Original Paper

Digital Practices by Citizens During the COVID-19 Pandemic: Findings From an International Multisite Study

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Abstract

Background: The COVID-19 pandemic brought digital practices and engagement to the forefront of society, which were based on behavioral changes associated with adhering to different government mandates. Further behavioral changes included transitioning from working in the office to working from home, with the use of various social media and communication platforms to maintain a level of social connectedness, especially given that many people who were living in different types of communities, such as rural, urban, and city spaces, were socially isolated from friends, family members, and community groups. Although there is a growing body of research exploring how technology is being used by people, there is limited information and insight about the digital practices employed across different age cohorts living in different physical spaces and residing in different countries.

Objective: This paper presents the findings from an international multisite study exploring the impact of social media and the internet on the health and well-being of individuals in different countries during the COVID-19 pandemic.

Methods: Data were collected via a series of online surveys deployed between April 4, 2020, and September 30, 2021. The age of respondents varied from 18 years to over 60 years across the 3 regions of Europe, Asia, and North America. On exploring the associations of technology use, social connectedness, and sociodemographic factors with loneliness and well-being through bivariate and multivariate analyses, significant differences were observed.

Results: The levels of loneliness were higher among respondents who used social media messengers or many social media apps than among those who did not use social media messengers or used ≤1 social media app. Additionally, the levels of loneliness

were higher among respondents who were not members of an online community support group than among those who were members of an online community support group. Psychological well-being was significantly lower and loneliness was significantly higher among people living in small towns and rural areas than among those living in suburban and urban communities. Younger respondents (18-29 years old), single adults, unemployed individuals, and those with lower levels of education were more likely to experience loneliness.

Conclusions: From an international and interdisciplinary perspective, policymakers and stakeholders should extend and explore interventions targeting loneliness experienced by single young adults and further examine how this may vary across geographies. The study findings have implications across the fields of gerontechnology, health sciences, social sciences, media communication, computers, and information technology.

International Registered Report Identifier (IRRID): RR2-10.3389/fsoc.2020.574811

Introduction

Background

The first cases of COVID-19 caused by SARS-CoV-2 were detected in late 2019 in Wuhan, Hubei province, China, and within months, it had spread to 113 countries in the world, leading to the declaration of a pandemic by the World Health Organization (WHO) on March 11, 2020 [1]. The COVID-19 pandemic spread across the globe and substantially impacted all aspects of daily life. Based on their cultural beliefs, political philosophies, available resources, and health care systems, nations responded differently. Several strategies, such as social distancing and isolation, case detection and contact tracing, general lockdown, and quarantine of exposed individuals, were effective in the prevention of disease spread while the virus was being studied and vaccines were being developed [1].

There is a growing body of scholarly research exploring the relationship between technology (eg, digital devices, the internet, digital gaming, social media, and mobile apps) [2,3] and loneliness [4-6]. To negotiate the constraints associated with the pandemic, technology use significantly increased, since many activities, including employment, education, health care, and other daily activities, moved to online spaces [6]. Additionally, technology has been used as a coping mechanism to follow news, get entertained, connect with others, shop online, and participate in exercise [7]. Unfortunately, despite the great range of coping strategies, loneliness prevailed among multiple groups in the population. For example, research conducted for a duration of 1 month by Groarke et al [8] at the beginning of the UK lockdown (March 23, 2020) found that the frequency of loneliness was significantly higher among younger respondents aged 18-24 years (41.0%) and 25-34 years (28.2%) than among adults aged ≥65 years (3.3%). Marital status impacted feelings of loneliness, with respondents who reported being separated or divorced (46.9%), or single or never married (40.1%) experiencing greater loneliness than those who were married/living with a partner (40.1%) or widowed (34.8%). Additionally, people who were living alone also reported higher loneliness compared to that among those with coresidents. As a result, finding ways to reduce isolation was a primary area of concern for researchers and policymakers during the pandemic,

with technology use being in the forefront of this discourse as one of the potential solutions [9-18].

The pandemic brought to the fore the pivotal role the internet and Wi-Fi access played in the lives of individuals across the globe. Many individuals who conducted in-person (eg, work, leisure, and social connections) activities in the prepandemic society had to quickly transition online to ensure the same activities were achievable in this new world [7-14]. Globally, by understanding how technology was used by people living in different countries, we can better enhance our understanding of digital practices and the activities that are associated with technology use and digital practices. The United Nations (UN) [15] acknowledges that the pandemic was not only a global health crisis but also a disaster that impacted regions at the socioeconomic, security, and humanitarian levels. Further recognition notes how the pandemic has affected individuals, families, communities, and societies alike, with the UN [15] identifying strategies for socioeconomic responses.

Technology was used to reduce isolation and to address the negative outcomes of the COVID-19 pandemic and lockdowns [6,7]. The negative outcomes of the pandemic included the loss of employment and educational opportunities [5] and lack of access to the health care system [14] and mental health services, coupled with the uncertainty of the future and lack of knowledge about the virus. The issues of increased isolation and deteriorating mental health were identified as concerns during the COVID-19 pandemic [12]. To mitigate these negative outcomes, technology was employed as a possible solution [7]. This was particularly true in areas where access to technology and the internet was relatively universal [16-18]. For example, in a study conducted in April 2020 among 1374 US residents (54% female), increased use of digital communication was reported across platforms, including text messaging (43%), voice calls (36%), social media (35%), and video calls (30%) [19]. Interestingly, the same study also reported reduced digital communication use in 5% of participants during the pandemic, which included communication over social media (8%), voice calls (9%), email (10%), video calls (13%), and online gaming (17%) [19]. Younger people and women who were living alone and those who were concerned about their internet access reported increased use of digital communication, while older people reported reduced use of digital communication [19,20].

For many people globally, addressing social isolation experienced by themselves, friends, members of the community, or loved ones during lockdowns played a key role in their mental health [18,21]. Technology afforded people opportunities to remain digitally connected and explore new leisure experiences across virtual and digital environments [16,21,22]. Pennington found that social networking sites could allow users to "stay connected," and findings from this study ascertained that respondents who were actively engaging in posts felt less loneliness than those who were engaging with individuals on a face-to-face basis [23]. Technology use to maintain contact with family and friends is common across both rural and urban environments; however, a pre–COVID-19 study exploring technology use by adults aged 70 years or older in the United Kingdom and Canada found that participants from rural communities were more positive about the use of the internet, but the viewpoint of social media platforms was negative, and these individuals did not have a social media profile and preferred to engage in face-to-face conversations [24]. Participants in rural Canada engaged with social media platforms more than participants in rural United Kingdom, and participants in the urban areas of the United Kingdom and Canada used social media and networking sites frequently [24]. These studies suggested that the experiences with technology may differ across age, geography, and other demographic characteristics. Therefore, it is important to further understand the unique differences in the relationships among technology use, social isolation, self-reported mental health and well-being, and demographic characteristics during the COVID-19 pandemic.

Study Aims

This paper aimed to provide key insights from this exploratory descriptive study about the impact of loneliness and psychological well-being among people across different age cohorts and types of communities (eg, rural, urban, and metropolitan). Additionally, this paper will detail how technology played a role in access to community support via social media platforms from across diverse countries during the pandemic. The objectives were as follows: (1) to understand how technology played a role in access to community support for well-being; and (2) to examine the interaction among technology use, social isolation, and self-reported mental health and well-being during the COVID-19 pandemic across age, gender, home environment, and geography (including population density [rural, suburban, and urban] and country).

Methods

Overview

We report the methods and findings of an international multisite study conducted by a consortium of scholars from 13 countries to explore technology use, psychological well-being, COVID-19–specific questions (eg, access to support groups via social media sites), and loneliness among adults aged ≥18 years during the COVID-19 pandemic.

Study Design

The study protocol was developed by a consortium of scholars from Austria, France, Germany, India, Malta, Portugal,

Romania, Singapore, Spain, Turkey, and the United Kingdom, and has been described elsewhere [25,26]. This protocol describes the process of backward translation, the methods and approaches to participant recruitment, the different measures used in the online surveys, and the different versions of the surveys pertaining to respective legislation in countries (eg, Singapore) [25]. Two additional sites (the United States and Canada) joined the consortium after the protocol was published and therefore were not included in the earlier publication. A convenience sample was used across all countries during the rapid rollout and deployment in 2020 and 2021 [25]. A virtual snowball sampling approach was applied across the partners' existing networks using the capabilities of the internet [27,28].

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Human Research Ethics Committee of The Open University (protocol code HREC/3551/MARSTON). The survey was rolled out on April 4, 2020. Each partner communicated with the project lead prior to deployment of their country survey, and all respective documentation was provided to the project lead, which in turn was shared with the institutional ethics committee for an update. Data collected from this phase are referred to as Wave 1 data.

Two additional sites (the United States and Canada) joined the consortium in November/December 2020. Small changes in the wordings of the surveys were made to accommodate for differences in North American and British English, in addition to adjusting for the options available in North American communities. For example, "Ordering from a local bakery" was replaced with "Ordering take-out food," "Streaming BBC iPlayer" was replaced with "Reading and streaming the news," and "key worker" was replaced with "essential worker." Additionally, response options pertaining to the question of race and ethnicity were added to follow census categories. Data collected from these 2 countries are referred to as Wave 2 data.

Informed consent was obtained from all subjects involved in the study. Each site received ethical approval: National University of Political Studies and Public Administration (SNSPA–Romania) (no protocol number; granted April 20, 2020); Open University of Catalonia (Spain); Singapore University of Social Sciences (Singapore) (no protocol number; granted April 23, 2020); Ethics Committee of the Universitat Oberta de Catalunya (Spain) (no protocol number; granted April 22, 2020); Department of Health Sciences Management and Leadership, University of Malta (Malta) (protocol number 5274_04052020; granted May 19, 2020); Department of Informatics Engineering (DEI)/Center for Informatics and Systems (CISUC) at the University of Coimbra (Portugal) (protocol number CE-057/2020_PaulaSilva; granted May 27, 2020); Department of Mass Communication and Media Studies at the Central University of Punjab (India) (protocol number CUPB/IEC/29/05/20_8; granted May 29, 2020); Nursing Science, Age and Care Research Group at the Medical University Graz (Austria); Department of Sociology at the University of Vienna, the Institute of Nursing Science at the Medical University of Graz (Austria) (protocol number 32-425 ex 19/20; June 5, 2020); the Board for the Ethical Review of

Research Projects of the Institute for Communication Science (IfK) of the Westphalian-Wilhelms University of Münster (Germany) (no protocol number; granted May 7, 2020); Canakkale Onsekiz Mart University (Turkey) (protocol code 2020/83; granted June 15, 2020); Clemson University (United States) (IRB2020-435); and University of Northern British Columbia (Canada) (protocol code E2021.0323.009.00; granted May 19, 2021).

Recruitment

Data collection for Waves 1 and 2 involved online survey invitations (deployed via Qualtrics) distributed through various professional and personal networks, mailing lists, social media platforms, snowball sampling, and the project website [28].

The Wave 1 survey (English/United Kingdom) was deployed online on April 4, 2020, and from that point onwards, consortium partners joined the project organically. The criteria for participation were as follows: (1) age of 18 years or above and (2) regular use of information and communication technology. The first wave of data was collected between April 4, 2020, and September 30, 2020, in 10 countries (Austria, France, Germany, India, Malta, Portugal, Romania, Singapore, Turkey, and the United Kingdom) and in 9 languages (Catalan, English, French, German, Hindi, Mandarin, Romanian, Spanish, and Turkish). Each survey was open for 3 months, with the English/United Kingdom survey closing on July 4, 2020. The final survey in the first wave of data closed at the end of September 2020. Wave 2 data were collected in the United States (March 29, 2021, to June 29, 2021) and Canada (June 29, 2021, to October 3, 2021).

Materials

The survey deployed can be found in Multimedia Appendix 1 and in the study protocol [25]. The survey included multiple questions organized into several sections. Section A focused on questions relating to computer use and behavior based on previous iterations of the survey conducted in previous projects [2,3,29-31] and described in the study protocol [25]. Section B focused on COVID-19–related questions and the purpose of using technology (eg, using social media to communicate, and challenges faced). Section C focused on activities of daily living during COVID-19. These items were new and were added to the survey to capture social connections/friendships, time spent, key worker responsibilities, and giving something back [28]. Section D focused on psychological well-being [32,33] and included 18 items and 6 aspects (autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance of psychological well-being). The Cronbach alpha was .844. Section E focused on eHealth/digital literacy [34] and included an 8-item measure (1-5 points on a Likert scale). Section F focused on loneliness and included the UCLA Loneliness Scale version 3. This measure involves a Likert scale (1-4 points) [35], and the Cronbach alpha was .862 across all countries. It has been used to accurately measure

loneliness in both younger and older populations [36-38]. This survey has been applied for wider use across the general population [35]. Section G focused on digital software technologies. These items were new and were added to the survey to capture the use of technology to relay messages via a national emergency alert system (eg, mobile app, SMS text message, etc) [2,3,39]. Section H focused on demographic questions. These included age group (18-29 years old, 30-39 years old, 40-49 years old, 50-59 years old, or ≥60 years old), gender (male, female, or prefer to self-describe), education (primary or less than high school, high school, bachelor's degree, master's/professional degree, or PhD), marital status (having a partner, widowed/divorced, or single), number of people staying in the same household, employment status (working, retired, or out of a job), and physical space (metropolitan/city, suburban, small town, or rural area) [2,3,24,29-31,40,41].

The study protocol [25] describes clearly and succinctly how this project was established into a multisite project. Because of national, linguist, and legal differences, there were minor changes across the different versions of the deployed surveys. This was led by each project lead (site) and the principal investigator.

Data Analysis

Upon completion of data collection, all missing data points and data-related issues were identified and addressed. Respondents with missing data for the UCLA Loneliness Scale version 3 measure were removed prior to data analysis. Bivariate analyses were conducted to examine continuous variables (eg, UCLA 20-item Loneliness Scale version 3) among different groups based on their age, gender, type of community, etc, and a 2-sided 1-way ANOVA or Student t test was used based on the number of levels. For analysis of categorical variables, crosstab analyses followed by a Pearson chi-squared test and a likelihood ratio chi-squared test were performed. Ordinary least squares (OLS) regression analyses were conducted to examine to what extent the use of technology influenced the feeling of loneliness and to identify sociodemographic factors that influence the feeling of loneliness. An alpha level of $P<.05$ was used to indicate statistical significance. Estimated effect sizes were calculated with η. It should be noted that the age categories for Wave 1 and Wave 2 data were not the same because the data collected in Wave 2 included 6% of respondents aged between 50 and 59 years. To provide power for statistical tests of the data collected in Wave 2, we combined the data pertaining to respondents aged 50 years or over into a single category.

Results

Overview

In this section, both Wave 1 (collected in 2020) and Wave 2 results (collected in 2021) are presented. Table 1 presents a breakdown of the survey response rates.

Table 1. Survey response rates.

Site (country) and language	Date survey opened	Date survey closed	Sample (N=3244), n (%)
Austria			
German	June 5, 2020	September 5, 2020	240 (7.4)
Canada			
English	June 1, 2021	September 31, 2021	209 (6.4)
France			
French	May 12, 2020	August 12, 2020	135 (4.2)
Germany			
German	June 4, 2020	September 4, 2020	329 (10.1)
India			
English	May 31, 2020	August 31, 2020	320 (9.9)
Hindi	May 31, 2020	August 31, 2020	49 (1.5)
Malta			
English	May 19, 2020	August 19, 2020	103 (3.2)
Portugal			
Portuguese	May 29, 2020	August 29, 2020	37 (1.1)
Romania			
Romanian	April 20, 2020	July 20, 2020	447 (13.8)
Singapore			
English	May 17, 2020	August 17, 2020	82 (2.5)
Mandarin	May 13, 2020	August 13, 2020	17 (0.5)
Spain/South America			
Catalan/Spanish	May 4, 2020	August 4, 2020	382 (11.8)
Turkey			
Turkish	June 29, 2020	September 29, 2020	108 (3.3)
United Kingdom			
English	April 3, 2020	July 4, 2020	548 (16.9)
United States			
English	March 29, 2021	June 18, 2021	238 (7.3)

Lockdown Directives

Lockdown measures were implemented at different times across the different sites, starting as early as February and continuing until spring 2021 [42-61]. The measures implemented by respective national and regional governments varied considerably across the different sites [42-61], with several varying forms of directives being implemented across different states, provinces, and counties. Such measures included closure of all nonessential shops and retail outlets, introduction of education and work from home orders [42-61], enforcement of curfews (eg, 6 PM to 6 AM/9 PM to 6 AM) [49,58], enforcement of fines [49,51-57,59], enforcement of border controls [42-61], adoption of appropriate measures for people coming into the country [44-46,52,61], and requirement of documentation for proof of purpose (eg, grocery shopping/medicines, or going to work/emergency work) for leaving the home during lockdown [49,58]. In some instances, older adults (age ≥65 years) were allowed to leave their homes between 11 AM and 1 PM [59], while in other regions, roadblocks were used to monitor travel [49,58] and police were deployed onto public transport networks (eg, train services) [52-57].

Respondent Characteristics

Table 2 presents various sociodemographic variables, in addition to the scores relating to loneliness, psychological well-being, and social media app use across Waves 1 and 2. Although the goal of this research was not to compare Wave 1 and Wave 2 data, it was observed through the data collected and analyzed that respondents in Wave 2 reported greater loneliness and experienced lower levels of psychological well-being when compared with the findings from the data collected during Wave 1. Data analysis of the UCLA Loneliness Scale version 3 measure showed that respondents did experience loneliness during Wave 1 (mean 48.11, SD 6.26) and Wave 2 (mean 49.63, SD 9.40). Psychological well-being was greater among

respondents in Wave 1 (mean 69.04, SD 10.21) than among respondents in Wave 2 (mean 60.42, SD 10.73). Regarding the number of social media apps used by the respondents, most respondents across both waves used 3 to 4 social media apps, while few respondents used ≥5 social media apps.

Table 3 presents data relating to respondents who reported joining a specific online COVID-19 support group. Overall, less than 40% of the respondents reported being a member of an online community group, with a lower proportion in Wave 1 (265/1187, 22.3%) than in Wave 2 (132/337, 39.2%). From the data collected in Wave 2, the only significant association was between the use of social networking messengers (eg, Facebook Messenger, Snap Chat, etc) and the UCLA Loneliness Scale score (t_{347}=3.79; P<.001). The levels of loneliness were higher among respondents who reported using social networking messengers than among those who did not use social networking messengers.

On investigating the impact of loneliness based on the type of community respondents reported living in, there was no significant difference in the data for Wave 1. Moreover, there was no statistical significance or interaction effects between the type of community the respondents lived in and technology use for Wave 1 data.

However, observations were ascertained and significant differences were identified from the data collected in Wave 2 ($F_{3,344}$=3.28; P=.02). The levels of loneliness were higher among respondents living in a small town (n=115; mean 51.16, SD 8.27) than among those living in a suburban area (n=124; mean 47.82, SD 10.22; P=.03). There were no other significant findings involving the different types of communities and the levels of loneliness from the data collected in Wave 2.

Wave 2 data showed a significant main effect based on the feeling of loneliness and the number of social media apps used ($F_{3,332}$=4.67; P=.003). Respondents who used no social media apps reported the lowest levels of loneliness (n=34; mean 43.88, SD 9.80). Additionally, the findings ascertained significance among respondents who were using 1 or 2 social media apps (n=116; mean 50.16, SD 8.36; P=.002), 3 or 4 apps (n=152; mean 50.58, SD 9.30; P<.001), and ≥5 apps (n=46; mean 50.85, SD 10.83; P=.004). There were no other significant findings involving the number of social media apps used by the respondents and the feeling of loneliness from the data collected in Wave 2. Moreover, the type of community where the respondents lived was included as an independent variable to investigate any potential interaction effects between these variables. However, data analysis showed that there were no significant interaction effects ($F_{9,332}$=0.98; P=.45).

Wave 1 data showed that there were no differences in psychological well-being among the types of communities the respondents lived in. However, Wave 2 data showed that there was a significant main effect based on the type of community respondents lived in and their psychological well-being ($F_{3,361}$=4.86; P=.003) (Table 4).

In Wave 2, the levels of well-being were significantly lower among respondents who reported living in a rural area (n=35;

mean 53.91, SD 14.02) than among those who reported living in a small town (n=119; mean 61.37, SD 10.89; P=.002) or a suburban area (n=131; mean 60.75, SD 11.13; P=.006). Data analysis of Wave 2 showed no other significant differences involving the type of community respondents lived in and their psychological well-being. Moreover, there were no significant differences ($F_{3,349}$=1.28; P=.28) on investigating the interaction of the type of community and the number of social media apps used with the psychological well-being of the respondents.

Tables 5 and 6 present OLS models based on the respondent characteristics and how technology use influences the feeling of loneliness according to the data collected in Waves 1 and 2, respectively. The OLS models include the independent variables of age, gender, education level, marital status, employment status, residence area, number of people living together in the same home environment, and psychological well-being, and the dependent variable of loneliness.

Two additional independent variables were included in the models and relate to the use of technology (number of social media apps used and joining a specific online COVID-19 support group). These specific independent variables were selected based on the research objective, which aimed to investigate the effects of technology use on the levels of loneliness experienced by the respondents while controlling for the characteristics during the COVID-19 pandemic. For each OLS model (Wave 1 and Wave 2), data reporting includes the estimated unstandardized coefficient (β) and standard error. Furthermore, we include the adjusted R-squared to describe the model fit.

For Wave 1, there was no association between technology use and loneliness scores. However, the levels of loneliness were higher among respondents who reported being single than among those who reported having a partner (P<.001). The levels of loneliness were higher among respondents who reported being unemployed than among those who reported being employed (P=.03). Moreover, the levels of loneliness were lower among respondents who reported having a PhD degree (P<.001), a master's degree or a professional degree (P<.001), a bachelor's degree (P<.001), or a high school level of education (P=.003) than among those who reported having a primary school level of education or no formal education at all. Data analyses showed that there were no differences among respondents located in European countries and the other countries.

Table 6 presents the data collected during Wave 2. The levels of loneliness were higher among respondents who reported being aged between 30 and 39 years than among those who reported being aged between 40 and 49 years (P=.04) or those who reported being aged ≥50 years (P=.01). Loneliness scores were higher among male respondents than among female respondents (P=.04). Furthermore, the levels of loneliness were higher among respondents who reported being unemployed or retired (P=.02) than among those who reported being employed (P=.04). Moreover, the levels of loneliness were higher among respondents who reported using one or more social media messaging apps (eg, Facebook, Snapchat, WhatsApp, etc) than

among those who reported not using any social media messaging apps (P=.003).

Table 7 presents data related to the psychological well-being of the respondents during Waves 1 and 2. The number of social media apps used and whether respondents joined (via a social media platform such as Facebook) a specific online COVID-19 support group were statistically significant. Psychological well-being was observed to be worse among respondents who reported living in a small town than among those who reported living in a metropolitan area or a city community (coefficient=−1.974; P=.004).

Psychological well-being was more likely to be worse among respondents who reported being single than among those who reported having a partner (coefficient=−1.768; P<.05). Psychological well-being was lower among respondents aged between 18 and 29 years than among those aged between 30 and 39 years (P=.003) and those aged between 40 and 49 years (P=.04). Additionally, psychological well-being was lower among male respondents than among female respondents (P=.006). Moreover, psychological well-being was lower among respondents who reported being unemployed than among those who reported being employed (P=.04). Data analysis also identified the type of community impacted in terms of psychological well-being, and psychological well-being was higher among respondents who reported living in a small-town community than among those who reported living in a metropolitan or city community (P=.004).

Table 2. Sociodemographic characteristics.

Characteristic	Wave 1 (N=1187), n (%)	Wave 2 (N=337), n (%)
Member of a support group on social media	265 (22.3)	132 (39.2)
Number of social messaging apps used		
0	43 (3.6)	31 (9.2)
1-2	427 (36.0)	113 (33.5)
3-4	454 (45.9)	147 (43.9)
≥5	172 (14.5)	46 (13.4)
Age group (years)		
18-29	314 (26.5)	120 (35.6)
30-39	284 (23.9)	92 (27.3)
40-49	303 (25.5)	64 (19.0)
50-59	161 (13.6)	23 (6.8)
≥60	125 (10.5)	38 (11.3)
Gender		
Male	340 (28.7)	91 (27.0)
Female	831 (70.0)	242 (71.8)
Nonbinary	8 (0.7)	2 (0.5)
Choose not to answer	8 (0.7)	2 (0.7)
Education level		
Primary or less than high school	58 (4.9)	11 (3.3)
High school	177 (14.9)	23 (6.8)
College diploma/some college or university	N/A[a]	107 (31.8)
Bachelor's degree/professional degree	321 (27.0)	85 (25.2)
Master's degree	416 (35.0)	62 (18.4)
PhD	215 (18.1)	49 (14.5)
Marital status		
Having a partner/married	628 (52.9)	194 (57.6)
Divorced/separated	82 (6.9)	12 (3.6)
Widowed	34 (37.3)	7 (2.1)
Single	443 (2.9)	121 (35.9)
Prefer not to say	0 (0)	3 (0.9)
Employment status		
Employed	844 (71.1)	264 (78.3)
Retired	58 (4.9)	30 (8.9)
Not employed (out of a job or due to other reasons)	285 (24.0)	43 (12.8)
Type of community (residence)		
Metropolitan/city	608 (51.2)	74 (22.0)
Suburban	233 (19.6)	117 (34.7)
Small town	188 (15.8)	113 (33.5)
Rural area	158 (13.3)	33 (9.8)
Number of people living in the home environment		
1	182 (15.3)	41 (12.2)
2	416 (35.1)	137 (40.7)

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Characteristic	Wave 1 (N=1187), n (%)	Wave 2 (N=337), n (%)
3	222 (18.7)	58 (17.2)
4	238 (20.1)	49 (14.5)
≥5	129 (10.9)	52 (15.4)
Region		
Europe	821 (69.2)	N/A
North America	124 (10.5)	337 (100.0)
Asia, Middle East, or South America	242 (20.4)	N/A

[a]N/A: not applicable.

Table 3. Impact of technology use on loneliness scores.

Variable	Wave 1		Wave 2	
	Loneliness score, mean (SD)	P value	Loneliness score, mean (SD)	P value
Member of an online community support group		.49		.29
Yes	43.88 (5.65)		48.87 (8.86)	
No	44.18 (6.42)		49.96 (9.96)	
Use of the internet to stay connected with friends, family, or peers		.50		.25
Yes	48.46 (6.97)		49.78 (6.91)	
No	48.27 (7.30)		48.21 (8.57)	
Use of social media platforms		.21		.18
Yes	48.47 (6.97)		49.66 (9.35)	
No	48.02 (7.44)		46.20 (11.7)	
Use of social networking messengers		.23		<.001
Yes	48.41 (6.98)		50.15 (9.28)	
No	49.47 (7.23)		43.89 (9.36)	

Table 4. Impact of the type of community on psychological well-being in Wave 2.

Community comparison	Mean difference	95% CI	P value
Metro/city vs rural	4.73	−0.96 to 10.43	.14
Metro/city vs small town	−2.71	−6.78 to 1.34	.31
Metro/city vs suburban	−2.10	−10.43 to 0.96	.53
Small town vs rural	7.45	2.05 to 12.85	.002
Suburban vs rural	6.83	1.49 to 12.18	.006
Small town vs suburban	0.62	−2.93 to 4.18	.97

Table 5. Wave 1 ordinary least squares regression of sociodemographic characteristics and use of technology regarding loneliness scores.

Variable	Coefficient[a] (SE)
Age group (reference: 18-29 years)	
30-39 years	0.170 (0.61)
40-49 years	0.722 (0.62)
50-59 years	0.459 (0.71)
≥60 years	−0.378 (0.87)
Gender (reference: female)	
Male or nonbinary/refused to answer	−0.045 (0.39)
Education level (reference: primary or less than high school)	
High school	−2.756 (0.94)[b]
Bachelor's degree	−3.622 (0.90)[c]
Master's/professional degree	−3.981 (0.88)[c]
PhD	−4.073 (0.95)[c]
Marital status (reference: having a partner)	
Divorced/separated/widowed	0.568 (0.67)
Single	2.441 (0.48)[c]
Employment status (reference: working)	
Retired	−0.883 (1.01)
Not working (out of a job or due to other reasons)	1.045 (0.49)[d]
Residence (reference: metropolitan/city)	
Rural	−0.025 (0.58)
Small town	0.959 (0.53)
Suburban	0.564 (0.48)
Number of people living in the home environment (reference: 1)	
2	0.094 (0.61)
3	−0.674 (0.67)
4	−0.368 (0.68)
≥5	−0.223 (0.79)
Number of social media apps used (reference: 0)	
1-2	−0.549 (0.98)
3-4	−0.852 (0.98)
≥5	−0.799 (1.06)
Joining a specific online COVID-19 community support group on social media (reference: no)	
Yes	−0.44 (0.43)

[a]Adjusted R^2=0.059.

[b]$P<.01$.

[c]$P<.001$.

[d]$P<.05$.

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Table 6. Wave 2 ordinary least squares regression of sociodemographic characteristics and use of technology regarding loneliness scores.

Variable	Coefficient[a] (SE)
Age group (reference: 18-29 years)	
30-39 years	1.13 (1.52)
40-49 years	−2.89 (1.83)[b]
≥50 years	−3.67 (2.15)[b]
Gender (reference: female)	
Male	2.10 (1.24)[b]
Prefer not to say	0.57 (7.39)
Nonbinary, gender fluid	4.53 (5.60)[b]
Education level (reference: primary or less than high school)	
High school	−0.04 (3.55)
Bachelor's degree	3.80 (3.13)
College diploma/some college	1.64 (3.09)
Master's/professional degree	2.24 (3.22)
PhD	4.72 (3.27)
Marital status (reference: having a partner)	
Divorced/separated	1.59 (2.87)
Widowed	−0.44 (4.03)
Single	2.07 (1.53)
Prefer not to say	3.61 (5.99)
Employment status (reference: working)	
Retired	4.42 (2.37)[b]
Not working (out of a job or other reasons)	3.90 (1.65)[b]
Residence (reference: metropolitan/city)	
Rural	−1.18 (2.07)
Small town	0.64 (1.49)
Suburban	−2.90 (1.47)
Number of people living in the home environment (reference: 1)	
2	−1.84 (1.89)
3	−1.52 (2.08)
4	−1.03 (2.26)
≥5	−0.62 (2.29)
Number of social media apps used (reference: 0)	
1-2	5.95 (1.98)[c]
3-4	5.96 (1.97)[c]
≥5	4.97 (2.30)[b]
Joining a specific online COVID-19 community support group on social media (reference: no)	
Yes	−1.02 (1.17)

[a]Adjusted R^2=0.081.

[b]$P<.05$.

[c]$P<.01$.

Table 7. Ordinary least squares regression of sociodemographic characteristics and use of technology regarding psychological well-being.

Variable	Wave 1, coefficient[a] (SE)	Wave 2, coefficient[b] (SE)
Age group (reference: 18-29 years)		
30-39 years	−0.72 (1.00)	4.85 (1.62)[c]
40-49 years	−0.02 (1.03)	4.06 (1.96)[d]
50-59 years	−1.63 (1.17)	__[e]
≥60 years	−0.29 (1.44)	—
≥50 years	—	4.04 (2.30)
Gender (reference: female)		
Male or nonbinary/refused to answer	0.26 (0.65)	−3.67 (1.31)[c]
Prefer not to say	—	1.67 (8.03)
Nonbinary, gender fluid	—	−5.75 (7.47)
Education level (reference: primary or less than high school)		
High school	−1.77 (1.55)	−6.17 (3.69)
Bachelor's degree	−2.77 (1.48)	−1.75 (3.28)
College diploma/some college	—	−2.99 (3.20)
Master's/professional degree	−1.38 (1.46)	−0.66 (3.36)
PhD	−2.20 (1.57)	−2.28 (3.43)
Marital status (reference: having a partner)		
Divorced/separated/widowed	−0.28 (1.12)	−0.44 (2.91)
Widowed	—	5.68 (3.99)
Single	−1.77 (0.80)[d]	1.88 (1.62)
Prefer not to say	—	2.91 (6.51)
Employment status (reference: working)		
Retired	0.75 (1.68)	−1.02 (2.51)
Not working (out of a job or due to other reasons)	−0.78 (0.82)	−3.48 (1.75)[d]
Residence (reference: metropolitan/city)		
Rural	1.05 (0.96)	−3.19 (2.20)
Small town	−1.97 (0.88)[d]	4.60 (1.57)[c]
Suburban	−0.35 (0.80)	2.82 (1.53)
Number of people living in the home environment (reference: 1)		
2	−0.29 (1.01)	3.89 (1.95)[d]
3	1.51 (1.10)	6.55 (2.16)[c]
4	−1.92 (1.13)	3.90 (2.34)
≥5	−2.29 (1.31)	5.88 (2.39)[d]
Number of social media apps used (reference: 0)		
1-2	0.53 (1.64)	2.56 (2.14)
3-4	0.65 (1.64)	1.60 (2.12)
≥5	2.2 (1.76)	3.93 (2.45)
Joining a specific online COVID-19 community support group on social media (reference: no)		
Yes	−0.39 (0.72)	−7.31 (1.23)[f]

[a]Adjusted R^2=0.021.

[b]Adjusted R^2=0.190.

[c]$P<.01$.

[d]$P<.05$.

[e]Category not present.

[f]$P<.001$.

Discussion

Principal Findings

This paper explored the relationship between technology use and loneliness during the COVID-19 pandemic. We observed some associations between social network messaging but only during the second wave of data collection in 2021 from respondents in North America. Loneliness scores were higher among respondents who were using social network messaging apps than among respondents who were not using such apps. We did not observe such associations during the initial first wave of data collection in 2020 across 13 other countries. Additional findings showed that gender and age of the respondents influenced loneliness scores in both waves of data collection. In the second wave, feelings of loneliness were higher among males than females and were higher among respondents aged 30-39 years than among those in older age groups.

Comparison With Prior Work

Our findings align with the findings of other studies that social media communication and internet usage increased loneliness during the pandemic [17,18,62-64]. Individuals who were lonely tended to use social media and the internet more, which has been associated with poorer mental health and increased prevalence of anxiety and depression. Such findings call for actions and standards from schools, workplaces, and governments regarding the use and misuse of social media and the internet. A "one-size-fits-all" approach may not benefit everyone. Exploring and identifying different options should be considered to stay (remotely) connected without a negative impact on mental health.

Similar to the findings of prior studies, we observed that being a member of community support groups or being a part of a group activity had a positive impact on loneliness [65]. Additionally, the UN [15] has outlined challenges and specificities in a bid to recover regions and impacted areas identified during the pandemic. From a socioeconomic perspective, the UN response includes the following 5-point framework [15]: (1) *ensuring all essential health services are still available and protecting health systems*; (2) *helping people cope with adversity, through social protection and basic services*; (3) *protecting jobs and supporting small and medium-sized enterprises and informal sector workers through economic response and recovery programs*; (4) *guiding the necessary surge in fiscal and financial stimulus to make macroeconomic policies work for the most vulnerable and strengthening multilateral and regional responses*; and (5) *promoting social cohesion and investing in community-led resilience and response systems*. These 5 streams are connected by a strong environmental sustainability and gender equality imperative to build back better [15].

These findings further support the observation that it is not necessarily the use of the internet or social media that influences loneliness but the involvement in online communities and activities that can influence loneliness. Building on the existing reports of the UN, WHO, and Pan American Health Organization surrounding digital (eHealth) transformation [66-69] and appropriate strategies for preparing and responding to influenza pandemics, future research may investigate the direction of this relationship and the impact of social cohesion with a view to improving community and societal resilience. Yet, we identified that single respondents and those with lesser formal education were lonelier than their counterparts across both waves of data collection. Additionally, we observed that males, younger respondents (aged 18-29 years), and unemployed respondents were comparatively lonelier. These findings align with the findings of prior studies that investigated the factors associated with loneliness during the COVID-19 pandemic [8,44,70-72], although there are exceptions pertaining to the observations associated with gender. Although the UN [15] acknowledged how industries used digital transformation throughout 2020 to enable employees to continue working from home, there are still areas that were affected, resulting in an increase in unemployment and the number of hours lost. With regard to unemployment, the UN noted that it has led to a greater impact on the health and well-being of individuals and families.

Data from the first wave of collection showed that the levels of psychological well-being were lower among respondents living in small towns than among those living in metropolitan areas. However, the data collected in the second wave showed that the levels of psychological well-being were lower among respondents living in rural areas than among those living in small towns or suburban settings. Moreover, the UN [15] has mentioned how the pandemic has revealed inequalities, resulting in many challenges for service provision and frontline staff in delivering health care specifically in urban areas. According to the UN [15], these challenges are varied and include health care access, inadequate housing, poor infrastructure (eg, transport, water, and sanitation), and employment precarity. However, the UN has mentioned that cities or metropolitan areas are perceived as "hubs of resilience and human ingenuity and this crisis has shown how city dwellers can adapt overnight to new ways of working and functioning while demonstrating extraordinary solidarity and support for one another." Further, in the second wave data set, the levels of well-being were lower among respondents living in metropolitan areas or cities than among those living in suburban areas, and those living in small towns were lonelier than those living in suburban areas.

Collectively, these findings align with the findings of some previous studies that identified how small towns and rural areas may provide fewer options than cities for in-person activities, social engagements, health care access opportunities, and other

programs that influence mental health [73-79]. Still, other studies have observed how psychological distress is higher among people living in urban areas than among those living in rural areas. It appears that the data presented in this paper align with the narrative described by the UN [15], and this situation may be explained not by residing in urban areas per se but by the lack of access to outside spaces and environmental amenities (ie, green spaces) that leads to psychological distress [80,81]. The data related to respondents residing in cities and metropolitan areas indicate a greater sense of community and resilience. Moreover, analyses of Canadian data have identified age and gender differences across varying community types, use of social media, and loneliness [82].

Contribution and Implications

This international multicenter study was launched as a rapid response to the WHO declaring a pandemic [1] and presents a snapshot of the impact technology has on people based on the type of community they live in, their age, and their marital status during the pandemic. The consortium's goal was to provide scholars, policymakers, educationalists, and historians (in the future) an opportunity to garner a greater understanding of societal behavior and technology use during a specific timeframe. Specifically, we aimed to enhance societal understanding of the role technology plays within and across our societies when it comes to addressing environmental aging, loneliness, and isolation, which may facilitate appropriate planning for future scenarios and crises.

Limitations

One limitation of this work is the difficulty in presenting a cross-national perspective, given the global spread of the COVID-19 pandemic and the locations of the consortium members. The rates of survey completion varied considerably across study sites. Given the nature of survey deployment, consortium partners used their own existing mailing lists, networks, and social media platforms, and with this, the English version of the survey may have reached people who were not necessarily located in the United Kingdom but abroad instead. The design of this project only provides a snapshot of experiences shared by people who have access to technology and internet services. Future research should consider collecting more representative data.

Conclusions

Our multisite international study showed a contrary trend whereby respondents from 2 countries in 2021, who installed more social media apps on their mobile devices, experienced greater feelings of loneliness. However, these trends did not extend equally across all countries where data were collected in 2020. Additionally, we observed how some sociodemographic factors, specifically age, gender, marital status, and type of community, were associated with loneliness and psychological well-being during the pandemic. Access and use of digital technologies, the internet, and social media have increased since the beginning of the COVID-19 pandemic within developed and developing countries. Although some increases can be attributed to trends in working and studying from home, the increased use of social media platforms and messengers has also been tied to desires to stay connected with friends, families, and peers to avoid loneliness. Future studies and discourse should start to consider the role and access of transgenerational technology [83] to explore and understand the sociodemographic factors when implementing programs and activities to reduce loneliness and improve well-being across the rural and urban spectrum.

Authors' Contributions

Conceptualization: HRM and SE; methodology: HRM; formal analysis: VGP and PCK; investigation: HRM; resources: HRM and SE; data curation: HRM, IS, MHEB, PCK, LI, SCB, RK, PS, VGP, FG, HOC, HA, BBK, SF, CR, and GS; writing-original draft preparation: HRM, IS, VGP, PCK, SF, and CR; writing-review and editing: HRM, SE, SCB, RK, PAS, SF, MHEB, IS, and CR; supervision: HRM, SE, IS, and MHEB; project administration: HRM, IS, LI, and CR. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Online survey in Wave 1.
[PDF File (Adobe PDF File), 238 KB-Multimedia Appendix 1]

References

1.   Khanna RC, Cicinelli MV, Gilbert SS, Honavar SG, Murthy GSV. COVID-19 pandemic: Lessons learned and future directions. Indian J Ophthalmol 2020;68(5):703-710 [FREE Full text] [doi: 10.4103/ijo.ijo_843_20]

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2.   Freeman S, Marston HR, Olynick J, Musselwhite C, Kulczycki C, Genoe R, et al. Intergenerational Effects on the Impacts of Technology Use in Later Life: Insights from an International, Multi-Site Study. Int J Environ Res Public Health 2020 Aug 07;17(16):5711 [FREE Full text] [doi: 10.3390/ijerph17165711] [Medline: 32784651]

3.   Genoe R, Kulczycki C, Marston H, Freeman S, Musselwhite C, Rutherford H. E-Leisure and Older Adults: Findings from an International Exploratory Study. Therapeutic Recreation Journal 2018;52(1):1-18 [FREE Full text] [doi: 10.18666/TRJ-2018-V52-I1-8417]

4.   Haddon L, Loos E, Mante-Meijer E. Generational Use of New Media. Abingdon, UK: Routledge; 2016.

5.   Shah SGS, Nogueras D, van Woerden HC, Kiparoglou V. The COVID-19 Pandemic: A Pandemic of Lockdown Loneliness and the Role of Digital Technology. J Med Internet Res 2020 Nov 05;22(11):e22287 [FREE Full text] [doi: 10.2196/22287] [Medline: 33108313]

6.   Burholt V, Windle G, Gott M, Morgan DJ. Technology-Mediated Communication in Familial Relationships: Moderated-Mediation Models of Isolation and Loneliness. Gerontologist 2020;60(7):1202-1212 [FREE Full text] [doi: 10.1093/geront/gnaa040] [Medline: 32369112]

7.   Vargo D, Zhu L, Benwell B, Yan Z. Digital technology use during COVID-19 pandemic: A rapid review. Human Behav and Emerg Tech 2020;3(1):13-24 [FREE Full text] [doi: 10.1002/hbe2.242]

8.   Groarke JM, Berry E, Graham-Wisener L, McKenna-Plumley PE, McGlinchey E, Armour C. Loneliness in the UK during the COVID-19 pandemic: Cross-sectional results from the COVID-19 Psychological Wellbeing Study. PLoS One 2020 Sep 24;15(9):e0239698 [FREE Full text] [doi: 10.1371/journal.pone.0239698] [Medline: 32970764]

9.   Garfin DR. Technology as a coping tool during the coronavirus disease 2019 (COVID-19) pandemic: Implications and recommendations. Stress Health 2020;36(4):555-559 [FREE Full text] [doi: 10.1002/smi.2975] [Medline: 32762116]

10. Gauthier A, Lagarde C, Mourey F, Manckoundia P. Use of Digital Tools, Social Isolation, and Lockdown in People 80 Years and Older Living at Home. Int J Environ Res Public Health 2022;19(5):2908 [FREE Full text] [doi: 10.3390/ijerph19052908] [Medline: 35270600]

11. Sen K, Prybutok G, Prybutok V. The use of digital technology for social wellbeing reduces social isolation in older adults: A systematic review. SSM Popul Health 2022;17:101020 [FREE Full text] [doi: 10.1016/j.ssmph.2021.101020] [Medline: 35024424]

12. Williams SN, Armitage CJ, Tampe T, Dienes K. Public perceptions and experiences of social distancing and social isolation during the COVID-19 pandemic: a UK-based focus group study. BMJ Open 2020 Jul 20;10(7):e039334 [FREE Full text] [doi: 10.1136/bmjopen-2020-039334] [Medline: 32690752]

13. Ganesan B, Al-Jumaily A, Fong KNK, Prasad P, Meena SK, Tong RKY. Impact of Coronavirus Disease 2019 (COVID-19) Outbreak Quarantine, Isolation, and Lockdown Policies on Mental Health and Suicide. Front Psychiatry 2021 Apr 16;12:565190 [FREE Full text] [doi: 10.3389/fpsyt.2021.565190] [Medline: 33935817]

14. Ting DSW, Carin L, Dzau V, Wong TY. Digital technology and COVID-19. Nat Med 2020 Apr 27;26:459-461 [FREE Full text] [doi: 10.1038/s41591-020-0824-5] [Medline: 32284618]

15. United Nations Comprehensive Response to COVID-19: Saving Lives, Protecting Societies, Recovering Better. United Nations. 2020. URL: https://unsdg.un.org/resources/united-nations-comprehensive-response-covid-19-saving-lives-protecting-societies-0 [accessed 2023-02-17]

16. Fisk M, Livingstone A, Pit SW. Telehealth in the Context of COVID-19: Changing Perspectives in Australia, the United Kingdom, and the United States. J Med Internet Res 2020;22(6):e19264 [FREE Full text] [doi: 10.2196/19264] [Medline: 32463377]

17. Marston HR, Kowert R. What role can videogames play in the COVID-19 pandemic? [version 2; peer review: 2 approved]. Emerald Open Res 2020;2:34 [FREE Full text] [doi: 10.35241/emeraldopenres.13727.2]

18. Marston HR, Morgan DJ. International Psychogeriatric Association. URL: https://oro.open.ac.uk/70814/ [accessed 2023-02-17]

19. Schlomann A, Seifert A, Zank S, Woopen C, Rietz C. Use of Information and Communication Technology (ICT) Devices Among the Oldest-Old: Loneliness, Anomie, and Autonomy. Innov Aging 2020;4(2):igz050 [FREE Full text] [doi: 10.1093/geroni/igz050] [Medline: 31911953]

20. Nguyen MH, Gruber J, Fuchs J, Marler W, Hunsaker A, Hargittai E. Changes in Digital Communication During the COVID-19 Global Pandemic: Implications for Digital Inequality and Future Research. Soc Media Soc 2020 Jul 09;6(3):2056305120948255 [FREE Full text] [doi: 10.1177/2056305120948255] [Medline: 34192039]

21. Hwang T, Rabheru K, Peisah C, Reichman W, Ikeda M. Loneliness and social isolation during the COVID-19 pandemic. Int Psychogeriatr 2020;32(10):1217-1220 [FREE Full text] [doi: 10.1017/S1041610220000988] [Medline: 32450943]

22. Son JS, Nimrod G, West ST, Janke MC, Liechty T, Naar JJ. Promoting Older Adults' Physical Activity and Social Well-Being during COVID-19. Leisure Sciences 2021;43(1-2):287-294 [FREE Full text] [doi: 10.1080/01490400.2020.1774015]

23. Pennington N. Communication outside of the home through social media during COVID-19. Comput Hum Behav Rep 2021;4:100118 [FREE Full text] [doi: 10.1016/j.chbr.2021.100118] [Medline: 34568638]

24. Marston HR, Genoe R, Freeman S, Kulczycki C, Musselwhite C. Older Adults' Perceptions of ICT: Main Findings from the Technology In Later Life (TILL) Study. Healthcare (Basel) 2019;7(3):86 [FREE Full text] [doi: 10.3390/healthcare7030086] [Medline: 31277387]

25. Marston HR, Ivan L, Fernández-Ardèvol M, Rosales Climent A, Gómez-León M, Blanche- TD, et al. COVID-19: Technology, Social Connections, Loneliness, and Leisure Activities: An International Study Protocol. Front Sociol 2020;5:574811 [FREE Full text] [doi: 10.3389/fsoc.2020.574811] [Medline: 33869500]

26. COVID-19: Technology, social connections, loneliness and leisure activities. The Open University. 2020. URL: https://www.open.ac.uk/health-wellbeing/covid-19/technology-social-connections-loneliness-leisure-activities [accessed 2023-02-17]

27. Ayhan H. Non-probability Sampling Survey Methods. In: Lovric M, editor. International Encyclopedia of Statistical Science. Berlin, Heidelberg: Springer; 2011:979-982.

28. Benfield JA, Szlemko WJ. Internet-Based Data Collection: Promises and Realities. Journal of Research Practice 2006;2(2):Article D1 [FREE Full text]

29. Marston HR. Millennials and ICT—Findings from the Technology 4 Young Adults (T4YA) Project: An Exploratory Study. Societies 2019;9(4):80 [FREE Full text] [doi: 10.3390/soc9040080]

30. Marston HR. Older adults as 21st century game designers. Comput Game J 2012 May 15;1(1):90-102 [FREE Full text] [doi: 10.1007/bf03392330]

31. Marston HR, Kroll M, Fink D, de Rosario H, Gschwind YJ. Technology use, adoption and behavior in older adults: Results from the iStoppFalls project. Educational Gerontology 2016 Jan 08;42(6):371-387 [FREE Full text] [doi: 10.1080/03601277.2015.1125178]

32. Ryff CD, Keyes CL. The structure of psychological well-being revisited. Journal of Personality and Social Psychology 1995;69(4):719-727 [FREE Full text] [doi: 10.1037/0022-3514.69.4.719]

33. Ryff CD, Singer B. The Contours of Positive Human Health. Psychological Inquiry 1998;9(1):1-28 [FREE Full text] [doi: 10.1207/s15327965pli0901_1]

34. Norman CD, Skinner HA. eHEALS: The eHealth Literacy Scale. J Med Internet Res 2006 Nov 14;8(4):e27 [FREE Full text] [doi: 10.2196/jmir.8.4.e27] [Medline: 17213046]

35. Russell DW. UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. J Pers Assess 1996;66(1):20-40 [FREE Full text] [doi: 10.1207/s15327752jpa6601_2] [Medline: 8576833]

36. Lee E, Depp C, Palmer B, Glorioso D, Daly R, Liu J, et al. High prevalence and adverse health effects of loneliness in community-dwelling adults across the lifespan: role of wisdom as a protective factor. Int. Psychogeriatr 2018;31(10):1447-1462 [FREE Full text] [doi: 10.1017/s1041610218002120]

37. Jeste DV, Di Somma S, Lee EE, Nguyen TT, Scalcione M, Biaggi A, et al. Study of loneliness and wisdom in 482 middle-aged and oldest-old adults: a comparison between people in Cilento, Italy and San Diego, USA. Aging Ment Health 2021;25(11):2149-2159 [FREE Full text] [doi: 10.1080/13607863.2020.1821170] [Medline: 33000647]

38. Tomstad S, Dale B, Sundsli K, Saevareid HI, Söderhamn U. Who often feels lonely? A cross-sectional study about loneliness and its related factors among older home-dwelling people. Int J Older People Nurs 2017;12(4):e12162 [FREE Full text] [doi: 10.1111/opn.12162] [Medline: 28752653]

39. Sheerman L, Marston HR, Musselwhite C, Morgan D. COVID-19 and the secret virtual assistants: the social weapons for a state of emergency [version 1; peer review: 2 approved, 1 not approved]. Emerald Open Res 2020;2:19 [FREE Full text] [doi: 10.35241/emeraldopenres.13571.1]

40. Education in the United States. Wikipedia. URL: https://en.wikipedia.org/wiki/Education_in_the_United_States [accessed 2022-06-05]

41. List of ethnic groups. UK Government. URL: https://www.ethnicity-facts-figures.service.gov.uk/ethnic-groups [accessed 2022-06-05]

42. Pollak VM, Kowarz N, Partheymüller J. Chronology of the Corona Crisis in Austria - Part 1: Background, the way to the lockdown, the acute phase and economic consequences. University of Vienna. 2020. URL: https://viecer.univie.ac.at/en/projects-and-cooperations/austrian-corona-panel-project/corona-blog/corona-blog-beitraege/blog51/ [accessed 2023-02-17]

43. Pollak M, Kowarz N, Partheymüller J. Chronology of the Corona Crisis in Austria - Part 3: A calm summer and the beginning of the second wave. University of Vienna. 2020. URL: https://viecer.univie.ac.at/en/projects-and-cooperations/austrian-corona-panel-project/corona-blog/corona-blog-beitraege/blog79/ [accessed 2023-02-17]

44. COVID-19 in Canada: A One-year Update on Social and Economic Impacts. Statistics Canada. 2021. URL: https://www150.statcan.gc.ca/n1/pub/11-631-x/11-631-x2021001-eng.htm [accessed 2022-12-13]

45. Urrutia D, Manetti E, Williamson M, Lequy E. Overview of Canada's Answer to the COVID-19 Pandemic's First Wave (January-April 2020). Int J Environ Res Public Health 2021;18(13):7131 [FREE Full text] [doi: 10.3390/ijerph18137131] [Medline: 34281075]

46. Long JA, Malekzadeh M, Klar B, Martin G. Do regionally targeted lockdowns alter movement to non-lockdown regions? Evidence from Ontario, Canada. Health Place 2023;79:102668 [FREE Full text] [doi: 10.1016/j.healthplace.2021.102668] [Medline: 34548221]

47. Bosen R, Thuran J. Chronology: How COVID has spread in Germany. DW. 2021. URL: https://www.dw.com/en/covid-how-germany-battles-the-pandemic-a-chronology/a-58026877 [accessed 2023-02-17]

48. COVID-19 pandemic in Portugal. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Portugal [accessed 2022-12-13]

49.   COVID-19 pandemic in Spain. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Spain [accessed 2022-12-13]

50.   COVID-19 pandemic in Turkey. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Turkey [accessed 2022-12-13]

51.   Timeline of UK coronavirus lockdowns, March 2020 to March 2021. Institute for Government. URL: https://www.institute forgovernment.org.uk/sites/default/files/timeline-lockdown-web.pdf [accessed 2023-02-13]

52.   COVID-19 lockdown in the United Kingdom. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_lockdown_in_the _United_Kingdom [accessed 2022-12-13]

53.   Timeline for Coronavirus (COVID-19) in Scotland. SPICe Spotlight. URL: https://spice-spotlight.scot/2022/11/25/timeline-of-coronavirus-covid-19-in-scotland/ [accessed 2022-12-11]

54.   COVID-19 pandemic in Scotland. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Scotland [accessed 2022-12-13]

55.   Coronavirus timeline: Welsh and UK governments' response. Welsh Parliament. URL: https://research.senedd.wales/rese arch-articles/coronavirus-timeline-welsh-and-uk-governments-response/ [accessed 2022-12-11]

56.   COVID-19 pandemic in Wales. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Wales [accessed 2022-12-13]

57.   COVID-19 pandemic in Northern Ireland. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Northern _Ireland [accessed 2022-12-13]

58.   COVID-19 pandemic in France. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_France [accessed 2022-12-13]

59.   COVID-19 pandemic in Romania. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Romania [accessed 2022-12-13]

60.   COVID-19 pandemic in Germany. Wikipedia. URL: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Germany [accessed 2022-12-13]

61.   Marston HR, Shore L, White P. How does a (Smart) Age-Friendly Ecosystem Look in a Post-Pandemic Society? Int J Environ Res Public Health 2020;17(21):8276 [FREE Full text] [doi: 10.3390/ijerph17218276] [Medline: 33182413]

62.   Geirdal A, Ruffolo M, Leung J, Thygesen H, Price D, Bonsaksen T, et al. Mental health, quality of life, wellbeing, loneliness and use of social media in a time of social distancing during the COVID-19 outbreak. A cross-country comparative study. J Ment Health 2021;30(2):148-155 [FREE Full text] [doi: 10.1080/09638237.2021.1875413] [Medline: 33689546]

63.   Boursier V, Gioia F, Musetti A, Schimmenti A. Facing Loneliness and Anxiety During the COVID-19 Isolation: The Role of Excessive Social Media Use in a Sample of Italian Adults. Front Psychiatry 2020;11:586222 [FREE Full text] [doi: 10.3389/fpsyt.2020.586222] [Medline: 33363484]

64.   Bonsaksen T, Ruffolo M, Leung J, Price D, Thygesen H, Schoultz M, et al. Loneliness and Its Association With Social Media Use During the COVID-19 Outbreak. Social Media + Society 2021;7(3):205630512110338 [FREE Full text] [doi: 10.1177/20563051211033821]

65.   Lisitsa E, Benjamin KS, Chun SK, Skalisky J, Hammond LE, Mezulis AH. Loneliness Among Young Adults During COVID-19 Pandemic: The Mediational Roles of Social Media Use and Social Support Seeking. Journal of Social and Clinical Psychology 2020;39(8):708-726 [FREE Full text] [doi: 10.1521/jscp.2020.39.8.708]

66.   Developing a National eHealth Strategy. Pan American Health Organization. URL: https://iris.paho.org/handle/10665.2/55661 [accessed 2022-12-12]

67.   WHO compendium of innovative health technologies for low-resource settings: 2016-2017: medical devices, eHealth/mHealth, medical simulation devices, personal protective equipment, assistive products, other technologies. World Health Organization. URL: https://apps.who.int/iris/handle/10665/274893 [accessed 2023-02-13]

68.   Pandemic influenza preparedness and response : a WHO guidance document. World Health Organization. URL: https://apps.who.int/iris/handle/10665/44123 [accessed 2023-02-13]

69.   Progress report on utilizing eHealth solutions to improve national health systems in the African Region: information document. World Health Organization. URL: https://apps.who.int/iris/handle/10665/334099 [accessed 2023-02-13]

70.   Marmarosh CL, Forsyth DR, Strauss B, Burlingame GM. The psychology of the COVID-19 pandemic: A group-level perspective. Group Dynamics: Theory, Research, and Practice 2020;24(3):122-138 [FREE Full text] [doi: 10.1037/gdn0000142]

71.   Hoffart A, Johnson SU, Ebrahimi OV. Loneliness and Social Distancing During the COVID-19 Pandemic: Risk Factors and Associations With Psychopathology. Front Psychiatry 2020;11:589127 [FREE Full text] [doi: 10.3389/fpsyt.2020.589127] [Medline: 33329136]

72.   Hansen T, Nilsen TS, Yu B, Knapstad M, Skogen JC, Vedaa Ø, et al. Locked and lonely? A longitudinal assessment of loneliness before and during the COVID-19 pandemic in Norway. Scand J Public Health 2021;49(7):766-773 [FREE Full text] [doi: 10.1177/1403494821993711] [Medline: 33645336]

73.   O'Connor RC, Wetherall K, Cleare S, McClelland H, Melson AJ, Niedzwiedz CL, et al. Br J Psychiatry 2021;218(6):326-333 [FREE Full text] [doi: 10.1192/bjp.2020.212] [Medline: 33081860]

74. Bu F, Steptoe A, Fancourt D. Who is lonely in lockdown? Cross-cohort analyses of predictors of loneliness before and during the COVID-19 pandemic. Public Health 2020 Sep;186:31-34 [FREE Full text] [doi: 10.1016/j.puhe.2020.06.036] [Medline: 32768621]

75. Mueller JT, McConnell K, Burow PB, Pofahl K, Merdjanoff AA, Farrell J. Impacts of the COVID-19 pandemic on rural America. Proc Natl Acad Sci U S A 2021;118(1):2019378118 [FREE Full text] [doi: 10.1073/pnas.2019378118] [Medline: 33328335]

76. Henning-Smith C. The Unique Impact of COVID-19 on Older Adults in Rural Areas. J Aging Soc Policy 2020;32(4-5):396-402 [FREE Full text] [doi: 10.1080/08959420.2020.1770036] [Medline: 32475255]

77. Wang Y, Kala MP, Jafar TH. Factors associated with psychological distress during the coronavirus disease 2019 (COVID-19) pandemic on the predominantly general population: A systematic review and meta-analysis. PLoS One 2020;15(12):e0244630 [FREE Full text] [doi: 10.1371/journal.pone.0244630] [Medline: 33370404]

78. Isaac V, Cheng T, Townsin L, Assareh H, Li A, McLachlan CS. Associations of the Initial COVID-19 Lockdown on Self-Reported Happiness and Worry about Developing Loneliness: A Cross-Sectional Analysis of Rural, Regional, and Urban Australian Communities. Int J Environ Res Public Health 2021;18(18):9501 [FREE Full text] [doi: 10.3390/ijerph18189501] [Medline: 34574425]

79. Hubbard G, den Daas C, Johnston M, Murchie P, Thompson CW, Dixon D. Are Rurality, Area Deprivation, Access to Outside Space, and Green Space Associated with Mental Health during the COVID-19 Pandemic? A Cross Sectional Study (CHARIS-E). Int J Environ Res Public Health 2021;18(8):3869 [FREE Full text] [doi: 10.3390/ijerph18083869] [Medline: 33917067]

80. Grima N, Corcoran W, Hill-James C, Langton B, Sommer H, Fisher B. The importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. PLoS One 2020;15(12):e0243344 [FREE Full text] [doi: 10.1371/journal.pone.0243344] [Medline: 33332364]

81. Noël C, Rodriguez-Loureiro L, Vanroelen C, Gadeyne S. Perceived Health Impact and Usage of Public Green Spaces in Brussels' Metropolitan Area During the COVID-19 Epidemic. Front. Sustain. Cities 2021;3:668443 [FREE Full text] [doi: 10.3389/frsc.2021.668443]

82. Chidiac M, Ross C, Marston HR, Freeman S. Age and Gender Perspectives on Social Media and Technology Practices during the COVID-19 Pandemic. Int J Environ Res Public Health 2022;19(21):13969 [FREE Full text] [doi: 10.3390/ijerph192113969] [Medline: 36360853]

83. Marston HR, Shore L, Stoops L, Turner RS. Transgenerational Technology and Interactions for the 21st Century: Perspectives and Narratives. Bingley, United Kingdom: Emerald Publishing; 2022.

Abbreviations

OLS: ordinary least squares
UN: United Nations
WHO: World Health Organization

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