National Survey of Older Adults in Canada: Social and Health Care System Determinants of E-Health Applications Use

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Abstract

Little is known about e-health applications use by elderly in relation to social and system level determinants. We conducted a national survey of 2000 seniors in Canada assessing their use of technology and e-health applications, social determinants and interaction with the health care (HC) system. The findings show technological readiness (85% owned computers, 74% used Internet daily/weekly, 90% used e-mail) that does not translate into e-health applications use. Internet use to connect with a HC professional, access test results or patient portal, or medical appointment booking was very limited. The use of wearables, telemonitoring, and fall detection technology was 11.9%, 9.4%, 4.2%, respectively. Digital divide exists among seniors, underscored by significant relationship between e-health applications use and social determinants. Private insurance and willingness to pay for quicker access are related to more frequent mApps and Internet use for accessing health information and exchanging with HC providers.

1. Introduction

Population aging is a global phenomenon that has implications at the social, economic, and health systems levels. By 2050, the number of older adults will double to reach 2.1 billion worldwide (World Health Organization, 2021). In Canada, around 18.5% of the population are ≥65 years representing 7,081,792 Canadians (Statistics Canada, 2022). With older Canadians constituting the fastest growing age group (National Institute on Aging, 2020), challenges are surfacing in relation to the ability of the health care (HC) system to address their needs, but opportunities are also presenting for technology-enabled transformation.

In recent years, there has been growing interest in studying technology in relation to older adults given its potential in the provision of support for this group (Czaja, 2016; Haase et al., 2021; Heinz et al., 2013; McMurtrey et al., 2011; Sixsmith et al., 2022). Older adults are expected to play a more active role in the management of their health given the shortage of providers (e.g., nurses, care workers) and the shift of care delivery outside of medical settings. Yet, they have grown up in a different era, during which the current technologies in our society did not exist, and thus may have different opinions about them (Heinz et al., 2013).

A recent study on the use of mobile health technology and digital self-tracking among seniors compared to the general population in Canada showed limited leveraging of these technologies in partnership with providers (Jaana & Paré, 2020). More than 60% of elderly indicated tracking their health manually (Jaana & Paré, 2020). As baby boomers move into the "third age", which is associated with retirement and characterized by searching for new experiences and learning new things, there is an increasing need to assess their knowledge and use of information technologies (Quan-Haase et al., 2016). This is especially important in light of the projected increase in the proportion of older adults (Statistics Canada, 2016), and the limited resources available to support them.

From a theoretical perspective, the life course theory (Elder, 1974; Elder & Rockwell, 1979) provides the foundation for this research. This interdisciplinary theory emphasizes the relation between a person's choices on one hand, and their socio-economic context in which they live on the other hand. It perceives individuals as capable of making decisions within existing opportunities and constraints (Hutchison, 2019). According to this perspective, the family constitutes a "social group" that is embedded in a larger social context (*Life Course Theory*, 2022), and questions related to the context are at the core of the life course theory (Elder & Rockwell, 1979). Hence, this theory will allow us to investigate the choices of older adults on e-health applications use in relation to their social environment and existing opportunities and constraints related to the HC system. The principles that characterize the life course theory include georgraphical location, social ties (i.e. presence of attributes of family members and societal experiences), stages in life (i.e. generational group differences), variability (i.e. in gender, social class, education, wealth, family support),

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and personal control (i.e. environmental opportunities and constraints), all of which can present circumstances and shape individuals' perceptions and decisions (*Life Course Theory*, 2022). In this research, the social characteritics and living environment represent the micro level dimension, and the HC system represents the macro level one. These social and contextual elements are expected to influence older adults' decisions to accept and use technologies.

Social determinants represent non-medical factors that are perceived as important in shaping health outcomes in populations (World Health Organization, 2022). Addressing these detemrinants is fundamental to ensure that adequate strategies and policies are in place, and decrease inequities (World Health Organization, 2022). Despite their relevance to the discussion on HC, limited research has examined their relationship with technology and e-health applications use, which would ultimately impact the utilization of HC services. In addition, the interaction of elderly with the HC system represents a unique context, thus influencing their decision to use digital health technologies and e-health applications. Thefore, we hypothesize that social determinants and the interaction with the HC system can affect the elderly decision to use technology and e-health applications (Figure 1). In the following sections, we provide an overview of Canadian older adults and their technology and e-health applications use, and examine the association with social environment characteristics and interaction with the HC system.

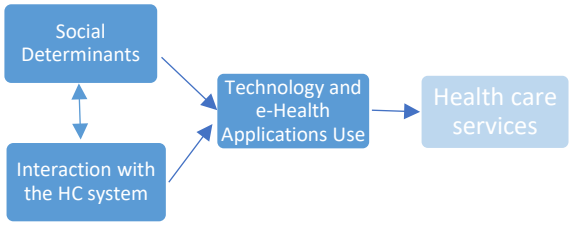

Figure 1. Conceptual Framework

2. Methods

2.1 Study Design and Sample

A cross-sectional pan-Canadian survey of older adults was conducted to assess their technology-related behavior and investigate the use of specific technologies and IT solutions. The survey was administered online using a self-administered Computer-Assisted Web Interface (75%) and Computer Assisted Telephone Interview (25%). A random national sample of 2,000 Canadian residents, aged 65 years and older, who speak English or French, was selected from a proprietary online panel of one of the largest Canadian research market firm (Léger Company), which includes more than 400,000 Canadian households. In order to maintain a random sample, no quotas were set initially. The data were weighed after sampling, according to gender, age, and region to maximize sample representativeness.

Eligible respondents approved an informed consent form prior to completing the questionnaire. Ethics approval was granted by the University of Ottawa research ethics committee.

2.2 Survey and Data Collection

The survey instrument consisted of different sections that covered three main areas: 1) socio-demographic characteristics, living environment and interaction with the HC system; 2) technology and Internet/e-health applications use; 3) chronic disease, and fall detection (FDT) and telemonitoring (TM) technology.

Grounded in the principles of the life course theory capturing the micro level environment, socio-demographic variables were measured with standardized indicators used in other international surveys (Accenture Consulting, 2016; Brown, 2016; GFK, 2019). These include: gender; age; region; income; education; language; and occupation. Questions assessing the living environment were included (e.g., community, home/retirement home, alone/with someone) to give a comprehensive overview of the elderly social context.

To measure the macro level opportunities and constraints, we assessed the interaction with the HC system through indicators that capture the availability of private insurance, family physician and home care; perception of own health; willingness to pay for quicker access to services; and hospitalizations and emergency room visits in the past 6 months. Satisfaction with the HC system, access to HC services, and the HC services received were also included in the survey.

The section on technology investigated the use of devices (e.g., wearables, smartphones), applications, and social media platforms. The frequency of use of mApps for health and Internet for accessing information/resources and communicating with providers was measured on a [1-5] scale (1=Never to 5=Always). The interest/willingness to exchange online information was also measured on a [1-5] scale (1=Not at all to 5=Totally). Last, familiarity with FDT and TM technology (Not at all to Extremely familiar), past use, and willingness to use them again were also included.

The survey was pretested with 47 respondents by phone and on the web; change was made to the skip pattern for one of the questions. Data collection was done over a 3-week period (July-August 2018). Online respondents accessed their surveys using a unique identifier. The survey completion time was 8-10 minutes.

2.3 Data Analysis

Descriptive data analysis described the profile of Canadian older adults and their technology-related behavior. Bivariate non-parametric analyses (Mann Whitney/Kruskal Wallis for continuous variables, Chi-square/Fischer Exact test for categorical variables) examined the association between socio-demographic characteristics, living environment, and interaction with the HC system in relation to Internet/e-health applications use. Multivariate regression analysis for e-health applications use (scales) and binary logistic regression (wearables, TM and FDT) were performed to examine the final significant relationships.

3. Results

3.1 Sample Characteristics

Table 1 presents an overview of the sample socio-demographic characteristics. There was a good variation in relation to the social determinants. The largest group of respondents were 70-74 years old, women, married, had a college or university degree, earned less than CAN $75,000, spoke English, and lived in Ontario or Quebec (most populous provinces and largest HC jurisdictions). Around 68% lived in metropolitan cities or suburbs, 96% lived in their homes; around one third lived alone.

Table 1. Overview of the Sample

Socio-Demographic Characteristics	Total (N=2000)
	N (%)
Gender	
Man	908 (45.4)
Woman	1092 (54.6)
Age	
Between 70 and 74	479 (23.9)
Between 75 and 79	360 (18.0)
Between 80 and 84	323 (16.2)
85 or older	175 (8.7)
I prefer not to answer	663 (33.2)
Highest Education Level	
Elementary School	42 (2.1)
Intermediate School	56 (2.8)
High School	630 (31.5)
College degree	523 (26.2)
University, undergraduate	476 (23.8)
University, graduate degree	244 (12.2)
Other	28 (1.4)
Marital Status	
Single	141 (7.0)
Married	1201 (60.1)
Widowed	401 (20.1)
Separated/divorced	248 (12.4)
Other	9 (0.4)
Employment	
Employed full-time	77 (3.8)
Employed part-time	94 (4.7)
Retired	1790 (89.5)
Other	39 (1.9)
Income	
< $25,000	202 (10.1)
$25,000 - $49,999	519 (25.9)
$50,000 - $74,999	393 (19.6)
$75,000 - $99,999	270 (13.5)
$100,000 - $124,999	122 (6.1)
$125,000 - $149,000	70 (3.5)
≥ $150,000	61 (3.1)
I prefer not to answer	364 (18.2)
Home Language	
French	459 (23.0)
English	1496 (74.8)
Other	45 (2.2)
Region	
Prairies (Alberta, Saskatchewan, Manitoba)	293 (14.7)
British Columbia	287 (14.3)
Maritimes (New Brunswick, Nova Scotia, PEI)	126 (6.3)
Ontario	30 (38.0)
Newfoundland and Labrador	760 (1.5)
Quebec	505 (25.2)
Living Environment	**Total (N=2000)**
Living Community	
Rural (<2500 persons)	306 (15.3)
Small town (2500-10,000 persons)	306 (15.3)
Suburb (10,000 -50,000 persons)	479 (23.9)
Metropolitan (>50,000 persons)	890 (44.5)
I don't know	19 (1.0)
Where do you live	
My home	1922 (96.1)
A retirement home	76 (3.8)
Other	2 (0.1)
Living Situation	
Alone	665 (33.3)
With your wife/husband/partner	1205 (60.3)
With family or friends	119 (5.9)
Other	11 (0.5)

3.2 Interaction with the HC System

Around 55% of Canadian older adults in the community, who usually have access to a national health insurance, reported also having private insurance (Table 2). The vast majority had a family physician, did not receive home care services, and reported good to excellent health. Around 8% and 14% had hospitalizations and emergency visits, respectively, and one third were willing to pay for quicker access to HC services.

Table 2. Interaction with the HC System

	Total (N=2000)
Private insurance	
Yes	1098 (54.9)
No	902 (45.1)
Family physician	
Yes	1896 (94.8)
No	104 (5.2)
Home care	
Yes	83 (4.1)
No	1917 (95.9)
Willingness to pay for quicker access	
Yes	647 (32.4)
No	1353 (67.6)
Perception of own health	
Excellent	242 (12.1)
Very good	694 (34.7)
Good	725 (36.2)
Fair	281 (14.0)
Poor	59 (2.9)
Hospitalization (past 6 months)	
Yes	164 (8.2)
No	1836 (91.8)
Emergency room visits (past 6 months)	
Yes	278 (13.9)
No	1717 (85.9)
I don't know	5 (0.2)
No. hospitalizations (past 6 months) [a]	
Mean	1.7
[Min-Max]	[1-5]
No. emergency visits (past 6 months) [b]	
Mean	1.5
[Min-Max]	[1-8]

[a] Out of 164 older adults who reported being hospitalized.
[b] Out of 278 older adults who reported emergency room visits.

Overall, Canadian elderly reported a good level of satisfation with the HC system (72.6%), with access to HC services (79.1%), and with the HC services that they received over the past two years (84.5%) (Figure 2).

3.3 Technology, Applications and Internet Use

As shown in Table 3, the vast majority of surveyed older adults owned a computer (85.2%), and more than 50% reported having a tablet or ipad (58%) and a smartphone (54%). A much smaller percent reported owning wearables/mobile devices (11.7%). When asked about the use of different applications, 90% said that they used e-mail, 50% used phone text messaging (e.g., WhatsApp, Messenger), 54% used Facebook (Table 3). Except for a small percent (12%), participants in our survey confimed Internet use over the past 6 months, mostly daily (74%) or a few times a week (9%).

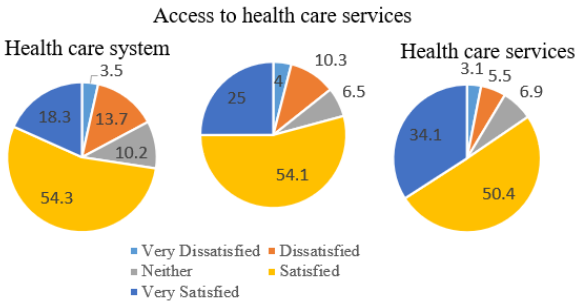

Figure 2. Older Adults Satisfaction with the System, Access, and Services

Despite the frequent Internet use and high prevalence of computers among Canadian older adults, the majority did not use the Internet to connect with a HC professional, access their test results or patient portal, or book a medical appointment (Table 3). Yet, they expressed willingness to sometimes use e-mail to exchange with their physicians and HC professionals about their health, and some interest in obtaining information about trutworthy websites relevant to their health condition, and accessing their medical records.

Many elderly reported being diagnosed with one or more chornic conditions (62%), and 14% fell in the past 6 months (average of 7 falls) (Table 4). With regard to TM and FDT, the prevalence of use among older adults in Canada, was 9.4% and 4.2%, respectively. Respondents indicated a very low level of familiarity with TM as opposed to FDT. Among the respondents who have or are currently using TM and FDT, around 81% and 87% reported their willingness to use these technologies again in the future, respectively, which attests to their level of satisfaction.

3.4 Social Determinants and Techonology/e-Health Application Use

Socio-demographic variables and living environment (i.e., social determinants) were significantly associated with technology and applications use (Table 5). Marital status/partner, region of residence/province, living community, and with whom, were among the variables with significant relationship with the majority of the technology and e-health applications variables. For example, being separated/divorced was significantly associated with higher mean rank frequency of Internet use for searching for online health information, self-diagnosis, and e-booking, whereas being married/partner had the highest rank for online access to lab results, patient portals, willingness to discuss health condition via e-mail, interest in online access to medical records, and using FDT.

Table 3. Technology and Internet Use

	Total (N=2000)
	N (%)
Technologies Owned [a]	
Computer (desktop or laptop)	1703 (85.2)
iPad or tablet	1153 (57.7)
Smartphone	1077 (53.9)
Wearable /mobile devices	238 (11.9)
None of the above	168 (8.4)
Regular Applications Use [a]	
Phone text messaging	917 (50.1)
Video chat	445 (24.3)
E-mail	1654 (90.3)
Facebook	983 (53.6)
Twitter	118 (6.4)
Video games	233 (12.7)
Internet Use (past 6 months)	
Yes	1761 (88.1)
No	238 (11.9)
Frequency of Internet Use (past 6 months)	
Everyday	1472 (73.6)
A few times a week	180 (9.0)
Once a week	52 (2.6)
2 to 3 times a month	33 (1.7)
Once a month or less often	12 (13.2)

[a] Respondents were asked to specify all technologies owned and applications used (percentages exceed 100%)

Frequency of Internet use over the past 6 months to… (e-health applications)	**[1-5] scale**
	Median [Min-Max]
Use of mobile applications for health (using smartphone/tablet)	1 [1-5]
Search for online information about a health problem or condition	3 [1-5]
Self-diagnose yourself when you have a health problem	2 [1-5]
Ask a HC professional questions about your health	1 [1-5]
Access your laboratory test results	1 [1-5]
Access a patient portal or your EMR	1 [1-5]
Book a medical appointment online	1 [1-5]
Participate in discussion forms to discuss aspects related to your health	1 [1-5]
	[1-5] scale
	Median [Min-Max]
Willingness to use email to discuss health condition instead of face-to-face	2 [1-5]
Interest in obtaining information on trusty websites on one's health condition	3 [1-5]
Interest in having online access to medical records	3 [1-5]

Table 4. TM and Fall Detection Technologies

TM Technology	**Total (N=2000)**
	N (%)
Have you been diagnosed with one or several chronic conditions?	
Yes	1237 (61.8)
No	763 (38.2)
Current and/or past TM use? [a]	
Yes	189 (32.7)
No	388 (67.3)
Willingness to use this technology again in the future [b]	
Yes, With video imagery	86 (45.5)
Yes, Without video imagery	68 (36.0)
No	35 (18.5)

[a] Questions on TM use only applicable to respondents diagnosed with chronic conditions and who indicated familiarity with this technology (n=577)
[b] Out of the total who indicated current or past use of TM (n=189)
TM: Telemonitoring

FDT Technology	**Total (N=2000)**
	N (%)
Incident of fall(s) (past 6 months)	
Yes	275 (13.7)
No	1725 (86.3)
No. falls (past 6 months) [c]	
Mean [Min-Max]	7.19 [0-20]
Current and/or past use of FDT [d]	
Yes	84 (6.2)
No	1261 (93.8)
Type of FDT used [e]	
Wearable devices on the body	57 (68.0)
Non-wearable home automation systems	27 (32.0)
Use of video imagery with technology [e]	
Yes	4 (5.1)
No	80 (94.9)
Willingness to use this technology again in the future [e]	
Yes, With video imagery	30 (35.7)
Yes, Without video imagery	43 (51.2)
No	11 (13.1)

[c] For respondents indicating having fell in the past 6 months (n=275)
[d] Questions on FDT use only applicable to respondents who indicated of familiarity with this technology (n=1345)
[e] Out of total who indicated current/past use of FDT (n=84)
FDT: Fall Detection Technology

Older adults' familiarity with…	**[1-5] scale**
(1-5 Likert scale)	Median [Min-Max]
HC technologies for chronic disease management	1 [1-5]
Technologies to detect falls or fall risk	3 [1-5]

Table 5. Social Determinants and e-Health Applications

	P-Value										
Internet use to.. [1-5] scale	*Sex*	*Age*	*Education*	*Marital Status*	*Employment*	*Income*	*Region*	*Language*	*Community*	*Live in..*	*Live with..*
Search online for information	**<0.001 (female)**	0.097	**<0.001 (grad)**	**<0.001 (separated)**	0.474	**0.002 (75-99K)**	**0.032 (ON)**	0.220	**<0.001 (Suburbs)**	0.223	0.216
Self-diagnose	**<0.001 (female)**	**0.010 (80-84 yrs)**	0.068	**0.037 (separated)**	0.349	0.063	0.074	**0.001 (ENG)**	**0.006 (suburbs)**	0.866	0.789
Ask HC professional	0.493	**0.007 (80-84 yrs)**	0.403	0.344	0.304	0.098	**<0.001 (BC)**	**<0.001 (ENG)**	0.086	0.632	0.062
Access lab results	0.402	0.546	0.084	**<0.001 (married/P)**	**0.037 (retired)**	**<0.001 (100-124K)**	**<0.001 (BC)**	**0.001 (ENG)**	**<0.001 (suburbs)**	0.105	**<0.001 (spouse/ partner)**
Access patient portal/ EMR	0.235	**0.027 (80-84 yrs)**	0.887	**0.008 (married/P)**	0.217	0.319	**<0.001 (BC)**	0.328	**0.014 (suburbs)**	0.985	**0.004 (spouse/ partner)**
Book appointment	**0.002 (male)**	0.105	**0.001 (grad)**	**0.023 (separated)**	0.670	**0.008 (125-149K)**	**0.001 (NL)**	0.086	**<0.001 (metropolitan)**	0.100	**0.011 (spouse/ partner)**
Participate in discussion forums	0.439	0.169	0.530	0.964	0.255	0.304	0.357	**0.001 (ENG)**	0.501	0.147	0.486
Use email to discuss health	**<0.001 (male)**	**<0.001 (70-74 yrs)**	**<0.001 (grad)**	**<0.001 (married/P)**	0.083	**<0.001 (>150K)**	**<0.001 (Maritimes)**	0.634	0.651	**<0.001 (home)**	**<0.001 (spouse/ partner)**
Willingness/Interest in.. [1-5] scale											
Obtaining information on trusted websites	**<0.001 (male)**	**<0.001 (70-74 yrs)**	**<0.001 (grad)**	**<0.001 (married/P)**	**0.002 (PT employed)**	**<0.001 (>150K)**	**<0.001 (ON)**	0.377	**0.001 (suburbs)**	**<0.001 (home)**	**<0.001 (spouse/ partner)**
Accessing online medical records	**<0.001 (male)**	**<0.001 (70-74 yrs)**	**<0.001 (grad)**	**<0.001 (married/P)**	0.076	**<0.001 (>150K)**	**<0.001 (ON)**	**0.018 (FR)**	**<0.001 (suburbs)**	**<0.001 (home)**	**<0.001 (spouse/ partner)**
Use of.. (yes/no)											
mApps for health (freq)	0.997	0.003	0.115	**<0.001 (married/P)**	0.711	**0.002 (>150K)**	**0.007 (BC)**	0.636	**<0.001 (metropolitan)**	0.099	**0.029 (spouse/ partner)**
Wearables	0.367	**<0.001 (70-74 yrs)**	**0.002 (high school)**	0.106	0.234	**<0.001 (75-99K)**	**0.002 (NL)**	**<0.001 (ENG)**	0.088	0.889	**0.022 (spouse/ partner)**
TM	0.249	0.187	0.492	0.764	0.913	0.586	0.629	**0.030 (ENG)**	**0.030 (metropolitan)**	**0.022 (home)**	0.633
FDT	0.112	**0.026 (70-74 yrs)**	0.519	**0.013 (married/P)**	0.952	0.522	0.992	0.536	0.669	**0.009 (home)**	**0.015 (spouse/ partner)**

TM: Telemonitoring Technology; FDT: Fall detection technology; P: Partner; BC: British Columbia; ON: Ontario; ENG: English; FR: French
Significant associations in bold show the categories with the highest technology use and rank frequency for e-health applications use

Significant variations across provinces were also observed. British Columbia was the province with the highest mean rank frequency of Internet use for health-related online activity among the elderly. Living in the cities and suburbs showed higher rank frequency of e-health applications compared to rural areas and small towns. A similar pattern was noticed for elderly living with a partner in relation to the use of e-health applications, use of wearables and FDT.

Except for willingness to search for online information about a health problem and using Internet for self-diagnosis, men had high rank frequency of Internet use. Being 70-74 years old, holding a graduate degree, and a high bracket income was significantly associated with high rank frequency of some e-health applications use. Last, older adults living at home with a partner more frequently used wearables, TM and FDT compared to their counterparts.

3.5 Interaction with the HC System and Technology/e-Health Application Use

When examining the relationship between variables related to the interaction with the HC system and e-health application use, two variables were predominantly and consistently significant (Table 6). Having private insurance and willingness to pay out of pocket for quicker access to services were associated with technology use and higher rank frequency of e-health applications use. A higher percent of elderly who reported not having been hospitalized, nor had emergency visits (past 6 months), nor receiving home care services, reported using FDT, compared to their counterparts.

3.6 Multivariate Analysis

The results of the multivariate analysis examined the relationship between technology/e-health applications use and the social determinants and interaction with the HC system variables, which were significant at the bivariate analysis level (Table 7).

A considerable number of social determinants remained significant, after controlling for other variables. Women reported more frequent search for online information about health problems and Internet use for self diagnosis, but less for e-mailing to discuss health conditions and obtaining information about trusty websites.

Older adults and speaking English had higher frequency of using the Internet to self-diagnose themselves, ask HC professionals questions about health, participate in health discussion forums, and access lab results. They also reported higher interest in online access to their medical records. Older age groups and higher income were associated with less e-Health applications use. Marital status, region, and living environment were also significantly associated measures of Internet use after controlling for all other variables (Table 7). Perceived poorer health status was significantly associated with less mApps use. Elderly in the older age categories and those who earned $75,000-99,999 used less wearables. Living with a spouse/partner or in a retirement home was associated more use of TM and FDT, respectively.

Table 6. Interaction with the HC System Bivariate Analysis Results

	P-Value						
Internet Use to.. [1-5] scale	*Family Physician*	*Private Insurance*	*Home Care Services*	*Pay for quicker access*	*Perception of health*	*Hospitalizations*	*Emergency visits*
Search online for information	0.171	**<0.001 (Yes)**	**0.010 (No)**	**<0.001 (Yes)**	0.429	0.563	**0.001 (Yes)**
Self-diagnose	0.087	0.200	**0.024 (No)**	**<0.001 (Yes)**	0.294	0.603	0.507
Ask HC professional	0.182	**0.040 (Yes)**	0.190	**<0.001 (Yes)**	0.351	0.667	0.299
Access lab results	0.042	**0.008 (Yes)**	0.768	**<0.001 (Yes)**	**0.005 (fair)**	**0.002 (Yes)**	0.075
Access patient portal/ EMR	**0.016 (Yes)**	**0.018 (Yes)**	0.544	**<0.001 (Yes)**	0.271	**0.002 (Yes)**	**0.014 (Yes)**
Book appointment	**0.005 (Yes)**	**0.004 (Yese)**	0.631	**0.001 (Yes)**	0.923	0.116	**0.020 (Yes)**
Participate in discussion forums	0.897	0.251	0.665	**0.021 (Yes)**	**0.029 (excellent)**	0.784	0.839
Use email to discuss health	0.669	**<0.001 (Yes)**	**0.002 (No)**	**<0.001 (Yes)**	**0.044 (excellent)**	0.158	0.737
Willingness/Interest in.. [1-5] scale							
Obtaining information on trusted websites	0.256	**<0.001 (Yes)**	**0.001 (No)**	**<0.001 (Yes)**	0.941	**0.046 (No)**	0.239
Accessing online medical records	0.088	**<0.001 (Yes)**	**0.002 (No)**	**<0.001 (Yes)**	0.483	0.115	0.977
Use of… (yes/no)							
mApps for health (freq)	**0.031 (Yes)**	**<0.001 (Yes)**	0.848	**<0.001 (Yes)**	**0.031 (excellent)**	0.397	0.396
Wearables	0.164	**0.003 (Yes)**	0.761	**<0.001 (No)**	**<0.001 (v./good)**	0.730	0.709
TM	0.904	**0.053 (Yes)**	0.112	0.243	0.326	0.985	0.779
FDT	0.340	0.760	**<0.001 (No)**	0.796	0.071	**<0.001 (No)**	**0.002 (No)**

TM: Telemonitoring Technology; FDT: Fall detection technology; feq: Frequency on [1-5] scale
Significant associations in bold show the categories with the highest technology use and rank frequency for e-health applications use

Table 7. Multivariate Analysis Results

	Social Determinants	HC System
Internet use to.. [1-5] scale		
Search online for information	Sex Income Region/province	Home Care** Private Insurance Pay for quicker access
Self-diagnose	Sex Age Marital Status Language	Home Care** Pay for quicker access
Ask HC professional	Age Language**	Private insurance Pay for quicker access
Access lab results	Employment Region/province Language	Private insurance Pay for quicker access Hospitalization
Access patient portal/ EMR		Family physician Private insurance Pay for quicker access Hospitalization
Book appointment	Education** Live with**	Family physician Private insurance Pay for quicker access
Participate in discussion forums	Language**	Pay for quicker access
Use e-mail to discuss health	Sex Age Income	Private insurance Pay for quicker access Perception of health
Willingness/Interest in.. [1-5] scale		
Obtaining information on trusted websites	Sex** Age Income Live with** Marital status**	Private insurance Pay for quicker access
Accessing online medical records	Sex Age Income Language Community Live with	Private insurance Pay for quicker access
Use of… (yes/no)		
mApps for health (freq)	Region/Province** Perceived health status	Private insurance Pay for quicker access
Wearables	Age Income	
TM	Live with	
FDT	Live where	Home care services Emergency visits

TM: Telemonitoring Technology; FDT: Fall Detection Technology; freq: Frequency
** Significant at 10% significance level; all others at 5% significance level

For variables related to the interaction with the HC system, having a private insurance and willingness to pay out of pocket for quicker access to HC services were consistently and significantly associated with all Internet use applications by elderly. These two variables are indicative of a certain economic status that enables elderly to afford having Internet and incurring the costs that may be associated with more frequent use of mApps for health. Older adults who did not receive home care services reported higher frequency searching online for information about health problems/conditions and self-diagnosing themselves, and more use of FDT. The odds of using FDT were higher for those who used emergency visits in the past 6 months. Elderly who have been hospitalized had higher frequency of using the Internet for accessing lab results and patient portals. Last, perception of good health status was associated with more frequent online communication with HC professionals.

4. Discussion

E-health applications refer to a broad range of devices, Internet and applications that can support the management of chronic conditions and health (Alvarez-Perez et al., 2021). Older adults represent an important group of our society who can benefit from these tools.

The findings show readiness and willingness of the elderly in the comuunity to use e-health applications that can support their health and well-being. A vast majority owned computers and other devices (smartphone, tablet), and used Internet on a daily basis (90% used e-mail). Yet, this technological readiness does not translate into actual applications use. The respondents indicated very limited Internet use to connect with HC professionals, access their test results or a patient portal, or book a medical appointment. The use of wearables, TM and FDT was also low (11.9%, 9.4% and 4.2%, respectively). The experience of older adults who used some of these technologies was positive as confirmed by the vast majority reporting willingness to use them again in the future (mostly TM with and FDT without video imaging).

Older age is particularly characterized by social and environment conditions that may impact their use of e-health applications. Prior research on older adults' use of technology for web-based socialization discussed the relevance of financial and knowledge barriers, as well as social factors related to family, social motivation and appropriate environments (Haase et al., 2021). Another study by Sixsmith and colleagues (2022) pointed to the need to investigate social and economic factors that persist as challenges to technology uptake among older adults. A national survey of Canadians also recently showed no significant differences between older adults and the general adult population on satisfaction with mHealth technologies albeit significant differences in the use of Internet and smart technologies (Jaana & Paré, 2020). Thus, it is important to examine the social micro-level and health care system-related macro level variables that contribute to and can explain the variation in technology and e-health applications use.

This research reveals that social determinants have a significant association with e-health applications among older adults, which can inform future strategies and policies aiming at supporting the use of

technologies/applications by elderly in the community. Clearly, these strategies have to be "customized" and tailored to the particularities of the sub-groups of older adults. For example, the fact that senior women reported more frequent use of Internet to search for online information about health problems and self-diagnose themselves when having a health problem, and yet indicated less interest to obtain information about trusty websites that they can use about their health condition, implies that more counceling and education efforts should be targeted to this sub-group to avoid misinformation and subsequent health complications.

English-speaking elderly reported more frequent use of Internet for accessing and exchanging information on health compared to their counterparts. This can be attributed to more limited content/resources available in other languages, or to deeper cultural differences. Future studies should explore the underlying reasons behind these differences and propose strategies to engage and facilitate the use of e-health among non-English speaking elderly.

Older adults in the higher age brackets used less e-health applications as did those with higher income. Yet, having private health insurance and willingness to pay out of pocket for faster access to services were consistently associated with mApps and Internet use for accessing and exchanging health information. This implies that there is a pattern of e-health applications use among older adults who have the capacity to pay for insurance and services, but also have other socio-economic characteristics that shape their decisions to use these technologies. Future research should investigate the various personas orprofiles that can explain these patterns and examine the underlying reasons behind these relationships.

Two important findings in this study relate to higher odds of using FDT by elderly who used emergency services, and lower odds of using mApps for health among those who reported poorer perceived health, after controlling for all other variables. It is not clear whether higher frequency of FDT use is the result of more emergency services or vice versa. It appears important to study this association over time in order to determine the optimal decision strategy and timing regarding FDT use. With regard to mApps use, strategies should be developed to target elderly with poor perceived health to engage them with mApps that can benefit their health.

The findings point to some digital divide among older adults in Canada, especially with elderly who may be needing most support (e.g., older seniors, living alone, or having lower perceived health status) who reported least frequency of use of relevant digital technologies and e-health applications, and thus benefitting least from them. Some interesting iniatives and innovative projects are emerging to address concerns that elderly face in the community, including social isolation and support for aging in place (Bier et al., 2022). It is important that these iniatives be assessed in terms of usability and acceptability by different groups of seniors in line with these findings. The discussion of social influence on technology use has been extensively addressed in the literature through the UTAUT model (Venkatesh et al., 2003) and the health informatics research based on this model. Our findings expand on this construct, and we recommend including social determinants when assessing technology use by older adults in future studies. In addition, we propose incorporating a macro level dimension in relation to the interaction of elderly with the HC system.

It is important to note some limitations associated with this research. The cross-sectional nature of this study precluded a thorough assessment of causal relationships between social determinants and variables related to the interaction with the HC system. The data were collected prior to the COVID-19 pandemic, and as such, we cannot confirm if there were changes specifically associated with the pandemic that may have otherwise affected the relationships that were found. It is worth noting however that the pandemic crisis has further marked the need of leveraging technologies to support older adults in the community, especially with the social isolation and inability to provide them with the direct support and care needed. Therefore, we would expect that e-health applications use may have increased during the pandemic, which would be important to assess in future studies. Last, the closed-ended nature of the questions included in the survey did not allow us to fully uncover the reasons behind some of the association patterns that were observed. Future research can build on these findings and further expand the dimensions considered in a conceptual model that can be tested with e-health applications use in other contexts.

5. Conclusions

This study presents unique contributions to research and practice by examining an area related to e-health applications use by elderly that is understudied. The findings reveal some "digital divide" among older adults, which may also be occurring in the context of other countries. The results emphasize the importance of considering social determinants and seniors' experiences while interacting with the HC system, when developing strategies and policies to support technology-enabled care at the community level. We call for future research that can build on these findings and contribute to a more comprehensive conceptual model, which includes dimensions related to HC providers and technology characteristics/infrastructure.

Seniors represent a growing sub-group of the population who require a high level of care coordination, and account for the largest expenditures in the HC system. The latest pandemic brought to light weaknesses and challenges in relation to elderly in the community that may be addressed by leveraging e-health applications. Therefore, there is urgency to develop strategies and policies to cater for the needs of older adults, with particular attention to the fact that "one solution does not fit all". Although tehnological devices and tools are available and accessible to older adults, a technological chasm persists that can hinder effective e-health applications use. This will necessitate health policies and initiatives that enable funding, coverage, and technological infrastructure, which are conducive to digital health services delivery by HC professionals and online exchange and support with older adults.

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