.5 Digital Literacy

Part V of the questionnaire examined the digital literacy levels of the individuals who participated in this investigation. Digital literacy is the level of comprehension an individual has towards technology (Aviram & Eshet-Alkalai, 2006). Question 22 seeked to assess the familiarity of technology for each participant, which was evaluated via a Likert-type scale format. To examine these findings, the Chi-squared test was utilized to compare age with the respondent's familiarity towards technology. The test yielded a result of 0. 00 (3.065e-05), which is statistically significant. Bonferroni's test was undertaken next, which yielded for option 1 a p-value < 0.001,and for option 5 a p-value of < 0.001. The question was then examined again, this time using sex as the independent variable, which yielded a p-value of 0.03. When correcting for multiple comparisons, option 1 (p-value of < 0.01) showed up as being statistically significant.

Question 23 examined the respondent's understanding and knowledge about how to acc ess health related information via the Internet. The t-test comparing age yielded a result of $p < 0.001$, which was deemed to be statistically significant. The t-test was undertaken a second time to examine sex with the results from question 23. This yielded a p-value of 0.38.

Question 25 examined the how comfortable participants were in terms of using new tec hnologies. The t-test comparing age yielded a result of $p < 0.0001$, which found to be highly stat istically significant. The t-test was undertaken a second time to examine sex with the results from question 23. This yielded a p-value of 0.72, which is not statistically significant.

## 3.6 Access to Technology

Part VI of the questionnaire examined the respondent's current use and access of technology. Please note that Question 28 was omitted as it was a repeat of question 21. Question 26 examined whether an individual currently has (i.e., responded YES) or has no (responded NO) access to technology and ICT. 26 millennials answered "yes", and one millennial answered "no". 17 older adults answered "yes", whereas 5 older adults answered "no" ($p = 0.11$). Two adults did not answer The Chi- test was also employed to examine sex as an inde pendent variable. 33 females answered "yes", whereas 5 females answered "no". Similarly, 10 m ales answered "yes" and one male answered "no" ($p = 0.10$).

## 3.7 E-Health

Part VII examined the respondents' access, use and understanding of E-health-based technologies. Question 29 examined whether or not participants felt comfortable using and accessing E-health based systems, and was assess via a Likert-type scale. This yielded a p-value of $<0.01$, which was deemed to be statistically significant. The t-test was also employed to

examine sex as the independent variable, which yielded a non significant p-value of 0.40.

Question 30 assessed whether or not felt comfortable using and accessing E-health based records online, such as blood tests. Results for this question yielded a p-value of $\leq 0.01$, which was deemed to be statistically significant. The t-test was repeated using sex as the independent variable, which resulted in a non-significant p-value of 0.40.

Questions 31 to 33 inclusive, sought to illicit information regarding the preferred method for obtaining health related information, and ranked typed of sources personally preferred from most preferred (1) to least preferred (6). Chi-square analysis revealed that  option (i.e.,  primary health provider), was found to be statistically significant with a p-value of 0.02. Additionally, respondents who ranked Ontario Telehealth higher up on their preferred list, was also found to be statistically significant ($p \leq 0.001$). When asked how respondents prefer to get their information on the Internet, a statistically significant number of individuals ($p \leq 0.001$) responded that they use search engines. Additionally, a significant number of individuals ($p=0.05$) responded that they accessed their own E-health records. Lastly, respondents were asked how they prefer to get their information via printed sources (e.g., brochures). Obtaining information from a nurse was found to be statistically significant here ($p < 0.01$).

# Chapter IV: Discussion and Conclusion

The aim of my thesis was to examine the impact of the digital divide on the use and access to E-health based information on millennials and older adults in Ontario, Canada. The results of the study support the common conviction and reasoning that older adults are lacking in digital literacy, access, and use of ICTs (information communication technologies). One may argue that in our current technologically driven society, this may result in knowledge gaps and potentially lower quality of life in relation to their physical and mental health. This study is novel and unique because, to my knowledge, this is the first Canadian study to examine the digital divide between older adults and millennials in terms of accessing and using e-health based technologies and Internet based technologies (ICTs).

It is noteworthy that Canadians are the most active users of the Internet worldwide at an average of 43.5 hours per week online (global average = approx. 20 hours/ wk), which illustrates the impact and dependence that technology is having on our society (Canadian Broadcasting Corporation [CBC], 2011). In fact, Canadian Internet users for the ages of 34 and younger has increased substantially from 72.6 in 2005 to 82.9 in 2009. Interestingly, Internet users aged 65 and older have also increased from 62.8% in 2005 to 65.9% in 2009 (Statistics Canada, 2013), but remains lower in terms of access and usage in comparison to millennials still. Moreover, as of January 2018, 89% of Canadians surveyed reported using the Internet on a daily basis (Statistica, 2018). Nonetheless, this trend suggests an increasing acceptance, reliance and use of ICTs by older Canadians. Indeed, the increased use of E-health and/or telehealth-based technologies, which are used to meet the healthcare needs of a client could support many older adults without having to leave the comfort of their home (Bartfay & Bartfay, 2018). Moreover, the development and employment of ICTs has had considerable effects on our daily lives including how we work, communicate, do banking and our taxes, shop, do business globally, and

socially interact on a daily basis. However, a barrier to this is the digital divide, which is the metaphorical gap used to describe the "haves" and "have-nots", and is considered to be an umbrella term to identify several socioeconomical, geographical, educational, and usage gaps (Aviram & Eshet-Alkalai, 2006; Compaine, 2001; Hinrichsen & Coombs, 2014; Millward, 2003; Sciadas, 2000). In sum, my thesis sought to analyze these gaps by comparing the millennial and older adult cohort, and to examine the differences between the usage and access to ICTS and how they impact the respondents: (i) physical health; (ii) mental health; (iii) access to technology; (iv) digital literacy, and (v) E-health.

## 4.1 Hypothesis One

This hypothesis predicted that older adults would report decreased usage and preference for obtaining their health-related information through the Internet and E-health websites, in comparison to millennials. The results obtained from this investigation support this hypothesis. As discussed in Chapter 3, each question was examined by looking at the respondent's age cohort and also by sex. Finding from this investigation suggest that older adults do not have a strong understanding of E-health, which would translate into them preferring more traditional methods of obtaining information, such as through the physician or written format (e.g., pamphlets and brochures contained in a pharmacy or clinic).

This finding is consistent with the study by Sciadas (2000), where it was reported that Internet access and usage in Canada declined dramatically depending on the age of the individual. Over 90% of teenagers used the Internet, in comparison to the less than 5% for adults aged 70 and older. Similarly, Loges and Jung (2001) also reported that age had a negative association with Internet usage. In their study, they found that older adults used less Internet-based applications, in comparison to younger adults. I wish to point-out that these

aforementioned studies did not specifically examine the respondents use or access to e-health based technologies per se. Hence, my study is novel and unique due to this added dimension, and which sheds preliminary light on a noted gap in the empirical health literature. Indeed, one may argue that as older adults do not use the Internet as much, this would also translate into a decreased understanding of digital literacy and E-health usage.

## 4.2 Hypothesis Two

The second hypothesis that older adults would report increased levels of reluctance to use the Internet, and E-health websites, in comparison to millennials. Based on the results obtained from this preliminary investigation, this hypothesis was partially supported. Specifically, when I examined the concept of access to ICTs for older adults, a statistically significant result was obtained. However, it is important to note that when examining how familiar the two cohorts were with technology, the result was not found to be statistically significant.

Although it appears that older adults are beginning to use, access and feel comfortable using the Internet and ICTs for e-health applications and purposes, there remains critical barriers and challenges that have to be overcome still. Statistics Canada (2016) reports that older adults comprise 65.9% of the population who use ICTs, whereas the millennials are almost fully integrated users of ICTs at 98%. Morris (2007) reports that there are several perceived barriers for E-literacy for older adults, which include a lack of interest, feeling too old to learn new things, fear of new technology, lack of access to ICTs, lack of computing skills and experience, costs for equipment and Internet services, concerns about privacy and security, and problems associated with disabilities (e.g., visual, auditory, physical or mental).

Similarly findings were also reported by Hong and Cho (2016), which examined four online behaviours: (i)seeking health information; (ii) buying medicine; (iii) connecting with

individuals who have similar health problems, and (v) communicating with their physician. In their study, they found that the digital divide was present if the individual is older, does not have a high school education, and has a low-income level (Hong and Cho, 2016).

Levy and coworkers (2014) also examined perceptions of older Americans aged 65 plus (N = 824) in regards to their e-health literacy on the digital divide between older and younger American adults. Results from their study revealed that only 9.7% of individuals with a low health literacy used the internet to access health information, in comparison to 31.9% of individuals who had higher health literacy levels. The authors argue that older American adults are still reluctant to access and use the Internet and E-health to obtain health-related information.

In my study, I was interested in making comparison between two key cohorts. Notably, millennials who were perceived to be high end users of e-health based technologies and ICTS, and older adults who were perceived to be low end users based on the available empirical evidence reviewed in Chapters 1 and 2. The results from my investigation support this contention and hypothesis.

## 4.3 Hypothesis Three

The third hypothesis predicted that older adults would report a preference for verbal and/ or conventional sources (e.g., physician, nurse, printed brochures) for obtaining their health-related information, in comparison to millennials. Finding from my investigating partially supported this hypothesis. Interestingly, both older adults and millennials reported that they preferred to verbally consult with their primary physician as their primary source of health-related information. Respondents were also asked how they prefer to gain access to their medical information online (e.g., blood tests, diagnosis of a condition or disease). Not surprisingly, a significant number of millennials ranked using search engines as either their primary or

secondary source, in comparison to older adults. Results from my investigation found that older adults did not feel as comfortable in terms of accessing their health-related information online, in comparison to millennials. These findings are also supported by a study by Van Deursen and colleagues (2011) who reported that older adults aged 65+ were not as familiar and comfortable accessing on-line technologies and information. Hesse et al., (2005) reported that their study participants viewed physicians as the most credible source for health information; only 48.6% reported using the Internet first, while only 10.9% consulted with their physician first. Similarly, Loges and Jung (2001) reported that age was negatively associated with Internet access and use. Specifically, older adults used less Internet-based applications in comparison to younger adults.

One interesting finding from my study was that older adults felt comfortable and had reported a noted preference for contacting Ontario's Telehealth services. Telehealth is a confidential, free telephone-based healthcare service that is available 24/7 (Government of Ontario, 2020). Anyone can access the service to reach a registered nurse, who will identify the best course of action for an individual's specific ailment (Government of Ontario, 2020). This is an important finding because it suggests that older adults feel comfortable accessing e-health and telehealth services, providing there is a "person" (e.g., nurse or physician) they can actually speak with and seek information and clarification on health-related matters. Indeed, Telehealth services in Ontario help to address issues surrounding confidentiality and privacy, which are major concerns of older adults and perceived barriers for accessing and using e-health based technologies per se. Similarly, findings have been reported by Bhuyan et al. (2016), and Makkert et al. (2016), for examples, who have identified confidentiality and privacy concerns as major deterrents for the use of ICTs by adults aged 65+.

## 4.4 Study Strengths

This investigation had several strengths, which I wish to highlight in this section. For example, this descriptive and comparative study was cost-effective and relatively easy to complete within a reasonable time frame, in comparison to other study designs (e.g., longitudinal prospective or retrospective study). This study is the first Canadian study, to my knowledge, to examine the digital divide and its' impact on older adults and millennials in regards to their e-health information and ICT access and usage. Although I most acknowledge that the focus of this study was limited to residents in the Durham Region, Ontario, and may not be applicable to all Canadians or situations across Canada (e.g., rural versus urban populations and availability of Internet services).

As noted above, Canadians are the most active users of the Internet worldwide (Canadian Broadcasting Corporation [CBC], 2011), and this study provides preliminary information regarding challenges to overcome the so called "digital divide" amongst Canadians. It may be argued that public health services and their delivery can be significantly enhanced through the use of innovative and interactive E-health- and/or telehealth-based technologies and interventions that are specifically tailored to meet the client's individual health care needs across the lifespan (Bartfay & Bartfay, 2018). Indeed, the implementation of Ontario's Telehealth service by registered nurses is a basic example of that innovation, and with Canada's aging population, more cost- and time-effective E-health based interventions will become the norm in our society and elsewhere.

It is also critical to note that currently, Canada still has many Internet "dead zones" where infrastructure for Internet connection has not been placed due to our unique geography and the rural/ urban divide population (Canadian Broadcasting Corporation [CBC], 2011). This

investigation provides preliminary evidence and support for the need to increase infrastructure and technology to address the geographical issues surrounding "dead zones". Indeed, I would argue that this would ultimately result in future cost savings, time and help to address issues surrounding geographical barriers and equity (e.g., for remote Inuit and First Nations people). Similarly, the Canadian Broadcasting Corporation [CBC] (2011) argues that broadband Internet is an essential service that should be delivered to all Canadians equally, regardless of where they reside in Canada.

## 4.5 Study Limitations

I wish to acknowledge that although my study had several noted strengths, there were inherent limitations which I wish to acknowledge as a researcher. For example, one limitation of a descriptive study is that there is a risk of causal inferences being made when there could be, in fact, none. Moreover, there could be temporal associations between hypothesized causes and effects that could be unclear (Grimes and Shulz, 2002). There were also potential missing data, which may have affected the analysis and final results obtained due to the right of participants to refuse to answer specific questions, as per Tri-Council and REB requirements. Notably, I observed that older adults were reluctant to answer certain questions (left blank) due to privacy and/or confidentiality concerns.

My study employed a non-random convenience sample to recruit participants from older adult centres and a single university. Hence, the results of my findings are limited to this noted sample and cannot be generalized to residents in Ontario or Canada, and might be considered as a potentially non-representative sample. My study also defined and examined specific age cohorts, notably those ages 65+ and those between the ages of 18 and 24. Hence, individuals between the ages of 25 to 64 and those under 18 years of age were not examined and the findings

may not be applicable to these noted cohorts. There was a presumption that the two age cohorts examined in this study would best represent high-end (i.e., millennials) versus low-end (i.e., older adults aged 65+), which may not, in fact, be the case. I also wish to acknowledge that the distribution of males versus females for my two aforementioned cohorts were not equally represented in nature and may have biased the outcomes and findings in part for my study. Indeed, the majority of the participants were either millennial or older adult females (See Chapter IV Results for demographic breakdown).

Although the questionnaire took on average approximately 10 to 15 minutes to complete for each cohort, there was also the risk of response set bias and/or responder fatigue which may have affected the final results obtained (Althubaiti, 2016). Moreover, given that the questionnaire was self-reported in nature, there is also a risk of recall and/or response bias, as is common with self-reported questionnaires (Althubaiti, 2016). Response bias occurs when a respondent answers the question to be either under or an over-estimation of their reflected feelings (Bowling, 2005). Lastly, the ranking criteria (i.e., Questions 31 to 33) proved to be challenging for some older adults to complete, as they chose to skip through it resulting in incomplete information being obtained for their cohort. Additionally, some older adults did not have access to a computer. Hence, they chose to skip part VII of the questionnaire which contained the majority of questions surrounding e-health usage and access.

This study was also completed prior to the COVID-19 pandemic, so it is important to note that the results are reflective of results prior to the increased usage and prevalence of e-Health based technologies as a result. If the study were replicated today or post-pandemic, I am certain that the results would be different, as the usage of E-health based technologies has increased substantially. As indicated by Jiang et al (2020), a hospital in Ontario switched to

phone-based appointments at the onset of COVID-19, and is seeing upwards of 400 patients a day.

## 4.6 Directions for Future Research and Implications for Public Health

This study should be replicated with a larger sample size, and with diverse populations (e.g., difference ethnic groups, immigrants, Indigenous people) and geographical area (e.g., rural versus urban), which would provide a more realistic representation of Canada's population as a whole. Moreover, it would be important to do follow-up studies across to determine how e-health and telehealth services can best be employed to address health needs and challenges across the lifespan. Additional studies are also warranted to examine other potential key independent variables (e.g., income levels, ethnicity, literacy, occupation) which may have bearing on the digital divide. Utilizing a dynamic model to measure behavioural changes over time would be also be a possible avenue for future research initiatives.

With the largest age demographic being baby boomers in Canada and aboard, and the associated increased prevalence of non-communicable diseases (NCD; e.g., heart disease, cancer, diabetes, Alzheimer's disease, depression) for this population, the use and application of public health prevention and promotion via e-health based technologies is expected to increase exponentially in the decades to come. For example, providing individuals with a way to reach their health care professionals without physically having to see them would reduce the burden of NCDs, decrease associated health care costs, save time, and increase the quality of life for many individuals.

## 4.7 Summary and Conclusion

The aim of my thesis was to examine the impact of the digital divide on the use and access to E-health based information on millennials and older adults in Ontario, Canada. The

results of the study support the common conviction and reasoning that older adults are lacking in digital literacy, access, and use of ICTs (information communication technologies). One may argue that in our current technologically driven society, this may result in knowledge gaps and potentially lower quality of life in relation to their physical and mental health. This study is novel and unique because, to my knowledge, this is the first Canadian study to examine the digital divide between older adults and millennials in terms of accessing and using e-health based technologies and Internet based technologies (ICTs).

Policy recommendations can also be implemented to further support the transition to e-Health based technologies in society. Creating programs and initiatives to support those who are not as familiar with technology will assist individuals in gaining access to various new avenues of healthcare that they might not have access to otherwise. With an increasingly digital lifestyle, it would also be possible to explore more methods of access to ICTs for those who may not have access to them. Additionally, policies can be changed to make them more e-usage friendly for those who do currently have access to ICTs and cannot access other methods of usage.

In conclusion, this study provides preliminary evidence for the presence of a digital divide between millennials and older adults aged 65+ in the Durham Region of Ontario, Canada in regards to accessing and using e-health based technologies and ICTs. Future prospective and interventional-based studies are warranted to examine how best to decrease barriers associated with the digital divide across the lifespan, and with diverse populations in Canada and abroad.

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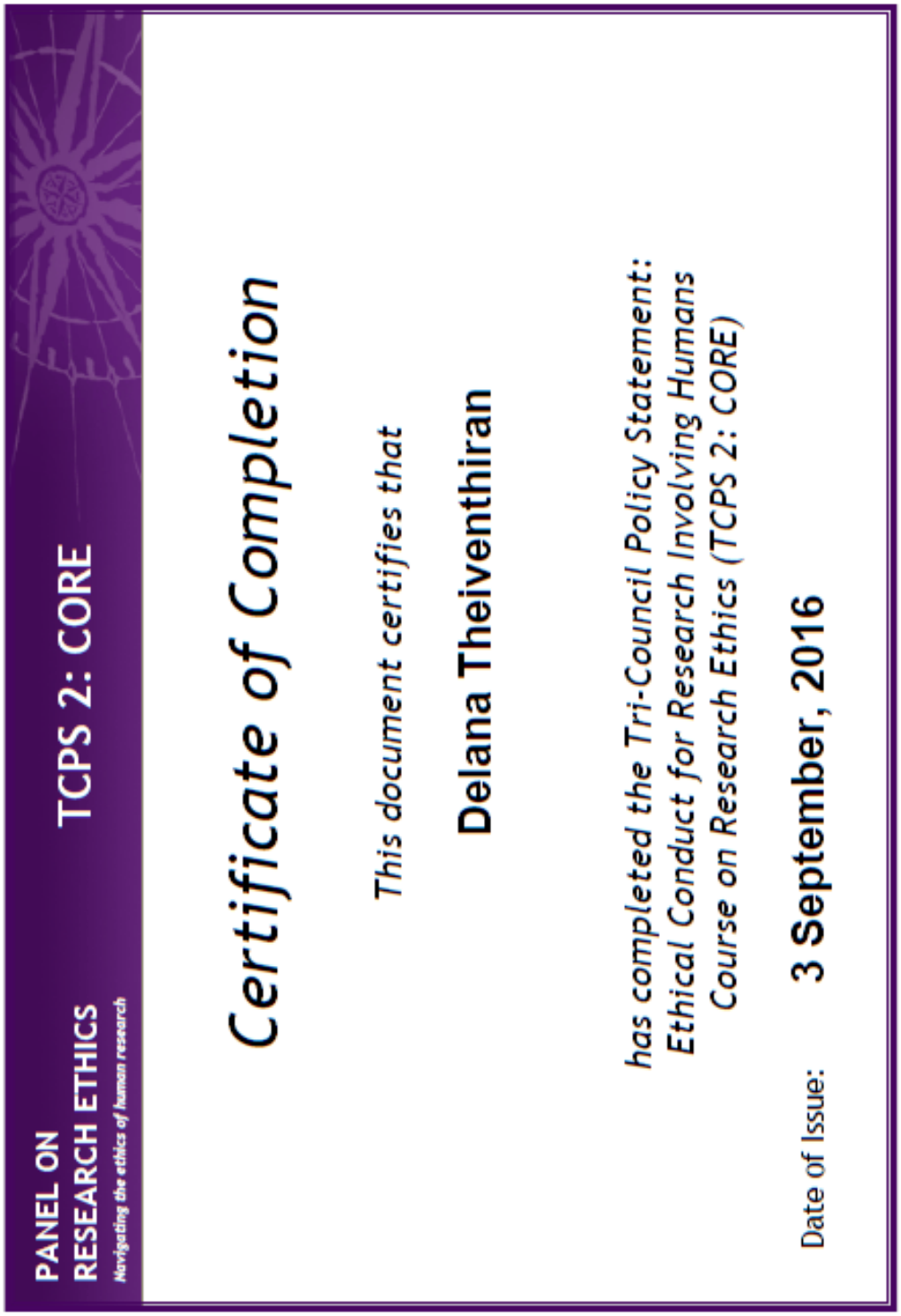
# Table of Appendices

**Appendix A: TCPS Core Certificate**



PANEL ON
RESEARCH ETHICS
*Navigating the ethics of human research*

TCPS 2: CORE

*Certificate of Completion*

*This document certifies that*

**Delana Theiventhiran**

*has completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCPS 2: CORE)*

Date of Issue: **3 September, 2016**

## Appendix B: Letter of invitation to participate in research investigation

**RESEARCH TITLE: THE DIGITAL DIVIDE: EXAMINING THE USE AND ACCESS TO E-HEALTH BASED TECHNOLOGIES BY MILLENNIALS AND OLDER ADULTS IN ONTARIO, CANADA**

Hello!

My name is Delana Theiventhiran and I would like to invite you to participate in a research study examining the usage and access to E-health based technologies by millennials and older adults in Ontario, Canada. This study is being conducted in partial fulfillment of the Masters of Health Sciences degree at the University of Ontario Institute of Technology (UOIT).

**The purpose of this study is to identify the impact of the use and access of E-health based technologies when compared with the millennial generation and the older adult generation in Ontario, Canada. Eligible participants are those aged 65+ years old, and those who are in the millennial generation, aged 15 to 22, currently residing in Ontario, Canada.**

Through your participation, I hope to determine the potential benefits and consequences related to the increased usage of E-health based technologies in Canadian society, and potentially provide an outlet to bring policy change.

Any further questions or concerns can gladly be answered by me, so please do not hesitate to contact me at (905)-721-8668 ext. 3947 or at delana.theiventhiran@uoit.ca.

Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Ethics and Compliance Officer, who can be reached at researchethics@uoit.ca or (905)-721-8668 ext. 3693.

Regards,

Graduate Student
Delana Theiventhiran, BHSc
MHSc Candidate
Faculty of Health Sciences
UOIT
Delana.theiventhiran@uoit.ca
905-721-8668 ext. 3947

Faculty Supervisor
Dr. Wally J. Bartfay, RN, PhD
Director of Health Sciences
Faculty of Health Sciences
UOIT
wally.bartfay@uoit.ca
(905)-721-8668 ext.2765
Fax: (905)-721-3189

## Appendix C: List of Senior Community Centres in the Durham Region of Ontario

| Name of Facility | Address | Telephone Number and e-mail address | Director and or Manager | Hours of Operation |
|---|---|---|---|---|
| **Ajax Senior Citizens Friendship Centre** | 46 Exeter Road, Ajax | (905)-686-1573 Ajaxseniorsclub@gmail.com | **President:** Fraser Grant | **Mon-Fri**: 9am-4:30pm 7pm-9:30pm |
| **South Pickering Seniors Club** | 910 Liverpool Road, Pickering | (905)-420-5049 spscl@sympatico.ca | Edward Fry | **Mon-Fri:** 9am-4pm **Sat**: 9am-12pm |
| **Oshawa Senior Citizens Centre (OSCC)** | **Legends**: 1661 Harmony Road North, Oshawa **John St:** 43 John Street West, Oshawa | (905)-576-6712 info@oscc.ca | **Executive Director:** Sandy Black **Programs & Service Director:** Colleen Zavrel | **Mon-Fri:** 8:30am-4:30pm **Sat:** 9am-5pm |
| **Orchard Villa Retirement Residence** | 1955 Valley Farm Rd, Pickering | (905) 831-2641 orchardvillaltc@southbridgecare.ca | **Executive Director:** April Beckett **Contact:** Jai | **24 hours** |

## Appendix D: Site Letter of Permission

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Date: _____

Dear Mr/Mrs/Ms. _____,

Hello!

I am conducting a research study entitled THE DIGITAL DIVIDE: EXAMINING THE SUE AND ACCESS TO E-HEALTH BASED TECHNOLOGIES BY MILLENIALS AND OLDER ADULTS IN ONTARIO, CANADA as my thesis research requirement for the degree of Master of Health Sciences (MHSc), specialization in Public Health at the University Of Ontario Institute Of Technology (UOIT) in Oshawa, Ontario.

In connection to this, I would like to take this opportunity to ask for your help and permission in allowing me to recruit study participants on your premises, at the above-mentioned location. Specifically, to collect the necessary data and information for my study pertaining to the use and access of E-health based technologies, demographics, daily activity processes, sleep patterns, and mental health status. Please note that participating is strictly voluntary, and all information and consent will be coded, and informed written consent obtained by all study participants in accordance with UOIT's REB (Research Ethics Board) and Tri-Council policy statements.

I would greatly appreciate your support and permission in this particular research endeavor.

Thank you very much for your time and cooperation.

Sincerely,

**Delana Theiventhiran, BHSc**
Delana.theiventhiran@uoit.ca
905-721-8668 ext. 3947
Graduate Student Researcher

**Dr.Wally J. Bartfay, RN,PhD**
wally.bartfay@uoit.ca
905-721-8668 ext.2765
Research Supervisor

## Appendix E: Recruitement Poster

**Want to win 1 out of 2 $25 gift cards, of your choosing?**

**PARTICIPANTS NEEDED FOR RESEARCH ON THE DIGITAL DIVIDE AND GENERATIONS!**

I am looking for those who are in the *millennial generation (aged 15 to 22) or the older adult generation (Aged 65+)* to take part in a study looking at the impact of the digital divide between the two generations.

You will be asked to complete one questionnaire examinng your technology and internet usage, as well as your physical health, mental health and your views on digital literacy and access to technology.

Your participation will take approximately 30 to 45 minutes and takes place in person at either the University of Ontario Institute of Technology or at a senior based facility in Durham region.

In appreciation for your time, you will be entered in a draw to win **1 out of 2 gift cards of your choosing, valued at $25 each!**

For more information about this study, or to volunteer for this study, please contact:
**Delana Theiventhiran**
Faculty of Health Sciences, UOIT, Oshawa, ON
**905-721-8668 ext. 3947**
**Email:** delana.theiventhiran@uoit.ca

This study has been reviewed by, and received ethic clearance by the UOIT Research ethics Board, Ref #:

Compliance Officer: compliance@uoit.ca, or 905-721-8668 ext. 3693

## Appendix F: Consent form

**RESEARCH TITLE:THE DIGITAL DIVIDE: EXAMINING THE USE AND ACCESS TO E-HEALTH BASED TECHNOLOGIES BY MILLENNIALS AND OLDER ADULTS IN ONTARIO, CANADA**

You are being cordially invited to participate in a study being conducted by Delana Theiventhiran (MHSc candidate) and Dr. Wally J. Bartfay from the Faculty of Health Sciences (FoHS) at the University of Ontario Institute of Technology (UOIT) in Oshawa, Ontario,Canada. This study is being performed in partial fulfillment of the Masters of Health Sciences degree by Ms. Delana Theiventhiran, and is being supervised by Dr. Wally J. Barfay. This study has been reviewed by the Research Ethics Committee at the University of Ontario Institute of Technology and has received clearance through the Research Ethics Board (REB) on the following date:

**Study Purpose**

**The purpose of this study is to identify the impact of the use and access of E-health based technologies when compared with the millennial generation and the older adult generation in Ontario, Canada.**

**Procedures**

If interested in participating in this study, you will be asked to complete either an online or a pencil and paper self-reported questionnaire. This questionnaire will consist of questions involving demographics, your online behaviours, and your daily lifestyle patterns. Other questions will include questions about your mood, your sleep, and your attitudes towards the increased usage of technology in daily processes. This entire process will take between 30-45 minutes to complete. Please note that the collected information will be primarily used for this study, and could possibly be used in other studies as secondary data.

**Potential Risks**

If there are any questions or tasks that make you feel uncomfortable, inappropriate or are too difficult to complete, you have the right to refuse. There may be a psychological risk where you may feel demeaned, worried, or embarrassed answering certain questions. If so, you have the right to skip the question or refuse to answer. We do not anticipate you will experience pain, discomfort or unease when participating in this study.

**Potential Benefits**

Through your participation in this study, you can help identify plausible health effects associated with the increased or decreased usage of technology. This study can also help identify probable areas for improvement and policy change in regards to the usage of E-health based technologies in Canadian society.

**Compensation**

Should you choose to participate in this study, your name will be entered into a random draw for a chance to win 1 out of 2 gift certificates of your choice, valued at $25 each. You must complete the questionnaire to be entered into the draw.

**Confidentiality**

All personal and health information, as well as questionnaire answers will be strictly confidential. The gathered information will be kept in a file under lock and key for a period of 5 years in a locked steel metal filing cabinet in the research supervisors' office, and then destroyed through a shredder. Only the research supervisor and the graduate student will have access to the office in which the cabinet is held. The electronic information and data analyses results will be destroyed within 5 years after the completion of the study using fileshredder, a free programme that permanently destroys files from your electronic device(s) that cannot be recovered. Your name will not be written on any questionnaires, documents, papers or publications. All collected data will be coded and will be anonymous. Your name will not appear in any peer reviewed publications, reports or conference proceedings that may arise from the analysis of the data, and only group findings will be presented and/or published. Hence, no individual findings or names will be disclosed or entered into any database. Only the supervisor, members of the supervisory committee and the graduate student will have access to the file(s).

**Participation/Withdrawal**

Participation is strictly voluntary. Withdrawing can be done do at any time, without any pertaining penalties or consequences. Your name will be omitted from any questionnaires, scales, reports, documents, and/or publications. It is not feasible to withdraw your information once data has been anonymized and grouped. The deadline to withdraw is _____ after which the withdrawal of information is not possible.

**Your Rights**

You may freely choose to consent to partake in this study or not. You also have the right to withdraw your consent at any time throughout the study without any consequences. Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Ethics and Compliance officer at researchethics@uoit.ca or (905) 721-8668 ext. 3693. In addition, if you have any further questions, concerns, or doubts about this study, feel free to contact myself, Delana Theiventhiran at delana.theiventhiran@uoit.ca, phone: (905) 721-8668 ext. 3947 and/or my supervisor Dr. Wally J.Bartfay at wally.bartfay@uoit.ca, phone: (905)-721-8668 ext. 2765. Thank you!

Sincerely,

Delana Theiventhiran, BHSc
MHSc Candidate
Faculty of Health Sciences
UOIT
Delana.theiventhiran@uoit.ca
905-721-8668 ext. 3947

Dr. Wally J. Bartfay, RN, PhD
Director of Health Sciences
Faculty of Health Sciences
UOIT
wally.bartfay@uoit.ca
(905)-721-8668 ext.2765
Fax: (905)-721-3189

**Consent**

**I consent to partake in this study being conducted by Delana Theiventhiran and supervised by Dr.Wally J. Bartfay.**

**Name of Participant (PRINT): _____**

**Signature: _____ Date: _____**

**Witness: (Name and Sign)_____ Date:_____**

✂ _____

**Please enter me for the chance to win 1 of 2 $25 gift certificates.**

**Information for the gift certificates draw:**

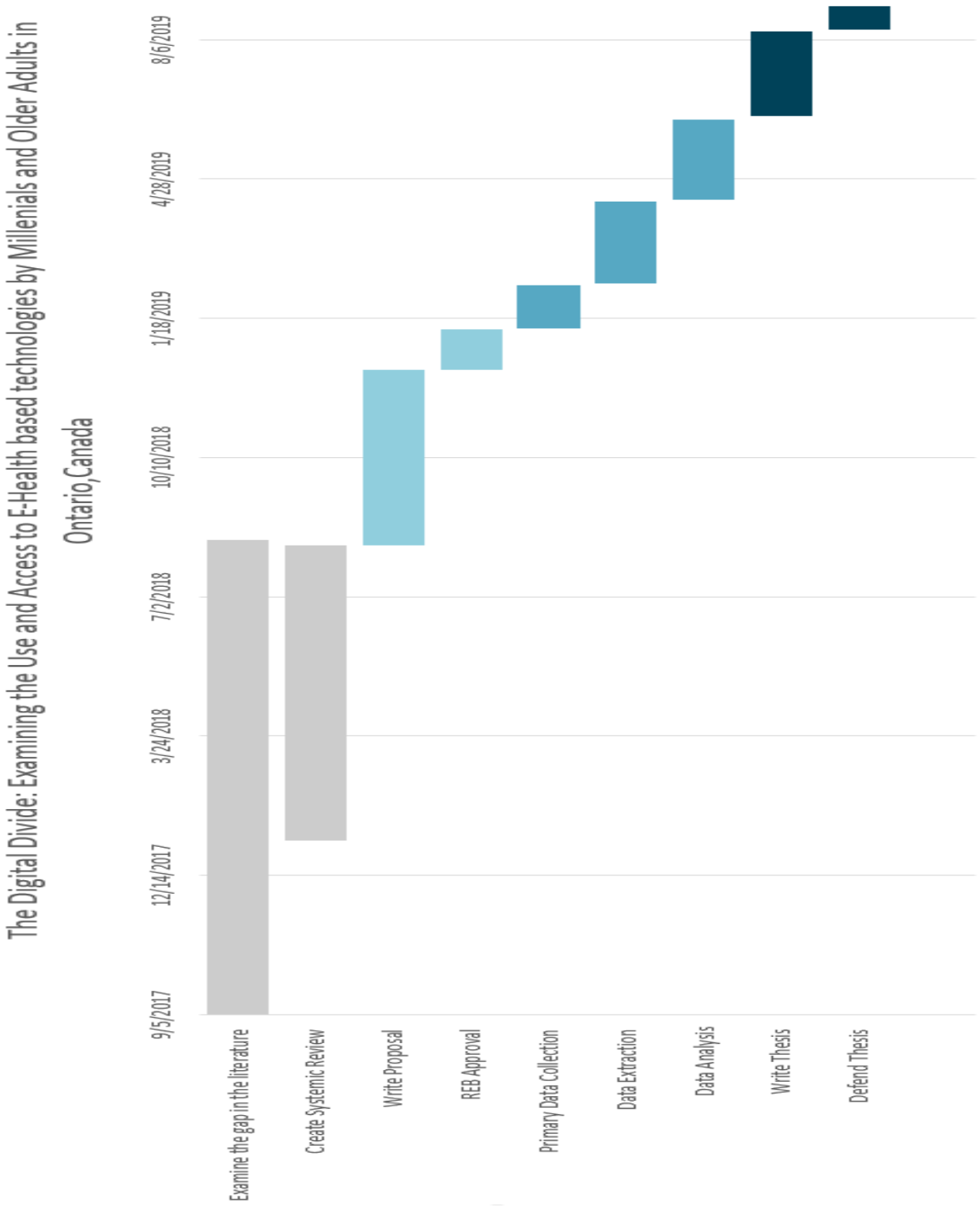
**Name_____**

**Preferred contact (phone or email address):**

**_____**

***Must complete questionnaire to be entered in draw**

## Appendix G: Time line for completion of study



## Appendix H: Demographic and E-health use questionnaire

### Demographic and E-health use questionnaire

**Health Questionnaire- Digital Divide Study**

**The objective of this study is to identify the effect of the use and access of E-health based technologies when compared with the millennial generation and the older adult generation in Ontario, Canada.**

**REB File No: 13540**

**Date: _____**

**Part I: Demographic Information**

Please provide the following information about yourself, and circle/ list which applies best to your situation or preferences.

1. What is your age? _____

2. What is your sex? _____
   Males (1)
   Females (2)
   Other (3)

3. Where do you currently reside? _____

   Durham Region (1)

   York Region (2)

   Toronto (3)

   Mississauga (4)

   Peel (5)

   Niagara Region (6)

   Ottawa Region (7)

   Other (8) Please specify: _____

4. What is your current personal status? _____
   Married (1)
   Common Law (2)
   Separated (3)
   Divorced (4)

Widowed (5)
Single (6)

5. What is the highest level of education received? _____
   Primary school (JK to Grade 8) (1)
   High School graduate (Grade 9 to 13) (2)
   Apprenticeship trade graduate (ie. Plumbing, electrician) (3)
   College graduate (4)
   University graduate (5)
   Professional or graduate school (6)
   Other (7) Specify: _____

6. What is your approximate household income including wages, retirement income, welfare and/or disability payments per year?

   _____

   Less than $10,000 (1)
   $10,000-$20,000 (2)
   $20,000-$30,000 (3)
   $30,000-$40,000 (4)
   $40,000-$50,000 (5)
   $50,000- $60,000 (6)
   More than $70,000 (7)

7. Are you currently: _____

   Retired (1)
   Working (2)
   Unemployed (3)
   Student (4)
   Other (5) Please specify: _____

**Part II: Physical Health**

**8.** How would you rate your overall physical health**?**

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Very poor | Poor | Satisfactory | Very good | Excellent |

9. On average, how many days per week do you engage in regular physical activity/ exercise?

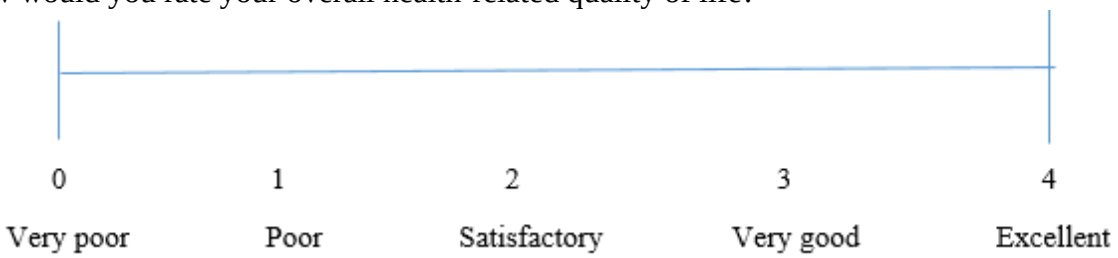
_____

a. 0 days
b. 1 day
c. 2 days
d. 3 days
e. 4 days
f. 5 days
g. 6 days
h. 7 days

10. If you engage in regular physical activity/ exercise, how long (duration) do you do this for an average per session?

a) 0-15 mins
b) 15-30 mins
c) 30-45 minutes
d) 45-60 mins
e) 1 hour or more.

11. How would you rate your overall health-related quality of life?




12. On an average day, how much time spend being sedentary or inactive in nature (e.g., sitting, lying down, driving to work or school) per day?

a) 0
b) 1-3 hours
c) 4-6 hours
d) 6-9 hours
e) greater than 10 hours.

13. On average, how many hours on average do you sleep per night during the regular work or school week (Monday to Friday)?

_____

0 to 2 hours (1)
2 to 4 hours (2)
4 to 6 hours (3)
6 to 8 hours (4)

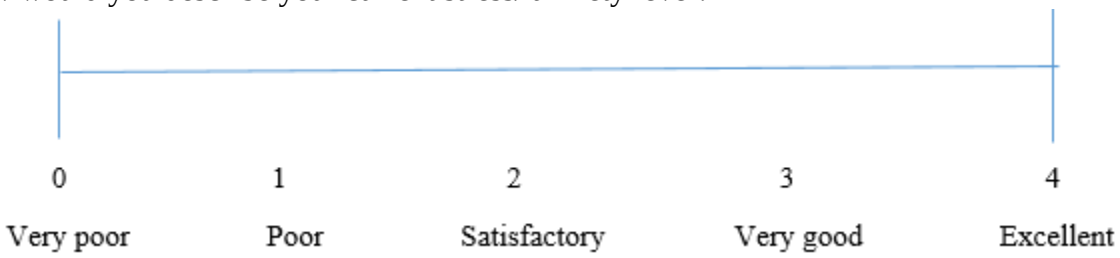
8 to 10 hours (5)
10+ hours (6)

14. On average, how many hours do you sleep per night during the weekends (Saturday and Sunday)? _____

0 to 2 hours (1)
2 to 4 hours (2)
4 to 6 hours (3)
6 to 8 hours (4)
8 to 10 hours (5)
10+ hours (6)

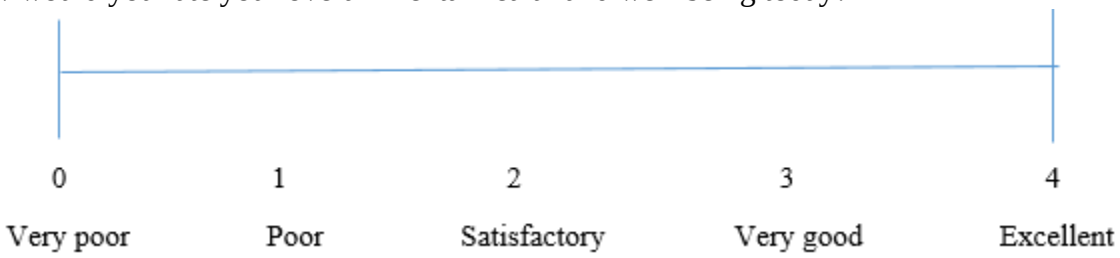
**Part III: Mental Health**

15. How would you describe your current stress/ anxiety level?




16. On average, how often do you partake in stress/ anxiety reducing behaviours per month? _____

17. How would you rate your overall mental health and well-being today?




**Part IV: Internet Usage**

18. On average, how often do you access/ use the Internet in a week? _____

Every day (1)
Few times a week (2)
Occasionally, as needed (3)
Not often (4)

Never (5)

19. On average, how many hours do you use/ access the Internet in any given day? _____

0 to 2 hours (1)
2 to 4 hours (2)
4 to 6 hours (3)
6 to 8 hours (4)
8 to 10 hours (5)
10+ hours (6)

20. What do you primarily use the Internet for? Circle all that apply.

Social Media (1)
Research (ie. Medical conditions) (2)
Getting News updates (3)
Shopping (4)
Banking (5)
Learning new hobbies (6)
Watching movies/videos (7)
Playing games (8)
Streaming music videos/ songs (9)
Getting directions (10)
Getting weather updates (11)
Just killing time (12)
Other- Please Specify _____ (13)

21. What methods and/or locations do you prefer to use to access the Internet? Circle/ list all that apply. _____

Common Room (1)
Library (2)
I own my own device (3)
Family member (4)
Other-Please specify (5) _____

**Part V: Digital Literacy**

22. How familiar are you with using technology such as smartphones? _____

Very familiar (1)
Somewhat familiar (2)
Comfortable (3)
Not so familiar (4)

Not familiar (5)

23. How would you rate your understanding of accessing the Internet from starting the computer or mobile device (e.g., tablet, smartphone) to accessing the browser?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Very poor | Poor | Satisfactory | Very good | Excellent |

24. Which types of electronic technologies do you use? Circle/ list all the apply. _____

Smartphones (1)
Laptops (2)
Gaming Systems (ie. PS4, PS3, Wii,Nintendo) (3)
Television (4)
Radio (5)
Telephone (6)
Tablets (7)
Other- Please specify (8) _____

25. How comfortable would you feel if given a new piece of technology to use?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Very poor | Poor | Satisfactory | Very good | Excellent |

**Part VI: Access to Technology**

26. Do you currently have access to any mobile ICTs (information communication technologies like smartphones, tablets, laptops)? _____

Yes (1)
No (2)

27. If No, why not? Circle/ list all that apply. _____

Lack of infrastructure (1)
Not familiar with using technology (2)
Not interested (3)

Not needed (4)
No access to Internet (5)
Fear of using these technologies (6)
Too expensive to afford new devices (7)
Other- Please specify _____ (6)

28. What methods do you use to access technology? _____
Common Room (1)
Library (2)
I own (3)
Family member (4)
Other-Please specify (5) _____

**Part VII: E-health**

29. I am comfortable with both accessing and using e-Health based systems


30. I am comfortable with both accessing and using e-Health based records (ie. Blood test results online).


31. I prefer to get my health-related information from the following sources. Please rank from (1) most preferred to (6) least preferred.

_____My primary physician, in person (face-to-face)
_____Nurse/nurse practitioner
_____Pharmacist
_____Allied Healthcare Professional (ie. Chiropractor, physiotherapist)
_____Ontario Telehealth services

_____Printed sources (e.g., pamphlets, books, medication inserts)

32. I prefer to get my health information online from the following sources. Please rank from (1) most preferred to (5) least preferred.

_____Search Engines (e.g., Google, Bing, Yahoo)
_____Government websites
_____Social media (e.g, Facebook, Twitter)
_____Mass media (e.g., News on TV stations, radio, printed newspapers)
_____E-health records

33. I prefer to get my information for the printed format from the following sources. Please rank form (1) most preferred to (6) least preferred.

_____Pamphlets or brochures
_____One page info letter from my physician
_____One page info letter from my nurse or nurse practitioner
_____ One page info letter from my pharmacists for any meds I may be taking
_____Getting paper copies of my health records and diagnostics tests
_____Books on health related topics of concern from my local library or bookstore

**THANK-YOU!**

## Appendix I: Thank You Letter

**RESEARCH TITLE: THE DIGITAL DIVIDE: EXAMINING THE USE AND ACCESS TO E-HEALTH BASED TECHNOLOGIES BY MILLENNIALS AND OLDER ADULTS IN ONTARIO, CANADA**

Hello!

Thank you for participating in my research study examining the usage and access to E-health based technologies by millennials and older adults in Ontario, Canada. This study is being conducted in partial fulfillment of the Masters of Health Sciences degree at the University of Ontario Institute of Technology (UOIT).

**The purpose of this study is to identify the impact of the use and access of E-health based technologies when compared with the millennial generation and the older adult generation in Ontario, Canada.**

By participating, you were able to determine the potential benefits and consequences related to the increased usage of E-health based technologies in Canadian society, and potentially provide an outlet to bring policy change. I aim to be completed with my thesis and study by August 2019, at which point you can access it at the UOIT library, or online if published.

Any further questions or concerns can gladly be answered by me, so please do not hesitate to contact me at (905)-721-8668 ext. 3947 or at delana.theiventhiran@uoit.ca.

Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Ethics and Compliance Officer, who can be reached at researchethics@uoit.ca or (905)-721-8668 ext. 3693.

Thank you once again for your participation!

Regards,

Graduate Student
Delana Theiventhiran, BHSc
MHSc Candidate
Faculty of Health Sciences
UOIT
Delana.theiventhiran@uoit.ca
905-721-8668 ext. 3947

Faculty Supervisor
Dr. Wally J. Bartfay, RN, PhD
Director of Health Sciences
Faculty of Health Sciences
UOIT
wally.bartfay@uoit.ca
(905)-721-8668 ext.2765
Fax: (905)-721-3189

## Appendix J: Ethical Approval REB File# 15340

| | |
|---|---|
| *Date:* | *June 04, 2019* |
| *To:* | *Wally Bartfay* |
| *From:* | *Ruth Milman, REB Chair* |
| *File # & Title:* | *15340 - Bridging The Digital Divide: Examining the Use and Access to E-health Based Technologies by Millennials and Older Adults in Ontario, Canada* |
| ***Status:*** | ***APPROVED*** |
| ***Current Expiry:*** | ***June 01, 2020*** |

Notwithstanding this approval, you are required to obtain/submit, to UOIT's Research Ethics Board, any relevant approvals/permissions required, prior to commencement of this project.

The University of Ontario, Institute of Technology (UOIT) Research Ethics Board (REB) has reviewed and approved the research study named above to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2 2014), the UOIT Research Ethics Policy and Procedures and associated regulations. As the Principal Investigator (PI), you are required to adhere to the research protocol described in the REB application as last reviewed and approved by the REB. In addition, you are responsible for obtaining any further approvals that might be required to complete your project.

Under the Tri-Council Policy Statement 2, the PI is responsible for complying with the continuing research ethics reviews requirements listed below:

**Renewal Request Form:** All approved projects are subject to an annual renewal process. Projects must be renewed or closed by the expiry date indicated above ("Current Expiry"). Projects not renewed 30 days post expiry date will be automatically suspended by the REB; projects not renewed 60 days post expiry date will be automatically closed by the REB. Once your file has been formally closed, a new submission will be required to open a new file.

**Change Request Form:** If the research plan, methods, and/or recruitment methods should change, please submit a change request application to the REB for review and approval prior to implementing the changes.

**Adverse or Unexpected Events Form:** Events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol (i.e. un-anticipated or un-mitigated physical, social or psychological harm to a participant).

**Research Project Completion Form:** This form must be completed when the research study is concluded.

Always quote your REB file number (**15340**) on future correspondence. We wish you success with your study.

Sincerely,

Dr. Ruth Milman
REB Chair
ruth.milman@uoit.ca

Emma Markoff
Research Ethics Assistant
researchethics@uoit.ca

*NOTE: If you are a student researcher, your supervisor has been copied on this message.*

# Appendix K:Approval Emails from Seniors Centres and Retirement Residences

## Figure 1: Approval Email From St. Andrews Friendship Centre

RE: Confirmation Email Regarding Research Inbox ×

**Delana Theiventhiran** <delana.theiventhiran@uoit.net> Wed, May 22, 11:26 AM
to fragrant

Dear Fraser,

This is Delana, and we spoke on the phone earlier today regarding the research being conducted on the premises. I am just sending you a confirmation email to confirm that you accept that research can be conducted on the premises. Please reply to this email with your confirmation. Thank you so much for all of your help!

Regards,
Delana Theiventhiran

**Fraser** <fragrant@rogers.com> Wed, May 22, 11:45 AM
to Delana

Delano, yes we will be involved with your research. I am the president of the Ajax ST.Andrews Friendship centre .

Thank you so much! Wonderful! Great, thanks!

Reply Reply all Forward

## Figure 2: Approval Email from South Pickering Seniors Club

**cal Cooper** <calandfrance@hotmail.com> Mon, Aug 12, 3:40 PM
to Delana

Hi Delana,

I just want to confirm that you will be coming to the South Pickering Seniors' Club tomorrow (August 13th) at 10:30 a.m. You will be presenting your questionnaire to our members at 10:45 a.m.

We are located at the East Shore Community Centre
910 Liverpool Rd (South of Bayly)
Pickering
Tel # at the site is 905 420 5049
If required, parking is at the back of the building.

See you tomorrow
France Cooper
905 831 1684

Sent from Mail for Windows 10

**Figure 3: Approval Email from Oshawa Seniors Citizens Centre**

**Colleen Zavrel** <CZavrel@oshawa.ca> Wed, May 29, 2:49 PM

to Sandra, Celeste, delana.theiventhiran@uoit.net

Hello Delana,

Thanks for your phone call and our conversation just now.

I shared with you that you would be welcome to have a table at the OSCC55+ Swing Into Summer event next Wednesday, June 5th from 10:30 – 2:00, taking place in Memorial Park. At this event you could recruit study participants for your master's thesis.

If you have any further questions please let me know.

Thanks,

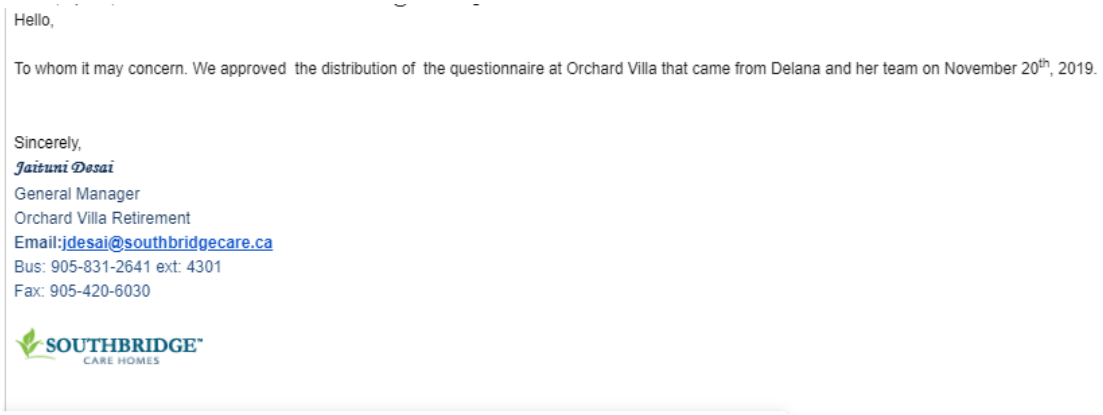
Colleen Zavrel | Director, Programs and Services

T: 905.576.6712 ext. 2834 | C: 289.928.5495 | F: 905.576.0848 | TTY: 905.436.5627

www.oscc.ca | Facebook | Twitter

OSCC55+ Oshawa Senior Community Centres

**Figure 4: Approval Email from Orchard Villa Retirement Residence**



Hello,

To whom it may concern. We approved the distribution of the questionnaire at Orchard Villa that came from Delana and her team on November 20th, 2019.

Sincerely,

*Jaituni Desai*

General Manager

Orchard Villa Retirement

Email:jdesai@southbridgecare.ca

Bus: 905-831-2641 ext: 4301

Fax: 905-420-6030

SOUTHBRIDGE CARE HOMES

# Appendix L: Poster Presentations and Abstracts

## Figure 1: Poster presented at Oxford University, UK and at the Royal College of Physicians, UK

OntarioTech UNIVERSITY

**Bridging the Digital Divide: Examining the Use and Access to E-Health Based Technologies by Millennials and Older Adults**

Delana Theiventhiran BHSc, MHSc (c), Dr. Wally J. Bartfay, RN, PhD, Dr. Caroline Barakat-Haddad, PhD, Dr. Terry Wu, PhD
Ontario Tech University

**Background**

**What is the digital divide?**
The digital divide is a complex phenomenon in which a metaphorical gap is present in between two groups of individuals who utilize ICT's (information communication technologies).
This gap provides cause for concern, especially with a society that is so technologically advanced in todays' day. Currently, little is known about how older adults and millennials access and use e-health based technologies. Hence, a systemic review was undertaken to address this noted gap in the literature.

**Research Methods**

A systemic review of the literature was undertaken employing the following three databases:
(i) PubMed, (ii) ERIC, and (iii) CINAHL.
They were examined using the search term "**digital divide and generations**" to identify any potential articles that were present.

*Ranking for Academic Sources*

**Findings**

The sample size was N=572, with 541 duplicate or non-relevant articles, which left 31 relevant articles to review. The initial search included the search term "digital divide" with a combination of words such as "older adults, 65+, elderly, and seniors" AND " millennials, young adults, college students, university students"

*Systematic Review Searches*

PubMed: • Jan 2009 to Aug 2018 • n=585
ERIC: • Jan 2009 to Aug 2018 • n=54
CINAHL: • Jan 2009 to Aug 2018 • n=14

Initial Search: Digital Divide AND Older adults, 65+, Elderly, Older adults AND Millennials, Young adults, College students, University students

Exclusion Criteria: letters to the editor, theory-focused articles, non-English articles

Inclusion Criteria: Published quantitative peer-reviewed articles published between the years January 2009 and May 2018; English only; focus on the target population for the review comprised of those aged 65+ and millennials only

N=572
541 Duplicate or non-relevant articles
31 Relevant articles

To extract required data from the studies, a data abstraction tool was created to obtain the following information:
(i) author
(ii) year of publication
(iii) sample size
(iv) country of origin
(v) design/methods
(vi) major findings/outcomes obtained.

**Results- Main Identified Themes**

**Age**
11 articles indicated age as being a large factor to the contribution of the digital divide. Millennials grew up with technology, whereas older adults were not as familiar and only used technology when required.

**Privacy Concerns**
5 articles identify that older adults are concerned by the collection and usage of internet applications, whereas millennials tend to skip reading the terms and conditions of an app to reach the benefits of the app.

**Digital Literacy**
The ability to use ICT's for research, knowledge retention, social and mechanical application. Digital literacy was found to be a contributing factor in 6 of the articles examined. Some barriers include: a fear of technology, feeling too old, etc.

**Access to the Internet**
Geographical location of an individual has largely to do with if they are able to gain access to information communication technologies and the internet. "**Dead zones**" often mean that a location lacks the infrastructure for internet usage.

**Lack of Canadian Research**
There is a lack of research that was completed in Canada. The majority of research surrounding the digital divide and different generations was from other countries such as Spain, USA, Poland and the Netherlands, with the USA being the greatest contributed to research.

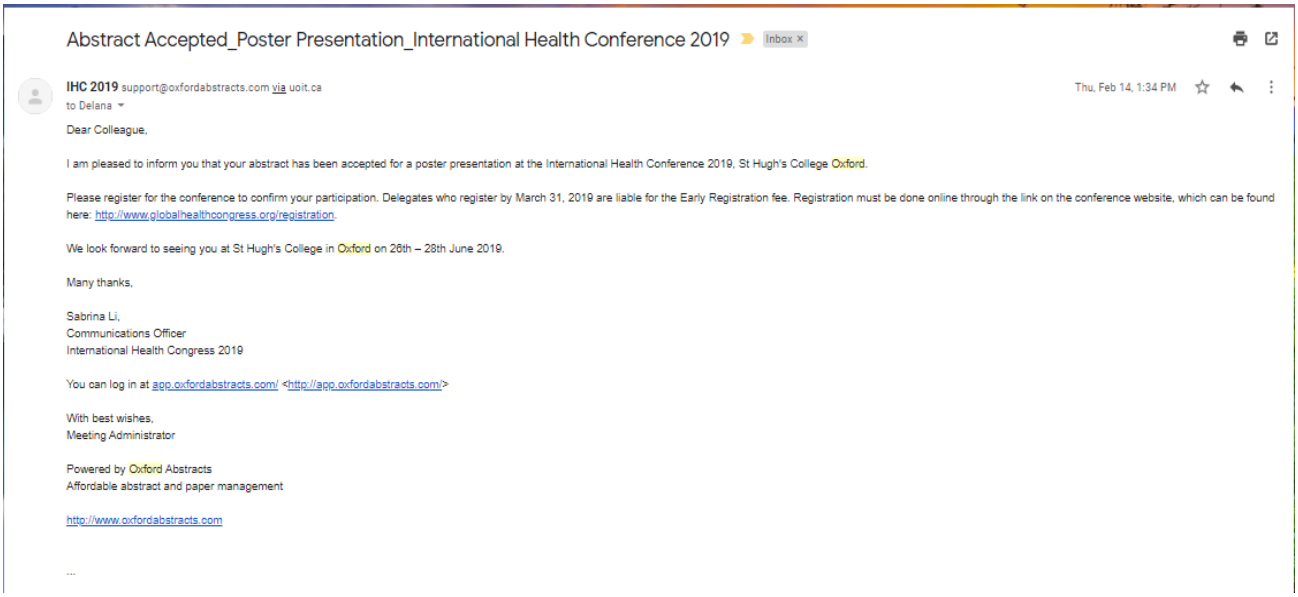
**Conclusions**

- Digital divide is still a large problem in society, and now that we have examined various factors (such as age, education, IT literacy and sociodemographic factors) leading to the gap being present, we can now examine the impact of the digital divide on health information received, used, distributed and collected by different generations.
- There is a dearth of literature in this area especially because it is a newer area of research. The consequences and benefits of technology being integrated into daily living is just being investigated.
- Majority of the literature for this topic was produced in the United States.
- A major public health challenge in the next decade will be to bridge the digital divide.

**Further Information**

Dr. Wally J. Bartfay
Faculty of Health Sciences
Ontario Tech University
Wally.bartfay@uoit.ca

**Figure 2: Acceptance Email for Poster Presentation at Oxford University, UK**



Abstract Accepted_Poster Presentation_International Health Conference 2019 Inbox ×

**IHC 2019** support@oxfordabstracts.com via uoit.ca Thu, Feb 14, 1:34 PM
to Delana

Dear Colleague,

I am pleased to inform you that your abstract has been accepted for a poster presentation at the International Health Conference 2019, St Hugh's College Oxford.

Please register for the conference to confirm your participation. Delegates who register by March 31, 2019 are liable for the Early Registration fee. Registration must be done online through the link on the conference website, which can be found here: http://www.globalhealthcongress.org/registration.

We look forward to seeing you at St Hugh's College in Oxford on 26th – 28th June 2019.

Many thanks,

Sabrina Li,
Communications Officer
International Health Congress 2019

You can log in at app.oxfordabstracts.com/ <http://app.oxfordabstracts.com/>

With best wishes,
Meeting Administrator

Powered by Oxford Abstracts
Affordable abstract and paper management

http://www.oxfordabstracts.com

...

**Figure 3: Poster Presentation Certificate at Oxford University, UK**

OXFORD FOUNDATION FOR KNOWLEDGE EXCHANGE

**CERTIFICATE OF PRESENTATION**

We hereby confirm that

***MISS DELANA THEIVENTHIRAN***

gave the following **POSTER** presentation

*The Digital Divide: Examining the Use and Access to E-Health based Technologies by Millennials and Older Adults*

**at the 5th International Health Conference in Oxford, UK**
**26th – 28th June 2019**

**Figure 4: Poster Presentation Acceptance at the Royal College of Physicians, UK**

ROYAL COLLEGE OF PHYSICIANS LONDON | 17-19 JUNE 2019

EUROPEAN
HEALTHCARE DESIGN
RESEARCH • POLICY • PRACTICE

Congress Secretariat
European Healthcare Design 2019
United Kingdom

15/02/2019

Ref: ABS2019/020

Delana Theiventhiran, Graduate Student (MHSc), Faculty of Health Sciences, University of Ontario Institute of Technology

Wally J. Bartfay, Director of Health Sciences, Faculty of Health Sciences, University of Ontario Institute of Technology

Dear Delana and Wally,

**Poster Presentation Acceptance for European Healthcare Design 2019**

Thank you for submitting an abstract to the 5th European Healthcare Design 2019 (EHD 2019) Congress & Exhibition at the Royal College of Physicians in London, from 17-19th June.

Following an anonymous, double blind evaluation by the EHD 2019 programme committee, we are pleased to inform you that your abstract, **"The Digital Divide: Examining the Use and Access to E-Health Based Technologies by Millennials and Older Adults"** has been accepted for presentation in poster format in a dedicated gallery area within the prestigious Library at the Royal College of Physicians. Your abstract will also be published in the Final Programme for the Congress.

Your poster should be designed to **A0 portrait size (841mm wide by 1189 mm high)**. Posters do not require mounting and will be fixed using Velcro or pins, both of which will be supplied by the appointed exhibition contractor. Posters should not be supplied in A1, A2 or A3 formats.

Our preference is for the posters to be delivered to the Royal College of Physicians in advance of the event so that they can all be fixed on Sunday 16th June and are ready to display when the congress opens on Monday 17th June. Please mail the poster to the following address at the venue to arrive by 5pm on Thursday 13th June:

*Royal College of Physicians, 53 Albany Street, London NW1 4EB*
*C/O Marc Sansom / Giulia Florindo*
*Title of Event: European Healthcare Design 2019*
*Room: Library*
*Date of event: 17-19th June, 2019*
*Name of company/sender:*
*Sender contact/mobile number:*
*This is a box of: Poster*

**Figure 5: Programme at the Royal College of Physicians, UK**

POSTER GALLERY

**P24 Multi-drug resistant pathogens in water systems – key risks and mitigation by design**
Elise Maynard (UK)
www.salus.global/article-show/ehd2019-p24

**P25 GOSH Zayed Research Centre – blurring the boundaries between medicine and research**
Graham Cossons (UK), Matthew Tulley (UK)
www.salus.global/article-show/ehd2019-p25

**P26 How digital and medical technology convergence is transforming health of developing countries**
Gary Hamilton (USA)
www.salus.global/article-show/ehd2019-p26

**P27 The digital divide: examining the use and access to e-health based technologies by millennials and older adults**
Delana Theiventhiran (Canada), Dr Wally J Bartfay (Canada), Dr Caroline Barakat-Haddad (Canada), Dr Terry Wu (Canada)
www.salus.global/article-show/ehd2019-p27

**P28 Creating a second nurse – how can a truly smart hospital empower patients?**
Matthew Marson (UK)
www.salus.global/article-show/ehd2019-p28

**P29 Strategic operations – doing more with less**
Sarah Holton (USA), Frank Kittredge (USA), Jane Ho (UK) Ben Martin (UK)
www.salus.global/article-show/ehd2019-p29

**P30 Wellbeing in crisis: patient-centred journey for mental health patients in the emergency department**
William Wang (UK), Dr Barbara Cleaver (UK)
www.salus.global/article-show/ehd2019-p30

**P31 How architectural elements can influence subjective experience and emotional state of patients and therefore facilitate the healing process**
Nour Tawil (Lebanon),
Richard Jedon (Czech Republic)
www.salus.global/article-show/ehd2019-p31

**P32 Opportunity for improvement with BIM and Lean methodology in the Santa Caterina Hospital extension**
Laia Isern Meix (Spain), Albert Vitaller Sanitró (Spain), Eva Roense (Spain)
www.salus.global/article-show/ehd2019-p32

**P33 Risk management in NHS healthcare infrastructure projects**
Songyang Li (UK), Andrew Price (UK), Dr Mohamed Osmani (UK)
www.salus.global/article-show/ehd2019-p33

**P34 Healthcare delivery in the 21st century and integration with the built environment**
Vivienne Reiss (UK), Hannes Koch (UK), Mark Titchner (UK)
www.salus.global/article-show/ehd2019-p34

**P35 Building performance for people**
Eszter Gulacsy (UK), Michelle O'Neill (UK)
www.salus.global/article-show/ehd2019-p35

**P36 Kachumbala Health Centre 3 – a new maternity ward for the people of Kachumbala**
Jessica Karsten (UK), Dan Flower (UK)
www.salus.global/article-show/ehd2019-p36

**P37 When does a chapel stop being a chapel? Celebrating the past and embracing the future during the redevelopment of the Royal Sussex County Hospital**
Anna Barnes (UK),
Samantha Sharman (UK)
www.salus.global/article-show/ehd2019-p37

EUROPEAN HEALTHCARE DESIGN 17-19 JUNE 2019 www.europeanhealthcaredesign.eu 27

**Figure 6: Publication on the European Healthcare Design Website**

Link: https://europeanhealthcaredesign.salus.global/journal/view/article/ehd2019-p27

HEALTHCARE / Mobile health

European Healthcare Design 2019

# The digital divide: examining the use and access to e-health based technologies by millennials and older adults

By Delana Theiventhiran and Wally J Bartfay | 12 Jun 2019 | 0

**This poster looks at how older adults and millennials access and use e-health based technologies.**

## Abstract

As the internet becomes the dominant channel of modern communications, there are many pragmatic reasons why the digital divide matters in accessing and using e-health based technologies. In general, the older generation may not be as familiar and comfortable with technology usage, and are put at a disadvantage compared with other generations such as millennials when examining and using e-health based platforms and technology. Currently, little is known about how older adults and millennials access and use e-health based technologies.

**Methods:** A systemic review of the literature was undertaken employing the following three databases: (i) PubMed; (ii) ERIC; and (iii) CINAHL; and employing the search term "digital divide and generations" to identify potential articles. To extract required data from the studies, a data abstraction tool was created to obtain the following information: (i) author; (ii) year of publication; (iii) sample size; (iv) country of origin; (v) design/methods; and (vi) major findings/outcomes obtained. Criteria included publication dates between January 2009 and August 2018, written in the English language, target populations of older adults aged 65+ and millennials, and peer-reviewed quantitative studies only.

**Results:** PubMed provided 505 potential articles, where 23 of those articles met the inclusion criteria. Specifically, ERIC provided 53 potential articles, where no articles met criteria following data extraction. CINAHL provided 14 potential articles, where eight articles met criteria following data extraction.

**Conclusion:** Practically speaking, identifying how newer e-health based technologies can be integrated into society and identifying why there is a gap with digital technology will help reduce the impact on those who are not familiar with technology. Several of the articles (n=9) indicated that age is one of the larger factors contributing to the digital divide.

Similarly, many of the examined articles (n=9) identify that privacy concerns are one of the main deterrents of technology usage for elderly individuals aged 65 and over. The older generation feels that privacy (n=2) is one of the major concerns, especially in regard to how data is collected, used and possibly sold to third-party groups. Furthermore, access to technology, the internet, and infrastructure also influence how individuals are able to receive and use information. A change in the way that healthcare is currently used, received and distributed would also help ensure that no generation is left behind in a technologically advanced society.

## Appendix M: Publication in the South Asian Journal of Nursing and Healthcare

ISSN 2664-8059 (Print) & ISSN 2706-767X (Online)
**South Asian Research Journal of Nursing and Healthcare**
*Abbreviated Key Title: South Asian Res J Nurs Health Care*

**| Volume-2 | Issue-1| Jan-Feb -2020 |** **DOI: 10.36346/sarjnhc.2020.v02i01.005**

**Original Research Article**

# The Digital Divide: Examining the Use and Access to E-Health Based Technologies by Millennials and Older Adults

Delana Theiventhiran, BHSc, MHSc[1], Dr. Wally J. Bartfay, RN, PhD[2*], Dr. Caroline Barakat Haddad[3], Dr. Terry Wu[4]

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[2]Faculty of Health Sciences, Ontario Tech University, 2000 Simcoe St N, Oshawa ON, L1H 7K4, Canada
[3]Faculty of Health Sciences, Ontario Tech University, 2000 Simcoe St N. Oshawa ON, L1H 7K4, Canada
[4]Faculty of Business and IT, Ontario Tech University, 2000 Simcoe St N., Oshawa ON, L1H 7K4, Canada

***Corresponding Author**
Dr. Wally J. Bartfay

**Article History**
Received: 22.01.2020
Accepted: 29.01.2020
Published: 29.02.2020

**Abstract:** ***Objectives:*** The digital divide is a complex phenomenon in which a metaphorical gap is present in between two groups of individuals who utilize ICT's (information communication technologies). This gap provides cause for concern, especially with a society that is so technologically advanced in todays' day. Currently, little is known about how older adults and millennials access and use e-health based technologies. Hence, a systematic review was undertaken to address this noted gap in the literature. ***Methods:*** A systematic review of the literature was undertaken employing the following three databases (i) PubMed, (ii) ERIC, and (iii) CINAHL were examined using the search term "digital divide and generations" to identify potential articles were present. A data abstraction tool was created to obtain the following information: (i) author, (ii) year of publication, (iii) sample size, (iv) country of origin, (v) design/methods, (vi) major findings/outcomes obtained. Inclusion criteria included publication dates between the years of Jan 2009 to Aug 2018, written in the English language, targeting the target population of older adults aged 65+ and millennials, as well as being peer reviewed quantitative articles. ***Results/Conclusion:*** There is a dearth of literature in this topic, as well as a decline of research produced from Canada. The consequences and benefits of technology being integrated into daily living are just being investigated. Additionally, a change in the way that healthcare is currently used, received and distributed would also help attribute to the change to ensure that no generation is left behind in a technologically advanced society.

**Keywords:** Digital divide, information communication technologies, ICT, older adults, millennials, technology, Internet, E-health.

## INTRODUCTION

Currently, there is a death of literature examining the use of technology to access health related information. The digital divide is a phenomenon that describes the divide between groups when utilising information communication technologies (ICTs) to help better their experience in society. Technology usage has widely been associated with those in the millennial generation, who are defined as individuals born between the years of 1981 to 2000 [1]. Milestones of their generation include the rise of technology such as smartphones and tablets, social media, as well as entering the work force during the economic recession [1]. Most millennials in today's day would be between the ages of 18 and 37. Older adults were born between 1946 and 1965, and would be between the ages of 54 and 72. With the rise of technology usage in society, those in the older adult generation may not be as familiar with technology and are thus put at a disadvantage compared to other generations such as millennials when examining and using e-health based platforms and technology.

## OBJECTIVES

This systematic review aims to identify the gaps that led to the digital divide between older adults and millennials, and identify ways to rectify this gap to be inclusive of all generations.

**Significance and Rationale**

Technology is used worldwide, and has become a major driving factor for many occupations, schooling & training, banking, shopping and even daily living as a form of socialization and entertainment. These daily activities have been converted onto the online platform, so individuals can enjoy the convenience of doing daily activities from the comfort of their own homes, or on the go. Internet users from the ages of 34 and younger has increased substantially from 72.6 in 2005 to 82.9 in 2009, moreover those aged 65 and older have also increased as well from 62.8% in 2005 to 65.9% in 2009 [2]. However, in a technologically advanced society, it is important to note that not everyone is familiar or comfortable with using these technologies. Although technology usage has increased exponentially over the past few decades, the generation of those aged 65 and older are still not fully online and integrated into the online platform.

This unfamiliarity of technology and a lack of usage is what present itself as the so-called "digital divide". The term "digital divide" was first coined to describe the noted gaps between different generations when they are utilising technology and information communication technologies. In comparison, older adults are not online as much and prefer traditional methods such as pamphlets and face-to-face contact with their health care providers to obtain their health information. Although those methods are valid ways to receive information, those who are 65+ are at a disadvantage when the online world provides them with significantly more up-to-date resources, such as Health Canada, Public Health Canada, government and not for profit NGO websites. These websites are able to provide a plethora of information for individuals who may be experiencing ailments that could be treated at home or over the counter. By accessing these online resources, these individuals are able to save time and health care expenses by avoiding a trip to their health provider or emergency room.

Despite the growth and the use of Internet based health related websites on various topics such as chronic and infectious disease, medications, nutrition and diets, there is currently a death of information related to who is actually accessing and how they are using these websites. Accordingly, a systematic review of the peer-reviewed literature was undertaken to address this noted gap and examine how older individuals compare to millennials in regards to access and usage of Internet based e-health related technology.

## METHODS

A systematic review of the literature was undertaken to examine the peer-reviewed literature related to the use and excess of Internet-based technologies and sites by those aged 65+ and millennials. Prior to the review of the literature, a preliminary search were completed to ensure that there were no similar systemic reviews studies conducted. For the purpose of this systemic review, we examined the following three online computer databases: (i) PubMed; (ii) CINAHL, and (iii) ERIC. Preliminary searches consisted of the key terms "digital divide AND generations", and a combination of different search terms to outline "digital divide and older adults" (ie. Older adults, elderly, 65+) as well as for millennials (ie. Young adults, university students, college students). Inclusion criteria for the systematic review included the following: (i) Published quantitative peer-reviewed articles published between the years January 2000 and May 2018; (ii) English only; (iii) Studies had to focus on the target population for the review compromised of those aged 65+ and millennials only (iv) Studies had to be qualitative in nature. Exclusion criteria for the systematic review included: (i) letters to the editor (ii) theory-focused articles and (iii) non-English articles. A data abstraction template was employed to assess the suitability of the articles, and compromised the following information: (i) type of article (research-based, quantitative, system review); (ii) ranking of article in the order listed in Flow Chart II (iii) authors; (iv) year of publication; (v) country of origin); (vi) main outcomes and/or conclusions. Once potential abstracts were located, articles were examined for their suitability. The reference lists for all located suitable articles were also examined for potential secondary data sources. Following the initial preliminary search, multiple other searches were employed using terms such as "65+" such as "elderly", and "senior", to ensure all potential and relevant articles were identified.

## RESULTS/FINDINGS

**PubMed**

The initial search on PubMed provided 505 potential articles. Following that search, inclusion criteria was manually applied, which brought down the list to 27 articles. After examining for suitability, 23 articles were selected and the data abstraction tool was then employed to extract data from the study.

**ERIC**

The initial search performed on ERIC provided 53 potential articles. Following the application of the inclusion criteria, that list was brought down to 11 potential articles. After examining for suitability, no articles were found to be suitable for the purpose of this study.

**CINAHL**

The initial search performed on CINAHL provided 14 potential articles. Following the application of the inclusion criteria, the list presented 12 hits. After examining for suitability, the list was brought down to eight hits, and had the data abstraction tool applied to extract relevant data from the study.

**Table-1: Summary of PubMed, ERIC, and CINAHL Articles**

| Authors and Country of Origin | Design/Methods | Major Outcomes | Ranking |
|---|---|---|---|
| Bhuyan, Lu, Chandak, *et al*. [3]- USA | • Looked at mobile health applications for health behaviours.<br>• 36% of individuals had health apps<br>• 60% reported usefulness of health apps in health behaviour goals.<br>• 35% stated there was helpfulness in medical care section making<br>• 38% reported usefulness in asking physicians new questions. | • Mobile health apps can reduce the burden on primary care, reduce costs and improve quality on health care.<br>• There is also a privacy concern on who has access to information in the mobile health apps. | III |
| Cresci, Yarandi, Morrell. [4]- USA | • Examined the health, demographic and social activities of urban older adults.<br>• Secondary analysis via 2001 Detroit citywide assessment of older adults. | • Computer users were younger, had a high level of employment and education, and were healthier and more active.<br>• Internet was used to connect with friends and family and playing games, and writing. | III |
| Delello, & McWhorter. [5]- USA | • Those 65+ are experiencing social isolation, loneliness, depression and decline in health.<br>• The study looks to find if ICTs (ipads) improved the lives of older adults | • Use of technology brought increased knowledge, closer gamily ties, and a greater connection to society. | III |
| Duplaga [6]- Poland | • Examined looking at Internet usage with those who have disabilities on a nationwide study in 2013 in Poland | • 33.05% were Internet users<br>• 3556 respondents with disability 51.02% were females<br>• 25.19% were 65+ | III |
| Gracia, & Herrero [2] – Spain | • Aims to look at the association between Internet use and self-rated health in older people and see if there is an interaction when examining socioeconomic status.<br>• 709 individuals were examined in Spain, and were compared using two age groups (55-64 and 65-74 years of age). | • Relationship between Internet usage and poor self rated health, which supported the notion that Internet users have better self rated health then those who are non users.<br>• When applied using social class, the relationship was eliminated, which suggest that the Internet is not a significant determinant of health in older people. | III |
| Hong, Cho. [7]- USA | • 2003 to 2011 using the HINTS survey.<br>• Examined by 4 online behaviours: seeking health info, buying medicine, connecting with people who have similar health problems, and communicating with doctors. | • Digital health divide between different demographic groups is narrow but those who are older, do not have a HS education, and low income lagged | III |
| Hong, *et al*. [8]- China | • Examine the current rates of access to mobile tools among Chinese individuals aged 45+. | • 18215 participants, 6.51% used Internet in the past month<br>• 83% owned a mobile phone | V |

| | | | |
|---|---|---|---|
| | • Used neighbourhood amenities and community level resources | • Divide is present in china in an older population. Internet access is limited to people with higher SES. | |
| Hurme, Westerback, & Quadrello [9]- Finland | • Sample of Finnish grandchildren and grandparents; examining distance, age, gender, and education for grandparents. | • The further the grandparent lives, the further the face-to-face contact is, but more letters and cards.<br>• Grandchildren tend to use text messaging instead. | I |
| Kania-Lundholm, Torres [10]-<br>Sweden | • Research on older active ICT users looks at why those who are older age consider themselves as unable to use technology | • Interviews with 30 older adults (Aged 66-89).<br>• Positioning theory is used to shed light on how the older people interview positioned as active older issues. | III |
| **Levy, Janke, Langa. [11]-**<br>**USA** | • Health literacy and use of Internet for obtaining health info.<br>• Among Americans 65+.<br>• Sample size was 824 individuals and 1584 Internet users. | • Results showed only 9.7% of individuals with low health literacy used the Internet to obtain health information<br>• Above compared to 31.9% of individuals who have health literacy.<br>• Persistent result after controlling SES, health status and general cog. ability | III |
| Levy, Janke, & Langa [11]-<br>USA | • Cross sectional survey using 225 adults to examine if HIT is able to improve quality of care and health outcomes. | • 76% of respondents had Internet access, users and nonusers of online health info differed.<br>• Those who used laptops, computers, and smartphones were more likely to be efficient in HIT. | V |
| Luger, Hogan, Richardson, Cioffari-Baillif, Harvey, & Houston [12]-<br>USA | • Older adults have less access to Internet<br>• Data collected via mail survey with a sample of 266 veterans aged 65+.<br>• 50% reported having no Internet access but they reported feeling comfortable with help to access Internet. | • Older individuals are willing to access the Internet if they have technology support. | III |
| Mackert, Mabry-Flynn, Champlin, Donovan, & Pounders [13]-<br>USA | • 4974 American adults were looked at to examine if health literacy affected HIT use. | • Patients with low health literacy did not use HIT tools as much but they thought HIT use was private.<br>• It is important to examine the way that HIT provides privacy and that individuals are able to use full benefits. | IV |
| Nguyen, Mosadeghi, & Almario [14]<br>United States of America | • 81.5% of individuals reported using the Internet previously.<br>• 64.5% stated that they used the Internet within the past year. | • Individuals who lived in lower income households and rural areas were less likely to have access to use Internet for health information. | III |
| Seifert, & Schelling [15]-<br>Switzerland | • Examined those aged 65+ living in Switzerland via telephone survey. | • Those online found better positive aspects of the Internet compared to those who didn't. | III |
| Van Deursen, & Van Dijk. [16] –Netherlands | • E-Health literacy is one of the bigger aspects that have been presented following the increase of technology in health care.<br>• 88 subjects participated in the study.<br>• Each subject had to work on assignments through the Internet and focused on areas such as operational, formal, informational and strategic. | • Unable to find out who is proficient in technology vs who is not.<br>• Subjects were able to complete 73% of the Internet tasks<br>• 73% of the formal tasks<br>• 50% of Internet tasks were completed<br>• 13% for informational skills<br>• Age and education were crucial contributors in this area. | III |

## DIRECTIONS FOR FUTURE RESEARCH

**Gaps in the Literature**

There is currently a death of literature examining the digital divide and the interaction between the millennial and older adult generation, in comparison to use for health related information. This is a cause for issue as technology is becoming increasingly integrated in society, (ie.smartphones, laptops, and tablets). These information communication technologies have also become critical assets to receive up-to-date health information. As a result, 86% of Canadians have become technology users, Statistics Canada, 2016. Statistics Canada 2016 also shows that the majority of non-technology users are those who are older adults and are not as accustomed to having technology integrated as a part of their lifestyles.

**Age**

Age was found to be one of the largest supporting factors in contributing to the digital divide. Many of the articles (N=11) indicated that age is one of the larger factors contributing to the digital divide. This can be attributed to the reasoning that millennials grew up with technology [9], and tend to use technology such as social media as a main form of communication [16]. Additionally, technology is largely used in the school and work setting to help support regular daily processes, applications and requirements. In regards to those 65+, they were found to be not as familiar with technology (N=5), and only utilize technology when actually required. Those aged 65+ were also found to need help to use technology [12].

A study by Loges and Jung [17]) also examined the digital divide and the relationship it has with age. They hypothesized that age has a negative association with Internet access. The study found that age leads to a change in the way that the participants respond on surveys. They also use less Internet-based applications, and use it less compared to their younger counterparts. Friemal [18] found that those individuals aged 65 years and older were partially excluded from Internet usage. Friemal [18] identified that social context has an increased influence on whether someone aged 65+ would be using the Internet or not. The studies by Korrupp and Szydlik [10] and Loges and Jung [17] further prove that age and the instances of usage often correlate with the level of familiarity an individual has with using the Internet.

**Health Information Technology Usage**

Nearly all Canadians under the age of 45 use the Internet every day [19]. This statistic states that usage decreases with increasing age, with those aged 65 and over reporting that the Internet used on occasion, or as required.

**Privacy Concerns**

Many of the examined articles (N=5) identify that privacy concerns were one of the main deterrents of technology usage for elderly individuals aged 65 and over. The older adult generation feels that privacy is one of the biggest concerns, especially in regards to the collection and usage of data that is collected by Internet applications and website developers. Other concerns involve t third parties involved and how they collect and store personal information. Younger generations were also giving away their personal information and data. Terms and conditions that were outlined in apps were often difficult to read, especially when they are filled with pages of technical terms. An academic paper written by Obar aand Oeldorf-Hirsch [20] outlines that online users tend to agree to terms of services and privacy policies 93% and 97% of the time, respectively. This is a cause for concern as the privacy policy and the terms of service should have taken between 29 and 32 minutes to read, which did not happen with the majority of participants (N=543). Many older adults indicate that terms and conditions are often long and extensive, which deters them away from trying new E-health technology (ie. app to measure heart rate and heart beat).

**Digital Literacy**

Digital literacy is the notion of how well an individual is able to use information communication technologies for processes such as research and knowledge retention, mechanical, as well as social application. According to Statistics Canada [19], there are many barriers to digital literacy, such as the attitude involving technology, age, socioeconomic status (SES), languages, and the general availability and access to these resources.

**Access to the Internet**

Access to technology and the internet also plays a large part in the way that individuals are able to receive and use information. The Canadian Radio-Television and Telecommunications Commission has stated that broadband internet is an essential service that should be delivered to all Canadians equally and adequately [6]. According to the Canadian Broadcasting Corporation, Canada has many Internet "dead zones", which are areas where infrastructure for Internet connection has not been placed. These "dead zones" are often seen as an individual moves further north and away from urban centres [6]. As a result, many smaller towns have been introducing their own broadband infrastructure to help combat that situation and provide equal access to the internet for all. With Canada's population largely being centered in urban centres, it still creates a concern for those who are in rural locations.

**Implications for Public Health**

The digital divide is still a large problem in society, and now that we have examined various factors (such as age, education, IT literacy and sociodemographic factors) leading to the gap being present, we can now examine the impact of the digital divide on health information received, used, distributed and collected by different generations. Practically speaking, identifying how newer healthcare technology can be integrated into society and identifying why there is a gap with digital technology will help reduce the impact on generations and individuals who are not as familiar with technology and Internet usage as their younger counterparts. The comprehension and understanding of this issue is important in today's day to reduce the digital divide would include identifying where there is a lack of access to the Internet and can be improved. The digital divide was attributed as one of the main causes, with the digital divide being defined as the notional gap that divides one generation from another due to a lack of comprehension involving the general usage of technology. This systematic review specifically targeted those who are aged 65+ and between 18-24 to examine the two extremes of technology usage. By investigating this and aiming to identify if any prior research had taken place, it was found that there was a death of literature in this area especially because it is a newer area of research. The consequences and benefits of technology being integrated into daily living is just being investigated. Another important aspect to consider is that there is also a death of literature on research that is being produced by Canada. The majority of the literature in this topic is produced is American descent. Additionally, a change in the way that healthcare is currently used, received and distributed would also help attribute to the change to ensure that no generation is left behind in a technologically advanced society.

The largest concern of all is how to prepare older adults for new and emerging e-health technologies. Older adults are just at 65.9% of the population who use technology, whereas the millennials are almost fully integrated at 98% [19]. With the increasing costs of healthcare, learning how to use technology can help support many older adults with their health care resources and reduce costs. With the proper support, older adults can learn how to use technology to help better their quality of life and reduce health care spending costs at the same time.

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life. *Journal of Applied Gerontology*, 37(1), 99-109.
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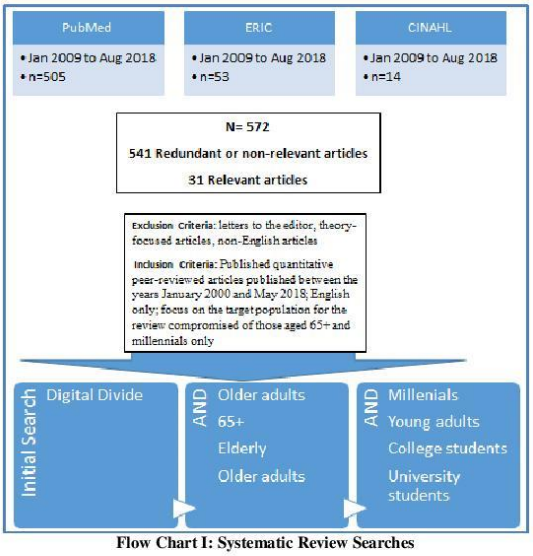
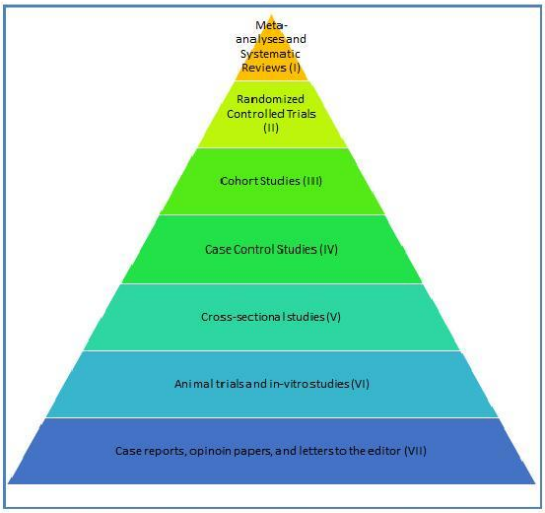



**Flow Chart I: Systematic Review Searches**




**Flow Chart-II: Ranking System for Academic Sources**

# Appendix N: Curriculum Vitae

DELANA THEIVENTHIRAN

| delana.theiventhiran@uoit.net

## SUMMARY OF SKILLS

Languages

· Fluent in Tamil and English

· Working proficiency in French

Software

· Microsoft Office (Word, Excel, Outlook, Powerpoint, Access, One Note)

· EndNote and Mendeley

· PS Suite, Meditech, ICD-10

· SPSS, SAS, R

Quantitative Skills

· Knowledge of research methods (ie. Hypothesis testing, cluster analysis, etc)

· Data entry and data management through implementation of raw data values into files

· Collected primary data by distributing and explaining consent forms and surveys to classes of 200 students, as well as older adult centres

· Conducted data analysis to obtain values for statistical significance

· Experience with survey conduction with Likert scales, questionnaires, etc

· Experience with literature reviews, and systemic reviews

· Manuscript and Thesis writing

· Knowledge of evidence-based practice principles, research process, research analysis, and familiarity with health resources.

· Utilize lay terms to easily communicate to individuals across all demographics (ie. Immigrants, Elderly, Students, etc)

## EDUCATION

2017-2020 Masters of Public Health (Honours), *University of Ontario Institute of Technology*

- Thesis Title: The Digital Divide: Examining the Use and Access to E-health Based Technologies by Millennials and Older Adults in Ontario, Canada

2013-2017 Bachelors of Health Sciences (Honours)- Public Health Specialization, *University of Ontario Institute of Technology*

- Dean's List student

## RESEARCH EXPERIENCE

September 2017-April 2020 Thesis Student, under supervision of Dr. Wally Bartfay, UOIT, Oshawa

· Conducted literature review to identify discrepancies between millennials and older adults in regards to the digital divide

· Conducted primary data collection within several seniors centres in Durham Region and the University of Ontario Institute of Technology

· Conducted data entry/analysis using SPSS, Excel and R

· Created systemic reviews in pressing issues surrounding technology, the digital divide, and nomophobia

· Ensured no ethical concerns had arisen to reduce and eliminate any harm to participants in the study

· Translated researched evidence into written clinical recommendations sections of the thesis which will help contribute to policy change

November 2015-April 2017 Research Assistant for Dr. Wally Barfay, *UOIT, Oshawa ON*

· Conducted primary data collection, data analysis, data entry and management

· Created poster for NaHSSA conference (Dalhousie University, Halifax), National Sleep Society Conference (Calgary, Alberta), Ontario Public Health Convention

· Presented poster at NaHSSA conference (Dalhousie University, Halifax), National Sleep Society Conference (Calgary, Alberta), Ontario Public Health Convention

· Created abstracts and submitted to various conferences relating to health nationally

September 2016-April 2017 Research Assistant (Practicum Placement), *Ontario Shores Centre for Mental Health, Whitby ON*

· Conducted literature review

· Interacted with patients and conducted data collection

· Created poster for Ontario Shores Poster Day

· Wrote discussion section

· Help develop evidence based population health intervention protocols aimed to improve the outcomes for various chronic condition patient groups who suffer from dementia

August 2016-April 2017 Research Assistant for Dr. Alan Monavvari, *Markham Stouffville Hospital*

· Conducted literature review to identify discrepancies between existing literature on obesity

· Conducted primary data collection within the hospital

· Conducted data entry/analysis using SPSS

## WORK EXPERIENCE

October 2019-January 2020

Graduate Research Assistant- Contract, Ontario Shores Centre for Mental Health Sciences, *Whitby ON*

- Conducted research with patients concerning the study being examined
- Collected raw data using an observatory method
- Communicated with patients, their families and supported them if help was required
- Used Meditech to access patient information
- Created reports outlining the results of the study

September 2017-April 2019

Teaching Assistant, *University of Ontario Institute of Technology*, Oshawa, ON

- Support the professor through marking, teaching, and supplemental learning for students
- Regularly advocate with students to ensure that they are reaching their full potential
- Mark and submit results in a timely manner
- Taught the courses:
  - Info Lit and Written Comm for HS- HLSC 1701U in Fall 2017 and Fall 2018
  - Interprofessional Health Care Teams- HLSC 3601U in Winter 2018 and Winter 2019
  - Intro to Health Services Management- HLSC 2601U in Winter 2019
  - Interdisciplinary Collaboration HLSC 4820U in Fall 2018
  - Intro to the Canadian Health Care System HLSC2802U in Fall 2018
  - Prevention and Rehab of Complex Chronic Conditions HLSC 3473U in Winter 2018

October 2016-April 2017

Exam Invigilator, *University of Ontario Institute of Technology, Oshawa ON*

- Invigilated exams by assisting the professor with exam distribution and collection
- Monitored the exam hall to ensure that students act with academic integrity in mind
- Assisted students with any concerns they might have during the exam

July 2016-August 2016

Medical Receptionist/ Data Entry Clerk, *Health For All, Markham ON*

- Discussed patient files with doctors and other health professionals in a confidential and private manner
- Called and answered phones, scheduled appointments, imputed patient information into PS Suite
- Communicated with patients and relayed test results
- Coded patient information into PS Suite as per DSM-9

August 2015 Office Intern, *Dr. Betty Choi-Fung Medical Practice*, Toronto ON

- Triaged patients
- Scheduled appointments, imputed patient information into the system (PS Suite)
- Contacted patients before and after their appointment to relay test results, appointment information, etc.
- Dealt with patients in a professional and confidential manner

July 2014-August 2014 Neurosurgery and Neurology Intern, *Great Ormond Street Hospital for Children, London UK*

- Observed surgery and treatment for children experiencing neurological concerns
- Learned to assess and speak with patients and their families in an empathic manner
- Dealt with patient's charts in a confidential manner

## PUBLICATIONS, POSTERS AND PRESENTATIONS

Publications

Bartfay, W., Wu, T., Bartfay, E., Zavitz, K., Earle, J., Horsborugh, S., . . . Theiventhiran, D. (2020). A Personalized Music Intervention (PMI) to Decrease BPSDs in Patients with Dementia on a Geriatric Dementia Unit: Promoting Patient Centred Care and Quality of Life. *American Journal of Biomedical Science and Research.* 9(4). 10.34297/AJBSR.2020.09.001412.

Theiventhiran, Delana & Bartfay, Wally & Haddad, Dr & Wu, Dr. (2020). The Digital Divide: Examining the Use and Access to E-Health Based Technologies by Millennials and Older Adults. South Asian Research Journal of Nursing and Healthcare. 02. 31-37. 10.36346/sarjnhc.2020.v02i01.005.

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Theiventhiran, Delana & Bartfay, Wally & Bartfay, Emma & Papaconstantinou, Efrosini & Stanyon, Wendy. (2016). The effects of excessive smartphone and other mobile ICTs use by millennials on their sleep and rest quality: Implications for public health. 10.13140/RG.2.2.22602.21443.

Posters and Conferences

"The Digital Divide: Examinng the Use and Access to E-Health Based Technologies by Millennials and Older Adults" in preparation for the World Health Congress 2019 Conference taking place at Oxford University, UK

"The Digital Divide: Examinng the Use and Access to E-Health Based Technologies by Millennials and Older Adults" in preparation for the European Healthcare Design conference taking place at the Royal College of Physicians in London, UK

"The Digital Divide: Examinng the Use and Access to E-Health Based Technologies by Millennials and Older Adults" in preparation for the The Future of Technology with a Conscience Forum in Oshawa, ON

"Smartphones in the bedrooms of university students results in alterations to sleep: Implications for public health" in preparation for NaHSSA conference at Dalhousie University

"The effects of excessive smartphone and other mobile ICTs use by millennials on their sleep and rest quality: Implications for public health" in preparation for the Ontario Public Health Convention 2017 and the Canadian Sleep Society Conference 2017

Presentations

International Health Congress 2019- Oxford University, Oxfordshire, UK

European Healthcare Design 2019- Royal College of Physicians, London, UK

The Future of Technology with a Conscience- Oshawa, ON

Brilliant Catalyst 2019 (UOIT with Ontario Shores)- Oshawa, ON

National Health Sciences Student Association, Dalhousie University, Halifax ON

Ontario Public Health Convention 2017- Toronto, ON

Canadian Sleep Society Conference 2017- Calgary, AB

Ontario Shores Research Day 2017- Whitby, ON

Ontario Public Health Convention 2016- Toronto, ON

## AWARDS

2019 *Brilliant Catalyst Award*

- $5000

2016-2019 *Experiential Learning Award-various amounts*

- Recipient of the Experiential Learning Award for 3 years

2014-2017 *Tuition/Bursary Awards-$1500-$2000*

- Recipient of several tuition awards

## Glossary of Key Terms

**Digital divide**: The gap between ICT "haves" and "have-nots". This includes access, digital literacy, location, age, as well as many other defining factors. It is often used as an umbrella term to describe the phenomenon.

**ICT**: Information Communication Technology

**Digital Literacy**: the ability to understand and coherently use technology for a specific purpose. This process commences from turning on the device to acquiring the specific purpose.

**Older Adults**: Those who are aged 65 and above

**Millennials**: Those who are aged 18 and above until age 25.

**Sociodemographic factors**: Factors like age, education, race, ethnicity and language, which are often predisposed.