

Needs and preferences for technology among Chinese family caregivers of persons with dementia: A pilot study

Journal of Rehabilitation and Assistive Technologies Engineering
Volume 5: 1–12
© The Author(s) 2018
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/2055668318775315
journals.sagepub.com/home/jrt

Chen Xiong^{1,2}, Arlene Astell^{3,4,5}, Alex Mihailidis^{1,2,6} and Angela Colantonio^{1,2,6}

Abstract

Background: Dementia is a major public health concern associated with significant caregiver demands and there are technologies available to assist with caregiving. However, there is a paucity of information on caregiver needs and preferences for these technologies, especially among Chinese family caregivers of persons with dementia in Canada.

Objective: The purpose of this study was to examine the technology needs and preferences of Chinese family caregivers of persons with dementia with a sex and gender lens in Canada.

Methods: A cross-sectional survey was conducted through the Yee Hong Centre of Geriatric Care in Canada. Frequency distributions, Wilcoxon Signed Ranks Test, and multiple regression analyses were performed.

Results: The majority of the 40 respondents did not demonstrate knowledge about technology to assist with caregiving. Ease of installation and reliability were identified as the most important features when installing and using technology respectively. Respondents demonstrated a positive attitude towards the use of technology during caregiving. Controlling for age, female respondents were significantly more receptive of technology.

Conclusions: Our findings suggest a need to increase awareness of technology options to assist caregiving in this ethnic population and provide insight for future development and marketing of technology that better align with caregivers' needs.

Keywords

Assistive technology, elderly, rehabilitation devices, remote sensing, smart homes

Date received: 21 June 2016; accepted: 16 April 2018

Introduction

Dementia has become a major concern in Canada, with an annual total economic burden of \$33 billion.¹ Approximately 750,000 Canadians are living with dementia related conditions and by 2038, that number will more than double to affect over one million Canadians.¹ Dementia results from several conditions, the most common being Alzheimer's Disease, and is an overall term that describes a wide range of symptoms associated with a decline in mental ability.² In addition to symptoms associated with cognitive decline, persons with dementia (PWD) also experience behavioral and psychological disturbances such as depressive mood, anxiety, restlessness, agitation among others.^{3,4}

With the high prevalence of dementia and an aging population, an increasing number of families are providing home care for an elder in the family who has

some degree of dementia. Within the home, care for PWD is often provided by their spouses or partners

¹Rehabilitation Sciences Institute, University of Toronto, Toronto, ON, Canada

²Toronto Rehabilitation Institute, University Health Network, Toronto, ON, Canada

³Department of Psychiatry, University of Toronto, Toronto, ON, Canada

⁴Ontario Shores Centre for Mental Health Sciences, Whitby, ON, Canada

⁵Faculty of Medicine, Dentistry & Health, University of Sheffield, Sheffield, UK

⁶Department of Occupational Science & Occupational Therapy; University of Toronto, Toronto, ON, Canada

Corresponding author:

Chen Xiong, Rehabilitation Sciences Institute, Rehabilitation Sciences Building, University of Toronto, 500 University Avenue, Room 260, Toronto, ON M5G 1V7, Canada.
Email: chen.xiong@mail.utoronto.ca



and adult children, who provide routine assistance with household chores and personal care.⁵ While the presence of kinship and the familiarity of the homecare environment has been shown to facilitate the caregiving process and delay unfavorable health outcomes such as death or institutionalization, caregiving for PWD remains a highly stressful experience for these family caregivers and may contribute to negative mental health and an increased risk of mortality and serious illness.^{6,7} Hence, interventions in the form of technology have been developed to improve the health and psychosocial outcomes of PWD and their caregivers.^{8,9} The provision of these technologies has been shown to reduce caregiving burden and diminish some of the physical and emotional effort entailed in supporting individuals with disability.^{10,11} These technologies include fall alarms, Global Position System (GPS) tracking devices, home monitoring cameras and cooker switch off devices.^{9,12} Together, these devices have identified to potentially improve independent living, safety, and autonomy of PWD and improve the quality of life of these individuals and their family caregivers.^{9,13} In particular, technology has also been developed to assist with PWD's Activities of Daily Living (ADLs). Defined as activities that are fundamental for self-care, ADLs include bathing, dressing, and going to the toilet.¹⁴ Additionally, PWDs need support with Instrumental Activities of Daily Living (IADLs), such as managing money and using public transport, which are more complex and critical for older adults to continue living independently.¹⁵ As support for these tasks are often provided by family caregivers of PWDs, there exists a huge potential for technology to address and support the completion of these tasks.¹⁶ As such, development of technologies that recognize and support these activities has become a focus for developers with the goal of maintaining PWD's independence as well as reducing demands placed on family caregivers.¹⁷ These technologies included COACH, a device designed to assist PWD through the task of handwashing and Ambient Kitchen, a system that provides assistance with tasks in the kitchen.¹⁸⁻²⁰

Given the wide range of technologies that have been developed to assist with caregiving, understanding user needs is important when selecting the appropriate technology for caregivers and PWD. However, there had been few studies that assessed caregiver needs with respect to technology. While previous studies have attempted to identify caregiver needs and preferences towards technology, there were outdated, conducted outside of the Canadian context and failed to address the impact of culture as well as sex and gender on these needs and preferences.^{17,21-23}

In a study conducted in 2001, Colantonio and colleagues examined the use and interest in support

strategies for Canadian caregivers including newsletters, telephone support and computer services.²¹ As part of the study, a telephone interview was administered to 148 caregivers of PWD recruited through Alzheimer Society for Metropolitan Toronto Wandering Persons Registry.²¹ As part of the interview, respondents were asked if they had ever used telephone, newsletters, or computer support.²¹ Additionally, respondents were also asked if they would like to use these forms of support strategies.²¹ The study demonstrated great interest by caregivers of PWD for support services other than traditional support groups.²¹ In particular, interests were highest for telephone support and newsletters.²¹ However, as this study was conducted more than 10 years ago, it did not reflect the latest trends in caregiver perceptions and technology development.

More recently in 2008, Rialle and colleagues conducted a survey investigating the perceptions of family caregivers of PWD regarding a selection of technology devices.²² Through a self-administered questionnaire completed by over 200 eligible participants, the study highlighted two opposite trends in the caregiver's opinions of technology: rejection of certain technologies and great confidence in the usefulness of others.²² In particular, technologies that increase the care recipient's safety and caregiver's social connectedness were most appreciated.²² While this study provided a pioneering insight into the needs and preferences of caregivers for PWD, the setting (greater Paris area) and the time of publication limited its applicability to the current local Canadian context.

In the same year, Mihailidis and colleagues conducted a pilot study that investigated the willingness of older adults and baby boomers to accept home monitoring technologies.²³ Through structured, mixed-methods interviews, the views and opinions of participants on various technologies including personal emergency response systems and fall detection systems were determined.²³ Results from this study showed participants would be accepting of the technologies if they allowed them to remain in their own homes and age in place.²³ However, as the study focused on home monitoring technology, the results may not be applicable to other technologies that can assist with caregiving. Moreover, the participants in the study were not caregivers of PWD, who may have different opinions and preferences of technology.

Finally, Czarnuch and Mihailidis administered an 85-item questionnaire to family caregivers of older adults with dementia to explore the needs and the roles of intelligent assistive technology (IAT) in support those needs in Canada.¹⁷ Through the completion of the questionnaire, the study explored challenging ADLs for an older adult with dementia to complete

independently, difficult ADLs for caregivers to assist, the role of IAT in supporting ADLs and features of functions of IATs designed to support ADLs.¹⁷ In the Canadian study, respondents to the survey demonstrated little knowledge of existing IATs.¹⁷ When asked about their preferences of IATs, respondents preferred technologies that were autonomous, familiar, simple, and unobtrusive.¹⁷ This research shed vital light on the caregiver needs of technology from a Canadian perspective. However, there was a paucity of exploration on the impact of culture differences on the caregiver needs and preferences of these technologies. Moreover, as highlighted within the study, factors such as the sex and gender differences among caregivers as well as care recipient were not examined.

Given Canada's multicultural society, it is paramount to take into consideration the impact of culture on the needs and preferences of technology among caregivers of PWD. Accounting for 4% of the Canadian population and up to 9% of the population in major cities, the Chinese community represents a rapidly growing proportion of our society.^{24,25} In addition, previous research has shown issues associated with the use of technology specific to this population.²⁶ Moreover, caregivers in Asian cultures have been found to be more susceptible to caregiver burden compared to their counterparts in Western societies.²⁷ As such, it is important to examine the needs and preferences of technology among this population so as to better inform the development of future technologies tailored to the various needs and characteristics of this population.

Beyond the paucity of research on the needs and preferences of Chinese caregivers of PWDs, there is also a paucity of information on the sex and gender differences with respect to these needs and preferences. Within the context of this study, sex refers to "...the biological and physiological characteristics that distinguish males from females". Gender refers to "...socially constructed roles, relationships, behaviours, relative power, and other traits that societies ascribe to women and men".²⁸ While these constructs are distinct, we recognize that they are on a continuum and interrelated. As such, we will be referring to both constructs as 'sex and gender' for the remainder of this paper. A thorough understanding of sex and gender differences in the needs and preferences of these technological advances is important, as females make up 75% of PWD and over 50% of caregivers in Canada.^{29,30} Research has shown that among caregivers, considerable sex and gender differences with respect to well-being, psychosocial health, and overall health exist.³¹ However, little is known about sex and gender differences in the caregivers' preferences for technology in the care of PWD.

Therefore, the aim of the study is to examine the needs and preferences of technology among Chinese family caregivers of PWDs. In particular, the study examines (1) the nature of use of technology by Chinese family caregivers of PWD, (2) perceived usefulness of technology in assisting Chinese family caregivers of PWD with their caregiving activities, (3) feature preferences of among Chinese family caregivers of PWD when installing and using technology, and (4) sex and gender influences on the technology needs and preferences of Chinese family caregivers of PWD. Following the introduction, this paper will elaborate on the study methods including study population and design, measure, procedure, data collection as well as analysis, results, discussion of the findings, limitations of the study, and conclusion.

Methods

Study population and design

This study was a cross-sectional survey. All potential respondents were Chinese family caregivers of PWDs residing in Canada. Due to the lack of a central database for Chinese caregivers of PWD across Canada, respondents were recruited from the Yee Hong Centre of Geriatric Care a long-term care organization in Toronto, Ontario, Canada (subsequently referred to as "Yee Hong"). Eligible respondents included those that met the following inclusion criteria (1) has previously or is currently providing care to an individual with dementia, (2) can speak, read, and write in English and/or Mandarin, and (3) is not a formally trained caregiver (e.g. registered nurse). Respondents who were not Chinese caregivers of PWD and those that were unable to complete the questionnaire due to language communication or cognitive barriers were excluded from the study (n=1). As this was a pilot study that served as the foundation of a larger study examining the needs and preferences of technology among Chinese family caregivers across Canada, the sample size was not calculated.

Measure

To date, there had been a lack of prior attempts to examine the needs and preferences of technology among Chinese family caregivers of PWD within a Canadian context. As such, the questions were based on a previous questionnaire administered to a Canada-wide population by Mihailidis and colleagues.¹⁷ The previous questionnaire was developed and piloted among academics, professionals, and experts in the field to ensure its reliability and validity. The current questionnaire consisted of five sections and a total of 78

items, including a mix of multiple choice and open-ended items. Recognizing the potential language needs of Chinese family caregivers of PWDs, the questionnaire was translated into Mandarin/Cantonese by a certified translator. Two independent, native speakers of Mandarin reviewed all items of the questionnaire. Their feedback was used to improve the wording and to ensure the accuracy of the translation. The time needed to complete the questionnaire (approximately 30 min) was also estimated through this review.

Procedure

Study packages were mailed by post to the mailing address of all potential respondents registered with Yee Hong during the Fall of 2015. The study package included a recruitment letter from Yee Hong and the research team, information and consent form and questionnaire. A return envelope with a pre-affixed postage and address label was also enclosed to allow potential respondents to return the survey to the research team upon completion. Potential respondents were also provided the option to complete the questionnaire online or over phone through a link and contact number provided in the recruitment letter respectively. In the event respondents had any questions or require clarification on the items of the questionnaire, they could contact the researchers using the email addresses or telephone numbers provided in the study package.

Data collection

Independent variables. Caregiver personal variables were collected to describe the study population. These variables included age, sex and gender, marital status, place of birth, race/ethnicity, languages spoken, highest level of education, employment status, living arrangement, financial aid, length of care and if they consider themselves as the primary caregiver. In addition, personal variables of the care recipient were also collected. These included the relationship with caregiver, age, sex and gender, marital status, place of birth, languages spoken, formal assistance, diagnosis of dementia, comorbidities, and ADLs.

Dependent variables. The nature of the respondent's technology use was assessed in the form of the use of 12 technology devices selected based on previous literature.¹² Examples of the selected technology devices included fall alarm, door alarm, home monitoring cameras, and medication reminder/dispensers. For each technology, respondents were asked if they had and/or used it. To assess respondents' awareness and knowledge of technology, they were asked how much they knew about technologies that support PWD and their

caregivers. Features preferences of technology were gathered by asking respondents to rank the features when installing and using technology from the most to least important. Finally, the uses and benefits of technology were measured in terms of the perceived ability for technology to assist in the care of the care recipient and allowed him or her to remain at home. Respondents were provided the list of ADLs and asked how much technology would assist the care recipient each of the activities.

Data analysis

Statistical analyses were performed using SAS v. 9.3 (SAS Institute, Cary, NC). Descriptive statistics in the form of frequency distributions, percentages, means, standard deviations, and medians were used to first describe the study sample. Additionally, descriptive statistics were also used for most objectives to examine the needs and preferences of technology among Chinese family caregivers of PWDs. Chi-square, Wilcoxon Signed Ranked test and multiple linear regression analyses were performed to identify any relationships between variables in influencing the needs and preferences of technology. A significance level of 0.05 was used for each inferential analysis.

Results

A total of 544 questionnaire packages were mailed out with the help of our community partner, Yee Hong. After a four month period of data collection, a total of 41 responses were received. Of all the responses received, one failed to meet the inclusion criteria and was not included for data analyses.

Table 1 provides the profiles for all respondents included in the study. Seventy percent of the respondents were female. The mean age was 62 years (SD 11.5) and the median age was 61 years. The youngest respondent was 34 years old and the oldest was 94 years of age. Majority of the respondents were married. With respect to the place of birth, 85% of the respondents were born outside of Canada. All of the respondents identified themselves as Chinese and 85% of them spoke primarily Chinese and/or Cantonese at home. Most of the respondents had a university certificate or diploma. Almost half of the respondents were working either full or part-time. With respect to living arrangements, 65% of the respondents resided in single detached houses. Almost half of the respondents lived with their care recipient in the same household or building. While caring for the care recipient, 85% of respondents did not receive any form or financial aid. With respect to the length of care, a third of the respondents reported to have taken care of their care

Table 1. Select caregiver personal variables of the study sample.

Personal characteristics		
Age (mean years, SD)	62, 11.5 N	Median = 61 %
<65	28	70
≥65	12	30
Gender		
Female	28	70
Male	12	30
Marital status		
Married	27	67.5
Place of birth		
In Canada	6	15
Outside of Canada	34	85
Race/ethnicity		
Chinese	40	100
Language most spoken at home		
Chinese/Cantonese	34	85
English	6	15
Highest level of education		
University certificate/diploma	28	70
College, CEGEP or non-university certificate/diploma	6	15
All others	6	5
Employment status		
Employed (full and part-time)	19	47.5
Retired	17	42.5
Living arrangements		
Single detached house	26	65
Townhouse	5	12.5
Duplex	5	12.5
Distance from care recipient		
Same household or building	19	47.5
Less than 30 min by car	12	30
More than 30 min by car	9	22.5
Financial aid		
Yes	6	15
No	34	85
Length of care		
Less than 2 years	13	33.3
3 to 5 years	11	28.2
6 years or more	15	38.5
Primary caregiver		
Yes	11	27.5
No	27	67.5

CEGEP: Collège d'enseignement général et professionnel.

recipient for 2 years or less, 28.2% have taken care of their care recipient for 3–5 years, and 38.5% have taken care of their care recipient for more than 6 years. Finally, 67.5% of respondents identified themselves as the primary caregiver.

Table 2. Select care recipient personal variables of study sample.

Personal characteristics		
Age (mean years, SD)	88, 7.3 N	Median = 89 %
Gender		
Female	26	33.3
Male	13	66.7
Relationship to caregiver		
Father/mother/father-in-law/ mother-in-law	29	74.4
Spouse	5	12.8
Marital status		
Married	16	40
Widowed	22	55
Place of birth		
In Canada	6	15
Outside of Canada	34	85
Language most spoken at home		
Chinese/Cantonese	39	97.5
English	6	2.5
Formal assistance		
Everyday	20	50
Once a week or more	10	25
Never	10	25
Diagnosis of dementia		
Alzheimer's disease	25	62.5
Other common health conditions		
Osteoporosis	10	25
Vision problems	10	25
Insomnia	5	12.5
Anxiety	11	27.5
Depression	19	47.5

Table 2 provides the characteristics of the respondents' care recipients. Sixty-six point seven percent of the care recipients were male. The mean age was 88 years (SD 7.3) and the median age was 89 years. Almost three quarters of the care recipients were parents or parents-in-law of the respondent. More than half of the care recipients were widowed. Majority of the care recipients were born outside of Canada. Almost all of the care recipients spoke primarily Chinese and/or Cantonese at home. Three quarters of the care recipients received some form of formal assistance in addition to the care provided by their caregivers. Majority of the care recipients had a diagnosis of Alzheimer's disease.

Figure 1 shows the nature of use of technology among the respondents. Among the 12 technologies

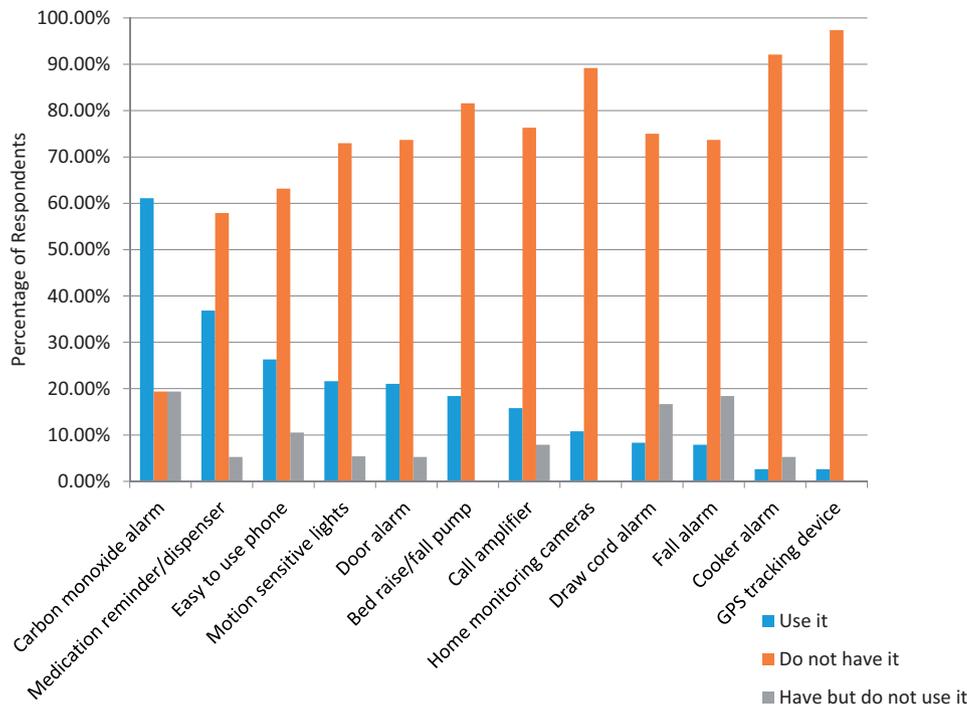


Figure 1. Technology use of respondents.

that are presented within the questionnaire, carbon monoxide alarms were the most often used device. This was followed by medication reminder/dispensers and easy to use phones with 36.8% and 26.3% of respondents reporting to have owned and used it respectively. With the exception of the carbon monoxide alarm, majority of the care recipients did not have the technology devices presented. When asked about the level of technology awareness, 57.9% of the respondents did not know much about technologies developed to assist with caregiving.

Figure 2 provides information on the perceived usefulness of technology among respondents. Respondents believed that technology would be useful for most the ADLs (mean score >2.5 out of 5). In particular, technology was perceived to be most useful in having daily conversations with the care recipients with an average score of 3.85 (SD = 1.66). This was followed by mobility (3.82, SD = 1.61) and using the toilet (3.73, SD = 1.64). On the other hand, technology was not perceived to be useful (mean score <2.5 out of 5) in preparing food (2.33, SD = 1.96), paying bills (1.76, SD = 1.9), and reminding the care recipient to do housework (1.33, SD = 1.69).

Tables 3 and 4 provide the ranking of the features respondents perceived as most useful when installing and using technology respectively. With respect to the installation of technology, being easy to install was considered the most important feature by 37.5% of the respondents. Similarly, reliability was identified as the

most important feature when using technology by almost 70% of respondents.

When examining the influence of sex and gender on the technology preferences, female respondents found technology to be significantly more useful in helping with the care recipient's ADLs when compared to their male counterparts (Wilcoxon Signed Ranks Test. $Z = -2.21, p < 0.05$). On the other hand, there were no significant differences between older and younger respondents with respect to their perceived usefulness of technology. Multiple regression analysis was conducted to test if sex and gender or age significantly predicted respondents' perceived usefulness of technology. The results indicated that the predictors explained 20.5% of the variance ($R^2 = 0.25, F(3,30) = 5.13, p < 0.05$). Only sex and gender was found to be a significant predictor of perceived usefulness of technology ($\beta = 1.25, p < 0.05$).

Discussion

This is the first study to our knowledge that examined the needs and preferences of technology among Chinese family caregivers of PWDs in Canada. Our findings showed that a 57.9% of Chinese family caregivers currently have little to no knowledge of the technologies that are available to assist caregivers. Specifically, most of them did not have or make use of most of the technologies presented in the questionnaire during caregiving. One of the most commonly used technologies was

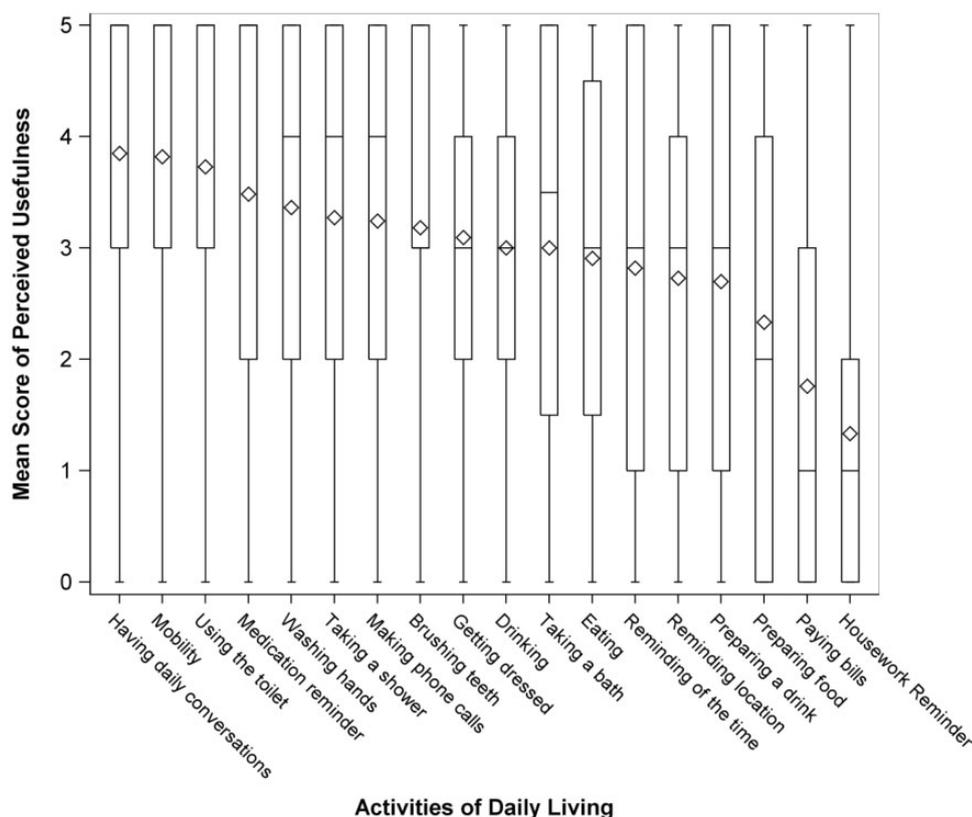


Figure 2. Usefulness of technology in assisting with ADLs.

Table 3. Most important feature when installing technology.

Feature	Percentage (%)
Easy to install	37.5
Easy to learn how to use	21.9
Cost	21.9
Clear operating instructions	15.6
Aesthetics of technology	3.1

Table 4. Most important feature when using technology.

Feature	Percentage (%)
Reliability of device	68.8
Ability for the system to work without manual input from user	21.9
Accessible outside of the home	6.3
Ability to set-up features of the device and customize its operation	3.1

the carbon monoxide alarm, with more than 60% of the respondents reporting to have used it. As non-intrusive devices that can alert and prevent carbon monoxide poisoning in households, carbon monoxide alarms play a vital role in ensuring the safety of the occupants and its uses are not limited to caregiving.³² Moreover, there had been efforts such as legislation and public campaigns that highlighted the dangers of carbon monoxide and promoted the adoption and installation of carbon monoxide alarms in households, which would further lead to an increase in its usage. Hence, it can be argued that the high rates of use of carbon monoxide alarms among respondents is a reflection of an increased understanding for the severe consequences

of carbon monoxide poisoning rather than awareness of the difference technologies available to assist in caregiving.

With the exception of the carbon monoxide alarm, most respondents did not own or use any of the other technologies presented in the questionnaire. Based on previous literature, this finding can be possibly attributed to the stigma associated with the use of these devices. Defined as a sign of social unacceptability, stigma can arise due to the shame or disgrace attached to something regarded as socially unacceptable and can lead to anxiety, depression, a distorted self-image as well as low self-esteem.³³ With respect to technologies for caregiving, installation, and usage of these devices

may lead other to perceive the users to be in poor health or frail.³⁴ Additionally, the placement of sensors, alarms, and control panels necessary for many of the devices presented in the questionnaire can give a household an institutional feel, especially if they are obtrusive or indiscreet.³³ Similarly, the use of GPS tracking devices can also create stigma associated being monitored or tagged. As a result, respondents may be reluctant to acquire and use these technologies due to the concern that it may further contribute to the stigma faced by their care recipients and themselves.

As such, steps will need to be taken during the design process of these technologies in order to minimize the stigma associated with its use. In particular, previous literature had alluded to the term “universal design”, which described efforts to develop products and solutions that are usable for everyone without the need for adaptation or specialized design”.³⁵ By increasing the appeal of these technologies to a wider range of consumers, their potentially stigmatizing image can be reduced. For example, the rapid development and proliferation of automated home technologies such as home monitoring cameras and motion sensitive lights will result in these technologies being the norm rather than the exception. That being said, despite the implementation of “universal design”, technology designed to monitor or prompt such as medication reminders may not garner the same level of popularity due to their limited use outside of the caregiving context. Under such circumstances, the device’s aesthetics will have a strong influence on how they will be perceived by others. In particular, devices that are discrete and less visible would be less stigmatizing compared to ones that are more conspicuous.³⁴

Respondents have confirmed that technology would be useful in helping with most of the care recipient’s ADLs, indicating that they are generally receptive to the use of technologies in assisting them with caregiving. In particular, technology was found to be most useful in having daily conversations with the care recipient, mobility and using the toilet. As such, these findings reflect the aspects of caregiving where respondents would most appreciate assistance in and provide a guide for developers when designing new technologies. Specifically, more efforts should be directed to creating devices or programs that assist with these ADLs as they would more likely to be better received. Outside of the realm of technology, these findings also speak to a need for programs and services that provide support to caregivers with respect to assisting with the ADLs of their care recipient.

On the other hand, respondents did not perceive technology to be useful in helping with the preparation of food, paying bills, and reminding the care recipient to do housework. Given that most respondents were

living in the same household as their care recipients, such findings are likely to be attributed to the fact that these ADLs are more likely to be already completed by the respondents on behalf of the care recipients. Hence, it is anticipated that care recipients would not require any assistance as they were no longer involved in these ADLs. Nonetheless, it remains important to explore the potential role and develop technologies to assist the care recipients in these ADLs for when the caregiver is not present (i.e. at work or not living in the same household). These trends were also reflected in previous studies on technology preference, which found devices that promoted social connectedness to be the most appreciated while devices that provided advice on food preparation were among the least appreciated.³⁶ Nonetheless, it is important to recognize that these needs and preferences have remained relatively similar over time and across cultural and geographical boundaries. This suggests the possibility of adapting rather than developing specific technologies from the ground up for this population, which can substantially shorten and reduce development time and costs respectively.

Among the respondents, being easy to install was the most important feature when installing technology (37.5%). This was followed by being easy to learn how to use (21.9%). Caregiving for PWDs is stressful.³⁷ As such, it is without a doubt that installation and use of the technology should be as simple as possible to avoid creating further burden on the caregivers. Additionally, caregiving is a time consuming endeavor.³⁸ Hence, technologies that are easy to learn and install will potentially save valuable time for the caregiver to engage in other caregiving activities. The cost of technology was also highlighted as one of the top features to consider when installing technology. There are many costs associated with caregiving, including but are not limited to lost wages due to reduced productivity at work, medication and transportation.³⁹ Given the existing strain on their finances, it is expected that respondents would value costs as one of the more important factors when acquiring and installing technology. Such a conclusion is congruent with previous studies that have identified the costs of technology as one of the major concerns among older adults considering technology.^{40,41} On the other hand, aesthetics was considered the least important feature when installing technology. While this factor may not play a significant role during the installation process, it may contribute to the stigma associated with dementia during the use of the technology as noted earlier. Hence, it is pivotal not to overlook the impact of aesthetics during the design and development process of technology.

With respect to features when using technology, respondents ranked reliability (68.8%) as the most

important feature, followed by the ability for the device to work without manual input (21.9%). Similarly, previous studies on technology for older adults had found that technology that functioned passively in the background and were unnoticeable to be more readily accepted.¹⁷ Given the numerous demands and pressures associated with caregiving, much of the attention of the respondents would be focused on the well-being of the care recipient. As such, they were unlikely to have additional time and resources to operate or respond to breakdowns in the technology. Nonetheless, there should be a basic level of control over the activation and de-activation of these technologies.⁴⁰ On the other contrary, the ability to receive performance reports regarding user performance and operation of the technology was ranked as the least important feature when using technology. While respondents may not value this feedback, they can provide insights on various aspects of the technology to researchers and developers. This information would in turn enable them to refine and create future generations of technology that would enhance and better align with the preferences of the end users.

While establishing the needs and preferences of technology among Chinese family caregivers of PWDs, this study also identified sex and gender differences with respect to the perceived usefulness of technology in assisting with care recipient ADLs and delaying care recipient's transfer to a residential care setting. Controlling for age, female respondents were more receptive towards the use of technology in assisting with caregiving when compared to their male counterparts. Such findings are in contrast with current literature on technology and gender. A meta-analysis of studies of gender differences in computer-related attitudes and behavior found that males had higher computer-efficacy and more positive affect about computers than females.⁴² More recently, males had been found to demonstrate a greater interest and more positive attitude towards information technologies compared to females.^{43,44} Differences with previous findings could be attributed to the specific purpose of the current set of technologies being investigated. As health-related technologies, there is a general positive attitude and tendency to use these devices.⁴⁵ When faced with the well-being of their care recipient and themselves, the perceptions of respondents are no longer influenced by gender but rather by the functionalities and reliability of the technologies.⁴⁶ As more female respondents in the study (51.9%) had taken care of the care recipient for a longer period of time (more than 6 years) compared to their male counterparts (8.3%), they may be more aware of their caregiving needs. Therefore, when presented with technologies, female respondents may be better able to align the functionalities of the technologies with their personal caregiving context. Similarly,

being the more experienced caregivers within the current study, female respondents may better able to draw from their caregiving experiences when evaluating the usefulness of technology. As a result, it was expected that female respondents in this study would be more likely to demonstrate greater receptivity and a more positive attitude towards technology compared to males.

Limitations

The strengths of our study included the translation of all the study materials to Mandarin/Cantonese. Given the possibility that a number of respondents may only be able to communicate in their native language, doing so would ensure that all eligible participants would be able to participate in the study. Given the anonymity of the survey, recruitment was done exclusive through Yee Hong, which minimized the possibility of individuals outside of the target population completing the survey. As such, it ensured that the findings are specific to and representative of the target population. However, our study was also subject to several limitations. One potential shortcoming of this study is the small study sample due to the relatively low response rate. Out of the 544 study packages that were distributed, only 41 responses were received by mail and online. Due to the limited sample size of our pilot study, cautionary interpretation of the survey responses is warranted. Hence, future surveys could adopt strategies of data collection such as the Tailored Design Method, which is a well-supported and generally accepted methodological survey framework that have been shown to maximize response rates.^{47,48} Another potential short-coming of the study is the limited geographical coverage. Due to the nature of our organizational partner, all of the respondents were based out of the Greater Toronto Area (GTA). As such, caution is warranted when applying the findings to other Chinese communities across Canada due to potential variations in environmental and social factors that may influence technology perceptions. Future studies should consider expanding recruitment to include other cities across Canada such as Calgary and Vancouver, which also have a large Chinese population so that comparisons can be made across geographical regions. In addition, future work should also consider the comparison of current findings with that among the general population of family caregivers, which may yield important cultural considerations when introducing future technologies among this population. Given the lack of technology use demonstrated by the respondents, a follow up examination of the factors associated with the rates of technology use will also be helpful in the planning of initiatives that promote technology for caregiving.

This can be achieved through in-depth interviews with family caregivers that gather their perspectives on technology that may be beyond the scope and aspects covered by the questionnaire. Finally, as the field of technology is rapidly evolving, the survey responses ought to be updated on a regular basis to reflect the most up-to-date technologies that have been developed to assist with caregiving. Nonetheless, this study would serve as the baseline for comparisons of future use of technology. More importantly, these findings provided concrete evidence and hold significant implications for policy-making and the future development of technologies for this population. First, it addresses a need for a framework that developers of technology for caregiving can work with when designing technologies that would best align with the needs and preferences of this population. Second, this study offers concrete evidence for federal and provincial authorities about the need for policies and guidelines that facilitate the use of technology among family caregivers.

Conclusion

Recognizing the technology needs and preferences of Chinese family caregivers of PWD is important when developing technologies for this population. In particular, technology developers and health professionals should incorporate these needs and preferences when designing and prescribing technologies that are better suited for this ethnic population. The results from the study suggest that the perception of technology differed between male and female Chinese caregivers, pointing to the importance of assessing technology needs and preferences through a sex and gender lens, especially with more males taking on the role of a family caregiver. In addition, future efforts should be directed towards exploring the influences of other environmental and social influences to better understand and address the nuances in the needs and preferences of technology within each caregiving context.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work is supported by the Canadian Consortium of Neurodegeneration in Aging (CIHR-CCNA). CX was supported by the 2015/2016 Frederick Banting and Charles Best Canada Graduate Scholarship-Master's, Toronto Rehabilitation Institute Student Scholarship, Harry C. Sharpe Fellowship and the Donald Menzies Bursary. AC

was funded by the Canadian Institutes of Health Research (CIHR) Chair in Gender, Work and Health [grant no. CGW-126580]. Data collection for this project was facilitated and supported by the Yee Hong Centre of Geriatric Care, Toronto, Ontario, Canada.

Guarantor

CX.

Contributorship

All authors contributed to the conception and design of the project. CX prepared the questionnaire (paper and online), analysed the data and drafted the manuscript. AA, AM and AC read and provided feedback on the manuscript before approving it for publication.

References

1. Alzheimer's Society of Canada. A new way of looking at the impact of dementia in Canada, www.alzheimer.ca/~media/Files/national/Media-releases/asc_factsheet_new_data_09272012_en.pdf (2005, accessed 1 June 2016).
2. Alzheimer's Association. What is dementia, www.alz.org/what-is-dementia.asp (2016, accessed 1 June 2016).
3. World Health Organization. Dementia, www.who.int/mediacentre/factsheets/fs362/en/ (2015, accessed 1 June 2016).
4. Mayo Clinic. Dementia definition, www.mayoclinic.org/diseases-conditions/dementia/basics/definition/con-20034399 (2014, accessed 1 June 2016).
5. Schulz R and Martire LM. Family caregiving of persons with dementia: prevalence, health effects, and support strategies. *Am J Geriatr Psychiatry* 2004; 12: 240–249.
6. Givens JL, Mezzacappa C, Heeren T, et al. Depressive symptoms among dementia caregivers: role of mediating factors. *Am J Geriatr Psychiatry* 2014; 22: 481–488.
7. Hughes TB, Black BS, Albert M, et al. Correlates of objective and subjective measures of caregiver burden among dementia caregivers: influence of unmet patient and caregiver dementia-related care needs. *Int Psychogeriatr* 2014; 26: 1875–1883.
8. Godwin KM, Mills WL, Anderson JA, et al. Technology-driven interventions for caregivers of persons with dementia a systematic review. *Am J Alzheimers Dis Other Demen* 2013; 28: 216–222.
9. Cahill S, Macijauskiene J, Nygård AM, et al. Technology in dementia care. *Technol Disabil* 2007; 19: 55–60.
10. Mortenson WB, Demers L, Fuhrer MJ, et al. How assistive technology use by individuals with disabilities impacts their caregivers: a systematic review of the research evidence. *Am J Phys Med Rehabil* 2012; 91: 984–998.
11. Mortenson WB, Demers L, Fuhrer MJ, et al. Effects of an assistive technology intervention on older adults with disabilities and their informal caregivers: an exploratory randomized controlled trial. *Am J Phys Med Rehabil* 2013; 92: 297–306.
12. Riikonen M, Mäkelä K and Perälä S. Safety and monitoring technologies for the homes of people with dementia. *Gerontechnology* 2010; 9: 32–45.

13. Bharucha AJ, Anand V, Forlizzi J, et al. Intelligent assistive technology applications to dementia care: current capabilities, limitations, and future challenges. *Am J Geriatr Psychiatry* 2009; 17: 88–104.
14. Covinsky KE, Palmer RM, Fortinsky RH, et al. Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: increased vulnerability with age. *J Am Geriatr Soc* 2003; 51: 451–458.
15. Noelker LS and Browdie R. Sidney Katz, MD: a new paradigm for chronic illness and long-term care. *Gerontol* 2014; 54: 13.
16. Van Hoof J, Kort HS, Van Waarde H, et al. Environmental interventions and the design of homes for older adults with dementia: an overview. *Am J Alzheimers Dis Other Demen* 2010; 25: 202–232.
17. Czarnuch S and Mihailidis A. The design of intelligent in-home assistive technologies: assessing the needs of older adults with dementia and their caregivers. *Gerontechnology* 2011; 10: 169–182.
18. Mihailidis A, Boger JN, Craig T, et al. The COACH prompting system to assist older adults with dementia through handwashing: an efficacy study. *BMC Geriatr* 2008; 8: 28.
19. Hoey J, Poupart P, von Bertoldi A, et al. Automated handwashing assistance for persons with dementia using video and a partially observable Markov decision process. *Comput Vis Image Underst* 2010; 114: 503–519.
20. Olivier P, Xu G, Monk A, et al. Ambient kitchen: designing situated services using a high fidelity prototyping environment. In: *Proceedings of the 2nd international conference on pervasive technologies related to assistive environments*, Corfu, Greece, 9 June 2009, p.47. ACM.
21. Colantonio A, Cohen C and Pon M. Assessing support needs of caregivers of persons with dementia: who wants what? *Community Ment Health J* 2001; 37: 231–243.
22. Rialle V, Ollivet C, Guigui C, et al. What do family caregivers of Alzheimer's disease patients desire in smart home technologies?-Contrasted results of a wide survey. *Methods Inf Med* 2008; 47: 63–69.
23. Mihailidis A, Cockburn A, Longley C, et al. The acceptability of home monitoring technology among community-dwelling older adults and baby boomers. *Assist Technol* 2008; 20: 1–12.
24. Statistics Canada. Immigration and ethnocultural diversity in Canada, www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-010-x/99-010-x2011001-eng.cfm (2014, accessed 1 June 2016).
25. Ontario Ministry of Finance. 2011 National household survey highlights: factsheet 2, www.fin.gov.on.ca/en/economy/demographics/census/nhshi1-2.html (2013, accessed 1 June 2016).
26. Chiu T, Marziali E, Colantonio A, et al. Internet-based caregiver support for Chinese Canadians taking care of a family member with Alzheimer disease and related dementia. *Can J Aging* 2009; 28: 323–336.
27. Torti FM Jr, Gwyther LP, Reed SD, et al. A multi-national review of recent trends and reports in dementia caregiver burden. *Alzheimer Dis Assoc Disord* 2004; 18: 99–109.
28. Canadian Institutes of Health Research. Definitions of sex and gender, www.cihr-irsc.gc.ca/e/47830.html (2015, accessed 18 September 2017).
29. Alzheimer's Society of Canada. Rising tide: the impact of dementia on Canadian society, www.alzheimer.ca/~media/Files/national/Advocacy/ASC_Rising_Tide_Full_Report_e.pdf (2010, accessed 1 June 2016).
30. Cranswick K and Dosman D. Eldercare: what we know today. *Can Soc Trends* 2008; 86: 49–57.
31. Chiou CJ, Chen I and Wang HH. The health status of family caregivers in Taiwan: an analysis of gender differences. *Int J Geriatr Psychiatry* 2005; 20: 821–826.
32. Hampson NB, Piantadosi CA, Thom SR, et al. Practice recommendations in the diagnosis, management, and prevention of carbon monoxide poisoning. *Am J Respir Crit Care Med* 2012; 186: 1095–1101.
33. Perry J, Beyer S and Holm S. Assistive technology, tele-care and people with intellectual disabilities: ethical considerations. *J Med Ethics* 2009; 35: 81–86.
34. Peek ST, Wouters EJ, van Hoof J, et al. Factors influencing acceptance of technology for aging in place: a systematic review. *Int J Med Inform* 2014; 83: 235–248.
35. Connell B, Jones M, Mace R, et al. *The principles of universal design, version 2.0*. Raleigh: North Carolina State University: The Center for Universal Design, 1997.
36. Rialle V, Ollivet C, Guigui C, et al. What do family caregivers of Alzheimer's disease patients desire in smart home technologies?-Contrasted results of a wide survey. *Methods Inf Med* 2008; 47: 63–69.
37. Gitlin LN, Belle SH, Burgio LD, et al. Effect of multi-component interventions on caregiver burden and depression: the REACH multisite initiative at 6-month follow-up. *Psychol Aging* 2003; 18: 361–374.
38. Schulz R, Mendelsohn AB, Haley WE, et al. End-of-life care and the effects of bereavement on family caregivers of persons with dementia. *N Engl J Med* 2003; 349: 1936–1942.
39. Lai DW. Effect of financial costs on caregiving burden of family caregivers of older adults. *Sage Open* 2014; 2.
40. Steele R, Lo A, Secombe C, et al. Elderly persons' perception and acceptance of using wireless sensor networks to assist healthcare. *Int J Med Inform* 2009; 78: 788–801.
41. Cohen-Mansfield J, Creedon MA, Malone TB, et al. Electronic memory aids for community-dwelling elderly persons: attitudes, preferences, and potential utilization. *J Appl Gerontol* 2005; 24: 3–20.
42. Whitley BE. Gender differences in computer-related attitudes and behavior: a meta-analysis. *Comput Human Behav* 1997; 13: 1–22.
43. Schumacher P and Morahan-Martin J. Gender, Internet and computer attitudes and experiences. *Comput Human Behav* 2001; 17: 95–110.
44. Meelissen MR and Drent M. Gender differences in computer attitudes: does the school matter? *Comput Human Behav* 2008; 24: 969–985.
45. Ziefle M and Wilkowska W. Technology acceptability for medical assistance. In: *4th international conference on pervasive computing technologies for healthcare*, Munich, Germany, 22 March–25 March 2010, pp.1–9.

46. Wilkowska W, Gaul S and Ziefle M. A small but significant difference—the role of gender on acceptance of medical assistive technologies. In: Leitner G, Hitz M and Holzinger A (eds) *HCI in work and learning, life and leisure*. Berlin-Heidelberg: Springer Berlin Heidelberg, 2010, pp.82–100.
47. Dillman DA, Smyth JD and Christian LM. *Internet, phone, mail, and mixed-mode surveys: the tailored design method*. New Jersey: Wiley Publishing, 2014.
48. Converse PD, Wolfe EW, Huang X, et al. Response rates for mixed-mode surveys using mail and e-mail/web. *Am J Eval* 2008; 29: 99–107.