# Impact of Technology on Social Isolation: Longitudinal Analysis from The National Health Aging Trends Study

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## Abstract

**Background:** Social isolation is a key public health concern and has been associated with numerous negative health consequences. Technology is increasingly thought of as a solution to address social isolation. This study examines the longitudinal association between the access and use of technology and social isolation in older adults 65 and older, living in the United States.

***Methods***: This observational cohort study included community dwelling older adults (N= 6,704) who participated in the National Health and Aging Trends Study (NHATS). Regression analyses were conducted using data from 2015 to 2019. Information about technology access and use were ascertained using self-reported questionnaires. The primary outcome was the risk for social isolation.

**Results:** At baseline the majority of older adults that were not socially isolated had a working cell phone [88%] or computer [71%] and used email or text messaging [56%]. Older adults that had access to [cell phone- incidence rate ratio (IRR) 0.62 (95% CI 0.48–0.81); computer- IRR 0.63 (95% CI 0.51–0.78)], and used technology [email or text messaging- IRR 0.64 (95% CI 0.51–0.80)] in the year prior had a lower risk of social isolation than older adults who reported they did not access or use technology. Additionally, over four years, older adults that reported they had access to a computer had had a lower risk [0.69(0.57, 0.84) for social isolation than their counterparts.

**Conclusion:** In this cohort study, technology access was associated with a lower risk for social isolation among community dwelling older adults. These findings suggest that technology has an important role in approaches that seek to prevent social isolation among older adults.

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**Keywords**

Technology; social isolation; community dwelling older adults

## INTRODUCTION

Social isolation is an important and underrecognized public health risk. It is defined as a lack of social contact with others; it differs from loneliness, which is a subjective feeling of isolation.[1,2] Nearly 1 in 4 community-dwelling adults age 65 and older in the United States are socially isolated, indicating that social isolation impacts a considerable proportion of older adults.[3] Social isolation can influence health through several different pathways, including affecting behaviors, interpersonal relationships, and compliance with medical recommendations.[4] Furthermore, social isolation is associated with mortality and functional decline in older adults.[5–7] Risk factors for social isolation among older people include family dispersal, decreased mobility and income, and loss of loved ones.[1] Additionally, being unmarried, male, having lower education attainment, having a low income, living alone, lacking participation in social groups, having fewer friends, and strained relationships are each independently associated with social isolation.[3,4] Given the detrimental health effects associated with social isolation, and the many risks linked with this burdensome problem, there is a great need to better understand factors that may buffer or protect older adults against social isolation.

Social connection is informed by the structure, function and quality of one's relationships or social network.[7] Increasingly, information and communication technologies including mobile phones, computers, and the internet influence the way in which individuals communicate and interact.[8] These technologies can serve a key role in facilitating communication (voice, video, text messaging) in a manner that is potentially more frequent than face to face, in-person opportunities. Technology can offer opportunities for connection with family, friends or others that could mitigate one's risk for social isolation by supporting one's social networks. Additionally, technology can enable enliven the function of one's connection (i.e. reminders for a family or friend to visit or allowing someone to participate in a virtual group).[1,9]

Previous studies examining social isolation interventions in older adults mostly focus on interventions that approach this issue via one-on-one strategies, group services, or wider community engagements.[10] One review suggested that technological interventions were most promising for addressing social isolation among older adults.[11] However, there are large gaps in our understanding of how technology access and use can influence social isolation in older adults. The dearth of longitudinal studies in this area means that the directionality of the relationship between technology and social isolation in older adults has not been fully examined. Further, few investigations have examined the association between technology and loneliness (subjective assessment of social connection) through self-report survey measure (i.e. UCLA Loneliness scale) or other psychosocial factors, which differs from social isolation (objective assessment of social connection). One study found internet use was linked to increased sense of wellbeing in a sample of older adults

age 80 and older.[12] Another found that internet use among adults over 65 years of age was associated with lower levels of loneliness.[13] Kim et al. used data from the 2011 National Health Aging Trends Study (NHATS) to examine how information and communication technologies (ICT) access and use were associated with social engagement. They found that men were more likely than women to access and use ICT, and there were differences in how each gender engaged with technology.[14] However, that study was unable to infer a causal relationship between ICT use and social engagement given the cross-sectional design. A study leveraging the 2012 wave of the Health and Retirement Study found social technology use was beneficial for older adults, and greater technology use was associated with better self-rated health, higher subjective well-being, and lower depression.[15] Yu et al. evaluated the longitudinal association of internet use and loneliness and found a mediating role of social contact using hierarchical linear modeling to determine how internet use impacts loneliness.[16] In a systematic review published in 2016 exploring the effects of ICT interventions on reducing social isolation in the older adults, ICT was consistently found to positively affect social support, social connectedness, and social isolation. Notably, all of the studies that used survey data included in this systematic review were cross-sectional.[17] A focus group study completed in a small, continued care senior facility assessed the impact of the COVID-19 pandemic and "Stay-at-Home" order on the mental and physical health of older adults found that technology access and connectivity are potential "game-changers" that should be prioritized for future research.[18]

A major limitation of cross-sectional studies is that they cannot exclude reverse causality. Examining the relationship between social isolation and technology longitudinally informs the creation of interventions targeting social isolation. This study leverages a nationally representative sample to determine the influence of technology access and use on social isolation risk among community dwelling older adults over time.

## METHODS

### Study design and participants

The NHATS is a nationally representative, longitudinal study of persons aged 65 and older and enrolled in Medicare (www.NHATS.org). The NHATS sample was drawn from the Medicare enrollment file. A stratified, three-stage sampling design was used: 95 primary sampling units (i.e. counties) were sampled from the contiguous U.S., then 655 zip codes were sampled from the counties, then a selection of beneficiaries were sampled from the zip codes who were age 65 and older as of September 30, 2010, with oversamples of the oldest age groups and of Black non-Hispanic persons. NHATS collected data via annual two-hour in-person, in home interviews by trained interviewers. The initial interview was conducted in 2011. In 2015 (Round 5), a replenishment of the sample was added. This analysis was conducted using Round 5 as baseline, given the larger sample size after the NHATS sample was replenished. In addition, analyses were run using data from Rounds 1–9 (2011–2019) and showed similar conclusions. When the sample person was unable to respond, due to impairment or illness, NHATS used a proxy that was familiar with the sample person's health and daily activities.[19] The total study sample included individuals whose data was available in public use files, (n= 7,089 in "Round 5" in 2015, 4,184 in "Round 9" in 2019).

In years 2015–2019, 4.2 – 4.6% of data per year was missing due to death and 2.4–10.8% of data per year was missing due to non-response to survey questions. Missing data was examined and judged to be missing at random (MAR) with regard to social isolation and the other measures used in this study. Community dwelling older adults were included in this study. Individuals living in a group home-like setting, assisted living facility, continuing care retirement community, nursing home, or other similar dwelling were excluded due to concerns that the factors that protect or predispose older adults to social isolation in congregate settings may differ in important ways from community dwelling older adults.

**Key Outcome: Social isolation—**In this study, social isolation is defined using a previously constructed typology of social isolation that focused on four domains: living arrangement, core discussion network size, religious attendance, and social participation.[3] Three levels of social isolation are: severe social isolation, social isolation, no social isolation. These varying isolation statuses were categorized ordinally with participants receiving one point for the following: living with at least one other person, talking to two or more people about "important matters" in the past year, attending religious services in the past month, and participating in other activities (clubs, meetings, or group activities, or doing volunteer work) in the past month. A sum score of zero indicated severe social isolation; a score of one, social isolation; and a score of two or more, no social isolation.

**Key Predictor: Technology Access and Use—**Technology access was defined as having a working cell phone or a working computer. Technology use was defined as sending messages by email or texting in the last month prior to survey completion. Responses utilized were obtained in a binary manner (yes or no).[19] Additional information on the purpose behind technology use was also assessed, giving insight into specific internet uses by older adults in different social isolation categories.

### Statistical analysis

Descriptive statistics were used to characterize the study sample by social isolation status in terms of no social isolation, social isolation, and severe isolation. Differences between groups were assessed using Chi-squared tests at baseline (Round 5). Analyses were performed to examine whether type of technology access (cell phone, computer) and use (email or texting) is correlated with social isolation.

We used a modified Poisson regression analysis in order to examine whether technology access and use in a given year (Rounds 5, 6, 7, and 8) was correlated with becoming socially isolated in the following year.[20] For this we included data only from participants who were initially not socially isolated to understand the role that access to technology plays in an individual's potential to become socially isolated. Social isolation and severe social isolation were combined to create a binary outcome measure. As individuals appear in the data for multiple years, the individual was treated as the nesting factor (level) of the multi-level model.

Next, the relationship between baseline technology use and access and first instance of becoming socially isolated in the subsequent four rounds was assessed in a series of Cox proportional hazard models, adjusting for age, sex, race/ethnicity, and education. Given

evidence of collinearity (variance inflation factor 4.24) with income and education in our data, income was not included in multivariate analyses. All longitudinal models were weighted using baseline year survey weights. All analyses were performed using Stata 15.1.

## RESULTS

### Cross-sectional relationships between technology access and social isolation at baseline

Table 1 shows the unweighted demographic stratified by social isolation classification groups in the baseline round. Of the baseline group, 77% were not socially isolated, 19% were socially isolated and 4% were severely socially isolated. At baseline the majority of older adults who were not socially isolated reported having a working cell phone (87.7%), working computer (70.5%), and used email or text messaging (55.9%). Supplemental Table 1 shows a cross-sectional univariate analysis evaluating the association between sociodemographic factors and technology access and use with social isolation in the baseline round this analysis revealed that gender (female), higher income category, higher education level, and technology access and use were significantly correlated with a lower incidence of social isolation.

### Longitudinal relationship between technology access and social isolation

In the longitudinal Poisson regression analysis adjusted for age, gender, race, and education, we found that the incidence rate of social isolation was lower for older adults that reported access to working cell phone technology (incidence rate ratio-IRR 0.62; 95% confidence interval: 0.48–0.81), working computer (IRR 0.63; CI 0.51–0.78), and use of email or text (IRR 0.64; CI 0.51–0.80) in the year prior (Table 2). Internet usage for specific tasks varied depending upon social isolation classification. Older adults who were not socially isolated had higher levels of internet use for ordering groceries and contacting medical providers (Supplemental Table 2). In the Cox proportional hazard analysis, all forms of technology access and use evaluated significantly reduced the risk of social isolation in univariate analyses. However, after controlling for baseline age, gender, race, and education, computer access was the only technology that was associated with decreased risk of social isolation (Table 3).

## DISCUSSION

These findings suggest technology access and use are associated with a lower risk for social isolation. Therefore, addressing technology access and use in older adults may be an opportunity to decrease social isolation and its adverse health impacts.[1,21] This work is especially timely given the COVID-19 pandemic, as some data suggest that social isolation has increased in older adults during the COVID-19 pandemic.[22,23] The role technology plays in social connections requires close evaluation given the current expansion of telemedicine, telehealth and overall social connections. In this study, we found that older adults who had access to technology and used the technology were less likely to be socially isolated the following year. Though several studies have focused on the barriers and challenges that older adults face in adopting technology, our study finds that lack of technology access and decreased use of technology increases the risk that an older adult will

subsequently experience social isolation. This is consistent with the other studies that have sought to examine this topic and advances the field by exploring the temporal aspect of this relationship.[16,18,24]

There were several limitations of this study. We rely on self-report data which may be subject to recall bias. Additionally, this study did not include controls for health factors that may affect technology use in older adults as the main focus was on technology access and use, future studies are needed to explore this nuance in which functional limitations due to sensory deficits may impact technology use. Further, performing a longitudinal analysis, we focus on sequential years of data, which may miss individuals who did not complete the study in sequential years. Notably, individuals who were sicker could have been more likely to drop out of this study, which would have skewed results. An additional limitation is that the framework for social connections included in this analysis are informed by prior approaches including the Berkman Syme Network Index, however, these domains may not capture all potential variability that may exist for each older adult's social connections. One final limitation is that there may be an effect income plays on technology access that this study did not examine due to collinearity with education.

Prior studies examining the relationship between social isolation and technology access were cross-sectional. Alternatively, this study adds longitudinal data to support the role of technology access and use on social isolation. Using data from NHATS (a nationally representative sample) allows for generalizability of these results to community-dwelling adults 65 and older living in the contiguous United States. The technologies that were surveyed in the NHATS cohort are basic technologies and this study still identified a significant relationship with social isolation. Access to basic technologies and use of these technologies has large implications for interventions that may positively impact social isolation in older adults. Social isolation was already a serious problem in older adults with significant implications for the health and wellbeing of older adults prior to the COVID-19 pandemic. Now, amid continued physical distancing that has further exacerbated concerns for social isolation, there is a critical need for better strategies to combat this phenomenon, which will require understanding which factors influence its persistence and which strategies can be optimized to address it. Furthermore, clinicians and policy makers should design and implement interventions that support routine assessment of technology access and use as well as the presence of social isolation in older adults.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

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**Key points:**

1.  More than 70% of community dwelling older adults have a working cell phone or computer; and 56% of these individuals utilize these devices for email or text messaging

2.  Technology access was associated with a lower incidence of social isolation in a representative sample of community-dwelling older adults in the United States.

**Why Does This Matter?**

Designing solutions that leverage technology may be an important part of strategies to prevent or address social isolation among older adults.

**Table 1.**

Baseline Participant Characteristics by Social Isolation Categories in the National Health and Aging Trends Study in 2015 (N = 6,704)

| | No Social Isolation | | Social Isolation | | Severe Isolation | | p value |
|---|---|---|---|---|---|---|---|
| **n, %** | 5154 (76.9) | | 1254 (18.7) | | 296 (4.4) | | |
| **Age** | | | | | | | |
| 65–69 | 796 | 15.54% | 184 | 14.67% | 41 | 13.85% | <0.001 |
| 70–74 | 1342 | 26.04% | 278 | 22.17% | 63 | 21.28% | |
| 75–79 | 1146 | 22.24% | 288 | 22.97% | 59 | 19.93% | |
| 80–84 | 957 | 18.57% | 233 | 18.58% | 50 | 16.89% | |
| 85–89 | 617 | 11.97% | 154 | 12.28% | 46 | 15.54% | |
| 90+ | 296 | 5.74% | 117 | 9.33% | 37 | 12.50% | |
| **Gender** | | | | | | | |
| M | 2132 | 41.37% | 619 | 49.36% | 136 | 45.95% | <0.001 |
| F | 3022 | 58.63% | 635 | 50.64% | 160 | 54.05% | |
| **Race/Ethnicity** | | | | | | | |
| White, non-Hispanic | 3568 | 69.23% | 834 | 66.51% | 190 | 64.19% | 0.027 |
| Black, non-Hispanic | 1060 | 20.57% | 256 | 20.41% | 67 | 22.64% | |
| Other | 139 | 2.70% | 35 | 2.79% | 13 | 4.39% | |
| Hispanic | 274 | 5.32% | 98 | 7.81% | 17 | 5.74% | |
| More than one | 4 | 0.08% | 3 | 0.24% | 1 | 0.34% | |
| Unknown/refused | 109 | 2.11% | 28 | 2.23% | 8 | 2.70% | |
| **Education n=3447** | | | | | | | |
| <HS | 448 | 17.00% | 184 | 28.71% | 63 | 36.84% | <0.001 |
| HS/GED/Trade | 918 | 34.84% | 227 | 35.41% | 57 | 33.33% | |
| >HS | 1269 | 48.16% | 230 | 35.88% | 51 | 29.82% | |
| **Income category** | | | | | | | |
| < $50, 000 | 4034 | 78.27% | 1111 | 88.60% | 275 | 92.91% | <0.001 |
| $50,000 - $100,000 | 721 | 13.99% | 103 | 8.21% | 11 | 3.72% | |
| > $100,000 | 399 | 7.74% | 40 | 3.19% | 10 | 3.38% | |
| **Technology access** | | | | | | | |
| Working Cell Phone (Y) | 4522 | 87.74% | 965 | 76.95% | 208 | 70.27% | <0.001 |
| Working Computer (Y) | 3486 | 70.50% | 621 | 52.14% | 97 | 33.56% | <0.001 |
| Email or Text (Y) | 2673 | 55.97% | 425 | 40.09% | 80 | 35.71% | <0.001 |

**Table 2.**

Incidence Rate of Social Isolation when Technology Access and Use in the Preceding Year 2015–2019 (N=6704)

| Technology | Incidence Rate Ratio[a] (95%CI), p value |
|---|---|
| **No access or use** | **Reference category** |
| Cell Phone in year prior | 0.623(0.479–0.811) *** |
| Computer in year prior | 0.634(0.514–0.781) *** |
| Email or text in year prior | 0.637(0.506–0.801) *** |

[a]Adjusted for baseline age, gender, race, and education

*p<0.05,

**p .01,

***p .001

**Table 3.**

Association Between Technology Access and Use and Time to First Social Isolation (2015–2019)

| Technology | Model 1 (unadjusted) | Model 2 (adjusted) |
|---|---|---|
| | Hazard Risk Ratio[a] (95% confidence Interval) | |
| No access or use | Reference category | |
| Cell Phone | 0.750 (0.622, 0.903) ** | 0.916 (0.673, 1.247) |
| Computer | 0.613 (0.537, 0.700) *** | 0.691(0.567, 0.842) *** |
| Email or text | 0.676 (0.589, 0.776) *** | 0.816 (0.654, 1.019) |

[a] Adjusted for baseline age, gender, race, and education

*
p<0.05,

**
p .01,

***
p .001