

Feeling Lonely, Engaging Online During the Outbreak of COVID-19: A Longitudinal Study of Chinese Older Adults

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Abstract

Background and Objectives: There is growing concern that the coronavirus disease 2019 (COVID-19) pandemic and associated social distancing policies may exacerbate mental health problems in older adults. Most studies primarily have focused on developed countries, whereas the mental consequences of the pandemic in developing countries are less well known. This study evaluates the influences of the global pandemic in relation to loneliness and family contact among older Chinese adults and examines the roles of internet adoption in alleviating the emotional experience of loneliness.

Research Design and Methods: We run individual fixed effects regression models using the 2018 and 2020 waves of the Chinese Family Panel Studies survey with 4,944 respondents aged 60 and above to capture the average within-person changes before and after the first outbreak of COVID-19 in China. We further examine the mediating effects of internet adoption on loneliness using structural equation modeling (SEM). Simultaneous SEM tested the effects of internet literacy and social network site use, and heterogeneous effects analyses were also conducted across subgroups.

Results: Fixed effects estimates indicated increased loneliness and decreased family contact during the pandemic. Moreover, more older adults were found to use the internet in 2020. The fixed-effect estimations and structural equation models consistently found that older adults' use of the internet contributed to more social contacts and virtual meetings with their children, which have alleviated the emotional experience of loneliness.

Discussion and Implications: Digital inclusion of older adults to adopt the internet can be beneficial to improve mental well-being and alleviate loneliness during times of pandemic crisis. The targeted acceleration of digitalization to reduce the digital divide needs to be considered.

Translational Significance: This study evaluates the influences of the global pandemic in relation to loneliness and family contact among older Chinese adults and examines the roles of internet adoption in mitigating the emotional experiences of loneliness. Based on longitudinal study designs and panel data, we found that increased loneliness and decreased family contacts during the pandemic. However, more older adults were found to use the internet in 2020 and the adoption contributes to more social contacts and virtual meetings with their children, which have mitigated the emotional experience of loneliness. Targeted reduction of the digital divide improves the well-being of older adults.

Keywords: Internet use, Loneliness, Mixed empirical methods, Pandemic

Since the outbreak of the coronavirus disease 2019 (COVID-19) pandemic, millions of cases and related deaths have been recorded worldwide. On the May 5, 2022, the number of COVID-19 deaths in the United States surpassed 1 million mark ([Coronavirus Resource Center, 2022](#)). The 2022 most recent strain, Omicron, which was assumed to be more transmissible and less severe, was intrinsically as severe as previous variants considering the risk of hospitalization and mortality ([Strasser et al., 2022](#)). In China, excess mortality in Wuhan was caused by the first-wave outbreak of the pandemic in 2020, and most were older adults ([Li et al., 2020](#); [Liu et al., 2021](#)). Although the number of all-time reported cases of

COVID-19 infection in China was approximately 1.91 million as of January, 2023 ([Our World in Data, 2023](#)), more than 500 million people were affected by lockdown measures. In the spring of 2022, 25 million residents in Shanghai stayed at home for more than 2 months. It is pivotal to unfold the ramifications of the COVID-19 pandemic on older adults for implementing mitigation measures in the current pandemic and potential future crises related to epidemic outbreaks. In this study, our first target is to provide a longitudinal study and assess the mental health consequences of COVID-19 on older adults in China.

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The pandemic and mobility restriction policies have exacerbated social isolation, which is a vital determinant of the well-being and mental health of older adults. As we know, COVID-19 swept across the world, and many countries introduced the practice of social distancing and implemented quarantine policies to varying degrees. In early 2020, containment measures were relatively homogeneous across provinces in China, including the use of masks, school closures, lockdowns, and social distancing, among others. Despite the effectiveness of these measures to contain the virus, restricted social interactions can have significant negative mental health consequences (Berg-Weger & Morley, 2020; Galea et al., 2020). A meta-analysis revealed a high prevalence of anxiety and depression among the general population of Chinese (Ren et al., 2020). The negative effect was more severe among older adults, as more mental health disorders were reported after the pandemic outbreak, compared with life before the global pandemic (Bao et al., 2021; Liu et al., 2022). Increased social isolation and disruptions of day-to-day functioning are detrimental for older adults who are particularly vulnerable to the risk of social isolation (Cudjoe & Kotwal, 2020). More severe symptoms of mental disorders have been reported when older adults have experienced unexpected closure (Jiang et al., 2020; Li et al., 2022).

During the pandemic, the use of digital technologies has contributed to bridging social distance (see, for instance, Iivari et al., 2020). However, the digital divide, the gap between those with internet access and those without, runs deeper between age groups even with the connectivity boost by the epidemic crisis. Unlike the young population, older adults are less likely to benefit from digital technology. In the United States, the gap between older adults (65+) and the youngest groups (18–29) of adults in internet use was 56% in 2012 and 21% in 2021 (Auxier & Anderson, 2021). In 2020, young people (15–24) in developing countries were 1.32 times more likely to connect than the rest population (International Telecommunication Union, 2021). The gap ratio would appear to be higher for older adults. In China, by the end of 2020, the proportion of Chinese internet users aged 60 and over was only 11.2%, far lower than the older adult population of 18.7% (Chinese Internet Network Information Center, or CNNIC, 2021).

In early 2020, China made excellent use of digital technologies to track routines and contain transmission. Mobile internet-based technology has played an irreplaceable role in China's response to the COVID-19 pandemic. People need QR codes to use public transport, seek health care, and enter supermarkets (Tai et al., 2021; Wang & Jia, 2021). Such measures have accelerated the digitalization of older adults and narrowed the digital divide across age cohorts. The proportion of internet users aged 60 and above increased from 6.7% in 2019 to 11.2% immediately after the first outbreak in 2020 (CNNIC, 2021). Although many older Chinese adults still face a considerable dilemma navigating the unfamiliar territory of QR codes (2D barcodes), mobile payments, and digitized information, would such unexpected digital inclusion (referring to activities necessary to ensure that all individuals, including the most disadvantaged, have access to and use of the internet) benefit them during the pandemic? Our second aim is to investigate the effects of internet adoption driven by the pandemic on older adults. Given the unclear future of the COVID-19 pandemic, our

results can shed new light on further mitigation measures and gain insight into successful aging in a time of epidemic crisis.

Based on a longitudinal study design, we identify the mental health consequences of COVID-19 for older adults as well as the effects of digital inclusion and further explore the potential mechanism. This study contributes to the literature in three ways. First, less is known about the ways COVID-19 affects the mental health of older adults in developing countries (Buenaventura et al., 2020; Lee et al., 2020; Wu, 2020). Given the socioeconomic disparities between developing and developed countries that further drive health disparities, there is a social urgency to examine the mental health consequences of COVID-19 for older adults in developing countries. Second, studies with cross-sectional designs or small sample sizes have not been able to elucidate causality and cannot be generalized to the population. To the best of our knowledge, longitudinal studies on the impacts of the pandemic on older adults are far too scarce; in particular, no such studies have been conducted to explore older adults' experiences in China. Third, limited studies have examined the roles of internet use in buffering the negative impacts caused by COVID-19 and associated policies (see, for instance, Marzouki et al., 2021). The pandemic has created situations in which older adults are urged to use digital technologies to remain socially connected in the face of social distancing. More evidence is needed to assess the ramifications of the COVID-19 pandemic on older adults. Last, the pandemic is far from over, and the practice of social distancing persists in order to shield high-risk older adults (MacLeod et al., 2021; Wu, 2020). Our findings will benefit policymakers and practitioners in designing strategies to mitigate the pandemic's adverse consequences and alleviate the sense of loneliness endured by older adults in China and around the world.

Literature Review

Mental Consequences of COVID-19

Considerable effort has been devoted to understanding the psychological consequences of the COVID-19 pandemic. Although many studies have suggested that older adults with chronic illnesses and a lack of technological facilities could suffer disproportionately from loneliness, they actually show great resilience with their unique adaptive mechanisms to preserve well-being during the COVID-19 pandemic (Minahan et al., 2021). Most cross-sectional studies examined the impacts of the pandemic across age groups. Older adults reported less pandemic-related stress, fewer life changes, and less social isolation than younger people (Birditt et al., 2021). A microlongitudinal study of 99 older adults in Switzerland showed substantial negative impacts on older adults' emotions, particularly loneliness (Macdonald & Hülür, 2021). Similarly, Krendl and Perry (2021), using a small sample of 120 older adults, have discerned those older adults experienced greater depression and loneliness than they had prior to the pandemic, and proximity to social network ties was associated with the social transformation. Some other evidence suggested no change in loneliness (Luchetti et al., 2020; Peng & Roth, 2021). The inconsistency might be related to their methodologies and sample sizes. In summary, the evidence is inconclusive as to whether older adults feel lonelier during the pandemic.

Internet Use and Mental Well-Being of Older Adults

Meanwhile, substantial evidence shows that internet use can be positively associated with the mental well-being of older adults (e.g., Nakagomi et al., 2022; Xu & Huang, 2021), which mental well-being is measured by loneliness, depressive symptoms, and anxiety (Lampinen et al., 2006). Older adults often use digital tools such as the Internet and mobile applications to stay connected with their family members and friends, strengthen family ties, increase social engagement, and subsequently improve their well-being (e.g., Barbosa Neves et al., 2018; Szabo et al., 2019). In most existing scholarship, researchers have demonstrated that internet use can help buffer social isolation and mitigate loneliness; however, a few studies have arguably shown no effect of internet use on well-being (Elliot et al., 2014; Slegers et al., 2008). Choi and DiNitto (2013) even found that internet use among elders could be associated with higher anxiety and depressive symptoms. Huang (2010) and Nie et al. (2017) also reported negative impacts of internet use on the mental well-being of older adults, although the analyses focus on the general population. The contradictory findings could be due to methodological issues and societal differences. The causal relationship between internet use and elders' well-being is far less established due to the lack of panel data (Casanova et al., 2021). Despite the ongoing debate on the impacts of internet use during the pandemic and lockdowns, the internet is doubtlessly an essential tool for people to connect with the outside world and avoid social isolation when physical contact is regulated.

Internet Use and Mental Well-Being During the Outbreak of COVID-19

Digital technology could keep people informed and connected. There are a growing number of studies examining the association of internet use with mental health issues during the pandemic, although most focus on the general population (e.g., Gao et al., 2020). Yue et al. (2021) investigated online activities and psychological well-being among the residents of Wuhan. They discerned that non-COVID-19-related self-disclosure was positively associated with psychological well-being, while the general social media use was associated with lower psychological well-being, and the effect was more pronounced during quarantine. Chu and colleagues (2021) scrutinized information-seeking patterns of older adults in Hong Kong in a 21-day study and found receiving information from more sources made them more worried. Nimrod (2022) interrogated stress induced by information and communication technology use among Israeli internet users aged 60 years old and above and found increased stress in 2020. A study examined cases of age-related digital divide scenarios from Chinese official news outlets in the context of the COVID-19 pandemic (Song et al., 2021). The results have illustrated that the COVID-19 pandemic not only accelerated the pace of digital transformation but also exacerbated the age-related digital divide. Stemmed by the digital disparity, older adults have also raised potentially serious concerns about those who barely use the internet (Yoon, et al., 2020). The concern is that older adults may become more isolated, which can lead to worse mental and physical outcomes. Further research is needed to provide a clear impact of internet use on the well-being of older adults during the pandemic.

Present Study

In this article, we shed new light on the experience of loneliness, one of the most important indicators of psychological well-being. Loneliness is an emotional feeling that occurs when an individual's relationships with others do not meet his or her expectations (Russell et al., 1980). Social connectedness is the experience of feeling close and connected to others. It includes feeling loved, cared for, and valued and is the foundation of interpersonal relationships (Baumeister & Leary, 1995). Scholars have long proposed a link between changes in social contacts and loneliness (Perlman & Peplau, 1981). Although Routasalo and their colleagues (Routasalo et al., 2006) clarified that loneliness and social isolation (lack of social contacts) are different concepts, much evidence showed that connection with others provides protection, and a lack of social contacts can stimulate the sensory experience of loneliness (Cacioppo & Hawkley, 2009). A meta-analysis confirmed that contact with family members can provide essential emotional support to older adults experiencing loneliness (Pinquart & Sorensen, 2001).

The present study extends this framework from two perspectives: First, we include the pandemic situation as the contextual factor. Social isolation during the COVID-19 pandemic has had a direct negative impact on the social connectedness of older adults. Second, we add internet use as a compensatory means of social contact, which becomes a more viable route than physical contact, especially during the pandemic. Nevertheless, the causal relationship between internet use and the mental well-being of older adults has yet been established. In this proposed research model, we seek to answer the following research question: What are the ramifications of the COVID-19 pandemic and the related policies on the mental well-being of older Chinese adults? What are the consequences and mechanisms of internet use on the mental well-being of Chinese older adults during the pandemic?

Using two waves of nationally representative data before and after the first outbreak of the pandemic, we examine the effects of COVID-19 on loneliness and family contacts among older adults using balanced panel data and fixed-effect estimations. We then evaluate the influences of internet use on loneliness and family contacts using both fixed effects models and structural equation models (SEM). We employ a longitudinal mediation model under a cross-sectional setting. In the SEM estimations, we use the lagged variable of internet use in 2018 as the key independent variable, family contacts in 2020 as mediators, and individuals' level of loneliness in 2020 as the dependent variable. The study also provides nuanced investigations into heterogeneous effects across gender, place of residence, and age ranges. In summary, our study provides novel evidence with a longitudinal study that identifies the psychological consequences of COVID-19 and evaluates the compensatory effects of digital inclusion.

Method

Study Design and Empirical Sample

Our sample was drawn from the Chinese Family Panel Studies (CFPS), a nationally representative biennial panel survey of Chinese residents (Xie & Hu, 2014). The CFPS was first launched in 2010 and employed a multistage stratified sampling procedure with implicit stratification. The most recent wave was collected after July, 2020. The first

outbreak of COVID-19 in China occurred in late 2019 in Wuhan. Following the breakout in Wuhan, most provinces in China initiated lockdown policies. In April, 2020, the lockdown was lifted in Wuhan, which represents the end of the first-round epidemic outbreak in China. Therefore, to capture the changing affective experiences and digital habits of older adults before and after the pandemic outbreak, we used data from the 2018 and 2020 waves, focusing on respondents aged 60 and older. After matching different waves through individual unique identification numbers and keeping common variables, we constructed a balanced panel, containing around 4,944 older adults tracked between 2018 and 2020. Note that there were 958 participants who participated in 2018 but failed to report their level of loneliness in 2020 so this sample could not be included in the main regression. Group difference tests show that this particular group is more disadvantaged. Thus, the effects captured in our study will persist or become even larger if they are taken into consideration.

Measurements

Loneliness

Loneliness was measured by the frequency of feeling lonely per week on a scale of 1–4: 1 (*not once or never*), 2 (*some of the time, 1–2 days*), 3 (*often, 3–4 days*) and 4 (*most of the time, 6–7 days*).

Meet and contact

We created two indices of family contact. Two questions were surveyed the older adults for each child by birth order respectively: How often did you meet with your child (“name of the child”) in the past six months? How often have you been in contact with your child (“name of the child”) through phone calls, messages, letters, email, etc. in the past six months? Responses were rated on the following scale: 0 (*never*), 1 (*once in several months*), 2 (*once in the past months*), 3 (*once a month*), 4 (*2–3 times a month*), 5 (*1–2 times a week*), 6 (*3–4 times a week*). A participant could have more than one child. We then summed the responses of all the children

for each older adult to construct ordinal variables representing the extent of contact frequency or meeting frequency. As presented in [Table 1](#), values of the two variables, *Meet* or *Contact*, ranged from 0 to 12 and higher scores indicate greater family contacts or visits.

Internet use

We used a dichotomous variable to measure whether respondents use the internet, 1 (*use the internet either via mobile phone or computer*) and 0 (*never use*). Presumably, older adults who adopted the Internet in 2018 may have more internet experience than those who adopted it in 2020. Therefore, we calculated *Internet skills* accordingly, 2 (*adopted in 2018*), 1 (*adopted in 2020*), and 0 (*never used*), to show the differences. An increasing number of older Internet users in China are adopting social networking (mainly via *WeChat*) ([CNNIC, 2022](#)). The 2020 wave of CFPS surveyed whether respondents use *WeChat*, a multipurpose social media, messaging, and payment application. We then created social network sites (*SNS*) use, 1 (*use*), and 0 (*never use*). Research suggested that older adults may use online communities to obtain social support, particularly to maintain contact with family and friends, but the relationship between SNS use, well-being, and cognitive function has been inconclusive ([Leist, 2013](#); [Newman, Stoner, & Spector, 2021](#); [Zhou et al., 2022](#)).

Furthermore, following the existing literature ([Arpino et al., 2018](#); [Rafnsson et al., 2015](#)), we control for a number of demographic characteristics and covariates in our structural equation model estimations: gender (1 = male, 0 = female), place of residence (1 = urban, 0 = rural), perceived social status (score 1–5 from the lowest to the highest), age (in years), marital status (1 = Married/cohabitating, 0 = single/widowed/divorced), education levels (score 1–7, from illiterate to graduated level) and self-rated health status (score 1–5, from the worst to the best).

Analysis

We began our analyses using a basic panel-data method with fixed effects regressions to compare the outcomes of

Table 1. Descriptive Statistics of the Balance Panel

Variables	2018				2020				<i>t</i> Value/ χ^2
	<i>N</i>	Mean	%	<i>SD</i>	<i>N</i>	Mean	%	<i>SD</i>	
Loneliness (1–4)	3,986	1.444		0.810	3,986	1.504		0.843	3.252***
Meet (0–12)	4,944	5.973		4.415	4,944	5.029		4.961	–11.166***
Contact (0–12)	4,944	6.237		4.227	4,944	5.349		4.473	–10.148***
Internet Use	4,944		13.9	0.005	4,944		16.8	0.005	31.37***
Age (60–97)	4,944	67.78		5.964	4,944	69.78		5.966	
Male	4,944		50.4	0.50	4,944		50.4	0.50	
SES (1–5)	4,762	3.045		1.194	4,762	3.232		1.155	
Married	4,944		82.5		4,944		70.3		
Education (1–7)	4,944	2.022		1.120	4,944	2.077		1.151	
Health (1–5)	4,944	2.520		1.243	4,944	2.570		1.263	
Urban	4,918		47.7	0.500	4,907		48.1	0.500	

Notes: *t* Test is used to test the differences before and after the outbreak of pandemic for variables of loneliness, meet, and contact, while the Chi-square test is used for the variable of internet use. SES = perceived social status; *SD* = standard deviation.

****p* < .001.

respondents after the first pandemic outbreak in 2020 within the same individuals before in 2018. We could not draw the causality through a counterfactual to compare a person who experienced the pandemic in 2020 with the same person who did not experience the pandemic at the same time. Instead, we run fixed-effects regressions to estimate within-person changes (Allison, 2009; Peng & Roth, 2022). This estimation method can partial out unobserved, individual endogenous bias (e.g., demographics and genetics). A Hausman test ($\chi^2 = 31.72, p < .001$) supports the selection of individual fixed-effect models and the rejection of random-effect models. After establishing the ramifications of the pandemic, we further examined the consequences of internet use on loneliness and family contacts. Also, we present regressions results of heterogeneous impacts across gender, residential, and different age groups.

We then used structural equation models to investigate the mechanism of the effects of internet use on loneliness via family contacts. In all the estimations, we controlled for age, gender, residential area, social status, marital status, education, and health status. Lagged structural equation modeling was used to address the potential reverse correlation concerns. The direct and indirect effects of Internet use, Internet skills, and SNS use on loneliness are analyzed. Analyses were conducted using Stata 16.

Results

Descriptive Statistics

Table 1 shows the descriptive statistics of all variables. Respondents average were 68 years old. 50% of them were male, and 48% lived in urban areas. In 2020, among all internet users, 89.8% of older adults used WeChat, a popular social media app among the Mainland Chinese population. *t* Test as well as Chi-square statistics have demonstrated that mean values of loneliness, family connection variables, and internet use are significantly different from 2018 to 2020. In our main regressions, variables of loneliness, meet, and contact are treated as continuous variables.

Fixed Effects Estimations of the Pandemic and Internet Use

As argued earlier, fixed effects regressions predicted within-person change before and after the first COVID-19 breakout. We visually show regression results in Figure 1. The intensive exposure to COVID-19 and related policies treatment was significantly positively related to the feeling of loneliness for older

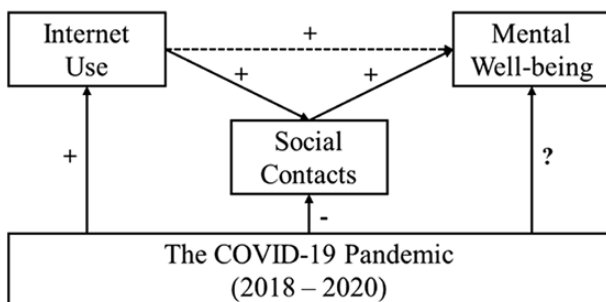


Figure 1. Proposed research model. COVID-19 = coronavirus disease 2019.

adults, $B = 0.060, SE = 0.016, p < .001, 95\% \text{ CI}: [0.030, 0.090]$. Moreover, it was significantly and negatively associated with the family contacts, for *Meet*, $B = -1.012, SE = 0.066, p < .001, 95\% \text{ CI}: [0.030, 0.090]$, for *Contact*, $B = -0.888, SE = 0.066, p < .001, 95\% \text{ CI}: [-1.141, -0.883]$. Meanwhile, older adults showed increased internet use, $B = .030, SE = .005, p < .001, 95\% \text{ CI}: [0.021, 0.039]$. Next, we examined the effects of internet use (see Figure 2). Internet use showed slightly negative relationship with loneliness, $B = -0.039, SE = 0.044, p = .38, 95\% \text{ CI}: [-0.126, 0.048]$ (see Figure 3). However, Internet use had significantly positive association with family contacts, for *Meet*, $B = 1.026, SE = 0.199, p < .001, 95\% \text{ CI}: [0.636, 1.416]$, for *Contact*, $B = 1.328, SE = 0.200, p < .001, 95\% \text{ CI}: [0.935, 1.721]$. Furthermore, the heterogeneous tests showed the effect of COVID-19 on loneliness was more severe for middle-old and above (≥ 75 years old), and rural older adults but was similar between male and female older adults (see Figure 4). Regression results are shown in Supplementary Tables 1 and 2.

SEM Analyses of the Mediating Effects of Internet Use

Then, we conducted lagged structural equation analyses with the 2018 and 2020 waves to examine the effect of internet use on loneliness (see Figure 5). The model fit indices show good fit: $\chi^2 = 192.57, df = 40, \chi^2/df = 4.8, CFI = 0.959, TLI = 0.939, RMSEA = 0.033, SRMR = 0.017$. The longitudinal mediation analyses show that Internet use (2018) predicted a decrease in loneliness during the pandemic, $B = -0.05, p = .001, 95\% \text{ CI}: [-0.08, -0.02]$. Furthermore, Internet use (2018) also mitigated loneliness through increasing family contacts with children, $B = 0.08, p < .001, 95\% \text{ CI}: [0.047, 0.104]$.

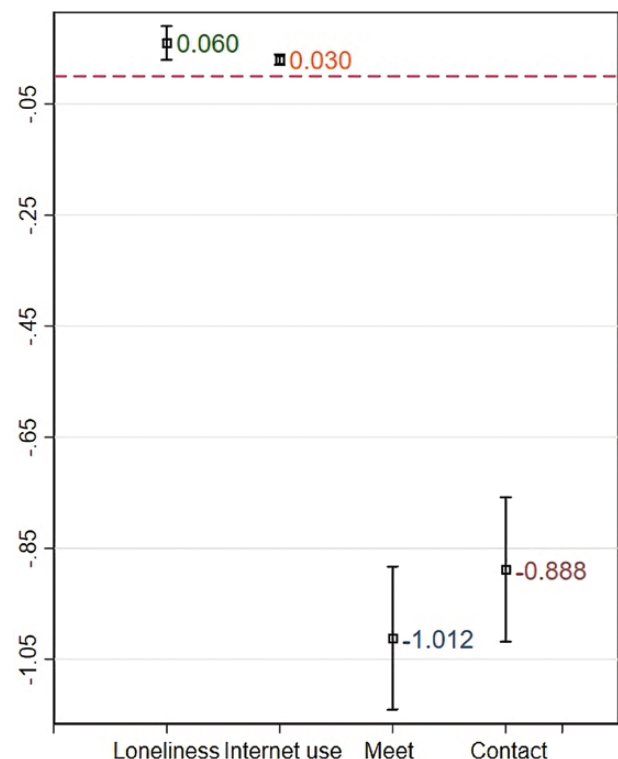


Figure 2. Changes in loneliness, internet use, family contacts within-person before and after the 2020 pandemic outbreak, estimates with individual fixed effect. Error bars represent 95% confidence intervals.

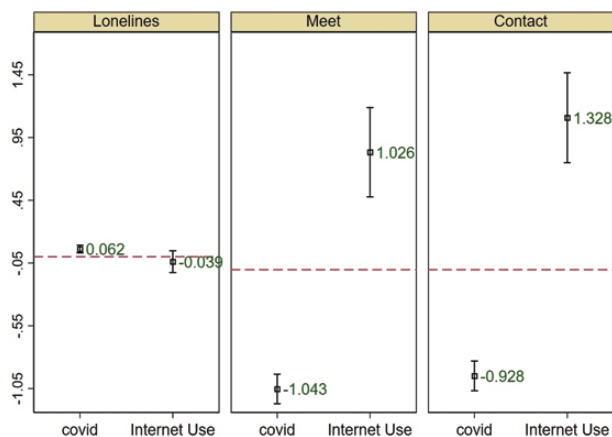


Figure 3. The effects of internet use on reducing loneliness and increasing the family contacts during the pandemic, estimates with individual fixed effect. Error bars represent 95% confidence intervals.

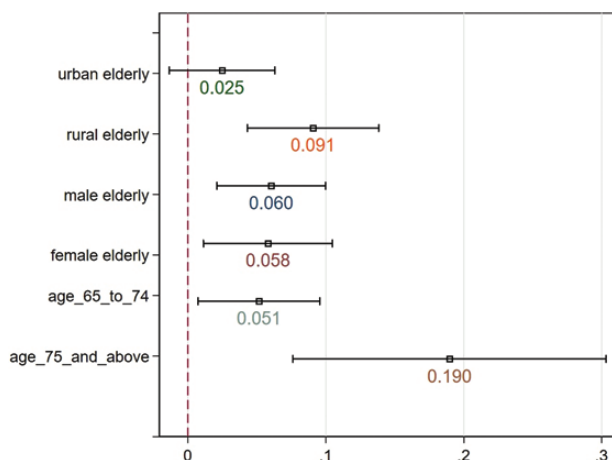


Figure 4. Heterogeneous effects of the pandemic on loneliness across gender, residential, and age groups, estimates with individual fixed effect. Error bars represent 95% confidence intervals.

Next, we analyzed the effects of internet skills and SNS use during the pandemic (2020 wave) with Structural equation models (SEM). For the model of internet skills, model fit indices are: $\chi^2 = 42.22$, $df = 10$, $\chi^2/df = 4.2$, CFI = 0.964, TLI = 0.914, RMSEA = 0.028, SRMR = 0.013. For a model of SNS use, model fit indices are: $\chi^2 = 24.38$, $df = 13$, $\chi^2/df = 1.87$, CFI = 0.962, TLI = 0.929, RMSEA = 0.028, SRMR = 0.02. Both models indicate a good fit. We analyzed the indirect effect of bootstrapping (replications 1,000) Table 2. Internet skills have a significant indirect effect in predicting loneliness during the pandemic, $B = -0.009$, $p = .007$, 95% CI: [-0.020, -0.003]. The more skilled user could use the internet to facilitate the connection between children. Using WeChat also alleviates loneliness but only through direct effect, $B = -0.081$, $p = .004$, 95% CI: [-0.150, -0.013]. SNS use seems more like an additional channel to provide social support.

Discussion

Today, even with vaccination efforts in full swing, the elimination of COVID-19 seems out of reach. Social distancing

remains a critical intervention strategy in the ongoing pandemic, especially for older adults in China. However, health and social isolation are the two most important determinants of the older population's prosperity and well-being. Great concerns have been raised that these social distancing policies increase loneliness (Galea et al., 2020). The present study is among the first representative findings that illustrate the effects of COVID-19 on loneliness for older adults in developing countries and the mediating roles of internet use.

With the longitudinal design and a representative sample, our study provides more substantial evidence of a significant increase in loneliness among Chinese older adults aged 60 and above after the outbreak of the pandemic (Sun et al., 2020). Meanwhile, our results show a decrease in family contacts suggesting social isolation during the pandemic. This is consistent with the increased physical isolation found in the work of Peng and Roth's work (2021), although they found an insignificant effect on loneliness among U.S. adults aged 50 and above. The practice of social distancing globally reduces mobility and limits family visits. Our estimates of fixed effect regressions further showed that the within-person increase in loneliness was more apparent for middle-old aged 75 or above than young-old, and more pronounced for rural than urban older adults. Middle-old and rural older adults could rely more on family contacts and have less social connection beyond the family (Chou, 2011; Cornwell & Waite, 2009; Liu et al., 2020). Therefore, the differences suggest an amplified effect associated with the pandemic on the existing social isolation and well-being gaps among older adults.

Another significant contribution of our study is that we have evaluated the claim that staying connected through digital contact could protect older adults from loneliness. Our results showed that getting online could facilitate the children's visits and communication with children, and further buffer the negative effects of the pandemic. Older adults would seek assistance from children when they start getting online, which could bring social support for them (Francis et al., 2018). Lagged SEMs have illustrated that internet use has both an indirect effect and a direct repercussion on feelings of loneliness. Moreover, internet skills show a similar effect pattern, suggesting skills development links to the potential benefits of digitalization. Concurrent SEM estimation with the 2020 wave reveals that SNS use has a significant negative relationship with loneliness. Although many older adults use only a small part of the functions within WeChat, the SNS provides them with a way to share their lives and opinions with others and allows the older adults to access a broad range of learning materials for personal use (Zeng et al., 2016). Social media communication is associated with more social contacts and social support, which contribute to a lower level of loneliness among older adults (Zhang et al., 2020). Consistent with these findings, our results showed that internet use can be a source of support for older adults to mitigate loneliness during the pandemic. Additionally, the benefits of internet use and digitalization could overweight the challenges of adults compared with nonusers. Considering the emerging trends of social isolation and loneliness experienced by older adults, our research findings have shed new light on digitalization-associated policy designs to support successful aging.

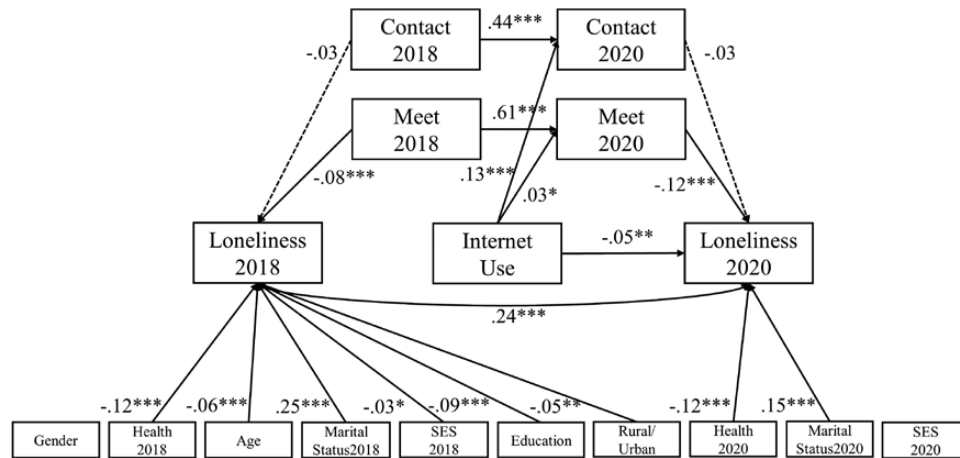


Figure 5. Model coefficients reported in the path diagram are standardized. Robust model fit indices: $N = 3,796$, $\chi^2 = 192.57$, $df = 40$, $\chi^2/df = 4.8$, CFI = 0.959, TLI = 0.939, RMSEA = 0.033, SRMR = 0.017. Only significant demographic variables and covariates were included. CFI = comparative fit index; RMSEA = root mean square error of approximation; SES = perceived social status; SRMR = standardized root mean square residual; TLI = Tucker Lewis index. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2. Decomposition of Effects Of Internet Skills and SNS Use with the 2020 Wave

Path	Model 1: internet skills ($N = 3,978$)		Model 2: SNS use ($N = 1,117$)	
	β	95% CI	β	95% CI
Internet skills/SNS → contact	0.192***	[0.164, 0.222]	0.050	[-0.007, 0.112]
Internet skills/SNS → meet	0.052*	[0.020, 0.084]	-0.022	[-0.083, 0.032]
Internet skills/SNS → loneliness (direct)	-0.015	[-0.045, 0.015]	-0.081**	[-0.150, -0.013]
Internet skills/SNS → loneliness (indirect)	-0.009**	[-0.020, -0.003]	0.001	[-0.020, 0.028]
via meet	-0.005**	[-0.010, -0.002]	0.003	[-0.012, 0.031]
via contact	-0.004	[-0.013, 0.002]	-0.002	[-0.015, 0.003]
Internet skills/SNS → loneliness (total)	-0.024	[-0.066, 0.006]	-0.080**	[-0.353, -0.021]

Notes: standardized regression coefficients (β) and 95% confidence interval (CI) were reported based on bootstrapped model with 1,000 replications; All demographic variables and covariates were controlled for: Robust model fit indices: Model 1, $\chi^2 = 42.22$, $df = 10$, $\chi^2/df = 4.2$, CFI = 0.964, TLI = 0.914, RMSEA = 0.028, SRMR = 0.013; Model 2, $\chi^2 = 24.38$, $df = 13$, $\chi^2/df = 1.87$, CFI = 0.962, TLI = 0.929, RMSEA = 0.028, SRMR = 0.02. CFI = comparative fit index; RMSEA = root mean square error of approximation; SNS = social network sites use; SRMR = standardized root mean square residual; TLI = Tucker Lewis index. * $p < .05$; ** $p < .01$; *** $p < .001$.

Implications

Our findings are vital for understanding how older adults respond to a pandemic-like situation. It provides evidence that the pandemic and social distancing policies negatively affect older adults. Digitalization can facilitate, encourage, and support older adults, whereas social isolation during the pandemic aggregates the effects of the digital divide (Cheshmehzangi, et al., 2022). Vulnerable populations, such as rural and older adults are more likely to be excluded from the benefits and potential of digital technologies, which could lead to mental health issues. In particular, our findings highlight the importance of digital inclusion for older adults. Once this pandemic is over, the policy option of lockdowns remains for future pandemics. Lessons for future policy designs can be drawn from our findings. Enforcement of lockdowns must take into account the negative consequences for the mental well-being of older adults.

The Chinese government used a series of digital technology approaches to contain transmission and such “digital by default” coincidentally accelerated the digital inclusion

of older adults, which nearly doubled before and after. This generalization of internet use encourages older adults to stay digitally connected and supports them through increasing family contacts. Policymakers should consider digital inclusion initiatives as interventions to reduce the impacts on the mental health of older adults. We urge policymakers to consider barriers to digital technology for older adults, such as inadequate skills to achieve digital literacy. It serves the current generation, not constrained by the scenario of the pandemic. Special efforts should be made to support older adults in using digital technology through training programs (Cotten et al., 2017). Aside from the wireless facilities, the user interface of programs and mobile applications can be designed to be older-adult-friendly (PRNewswire, 2021).

Limitations and Future Study

There are several limitations in our study. First, because we used previously collected survey data, we used relatively limited measures. Loneliness and self-reported health were

measured by a single item. Internet use was mainly accessed through an indicator for whether the participant used the internet or not, which could not provide details of using frequencies or different functional uses. Future research could use more comprehensive measurements to verify the findings further. Second, the COVID-19 pandemic varies in time, place, and intensity. It may disproportionately affect different populations (e.g., Mueller et al., 2021). The context of lockdown policies and related digital inclusion for older adults in different countries must be taken into account. Therefore, we caution against generalizing the findings to other groups. Third, the proportion of internet users among Chinese older adults was relatively low. The effects of digital inclusion need to be examined with a more extensive user group in the future.

Supplementary Material

Supplementary data are available at *Innovation in Aging* online.

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Conflict of Interest

Authors have no conflict of interest to report.

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Data Availability

Our data and programming code are available to other researchers for replication purposes when required. The original data set is available at <http://www.iss.pku.edu.cn/cfps/sjzx/gksj/index.htm> after application. Studies and results in the manuscript have not preregistered and there is no such requirement.

Author Contributions

Y. Xu conducted empirical analyses, organized the empirical results, and wrote the paper. D. Zhou planned the study, conducted empirical analyses, and revised the paper.

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