Association between loneliness and acceptance of using robots and pets as companions among older Chinese immigrants during the COVID-19 pandemic

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Abstract

Objectives: To examine loneliness experienced by middle-aged and older Chinese immigrants and its association with accepting technology as a companion (apps, Internet and robots) versus owning pets, when social distancing measures were implemented in New Zealand during the first COVID-19 outbreak.

Methods: This study conducted a community-based cross-sectional survey. Chinese immigrants who were 45–87 years old (n = 173) were invited to answer an online survey in the Chinese language, collecting demographic data, responses to the 6-item De Jong Gierveld Loneliness Scale and experiences in using technology and pet ownership. Descriptive analyses and inferential statistics tests were utilised in the data analysis.

Results: A moderate level of overall loneliness with a mean score of 3.68 (SD 1.84), ranging from 0 to 6, was reported by participants. Emotional and social loneliness ranged from 0 to 3 with mean scores of 1.69 (SD 0.98) and 1.99 (SD 1.24), respectively. Self-reported health, financial status, English language abilities, transportation and experiences of using the Internet and apps were significantly related to experiencing loneliness. Loneliness had a weak association with acceptance of robots and pets, but 67.8% and 58.3% of participants who felt lonely, accepted companionship of robots and pets, respectively.

Conclusions: The level of loneliness among older and middle-aged immigrants increased during the COVID-19 pandemic. Further evidence of the specific dimensions of loneliness and the utility of technology to alleviate loneliness among immigrant groups is needed. Interventions tailored for older people with specific cultural requirements to address loneliness are needed.

Keywords

apps, companion, computational intelligence, culturally diverse, lonely, pet, robot, social isolation, Internet
New Zealand is one of the main destination countries for Chinese immigrants, which includes those from mainland China, Hong Kong and Taiwan. At the 2018 Census, there were 247,770 Chinese aged 45 years old and over living in New Zealand. In terms of age distribution, 20 percent of the Chinese ethnic group in New Zealand were 45–60 years old and 10 percent were aged 60 years and older. With the increasing diversity in New Zealand communities, it was also noted that the ageing population within and across ethnic groups is rising. The Chinese group constitutes the largest ethnic group within New Zealand’s older Asian population, and 60 percent of the older Chinese population reside in Auckland.

Older adults are at increased risk of loneliness due to health deterioration and age-related losses, which prevent them from participating in social activities and maintaining meaningful relationships. Moreover, the process of immigration and adapting to a new culture in a host country often heighten the risks of loneliness in older immigrants. For example, the phenomenon called the ‘broken social convoy effect’ has been noted among immigrants, where social groups and established networks have been disrupted by one’s departure from the country of origin. In reference to this phenomenon, older immigrants normally encounter challenges of interrupted social networks and limited opportunities to build up new social relationships, which makes them vulnerable to experiencing loneliness. In New Zealand, intergenerational conflicts and imbalanced reciprocity have been deemed major causes for older Chinese immigrants’ loneliness. The expressions of loneliness among older Chinese immigrants were deeply rooted in specific Chinese cultural values, which, if not understood, pose complexities and challenges for healthcare and social care service providers to address these issues. Furthermore, due to the COVID-19 outbreak, public health measures, including social distancing recommendations to contain the spread of virus, have significantly reduced older people’s social interactions and increased the risk of becoming lonely.

Loneliness has been identified as a risk factor for older people’s poor health, serious illness, increased risk of cognitive impairment and mortality. Evidence from the literature has reported adverse impacts of loneliness, including increased symptoms of depression and suicidal ideation, negative health behaviours and diminished quality of life. However, evidence of loneliness in immigrant groups during the COVID-19 pandemic remains under-represented in research in ageing in New Zealand.

Over the past decades, the benefits of pet ownership and animal visitations in hospital and in long-term care, to foster social interactions and decrease loneliness, have been widely reported. The effect of pet companionship in loneliness has contributed to the impetus of examining companion robots, which may provide the same advantages as live animals but can be sustained with less care and are more hygienic. Moreover, the COVID-19 pandemic highlighted the importance and need to develop innovative digital and robotic technology-based interventions to address older people’s loneliness. Ma and colleagues reported that online communication technology significantly reduced the loneliness of older adults in China. Furthermore, the use of robots in various settings, particularly in Western countries, has significantly reduced experiences of loneliness in older people living in residential care homes in the UK and among older Americans who live alone in the community. In New Zealand, Robinson’s team also reported that residents significantly interacted more (talked and touched) with a companion robot than the resident dog as comparator. Despite the increasing international evidence, there has been limited application of these interventions reported in immigrant groups, which is also the case for Chinese immigrants in New Zealand, particularly among older Chinese. Therefore, this study aimed to examine loneliness among middle-aged and older Chinese immigrants and its association with the acceptance of using digital technology and its potential benefit in addressing social issues in ageing.
technology (apps, Internet and robots) versus owning pets when social distancing measures were implemented in New Zealand during the first COVID-19 outbreak.

2 | METHODS

2.1 | Study design

A cross-sectional design was employed in this study. We used an online survey to adhere to the social distancing measures. The survey consisted of two sections, with a 5-minute introductory video followed by the questionnaires. The video demonstrated a variety of types of companion robots, with different appearances and features. The content was presented in Mandarin with traditional Chinese subtitles for the purpose of helping potential participants to understand what companion robots are.

2.2 | Participants

Participants were invited if they met the inclusion criteria that they: (1) self-identified as having Chinese ethnicity; (2) held a permanent resident visa/New Zealand citizenship (by grant); (3) were aged 45 years or above; and (4) were able to access the Internet. The relevant questions were listed in the demographic information section to identify eligible participants.

2.3 | Ethical approval

Ethical approval was granted by the National Cheng Kung University’s Institution Review Board (Reference no. A-ER-105-509). Before answering the survey, participants were given a brief introduction as to the aims of the survey and were asked to confirm (by ticking a box) if they were willing to proceed. All respondents ticked this box, and responses were anonymous.

2.4 | Recruitment and data collection

The recruitment was supported by a principal stakeholder Age Concern Auckland, who provide Asian services for older people across Auckland, as well as Chinese community groups in different regions. Following ethics approval, a flyer (in Chinese) about the study, containing a link to the online survey, was advertised via word-of-mouth, WeChat and WhatsApp groups of Chinese members. To maximise participation and to increase the response rate, we promoted the flyer more frequently on web platforms of Age Concern Auckland and obtained support from social workers and group leaders. We received a total of 175 responses. There were 173 valid responses, and two responses were considered invalid as they did not meet the age criterion of the study.

2.5 | Measures

The online survey had traditional Chinese and a simplified Chinese version as a second option. The survey was divided into three sections: (1) social demographic background; (2) self-reported loneliness; and (3) experiences in using technology and eHealth, and experiences and acceptance of engaging with robots and pets.

The Chinese version of the 6-item De Jong Gierveld Loneliness Scale was the primary outcome measure to determine the status of loneliness. This scale consists of emotional loneliness and social loneliness subscales, and each of them contains three items. There are three response categories for each item: ‘no’, ‘more or less’ and ‘yes’. The scale gives a range of scores from 0 to 6, reading from the least lonely to most lonely. Following the 6 items, participants answered the final, direct question ‘Are you feeling lonely?’ A score of 0–1, 2–4 and 5–6 represented ‘no or mild’, ‘moderate’ and ‘severe’ loneliness levels, respectively. The scale has been validated and recommended as reliable (Cronbach’s $\alpha$ of the 6-item scale was 0.76, the intra-class correlation coefficients ranged from 0.98 to 1.00) to measure loneliness in older Chinese people. Participants’ experiences in using the Internet and apps were measured by the eHealth Literacy Scale (eHEALS), with eight questions, scoring from 1 (entirely disagree) to 4 (strongly agree). The instrument has been validated in older Chinese populations (Cronbach’s alpha was 0.98). A questionnaire of experience with and acceptance of robots and pets was adopted based on Chiu and colleagues’ study to measure the acceptability of robots and pets. It contains questions about the acceptability of choosing a robot or pet as a companion and their past experiences of using robots and owning pets. The question about the acceptability of robots and pets gave a range of scores from 0 to 10, reading from the least acceptable to most acceptable.

2.6 | Data analysis

Descriptive analyses and inferential statistics were performed with the R Studio 1.4.1103 statistical software package. Descriptive analyses, chi-square tests and ANOVA were applied to examine the loneliness status and its relationship with the use of robotic technology and keeping pets.
3 | RESULTS

3.1 | Participants’ characteristics

A total of 173 responses were included in this study. The mean age of the sample (n = 173) was 62.2 years (SD 9.4 years), and 133 were females and 40 were males. Of the 173 responses, 83 participants were older than 65 years. There were 75.1% participants who had emigrated from mainland China, and the percentage of immigrants from Hong Kong/Macao and Taiwan were 8.1% and 13.3%, respectively. The remaining 3.5% of the participants were Chinese groups, who had emigrated from other Asian countries. Most participants had a Bachelor’s degree or above, with good self-reported health and financial status. The majority of the participants were married or had a partner (82.1%) and 87.9% lived with family or with others. Approximately half of the participants (53.2%) had lived in New Zealand for more than 10 years. All of the participants reported living at home, while 64.7% of them lived in their own flats or houses. Around 70% of the participants used a private vehicle as their main mode of transport (see participants’ demographic information in Table 1).

3.2 | Status of loneliness

Participants reported a moderate level of overall loneliness with a mean score of 3.68 (SD 1.84), ranged from 0 to 6. Emotional loneliness ranged from 0 to 3 with a mean score of 1.69 (SD 0.98). The mean score of social loneliness was 1.99 (SD 1.24). Around 50% of the participants (n = 87) identified feelings of loneliness when asked directly ‘are you feeling lonely’ (see Table 2). Only 15% of the participants (n = 26) scored ‘no to mild’ levels of loneliness, and 44.5% (n = 77) scored a moderate level, while 40.5% (n = 80) had reported a severe level of loneliness (Figure 1).

3.3 | Experience and acceptance of using technology or owning pets

The mean score of accepting robots was 5.7 (SD 3.1), higher than the mean score of accepting pets as companions (4.7, SD 3.6). As shown in Table 3, 27.7% of the participants (middle-aged adults n = 24; older adults n = 24) reported an experience of using companion robots. Participants’ experiences of using apps and the Internet were more common than engaging with companion robots. The majority of participants (n = 161, 93.1%) had used the Internet, and 60.1% of them (n = 104) had used the Internet for

| Table 1 Sociodemographic characteristics of participants (N = 173) |
|---------------------------------|------------------|------------------|
| Variables                       | N (%) /Mean ± SD |
| Gender                          |                  |
| Female                          | 133 (76.9%)      |
| Male                            | 40 (23.1%)       |
| Age (years)                     |                  |
| 45–64                           | 90 (52%)         |
| 65–87                           | 83 (48%)         |
| Marital status                  |                  |
| Married or have a partner       | 142 (82.1%)      |
| Unmarried/widowed/single        | 31 (17.9%)       |
| Whether live alone or not       |                  |
| Yes                             | 21 (12.1%)       |
| No                              | 152 (87.9%)      |
| Original country or region      |                  |
| Mainland China                  | 130 (75.1%)      |
| Hong Kong and Macau             | 14 (8.1%)        |
| Taiwan                          | 23 (13.3%)       |
| Other Asian countries           | 6 (3.5%)         |
| Self-rated health (1–5 points)  | 3.32 ± 0.79      |
| Self-rated financial status (1–5 points) | 3.65 ± 0.83     |
| Self-rated English ability (1–5 points) | 2.52 ± 1.25    |
| Highest Academic qualifications |                  |
| High school or below            | 42 (24.3%)       |
| Bachelor’s degree or above      | 131 (75.7%)      |
| Purpose for immigration         |                  |
| Work                            | 18 (10.4%)       |
| Immigrated with adult children  | 66 (38.2%)       |
| Take care of grandchildren      | 28 (16.2%)       |
| Retirement                      | 31 (17.9%)       |
| Government policy               | 42 (24.3%)       |
| Duration of immigration         |                  |
| Less than 1 year                | 4 (2.3%)         |
| 1–10 years                      | 77 (44.5%)       |
| 10 years or above               | 92 (53.2%)       |
| Accommodation situation         |                  |
| Self-owned house                | 112 (64.7%)      |
| Rental                          | 61 (35.3%)       |
| Employment status               |                  |
| Retired                         | 129 (74.6%)      |
| Employed                        | 44 (25.4%)       |
| Main transportation             |                  |
| Self-drive                      | 121 (70 %)       |
| Public transportation           | 66 (38.2%)       |
| Walk                            | 33 (19.1%)       |
| Family assistance               | 27 (15.6%)       |
| No travel at all                | 5 (2.9%)         |

Note: Self-rated health, self-rated financial status and self-rated English language ability have a range of scores from 0 to 5, reading from ‘very bad’ to ‘very good’.

Purpose for immigration and main transportation measures allowed multiple answers.
over 10 years. Three in five participants (n = 107) could download and use apps independently, while 38.2% participants (n = 66) had no experience of this. More than half of the participants, 54.3% (n = 94), had experience of pet ownership.

3.4 | Associations between loneliness and participants’ acceptance and experiences of using technology, Internet and pet ownership

Table 4 presents the significant associations of self-reported health, financial status, English language abilities, transportation and experiences of using the Internet and apps with participants’ feelings of loneliness. Lower levels of health, financial status and English language constraints negatively impacted upon the participants’ experiences of loneliness. Participants who could drive a vehicle independently (n = 65) reported not feeling lonely, while those who identified walking as their main mode of mobility were more likely to report feeling lonely than their counterparts. Those who had experiences of using the Internet and apps, particularly for more than 10 years, found themselves not feeling lonely. The associations between loneliness status and the acceptance of robots and pets were not statistically significant, but among participants who reported feeling lonely, 67.8% and 58.3% of them accepted the companionship of robots and pets, respectively.

4 | DISCUSSION

Loneliness in old age is an important topic in gerontological research, but how loneliness is expressed in differing ethnic groups, such as in older Chinese immigrants, and the association between loneliness and their experiences of using the Internet, apps and robots, remains underreported. This study examined loneliness and its association with using technology and with the acceptance of robots and pets among middle-aged and older Chinese immigrants in New Zealand. The survey results showed a moderate level of overall loneliness in middle-aged and older Chinese immigrants in New Zealand during the implementation of the COVID-19 social distancing measures. The level of loneliness in this study was much higher than the loneliness of Chinese late-life immigrants in New Zealand reported by a previous study before the COVID-19 pandemic, where the overall loneliness scores measured by the Chinese version 6-item De Jong Gierveld Loneliness scale had a mean of 2.44. The COVID-19 pandemic caused a so-called ‘loneliness epidemic’ internationally, representing an unspoken toll of COVID-19. There was no significant difference in loneliness reported between middle-aged and older Chinese immigrants in this study. Self-reported health and financial status, and transportation were significantly related to loneliness, consistent with current studies in New Zealand, the United States and Canada. A majority of participants immigrated to New Zealand with their adult children. Previous studies reported that Chinese late-life immigrants usually immigrate to a host country to re-unite with

| Loneliness status | Mean ± SD |
|-------------------|-----------|
| Overall loneliness score (0–6 points) | 3.68 ± 1.84 |
| Emotional loneliness score (0–3 points) | 1.69 ± 0.98 |
| Social loneliness score (0–3 points) | 1.99 ± 1.24 |

| Are you feeling lonely? (Y/N) | N (%) |
|------------------------------|-------|
| Yes                          | 87 (50.3%) |
| No                           | 86 (49.7%) |

FIGURE 1 Distribution of DJG loneliness scale scores (N = 173)
their adult children, honouring traditional values and expressions of filial piety. However, the cultural stigma surrounding loneliness could prohibit older Chinese immigrants from disclosing their feelings and the status of intergenerational relationships to others. Researchers need to build a trusting relationship with older Chinese immigrants before exploring loneliness from a culturally related context. Participants of this study who reported loneliness experienced comparatively ideal health, financial status, Internet access and living arrangements. Yet in New Zealand, and indeed globally, the voices of those ‘hard to reach’ older Chinese immigrants, who lived alone, living with complex chronic diseases or without access to the Internet, mobile devices and apps have been mostly limited in reported studies.

Advances in using technology and the Internet have been identified in this study as having the potential to address middle-aged and older Chinese immigrants’ loneliness in New Zealand. The findings are consistent with WHO’s strategies on Healthy Ageing in reducing loneliness and social isolation among older adults through technology-based interventions. There has been increasing interest in the use of technological interventions, encompassing the use of the Internet, apps, companion and social robots, social media and virtual reality to increase social connections and alleviate loneliness in older people. Recent technological development enables older adults to access information through the Internet, to interact with others, and gain social support via online channels regardless of geographical distance. In addition, in Europe, companion robots were found to mitigate feelings of loneliness through building different types of supportive relationships, and they increased social interactions with other people for older Taiwanese in long-term care settings as well as among older Japanese in day care facilities and nursing homes. However, fewer studies on robots have addressed the loneliness of older Chinese immigrants living in their own homes in the community. Studies on older Chinese immigrants’ lifestyle and experience of loneliness in New Zealand communities have revealed that some older Chinese immigrants reluctantly discarded prior customary filial piety expectations, in favour of external services/resources to support their care arrangements and to help them cope with loneliness. To fill the research gap, this study examined the association between loneliness and the acceptance of robots and pets among middle-aged and older Chinese immigrants living in the community. Although the association was not statistically significant, which might be due to the limited experience of using robots among participants, we found

### Table 3: Acceptance and experiences of using technology, Internet and owning a pet

| Acceptance of companion robot and pet | Mean ± SD |
|-------------------------------------|-----------|
| Acceptance of companion robot (0–10 points) | 5.7 ± 3.1 |
| Acceptance of a pet (0–10 points) | 4.7 ± 3.6 |

| Experience of using companion robot (Y/N) | N (%) |
|------------------------------------------|------|
| Yes                                      | 48 (27.7%) |
| No                                       | 125 (72.3%) |

| Experience of downloading and using apps (Y/N) | N (%) |
|-----------------------------------------------|------|
| Yes                                           | 107 (61.8%) |
| No                                            | 66 (38.2%) |

| Experience of using the Internet (Y/N) | N (%) |
|----------------------------------------|------|
| Yes and ≥10 years                      | 104 (60.1%) |
| Yes and <10 years                      | 57 (32.9%) |
| No                                     | 12 (6.9%) |

| Experiences of owning pet and using animal-assisted therapy | N (%) |
|------------------------------------------------------------|------|
| Experience of owning a pet (Y/N)                           |      |
| Yes                                                        | 94 (54.3%) |
| No                                                         | 79 (45.7%) |

| Experience of using animal-assisted therapy (AAT) (Y/N) | N (%) |
|--------------------------------------------------------|------|
| Yes                                                    | 18 (10.4%) |
| No                                                     | 155 (89.6%) |

Note: The measurement of companion robot and pet acceptability gives a range of scores from 0 to 10, reading as from the least acceptable to the most acceptable.
TABLE 4  Associations between loneliness and sociodemographic factors, health status, and participants’ acceptance and experiences of using technology, Internet and owning pet

| Sociodemographic and health factors | Self-reported feeling ‘lonely’ (n = 87) | Self-reported feeling ‘not lonely’ (n = 86) | $X^2$(F) | p-value |
|------------------------------------|-----------------------------------------|-------------------------------------------|----------|---------|
| **Gender**                         |                                        |                                           |          |         |
| Female (n = 133)                   | 66 (75.9%)                              | 67 (77.9%)                                | 0.02     | 0.9     |
| Male (n = 40)                      | 21 (24.1%)                              | 19 (22.1%)                                |          |         |
| **Age**                            |                                        |                                           |          |         |
| 45–64 (n = 90)                     | 45 (51.7%)                              | 45 (52.3%)                                | NA       | NA      |
| 65–87 (n = 83)                     | 42 (48.3%)                              | 41 (47.7%)                                |          |         |
| **Self-rated health (1 to 5 points)** |                            |                                           | 3.07±0.80 | 3.58±0.68 | 20.55 | <0.001 |
| **Self-rated financial status (1–5 points)** |                  |                                           | 3.41±1.20 | 3.90±1.25 | 15.71 | <0.001 |
| **Self-rated English ability (1–5 points)** |                  |                                           | 2.28±1.34 | 2.77±1.24 | 3.23  | 0.009  |
| **Employment status**               |                                        |                                           |          |         |
| Retired (n = 129)                  | 67 (77.0%)                              | 62 (71.9%)                                | 0.32     | 0.6     |
| Employed (n = 44)                  | 20 (23.0%)                              | 24 (21.2%)                                |          |         |
| **Main transportation**             |                                        |                                           |          |         |
| Self-drive (n = 121)               | 50 (57.5%)                              | 65 (75.6%)                                | 5.58     | 0.02    |
| Public transportation (n = 66)     | 37 (42.5%)                              | 29 (33.7%)                                | 1.07     | 0.3     |
| Walk (n = 38)                      | 24 (27.6%)                              | 9 (10.5%)                                 | 7.14     | 0.008   |
| Family assistance (n = 27)         | 17 (19.8%)                              | 10 (11.6%)                                | 1.50     | 0.2     |
| No travel at all (n = 5)           | 5 (5.7%)                                | 0 (0%)                                    | 3.25     | 0.07    |
| **Purpose for immigration**         |                                        |                                           |          |         |
| Work (n = 18)                      | 11 (12%)                                | 7 (12.5%)                                 | 0.52     | 0.5     |
| Immigrated with adult children (n = 66) |                 |                                           | 36 (41.4%) | 30 (34.9%) | 0.52 | 0.5    |
| Take care of grandchildren (n = 28) | 16 (18.4%)                              | 12 (14.0%)                                | 0.34     | 0.6     |
| Retirement (n = 31)                | 17 (19.5%)                              | 14 (16.3%)                                | 0.13     | 0.7     |
| **Duration of immigration**         |                                        |                                           |          |         |
| Less than 1 year (n = 4)           | 2 (2.3%)                                | 2 (2.3%)                                  | 2.65     | 0.3     |
| 1–10 years (n = 77)                | 44 (50.6%)                              | 33 (38.4%)                                |          |         |
| 10 years or above (n = 92)         | 41 (47.1%)                              | 51 (59.3%)                                |          |         |
| **Marital status**                 |                                        |                                           |          |         |
| Married or have a partner (n = 142) | 70 (80.4%)                              | 72 (83.7%)                                | 0.13     | 0.7     |
| Single (n = 31)                    | 17 (19.5%)                              | 14 (16.3%)                                |          |         |
| **Whether live alone or not**      |                                        |                                           |          |         |
| Yes (n = 21)                       | 12 (13.8%)                              | 9 (10.5%)                                 | 0.19     | 0.7     |
| No (n = 152)                       | 75 (86.2%)                              | 77 (89.5%)                                |          |         |
| **Original country or region**     |                                        |                                           |          |         |
| Mainland China (n = 130)           | 71 (81.6%)                              | 59 (68.6%)                                | 4.91     | 0.2     |
| Hong Kong and Macau (n = 14)       | 6 (6.9%)                                | 8 (9.3%)                                  |          |         |
| Taiwan (n = 23)                    | 7 (8.0%)                                | 16 (18.6%)                                |          |         |
| Other Asian countries (n = 6)      | 3 (3.4%)                                | 3 (3.5%)                                  |          |         |
| **Highest academic qualifications**|                                        |                                           |          |         |
| High school or below (n = 42)      | 25 (28.7%)                              | 17 (19.8%)                                | 1.44     | 0.2     |
| Bachelor degree or above (n = 131) | 62 (71.3%)                              | 69 (80.2%)                                |          |         |
that participants were more likely to accept companionship of a robot than a pet. The finding is underpinned by previous studies where pet ownership was seen to improve loneliness in later life but where people were challenged by the cost and the physical requirements of their care, the possibility of forgetting to take care of a pet, or tripping or falling over them, and potential emotional difficulties following the death of a pet. Chiu et al also reported that middle-aged and older Chinese women in Taiwan preferred robots with an animal-like appearance, and experience with using apps was associated significantly with the acceptance of robots. Further evidence on the specific dimensions of loneliness and the utility of companion robots to alleviate loneliness among immigrant groups is needed.

People argue that the social involvement and family obligations surrounding Chinese culture among older people are possible reasons for them to prefer physical interactions rather than engaging more with the Internet or online platforms. In the context of COVID-19, participants affected by the social distancing measures might not have had usual face-to-face interactions, which might have influenced the experience of loneliness and perceived acceptance of robots or pet companionship during the pandemic period. The effectiveness of using technology in reducing loneliness should match the diverse needs, capabilities and situations of older people. For older Chinese immigrants, while using digital technology to ameliorate their loneliness, the function of technology should be developed to support them to meet family obligations as well; for example, applications are being developed to assist and support family caregivers and enhance older people's interactions with their children. Further evidence is needed to understand middle-aged and older Chinese immigrants' preferences and challenges of using technology and engaging with robots and/or pets in their own homes and the effect on addressing loneliness.
4.1 | Limitations

There are several limitations to this study. First, the use of an online survey as the method of data collection may have excluded potential participants who did not have access to the Internet or who were unable to complete the online survey. Moreover, the bias of self-reported data via the online survey is possible. Second, the data collection was only conducted in Auckland, New Zealand, limiting its applicability to the whole of New Zealand and in other host countries. Therefore, caution should be exercised when generalising results beyond this locality.

5 | CONCLUSIONS

Older Chinese immigrants in this study cohort were open to the use of technological interventions and pets for companionship. Future research on the dimensions of loneliness in connection with technological solutions is needed. Technology interventions should be tailored for older people in consideration of cultural features in addressing loneliness. In terms of measuring loneliness, commonly used standardised loneliness tools have acceptable utility with older Chinese immigrants; yet, they are not sufficient for understanding the nuanced loneliness experienced by middle-aged and older Chinese immigrants. Mixed methods and co-design research are encouraged to gain a more comprehensive insight into implementing technology-based interventions and how these could reduce loneliness. Co-designing technology will lead to user-friendly products and will cater for older adults to meet their needs.

ACKNOWLEDGEMENTS

We are grateful to Age Concern Auckland, Bodhi Association New Zealand, Browns Bay Chinese Association, Northcote Chinese Association for supporting with the study recruitment. The data, analytic methods and study materials will be made available to other researchers upon request and submit requests to corresponding author. This study was not preregistered.

CONFLICTS OF INTEREST

Dr Jed Montayre and Dr Mu-Hsing Ho are Associate Editors of the Australasian Journal on Ageing. No conflicts of interest declared.

DATA AVAILABILITY STATEMENT

Data available on request from the authors

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**How to cite this article:** Chiu C-J, Lo Y-H, Ho M-H, Montayre J, Zhao IY. Association between loneliness and acceptance of using robots and pets as companions among older Chinese immigrants during the COVID-19 pandemic. *Australas J Ageing*. 2022;41:414-423. doi: [10.1111/ajag.13075](https://doi.org/10.1111/ajag.13075)