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COVID-19 and Loneliness among Older Adults: Associations with Mode of Family/Friend Contacts and Social Participation

Namkee G. Choi, PhD*, Sarah Hammaker, BA, Diana M. DiNitto, PhD, C. Nathan Marti, PhD

The University of Texas at Austin Steve Hicks School of Social Work

Abstract

Objectives: Given physical/social distancing due to COVID-19, we examined associations between self-reported loneliness and changes in contact with family/friends and mode of social participation among older adults.

Methods: Data came from the 2020 National Health and Aging Trend Study (NHATS) and its supplemental mail COVID-19 survey (N=2,910 respondents who reported changes in loneliness during the COVID-19 outbreak). We fit a generalized linear model (GLM) with Poisson and log link using increased versus the same/decreased loneliness as the dependent variable and changes in frequencies of four modalities of contact with family/friends and social participation mode during COVID-19 as the independent variables.

Results: Approximately 19% of respondents reported feeling lonely on more days during COVID-19. GLM results showed that decreased in-person contact (AOR=1.42, 95% CI=1.17–1.73) and increased video call contact (AOR=1.30, 95% CI=1.01–1.66) with family/friends and on-line participation in clubs, classes, and other organized activities (AOR=1.36, 95% CI=1.04–1.77) were associated with higher odds of increased loneliness.

Conclusions: Virtual interaction is not an effective substitute for in-person interaction for older adults and is associated with increased loneliness.

Clinical Implications: Innovative means of making virtual contacts more similar to in-person contacts are needed to decrease older adults' loneliness during COVID-19.

Keywords

Loneliness; in-person contact; virtual contact; social participation; paid work

Introduction

Loneliness can be defined as “the unpleasant experience that occurs when a person’s network of social relationships is significantly deficient in either quality or quantity” (Perlman & Peplau, 1984, p.15).

*Corresponding author: Correspondence regarding this article should be addressed to Namkee G. Choi, Steve Hicks School of Social Work, University of Texas at Austin, 1925 San Jacinto Blvd, Austin, TX 78712. nchoi@austin.utexas.edu.

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Loneliness has been found to be related to social network size and composition, satisfaction with network contact, social engagement, and personal characteristics (e.g., marital status and health statuses) (de Jong Gierveld, 1989). De Jong Gierveld et al. (2015) also found that living in economically and socially challenging conditions is associated with loneliness among older adults. Loneliness poses significant risks for older adults' physical and mental health as it is associated with increased depression and anxiety; worsening functional impairment and frailty; decreased cognitive function, especially among those with lower education; and elevated risk of mortality (Cacioppo et al., 2010; Chen & Feeley, 2014; Holvast et al., 2015; Lara et al., 2019; Mehrabi et al., 2020; Santini et al., 2020; Shankar et al., 2013, 2017; Steptoe et al., 2013).

Loneliness has become an even greater public health concern during the COVID-19 pandemic (Smith & Lim, 2020). Older adults with chronic illnesses were advised to take more shelter-in-place and social distance precautions than younger adults as pre-existing chronic health conditions (e.g., cardiovascular and kidney diseases, diabetes) increased vulnerability to COVID-19 infection (Carlson et al., 2021; Kushkestanian et al., 2021; Sato et al., 2021). Although older adults report that family and friend relationships, digital social contact, and hobbies have been sources of comfort and joy during COVID-19, they also report increased stress, social isolation, and loneliness due to COVID-19 confinement and restrictions (Whitehead et al., 2021). Respondents age 60+ in the US Health and Retirement Study (HRS) (Hu & Qian, 2021) and the SHARE Corona Survey in 25 European countries and Israel (Atzendorf & Gruber, 2021) showed a notable increase in feelings of loneliness following the COVID-19 outbreak, and respondents age 60+ in the UK Understanding Society (USOC) COVID-19 survey showed a decline in general mental well-being (Hu & Qian, 2021). These and other studies of older adults during the COVID-19 outbreak have also found a higher likelihood and increased severity of loneliness, depression, and anxiety especially among women and those who were unmarried and/or living alone, had physical or functional health problems, and had less frequent social contacts (Atzendorf & Gruber, 2021; Fingerman et al., 2021; Kotwal et al., 2021; Li & Tang, 2021; Savage et al., 2021; Steptoe et al., 2021; Yang et al., 2021).

Although many older adults continue to have in-person contact and/or exchange support with family and friends via telephone and/or digital means, virtual contacts may not offer the same degree of emotional or instrumental support as in-person visits. Hu and Qian's (2021) US HRS- and UK USOC-based study showed that US older adults who did not reside with family/friends but had more frequent *in-person* contact with them during the outbreak were less likely to report loneliness and less likely to have become lonelier during the outbreak than those with less frequent contact. However, in both the US and UK, loneliness following COVID-19 was greater for older adults who reported more *virtual* (telephone, email, social media, video call) contact with family/friends, particularly if their in-person contact was limited. Data from nearly 28,000 older adults in the SHARE Corona Survey also showed that across countries in-person contacts at least once a week reduced the probability of feeling lonelier, whereas electronic contacts (phone, e-mail, or other electronic means) at least once a week increased feelings of loneliness since the outbreak (Atzendorf & Gruber, 2021). Thus, these studies show that increased virtual contact with family/friends is associated with increased, not decreased, loneliness among older adults.

In another study based a nationally representative sample of US adults age 70+, the proportion of those with any in-person visit with family/friends in a typical week decreased by almost 14 percentage points during the COVID-19 outbreak, and telephone calls and email/texting/social media contacts also decreased a bit, while the proportion of those with any video call contact increased by less than 3 percentage points (Choi et al., 2021). Telephone interviews with 151 community-dwelling individuals age 60+ (mean age 75, SD=10) in a large US city also showed that more than three-quarters reported minimal video-based socializing during the outbreak (Kotwal et al., 2021). These studies suggest that telephone or other virtual contacts did not fully replace reductions in in-person interactions with family/friends and in social gatherings, leading to increased isolation and loneliness.

As the COVID-19 outbreak has necessitated replacing most in-person activities with virtual ones, we should also examine whether virtual participation in other activities (work, volunteering, religious services, and other organized groups) is associated with increased, rather than decreased, loneliness. Virtual participation in these activities may not have the same degree of mental health benefits as virtual contact with family and friends since social ties from social activity participation may not be as central as family and close friendship ties (Antonucci et al., 2014). On the other hand, social activity participation forms part of self-identity, contributes to a positive self-concept and better physical health, and provides opportunities to give back to others (e.g., through volunteering) (Glei et al., 2005; Greenaway et al., 2016; Haslam et al, 2016; Steffens et al., 2016). Lack of in-person interactions with other group members may also lessen perceptions of social/group cohesion, camaraderie, and kinship, leading to increased loneliness. A study of Medicare beneficiaries age 65+ found that higher perceived social cohesion in one's community as defined by the individual and the frequency of going outside home/building were associated with lower depressive symptoms (Choi et al., 2015).

The studies summarized above examined associations between loneliness/changes in loneliness among older adults and mode of contacts (in-person or virtual) with family/friends during the COVID-19 outbreak. However, they did not examine whether older adults' own perceptions of changes in loneliness during the outbreak are associated with changes in the frequency of mode of family/friend contacts before and during the outbreak or the type and mode of social activity participation. Thus, the present study expands on previous research by examining associations of changes in self-reported loneliness with: (1) changes in frequency of in-person, telephone, email/text/social media, and video call contact with family/friends during the COVID-19 outbreak, and (2) mode of participation (in-person or online) in paid work, volunteering, religious services, and any clubs, classes, or other organized activities (referred to as social participation hereafter) among a representative sample of Medicare beneficiaries age 70+. Based on previous study findings, study hypotheses were: (H1) decreased in-person contact and increased video call contact with family/friends during the outbreak and (H2) online social participation will be associated with self-reports of increased loneliness versus same/decreased loneliness. The findings may provide insight into changes in older adults' loneliness perception during the COVID-19 outbreak and how these perceived changes are associated with changes in frequencies in the modes of family/friend contacts and the mode of social activity participation during the outbreak.

Methods

Data and sample

We used the public use data file of the 2020 National Health and Aging Trend Study's (NHATS) supplemental mail survey about participants' experiences during the COVID-19 outbreak. NHATS collects data annually from a nationally representative panel of Medicare beneficiaries aged 65+. The initial sample persons (SP) were first interviewed in 2011 and replenishment sample persons were added in 2015 (Kasper & Freedman, 2021). The COVID-19 questionnaires were mailed from the end of June 2020 through the end of October 2020 following data collected by telephone for the 2020 NHATS (Round 10 [R10]) from 3,961 SP (3,602 living in the community, 99 in nursing homes, and 269 in other facilities). COVID-19 questionnaire data collection continued through mid-January 2021, although most questionnaires were completed in July and August 2020. Of the 3,961 eligible SP, 3,257 provided data. However, of the 3,257 SP, 250 who were mailed a proxy questionnaire were not asked the questions about loneliness and 97 did not answer the loneliness questions, resulting in a sample size of 2,910, representing nearly 30 million Medicare beneficiaries age 70+, for the study. We linked the 2020 COVID-19 SP data file to the NHATS R10 SP data file to obtain data on sociodemographic factors (age, race/ethnicity, gender, marital status), diagnosed chronic medical conditions, depression and anxiety scores, and the number in social network and to the 2019 NHATS R9 SP data file to obtain income data (the 2020 NHATS SP file does not include income). The 97 respondents who did not answer loneliness questions did not differ from the 2,910 respondents who did on age ($F(2.56, 140.85) = 0.311, p = .786$), gender ($F(1, 55) = 0.453, p = .504$), income ($F(3.70, 203.45) = 0.971, p = .420$), and self-rated health ($t = -0.69, p = .492$). The study was exempt from the authors' institutional review board review.

Measures

Loneliness: Respondents were first asked, 'During the COVID-19 outbreak, in a typical week, how often have you felt lonely?' Response categories were never, rarely, some days, most days, and every day. Then, they were asked, 'Is this more often, less often or about the same as a typical week before the COVID-19 outbreak started?' Given that only 97 respondents answered that they felt less lonely, they were combined with those who reported the same level of loneliness ($n = 2,289$) for statistical analysis. Responses were coded as 0 = about the same or less often (same/less lonely), and 1 = more often (more lonely).

Changes in frequency of contact/communication with family/

friends: Respondents were asked how often (never, less than once a week, about once a week, a few times a week, or at least daily) 'in a typical week' SP had (1) in-person visits, (2) phone calls, (3) emails/texts or social media messages, and (4) video calls (including Zoom, FaceTime, and other online videoconferencing) with family and friends not living with the SP before and during the COVID-19 outbreak. By comparing contact frequencies before and during the outbreak. We generated the categories for contact frequency change (no change = 0, increased = 1, or decreased = 2) for each of the four contact/communication modalities. Increased frequency refers to a higher order frequency during than before the outbreak (e.g., at least daily or less than once a week from never, a few times a week from

less than once a week or never), while decreased frequency refers to a lower order frequency during than before the outbreak (e.g., never from less than once a week or more frequently, once a week from a few times week or more frequently).

Mode of social participation: Respondents were asked if, before and during the COVID-19 outbreak, they did paid work (or were self-employed), volunteered, attended religious services, and participated in clubs, classes, or other organized activities either online or in-person. Response categories were 0=no, did not do; 1=yes, online; and 2=yes, in-person. In this study, we focused on mode of social participation during the outbreak.

Covariates: These included sociodemographic and health-related variables. Sociodemographics included age group (70–74, 75–79, 80–84, or 85+ years); gender; race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, or Other); marital status (married/partnered, divorced/separated, widowed, never married); residence (in the community vs. residential care facility [but not a nursing home] or nursing home); income in 2019 (up to \$29,999, \$30,000–\$42,999, \$43,000–\$65,999, \$66,000–\$99,999, or \$100,000+); and the number in social network (i.e., number of confidants for important things in life; 0–5). Health-related variables were: (1) number of diagnosed chronic medical conditions (0–8 [heart attack or heart disease, hypertension, stroke, arthritis, osteoporosis, diabetes, lung disease, cancer]); we also report dementia diagnosis to describe the sample; (2) numbers of activities of daily living (ADL, 0–6) and instrumental activities of daily living (IADL, 0–6) for which the sample person received help due to health or functioning problems during the COVID-19 outbreak; (3) depressive symptom scores (0–6) measured with the two-item Patient Health Questionnaire-2 (PHQ-2; Kroenke et al., 2003), which captures the cognitive/affective symptoms of anhedonia and depressed mood; and (4) anxiety symptom scores (0–6) measured with the General Anxiety Disorder-2 (GAD-2; Kroenke et al., 2007). NHATS used a one-month reference period for the PHQ-9 and the GAD-2. To describe the sample, we also report whether respondents learned any new online technology or program during the outbreak, and if so, whether anyone helped them learn it.

Analysis

Analysis was done in two steps. First, we used design-based F- or t-tests and single-variable logistic regression analyses to compare those who reported increased loneliness (i.e., more lonely) to those who reported decreased/same degree of loneliness (i.e., same/less lonely) on (1) sociodemographic and health-related characteristics; (2) changes in frequencies of in-person, telephone, email/text/social media, and video call contacts with family/friends before and during the COVID-19 outbreak; and (3) the mode of social participation (i.e., work, volunteering, religious service, clubs/classes/other organized activities) during the outbreak. Second, to test the study hypotheses, we fit a generalized linear model (GLM) with Poisson and log link, with increased loneliness versus decreased/same degree of loneliness as the dependent variable, and changes in the frequency of each modality of contact with family/friends and mode of social participation as the independent variables. The covariates listed above were included as controls. Given that 2.9% to 7.1% of those providing data on changes in loneliness did not provide data on family and friend contact frequencies and 6.7% to 8.8% did not provide data on mode of participation, we imputed

values for missing data points using multiple imputation by chained equations (MICE) in which each variable was imputed under separate conditional distributions appropriate to each variable using Stata's (College Station, TX) missing data imputation procedure. We created 50 data sets in which missing values were replaced by imputed values before implementing the GLM. GLM models were fit for each of the 50 data sets and results were aggregates of the 50 models that were combined using Rubin's (1987) methods. Results are presented as adjusted odds ratios (AOR) with 95% confidence intervals (CIs). All analyses were conducted with Stata/MP 17's svy function to account for NHATS's stratified, multistage sampling design (DeMatteis et al., 2021). All estimates presented in this study are weighted except sample sizes. Statistical significance was set at $p < .05$.

Results

Sociodemographics, health characteristics, and technology learning: Comparison between same/less lonely and more lonely groups

Table 1 shows that 19.4% of the study respondents reported they felt lonely on more days in a typical week during than before the COVID-19 outbreak, while 80.6% reported feeling lonely to the same degree or less often. Among the same/less lonely group, 79.3% reported never or rarely feeling lonely, 16.4% reported feeling lonely on some days, and 4.3% reported feeling lonely on most days or every day. Among the more lonely group, 72.0% reported feeling lonely on some days, 20.5% on most days, and 7.5% every day.

The more lonely and same/less lonely groups did not differ on income, dementia diagnosis, and ADL impairments; however, those age 80–84 years and non-Hispanic Blacks had lower odds of perceiving increased loneliness, whereas females and those who were married or divorced, living in a residential care community, had more social network members, more chronic health conditions, more IADL impairments, higher depression and anxiety scores, and who learned a new technology during the outbreak had higher odds of increased loneliness. Compared to 23.4% of the same/less lonely group, 40% of the more lonely group reported that they learned a new online technology during the outbreak.

Family/friend contact frequency before and during COVID-19 by contact modality

Table 2 shows that before the COVID-19 outbreak, the more lonely and same/less lonely groups did not differ significantly on frequency of telephone contact with family/friends in a 'typical week'; however, higher proportions of the more lonely group had in-person, email/text/social media, and video call contacts daily or a few times a week. During the outbreak, overall, in-person contact frequency decreased for both the same/less lonely and more lonely groups; however, the decrease was more pronounced among the more lonely group. Before the outbreak, 84.7% of the same/less lonely group and 89.3% of the more lonely group reported having any in-person contact in a typical week. During the outbreak, 72.3% of the same/less lonely group and 72.1% of the more lonely group reported any in-person contact in a typical week. However, with respect to telephone and virtual contacts during the outbreak, the more lonely group still had more contacts with family/friends. For example, 95.9%, 83.3%, and 57.7% of the more lonely group, compared to 93.4%, 68.6%,

and 41.7% of the same/less lonely group, had telephone, email/text/social media, and video call contacts, respectively, at least once a week.

Changes in family/friend contact frequency and mode of social participation during COVID-19

Table 3 shows that following COVID-19, in-person contact frequency decreased among 49.8% of the more lonely group and 32.7% of the same/less lonely group and increased among 4.4% of the more-lonely group and 6.9% of the same/less lonely group. Differences between the more lonely and the same/less lonely groups in overall in-person contact frequency changes were statistically significant. Although telephone and email/text/social media contact frequencies also changed during the outbreak, the differences between groups were not significant. Larger proportions of both groups experienced decreases rather than increases in these contact frequencies. Video call contact frequencies increased for 20.6% of the more lonely group and 11.4% of the same/less lonely group during the outbreak, but they also decreased for 9.2% of the more lonely group and 6.7% of the same/less lonely group, and these group differences were statistically significant. Single-variable logistic regression results show that decreased in-person contact and increased video calls were associated with higher odds of increased loneliness.

With respect to social activity participation mode during the outbreak, volunteering, either on-line or in person, did not differ significantly between the same/less lonely and more lonely groups (11.9% and 10.9%, respectively). However, a significantly higher proportion of the same/less lonely than more lonely group reported participating in on-line or in-person paid work (12.8% vs. 7.5%), while significantly higher proportions of the more lonely than same/less lonely group reported on-line or in-person participation in religious services (35.2% vs. 32.1%) and clubs, classes, and other organized activities (22.7% vs. 14.8%). Single-variable logistic regression results show that in-person work was associated with lower odds of increased loneliness, while attending religious services and other activities online was associated with higher odds of increased loneliness.

Associations of changes in loneliness with changes in frequency of contacts with family/friends and social participation mode: Multivariable logistic regression results

Table 4 shows that decreased in-person contact (AOR=1.42, 95% CI=1.17–1.73) and increased video call contact (AOR=1.30, 95% CI=1.01–1.66) with family/friends and on-line participation in clubs, classes, and other organized activities (AOR=1.36, 95% CI=1.04–1.77) were associated with higher odds of increased loneliness during the COVID-19 outbreak, while in-person paid work was associated with lower odds of increased loneliness (AOR=0.53, 95% CI=0.29–0.96). Neither increased nor decreased telephone and email/text/social media contacts nor modes of volunteering and religious service attendance were significantly associated with increased loneliness. Of the control variables, being age 80–84 and non-Hispanic Black were associated with lower odds of increased loneliness; being divorced/separated or widowed or a facility resident and having income \geq \$100,000, more social network members, and higher depression and anxiety scores were associated with higher odds of increased loneliness. These results fully support H1 that decreased in person contact and increased virtual contact with family and friends would be associated with

increased loneliness and partially support H2 that online social participation would be associated with increased loneliness.

Discussion

Our examination of loneliness among older adults age 70+ and their modes of contact with family/friends and social participation showed that in a typical week, nearly a fifth of older adults reported feeling lonely on more days during than before the COVID-19 outbreak. As expected, in-person contacts with family/friends were significantly curtailed for a large proportion of those reporting increased loneliness (nearly one half), but one-third of those reporting no increase in loneliness also reported less in-person contact with family/friends. Interestingly, the frequency of telephone and email/text/social media contacts also decreased during the outbreak, although increased video call contacts for some (21% of the more-lonely group and 11% of the less lonely group) may mean that video calls substituted for in-person, telephone, and email/text/social media contacts for some older adults. However, for 9% of the more lonely group and 7% of the same/less lonely group, video call contacts also decreased during the outbreak. The overall net reduction in older adults' family/friends contacts suggests that some family/friends may have had less time/energy for contacting older relatives/friends due to increased responsibilities (e.g., children at home) and stressors (e.g., job loss and related financial strain, increased job-related demands for essential workers, and safety and health concerns) (Ettman et al., 2020; Garcini et al., 2021; Prime et al., 2021; Rapp et al., 2021).

As also expected, multivariable analysis shows that perception of increased loneliness was associated with decreased in-person contact with family/friends. However, while also consistent with previous study findings (Atzendorf & Gruber, 2021; Hu & Qian, 2021), the reasons that increased loneliness is associated with increased video call contact with family/friends needs further examination. Virtual contacts may be accompanied by digital stress or burnout (Mheidly et al., 2020), especially among some who have had to learn new digital skills to be able to connect with family/friends. Even among those who have used information and communication technology (ICT) previously, rapid changes in ICT can be confusing and anxiety-provoking. Video call contacts may also engender so called 'Zoom fatigue' that has been found in work-related meetings (Bailenson, 2021; Shockley et al., 2021). Small cell phone or tablet screens may also cause eye-strain. We also speculate that among older adults, virtual contact with family/friends differs substantially from in-person contact. Although virtual contact can provide affective support, it lacks embodied presence and human touch and cannot include many types of instrumental support that can be exchanged in in-person contacts. Many older adults with functional impairments may have had to forgo instrumental support (e.g., help with shopping). Others may miss or feel badly about not being able to provide assistance (e.g., child care) for family/friends during COVID.

We also found that online participation in clubs, classes, and other organized activities were associated with higher odds of increased loneliness. The fatiguing effect of camera use in virtual meetings (Bailenson, 2021; Shockley et al., 2021) may have been more of a concern in these kinds of meetings than meetings with family/friends. In addition, to the

extent that hands-on practice and coaching are an important component of clubs, classes, and other organized activities (e.g., painting, crafts, yoga), attendees may have found live or recorded online meetings that lack these components less effective or enjoyable. Older adults' participation in groups can increase 'bonding or bridging social capital,' conferring physical and mental health benefits (Kishimoto et al., 2013). Bonding social capital refers to trusting and cooperative relations with those similar in social identity; bridging social capital refers to connections with those who are dissimilar (Kishimoto et al., 2021). Online group participation may reduce opportunities for bonding and bridging, leading to lower satisfaction and sense of cohesion. The finding that in-person paid work (including self-employment) was associated with lower odds of increased loneliness also supports this speculation as in-person work likely involved interactions with others. Regardless of concerns about COVID-19 infection, the small number of older adults in the study who engaged in in-person work were less likely to report increased loneliness, perhaps due to a greater sense of belonging, mutual support, and fulfillment.

Our findings related to covariates—age, gender, race/ethnicity, marital status—are also consistent with studies discussed earlier. Those age 80–84 and non-Hispanic Blacks were less likely to report increased loneliness, but women and those who were divorced/separated or widowed, living in a facility, and who had higher depression and anxiety scores were more likely. Those with high incomes and with more people in their social network were also more likely to report increased loneliness, suggesting that some older adults with greater financial and social capital may have perceived greater loneliness from restrictions and confinement during the outbreak. This finding suggests that quality as well as quantity of contacts/relationships likely affects perceptions of loneliness.

In conclusion, most older adults have not experienced increased loneliness during the COVID-19 outbreak. However, among the almost one fifth who have, decreased in-person contact with family/friends and increased virtual contact were significant correlates. This suggests that virtual interaction is not an effective substitute for in-person interaction.

The findings have the following implications: With an increasing vaccination rate, safe ways to return to in-person interactions are needed. At the same time, virtual contacts are becoming a way of life with or without a pandemic; thus, innovative means for making virtual contacts more supportive and meaningful are needed. In designing age friendly societies and eliminating access barriers for all, the digital environment is just as important as physical and social environments (Marston & van Hoof, 2019; Peddle et al., 2021). Beyond seeking information and meeting other instrumental needs (e.g., banking, ordering medications), research on digital inclusion of older adults has begun to consider information and communication technology's role in strengthening and maintaining family bonds and intergenerational ties and other social connections (Freeman et al., 2020). Researchers have also proposed digital inclusion strategies that employ approaches 'with' rather than 'for' older adults to alleviate technology resistance and promote more social connections (Liddle et al., 2020).

The study has limitations. First, data are self-reported, and contact frequencies may have been subject to recall bias. Furthermore, the ordinal-level frequency measures did not

permit more detailed calculation of changes following the outbreak. Second, loneliness and changes in it were measured with two single-item questions and some adults may have under-reported due to stigma and social desirability bias. Third, most data collection occurred between June and August 2020 (i.e., the first three to six months of the ongoing COVID-19 pandemic); findings may therefore not be generalizable to the following months. Fourth, although over 96% of U.S. older adults have Medicare coverage, those not covered by Medicare are least likely to have digital access and are not represented in the study sample.

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Data Availability Statement:

This study is based on de-identified public-domain data (The National Health and Aging Trend Study).

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Clinical Implications

- The association of reduced in-person contact with greater loneliness among one-fifth of older adults during COVID-19 indicates that attention is needed to reduce isolation and prevent deterioration in mental health.
- A safe return to in-person contacts with family/friends and social activity participation is necessary to improve older adults' mental health.
- Innovative means of making virtual contacts more similar to in-person contacts are needed to decrease older adults' loneliness during COVID-19.

Table 1.

Sociodemographics, health characteristics, and technology learning by changes in loneliness during the COVID-19 outbreak

N (%)		Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)	F / t value, p ^a	More lonely vs. same/ less lonely OR (95% CI)
Frequency of loneliness in a typical week during the COVID-19 outbreak (%)				F(4.35, 239.27) =163.80, p<.001	
	Everyday	1.31	7.49		--
	Most days	3.0	20.50		0.77 (0.42–1.39)
	Some days	16.42	72.01		1.19 (0.58–2.43)
	Rarely	40.82	0		
	Never	38.46	0		
Age group (%)				F(2.37, 130.38) =1.82, p=.159	
	70–74	36.23	41.53		--
	75–79	29.94	27.29		0.80 (0.57–1.10)
	80–84	19.24	16.38		0.74 (0.57–0.96)*
	85+	14.58	14.80		0.89 (0.65–1.21)
Gender (%)				F(1.55)=31.63, p<.001	
	Male	47.91	28.61		--
	Female	52.09	71.39		2.29 (1.70–3.10)***
Race/ethnicity (%)				F(2.51, 138.20) =2.89, p=.047	
	Non-Hispanic White	78.39	85.69		--
	Non-Hispanic Black	7.89	4.94		0.57 (0.39–0.85)**
	Hispanic	7.56	5.01		0.61 (0.31–1.19)
	Other	6.15	4.36		0.65 (0.36–1.18)
Marital status (%)				F(2.72, 149.69) =6.66, p<.001	
	Married/partnered	57.14	48.36		--
	Divorced/separated	13.02	19.29		1.75 (1.27–2.41)**
	Widowed	26.45	31.14		1.39 (1.10–1.75)**
	Never married	3.40	1.22		0.42 (0.14–1.26)
Income (%)				F(3.90, 214.74) =0.72, p=.576	
	Up to \$29,999	29.46	26.77		--
	\$30,000–\$42,999	15.97	17.55		1.21 (0.82–1.79)
	\$43,000–\$65,999	18.97	17.02		0.99 (0.67–1.45)
	\$66,000–\$99,999	15.99	16.07		1.11 (0.76–1.61)
	\$100,000+	19.61	22.59		1.27 (0.90–1.78)
Residence (%)				F(1, 55)=4.12, p=.047	

N (%)		Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)	F / t value, p ^a	More lonely vs. same/ less lonely OR (95% CI)
	In community	95.98	94.38		--
	In residential care facility	4.02	5.62		1.42 (1.00–2.01)*
No. people in social network, M (SE)		2.46 (0.05)	2.90 (0.08)	t=-4.77, p<.001	1.25 (1.13–1.37)***
Dementia diagnosis (%)				F(1, 55)=0.01, p=.959	
	No	97.23	97.20		--
	Yes	2.76	2.80		1.01 (0.59–1.74)
No. of chronic medical conditions, M (SE)		2.53 (0.03)	2.85 (0.07)	t=-4.29, p<.001	1.19 (1.10–1.29)***
No. of ADLs ^b received help, M (SE)		0.18 (0.02)	0.22 (0.04)	t=-0.82, p=.416	1.06 (0.92–1.22)
No. of IADLs ^c received help, M (SE)		0.41 (0.03)	0.61 (0.07)	t=-2.62, p=.011	1.13 (1.04–1.22)**
Depression score, M (SE)		0.75 (0.03)	1.28 (0.06)	t=-7.94, p<.001	1.35 (1.25–1.46)***
Anxiety score, M (SE)		0.63 (0.03)	1.24 (0.08)	t=-7.22, p<.001	1.43 (1.32–1.55)***
Learned new technology to use online during the COVID-19 outbreak (%)				F(1,55)=30.76, p<.001	
	No	76.62	59.08		--
	Yes	23.38	40.02		2.19 (1.64–2.91)***

^aProbability values from design-based F or t tests denote differences between the same/less lonely group and the more lonely group.

^bEating, showering/bathing, dressing, toileting, getting out of bed, and help inside;

^cLaundry, meals, going outside, shopping, medication, and bill payment

* p<.05;

** p<.01;

*** p<.001

Table 2.

Contact with family/friends not living with and loneliness before and during COVID-19

	Before COVID		During COVID	
	Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)	Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)
In-person contact (%)				
At least daily	9.64	9.72	5.79	2.62
A few times a week	26.67	33.48	14.69	12.68
About once a week	21.07	24.11	19.14	16.31
<Once a week	27.35	21.94	32.70	40.52
Never	11.59	6.39	20.26	20.37
Missing	3.68	4.36	7.42	7.51
F / p ^a	F(4.46, 245.11)=3.00, p=.016		F(4.13, 226.94)=2.43, p=.047	
Telephone contact (%)				
At least daily	36.16	41.07	33.14	34.38
A few times a week	36.93	38.30	34.50	41.23
About once a week	15.61	11.75	15.91	12.28
<Once a week	7.22	4.90	9.88	7.97
Never	1.22	0.60	1.44	0.46
Missing	2.85	3.39	5.12	3.68
F / p ^a	F(4.24, 233.39)=1.36, p=.247		F(4.32, 237.60)=2.65, p=.031	
Email/text/social media contact (%)				
At least daily	29.65	43.38	24.28	39.76
A few times a week	26.81	27.78	26.19	28.57
About once a week	7.75	9.03	9.81	9.49
<Once a week	7.16	4.41	8.29	5.50
Never	21.98	10.37	21.76	9.79
Missing	6.65	5.03	9.67	6.89
F / p ^a	F(4.40, 242.20)=9.30, p<.001		F(4.51, 248.13)=9.97, p<.001	
Video call contact (%)				
At least daily	3.03	6.49	2.43	4.68
A few times a week	8.41	10.31	9.83	14.20
About once a week	8.82	9.81	10.99	17.11
<Once a week	20.32	23.39	18.43	21.75
Never	52.33	43.72	48.35	35.02
Missing	7.09	6.29	9.96	7.24
F / p ^a	F(4.52, 248.71)=2.81, p=.021		F(4.62, 254.32)=6.53, p<.001	

^aProbability values from design-based F tests denote differences between the same/less lonely group and the more lonely group.

Table 3.

Changes in family/friend contact frequencies during compared to before the COVID-19 outbreak by contact and social participation mode

N (%)		Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)	F, p ^a	More lonely vs. same/less lonely OR (95% CI)
In-person contact (%)				F(2.50, 137.47)= 10.82, p<.001	
	No change	51.54	36.54		--
	Increased	6.91	4.40		0.90 (0.49–1.64)
	Decreased	32.73	49.83		2.15 (1.73–2.66)***
	Missing	8.82	9.22		1.47 (0.84–2.57)
Telephone contact (%)				F(2.69, 147.77)= 0.71, p=.530	
	No change	67.25	65.75		--
	Increased	10.25	8.65		0.86 (0.55–1.36)
	Decreased	15.60	19.11		1.25 (0.90–1.74)
	Missing	6.90	6.50		0.96 (0.48–1.95)
Email/text/social media contact (%)				F(2.69, 147.91)= 1.43, p=.239	
	No change	69.27	70.30		--
	Increased	5.86	8.17		1.37 (0.88–2.15)
	Decreased	13.53	12.73		0.93 (0.67–1.28)
	Missing	11.34	8.79		0.76 (0.49–1.19)
Video call contact (%)				F(2.60, 143.27)= 7.27, p<.001	
	No change	69.98	60.65		--
	Increased	11.41	20.58		2.08 (1.50–2.88)***
	Decreased	6.69	9.18		1.58 (1.00–2.51)
	Missing	11.93	9.59		0.93 (0.60–1.43)
Working for pay (including own business) (%)				F(2.91, 160.26)= 5.30, p=.002	
	Did not work	80.21	85.74		--
	Worked online	4.08	4.70		1.07 (0.63–1.85)
	Worked in person	8.74	2.84		0.30 (0.16–0.59)**
	Missing	6.98	6.73		0.90 (0.59–1.38)
Volunteering (%)				F(2.98, 163.66)= 0.39, p=.758	
	Did not volunteer	80.63	81.07		--
	Volunteered online	4.51	4.89		1.08 (0.63–1.83)
	Volunteered in-person	7.42	5.98		0.80 (0.49–1.32)
	Missing	7.44	8.06		1.08 (0.72–1.61)

N (%)		Same/less lonely 2,386 (80.64%)	More lonely 524 (19.36%)	F, p ^a	More lonely vs. same/less lonely OR (95% CI)
Religious services (%)				F(2.93, 161.02)= 3.93, p=.010	
	Did not attend	60.00	56.09		--
	Attended online	19.84	26.80		1.44 (1.08–1.93)*
	Attended in-person	12.28	8.36		0.73 (0.49–1.09)
	Missing	7.88	8.75		1.19 (0.77–1.84)
Clubs, classes, or other organized activities (%)				F(2.76, 151.70)= 8.27, p<.001	
	Did not participate	77.68	68.83		--
	Participated online	8.77	16.22		2.09 (1.57–2.77)***
	Participated in-person	6.04	6.50		1.21 (0.78–1.89)
	Missing	7.50	8.46		1.27 (0.87–1.86)

Note:

^aProbability values from design-based F tests denote differences between the same/less lonely group and the more lonely group.

* p<.05;

** p<.01;

*** p<.001

Table 4.

Associations of changes in loneliness with changes in family/friend contacts and social participation mode during the COVID-19 outbreak: Results from generalized linear models with Poisson and log link

		More lonely vs. same/less lonely AOR (95% CI)
In-person contact with family/friends: vs. No change		
	Increased	1.03 (0.57–1.77)
	Decreased	1.42 (1.17–1.73) **
Telephone contact with family/friends		
	Increased	0.85 (0.59–1.23)
	Decreased	1.12 (0.87–1.44)
Email/text/social media		
	Increased	1.12 (0.78–1.59)
	Decreased	0.91 (0.71–1.18)
Video calls with family/friends		
	Increased	1.30 (1.01–1.66) *
	Decreased	1.06 (0.76–1.46)
Paid work during COVID: vs. No paid work		
	Worked online	0.96 (0.62–1.48)
	Worked in-person	0.53 (0.29–0.96) *
Volunteered during COVID: vs. Did not volunteer		
	Volunteered online	0.73 (0.47–1.11)
	Volunteered in-person	0.86 (0.58–1.27) *
Attended religious services: vs. Did not attend		
	Attended online	1.20 (0.94–1.52)
	Attended in-person	0.93 (0.65–1.33)
Participated in clubs, classes, other organized activities: vs. Did not participate		
	Participated online	1.36 (1.04–1.77) *
	Participated in-person	1.17 (0.80–1.72)
Age group: vs. 70–74 years		
	75–79	0.83 (0.66–1.05)
	80–84	0.78 (0.63–0.96) *
	85+	0.84 (0.62–1.14)
Female vs. male		
		1.53 (1.18–1.99) **
Race/ethnicity: vs. Non-Hispanic White		
	Non-Hispanic Black	0.62 (0.44–0.86) **
	Hispanic	0.68 (0.40–1.13)
	Other	0.81 (0.42–1.53)
Marital status: vs. Married/partnered		

	More lonely vs. same/less lonely AOR (95% CI)
Divorced/separated	1.68 (1.31–2.15) ***
Widowed	1.26 (1.01–1.57) *
Never married	0.62 (0.24–1.59)
Income: vs. Up to \$29,999	
\$30,000-\$42,999	1.25 (0.92–1.70)
\$43,000-\$65,999	1.14 (0.80–1.62)
\$66,000-\$99,999	1.42 (1.00–2.01)
\$100,000+	1.50 (1.07–2.10) *
Residential care vs. In the community	1.28 (1.02–1.60) *
No. people in social network	1.09 (1.01–1.19) *
No. of chronic medical conditions	1.07 (0.99–1.15)
No. of ADLs received help	0.91 (0.79–1.05)
No. of IADL received help	1.05 (0.98–1.13)
Depression score, M (SE)	1.15 (1.07–1.24)
Anxiety score, M (SE)	1.17 (1.09–1.26)
N=2,908	

*
p<.05;

**
p<.01;

p<.001