Social Science & Medicine 321 (2023) 115777

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Video call and depression among older adults during the COVID-19 pandemic in Japan: The JAGES one-year longitudinal study

Ryunosuke Shioya [a], Atsushi Nakagomi [a,*], Kazushige Ide [a], Katsunori Kondo [a,b]

[a] Department of Social Preventive Medical Sciences, Center for Preventive Medical Sciences, Chiba University, 1-33, Yayoi-Cho, Inage-Ku, Chiba-Shi, Chiba, 263-8522, Japan

[b] Department of Gerontological Evaluation, Center for Gerontology and Social Science, Research Institute, National Center for Geriatrics and Gerontology, 7-430, Morioka-Cho, Obu-Shi, Aichi, 474-8511, Japan

ARTICLE INFO

Handling Editor: Social Epidemiology Editorial Office

Keywords:
Health policy
Social connectedness
Online communication
Social distancing
Japan

ABSTRACT

Evidence of video call on preventing late-life depression during the COVID-19 pandemic is limited. We examined the associations of social contact (in-person, voice call, and video call) with incidence of depressive symptoms and evaluated whether specific factors (particularly, age and change in the frequency of in-person contact) affect these associations. We used longitudinal data from the 2019 and 2020 waves of the Japan Gerontological Evaluation Study, including 10,523 participants aged ≥65 years in 10 municipalities. Depressive symptoms were measured by the 15-item Geriatric Depression Scale (GDS-15) score ≥5 in main analysis, and GDS-15 score ≥4, 10, or continuous variable in sensitivity analyses. Social contact represented frequency changes before and during the pandemic: non-contact (reference), decreased-contact, maintained-contact, and increased-contact. We employed modified Poisson regression analysis. Compared to non-contact of video call, the association of increased-contact of video call with depressive symptoms was insignificant in main analysis (GDS-15 ≥ 5: risk ratio (RR) = 0.89, 95% confidence interval (CI): 0.79–1.01), whereas significant in sensitivity analyses (GDS-15 ≥ 4: RR = 0.89, 95% CI: 0.82–0.98; GDS-15 ≥ 10: RR = 0.71, 95% CI: 0.53–0.97; GDS-15 = continuous variable: B = −0.17, 95% CI: −0.33 to −0.002). In-person contact was significantly associated with lower incidence of depressive symptoms (non-contact: reference; maintained-contact: RR = 0.92, 95% CI: 0.85–0.99; increased-contact: RR = 0.84, 95% CI: 0.77–0.91), whereas voice call was not. Age and change in the frequency of in-person contact did not show significant effect modifications on the associations of video call with incidence of depressive symptoms after Bonferroni correction for multiple testing. In conclusion, this study suggests that the evidence supporting video call as a way to protect against depressive symptoms among older adults during the pandemic appears weak compared to the evidence for in-person contact.

1. Introduction

Late-life depression is a serious public health problem affecting a rapidly aging population worldwide. Depression among older adults is common, with a global prevalence of more than 5% for women and 4% for men in 2015 (World Health Organization, 2017). Late-life depression is associated with high risks of mortality, suicide, physical disability, and cognitive impairment (Fiske et al., 2009). The World Health Organization regarded depression as the most significant contributor to global disability (World Health Organization, 2017).

The coronavirus disease 2019 (COVID-19) pandemic has led to severe psychosocial consequences globally, including late-life depression (Briggs et al., 2021; Noguchi et al., 2021; Sepúlveda-Loyola et al., 2020; Zaninotto et al., 2022). Social distancing was mandatory during the COVID-19 pandemic, thereby increasing the risks of social disconnectedness (characterized as "scarcity of contact" (Cornwell and Waite, 2009)) and perceived isolation (i.e., loneliness (National Academies of Sciences & Medicine, 2020)) (Cudjoe and Kotwal, 2020), which contribute to depression among older adults (National Academies of Sciences & Medicine, 2020; Santini et al., 2020).

As a countermeasure, online communication may effectively protect mental health among older adults (Galea et al., 2020). Internet usage among older adults is increasing worldwide. The proportion of Internet users over 65 years reached 75% in the USA (Pew Research Center,

* Corresponding author. 1Yayoi-Cho, Inage-Ku, Chiba-Shi, Chiba, 263-8522, Japan.
E-mail address: bay2item@yahoo.co.jp (A. Nakagomi).

https://doi.org/10.1016/j.socscimed.2023.115777
Received 2 August 2022; Received in revised form 7 January 2023; Accepted 13 February 2023
Available online 16 February 2023

2022) and 53% in Japan (Ministry of Internal Affairs and Communications, 2022) in 2021. Several longitudinal studies before the COVID-19 pandemic reported that Internet use for connecting friends/family indirectly affected well-being via increased social engagement and decreased loneliness (Szabo et al., 2019), and Internet use for communication purposes was associated with a lower incidence of depression (Kondo et al., 2021; Lam et al., 2020; Nakagomi et al., 2022).

Video call is one of the promising online communication modes to prevent depression among older adults during the COVID-19 pandemic (Hajek and König, 2021). Previous studies reported the increase in video call as an alternative to in-person contact among older adults during the COVID-19 pandemic (Arpino et al., 2021; Freedman et al., 2022; Greenwood-Hickman et al., 2021). Given the ability to convey rich social cues, video call is closer to in-person contact than other online communication modes (Fox and McEwan, 2017). Indeed, a longitudinal study before the COVID-19 pandemic showed that video call was significantly related to reduced depressive symptoms among American adults aged over 50 years (Teo et al., 2019).

However, the effect of video call on preventing late-life depression during the COVID-19 pandemic could differ compared to before the pandemic (Hajek and König, 2021). Indeed, a longitudinal study using data from the 2015 and 2020 waves of the National Social Life, Health, and Aging Project (NSHAP) reported no significant associations of retrospectively reported video call contact during the COVID-19 pandemic with depressive feelings among American adults aged over 55 years (Hawkley et al., 2021).

As a possible reason for the inconsistent findings regarding video call before and during the COVID-19 pandemic (i.e., the association of video call with reduced depressive symptoms among American adults was significant before the pandemic (Teo et al., 2019), whereas insignificant during the pandemic (Hawkley et al., 2021)), the effect of video call on preventing late-life depression could vary depending on specific factors. Given the pandemic situation that restricts in-person contact, for example, those with less in-person contact during the pandemic could particularly benefit from video call contact. However, the relevant evidence during the COVID-19 pandemic remains scarce, and such an effect modification (i.e., the effect modification by the change in the frequency of in-person contact with regard to the association of video call with depressive symptoms among older adults) has not yet been investigated.

Additionally, age could also influence the association of video call with late-life depression. For example, the effect of video call to prevent depression could be greater especially among older individuals due to the tighter restriction of in-person contact because of their vulnerability to COVID-19. On the other hand, a cross-sectional online survey during the COVID-19 pandemic showed that video call was associated with less loneliness and higher quality of life among people aged 60–69 years, but not among people over 70 years (Bonsaksen et al., 2021) probably because of a lack of skills to use digital devices among the older group. Although such age-related differences could also be observed in late-life depression, the evidence is inconclusive; therefore, further exploration is needed.

Furthermore, the previous study during the COVID-19 pandemic was only conducted in one country (i.e., the USA) (Hawkley et al., 2021), therefore it is unclear whether such findings could be generalizable to the population in other contexts (e.g., country/culture). From the cultural perspective, for example, a normative imperative is founded on connecting with others in Eastern interdependent countries (e.g., Japan), whereas it is founded on independence from others in Western independent countries (e.g., the USA) (Markus and Kitayama, 1991). These cultural differences could affect the relationship between social contact and late-life depression as in a previous systematic review (Schwarzbach et al., 2014). Although this systematic review mainly focused on in-person contact before the COVID-19 pandemic (Schwarzbach et al., 2014), the effect of video call on preventing late-life depression during the pandemic could also vary between cultures considering the characteristics of video call (i.e., its similarity to in-person contact (Fox and McEwan, 2017)) and the abovementioned cultural differences (Markus and Kitayama, 1991). In terms of generalizability, further investigations in different contexts from the previous study (e.g., Japan) are needed.

We built two hypotheses according to the abovementioned previous studies. Hypothesis I: Considering its similarity to in-person contact compared to other online communication modes (e.g., voice call) (Fox and McEwan, 2017), video call would be effective in preventing late-life depression during the pandemic situation that restricts in-person contact. Hypothesis II: The protective effect of video call would differ by some factors such as age and change in the frequency of in-person contact during the pandemic: older people and people with less in-person contact during the pandemic could particularly benefit from video call contact. Using longitudinal data from the 2019 and 2020 waves of the Japan Gerontological Evaluation Study (JAGES) (Kondo, 2016; Kondo et al., 2018), this study aimed to assess the associations of social contacts through each communication mode (in-person, voice call, and video call) with depressive symptoms among older adults during the COVID-19 pandemic and to evaluate whether specific factors (particularly, age and a change in the frequency of in-person contact are relevant for the examination) affect the associations of video call with depressive symptoms in this age group.

2. Methods

2.1. Study participants

This is a one-year longitudinal study using the data from the 2019 and 2020 waves of the JAGES (Kondo, 2016; Kondo et al., 2018). The JAGES is a nationwide cohort study of older adults in Japan, focusing on social determinants of health and long-term care prevention (Kondo, 2016; Kondo et al., 2018). We conducted a baseline survey (2019 wave) in 10 voluntary municipalities (i.e., whose officials agreed to participate in the survey) before the COVID-19 pandemic from November 2019 to January 2020 (Fig. 1) (Sato et al., 2022). Based on the list of residents aged ≥65 years in each municipality, we mailed self-administered questionnaires to 88,476 independent individuals aged ≥65 years without long-term care certification (i.e., those who are physically and cognitively independent and not certified for eligibility to receive benefits from the public long-term care insurance service in Japan). The eligible individuals were randomly selected from each subdistrict (basically, elementary school or junior high school districts) of the municipalities whose officials voluntarily agreed to participate in the survey, and 62,973 returned the questionnaires (response rate: 71.2%). We conducted a follow-up survey (2020 wave) during the pandemic from November 2020 to February 2021 and the second state of emergency declaration from the Japanese government that requests people to maintain social distancing and nonessential activities. We mailed follow-up questionnaires to 12,705 individuals randomly selected from the group of baseline survey respondents, and 10,860 returned the questionnaires (response rate: 85.5%). We excluded 337 respondents whose age or sex was inconsistent between the two waves. Finally, we included 10,523 participants. Fig. 1 shows a flowchart of participants selection and temporal orders of pandemic-related events involved in our study.

Conforming to the principles of the Declaration of Helsinki, this study was approved by the Institutional Review Board of the affiliated university and research institution. All participants provided written informed consent in the questionnaires.

2.2. Outcome variable

We measured depressive symptoms using the 15-item Geriatric Depression Scale (GDS-15) (Yesavage and Sheikh, 1986), which is a validated tool for screening depression among older adults (Park and Kwak, 2021). Its score ranges from 0 to 15, and we adopted a cutoff

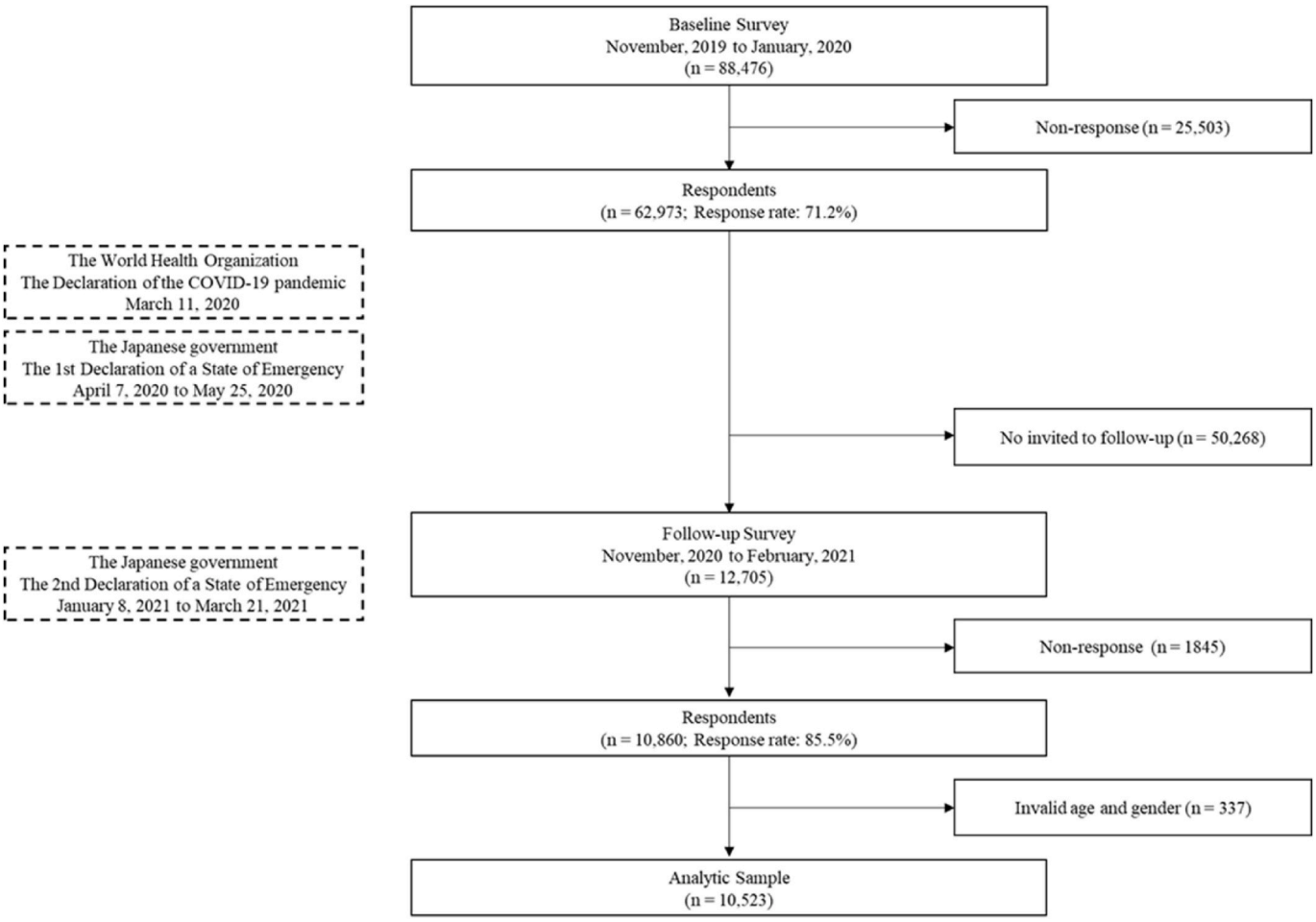

Fig. 1. A flowchart of participants selection and temporal orders of pandemic-related events.

value of 5, which is often used across several countries for screening depression (Pocklington et al., 2016).

In sensitivity analyses, we adopted a cutoff value of 4 according to the previous meta-analysis (Pocklington et al., 2016), a cutoff value of 10 for severe depressive symptoms, and the GDS-15 as a continuous variable.

2.3. Exposure variables

We examined changes in the frequency of each social contact (in-person, voice call, and video call) before and during the COVID-19 pandemic. We asked the participants how frequently they had in-person contact at both baseline and follow-up surveys with the following question: "How often do you meet friends?" During the follow-up survey, we asked them how often they experienced social contact through voice call or video call with the following questions: "How often did you use voice call to interact with family or friends before the spread of COVID-19 (i.e., before January 2020 in Japan)?"; "How often did you use video call to interact with family or friends before the spread of COVID-19?"; "How often do you use voice call for interactions with family or friends at present (i.e., from November 2020 to February 2021)?"; and "How often do you use video call for interactions with family or friends at present?" We provided the participants with the same answer choices for each question coded as follows: "0: none; 1: a few times/year; 2: 1–3 time(s)/month; 3: once a week; 4: 2–3 times/week; and 5: 4 times/week or more." Then, we created composite variables for each social contact (in-person, voice call, and video call) by subtracting the variable representing the frequency before the pandemic from the variable representing the frequency during the pandemic. Positive values for the composite variable indicated an increase in frequency (increased-contact), whereas negative values indicated a decrease in frequency (decreased-contact). The remainder showed no change in frequency. We further divided the remainder into two groups according to the social contact status at baseline: non-contact (the respondent answered "none" at both time points) or maintained-contact (the respondent answered having the same frequency of social contact at both time points). Thus, we classified changes in the frequency of each social contact (in-person, voice call, and video call) as follows: non-contact (never: reference), decreased-contact (decrease), maintained-contact (keep), and increased-contact (increase).

2.4. Control variables

The individual-level confounders included sociodemographic factors, physical health conditions, and social support, because these factors could correlate with social contact modes and depression among older adults (Fiske et al., 2009; Hunsaker and Hargittai, 2018; Lee and Coughlin, 2015; World Health Organization, 2017; Xiu-Ying et al., 2012; Yan et al., 2011). Sociodemographic factors included age, sex, educational attainment ($\geq$10 or $<$ 10 years), household equivalized income ($\geq$2 million or $<$ 2 million yen/year), occupational status (employed or unemployed), marital status (married or unmarried), and living arrangement (living together or alone). Physical health conditions consisted of current diseases (exist or none), activities of daily living (independent or dependent), and higher-level functional capacity measured using the Tokyo Metropolitan Institute of Gerontology Index

of Competence (TMIG) (score range: 0–13) (Koyano et al., 1991). Furthermore, emotional support (exist or none) and instrumental support (exist or none) constituted the social support. To evaluate emotional support, we used the question "Do you have someone who listens to your concerns and complaints?" For instrumental support, we used the question "Do you have someone who takes care of you when you are ill in bed for several days?"

The municipality-level confounders included population density (person/km^2) and whether a state of emergency has been declared in the living municipality (never or once or more) (Fig. 1). We selected these factors because a rural setting could be related to a higher incidence of depression (Kanamori et al., 2021) and the limited Internet use among older adults (Kondo et al., 2021) and a state of emergency declaration could change the communication modes of older adults (Arpino et al., 2021; Freedman et al., 2022; Greenwood-Hickman et al., 2021) and make them depressed due to restricted in-person contact (Briggs et al., 2021; Noguchi et al., 2021; Sepúlveda-Loyola et al., 2020; Zaninotto et al., 2022). We calculated the population density of each municipality using the Statistical Observations of Municipalities in 2019 from the Ministry of Internal Affairs and Communications.

We included the GDS-15 levels at baseline survey corresponding to outcome variables (binary variables (GDS-15 $\geq$ 5 or not, GDS-15 $\geq$ 4 or not, and GDS-15 $\geq$ 10 or not) and a continuous variable) as the prior outcome values.

2.5. Statistical analysis

We described participants' characteristics, presenting all continuous variables as mean and standard deviation and all categorical variables as percentages.

The proportion of the outcome variable was more than 10% (25.9%) in our study; thus, we employed modified Poisson regression models (Zhang and Yu, 1998). Using modified Poisson regression models with cluster-robust standard errors, we estimated the risk ratio (RR) and 95% confidence interval (CI) to examine the associations of the changes in the frequency of each social contact (in-person, voice call, and video call) with the incidence of depressive symptoms (Zou, 2004). All exposure variables were analyzed using the same model simultaneously as well as other control variables because the exposure variables could confound each other (e.g., those who decreased in-person contact during the pandemic may increase voice call and/or video call to maintain social connectedness) (Arpino et al., 2021; Freedman et al., 2022; Greenwood-Hickman et al., 2021).

We conducted subgroup analyses by all confounders: social contacts (in-person and voice call), age, sex, educational attainment, household equivalized income, occupational status, marital status, living arrangement, current diseases, activities of daily living, higher-level functional capacity, emotional support, instrumental support, population density, and whether a state of emergency has been declared in the living municipality. Then, we included interaction terms between the change in the frequency of video call and all confounders in the modified Poisson regression models to assess the effect modifications. For ease of interpretation, we converted all continuous variables into dichotomous variables in subgroup analyses (age: 65–74 years or over 75 years, TMIG score: 13 or 0–12, population density: $\geq$3000 or $<$ 3000 person/km^2).

We conducted three sensitivity analyses. For the first and second analysis, we adopted GDS-15 scores of 4 and 10 as the cutoff values of the outcome variable, respectively. Lastly, we employed linear regression models using the GDS-15 as a continuous variable.

We imputed missing data using multiple imputation analyses with the Markov chain Monte Carlo method, assuming that data were missing at random. The percentage of missing data for each variable was 0.0%–18.6%. We created 50 imputed data sets and combined the estimated parameters using Rubin's rule (Kenward and Carpenter, 2007; Rubin, 1996).

We used STATA 16.0 software (STATA Corp. LLC, College Station, TX, USA) for statistical analyses, with a statistical significance of $p < 0.05$. As for the assessment of effect modifications, the risk of type I error could occur due to multiple testing. To address this problem, we employed Bonferroni correction. We defined the more conservative p-value cutoff for Bonferroni correction as $p = 0.0031$ (0.05/16) by dividing the nominal significance level of the test ($\alpha = 0.05$) by the number of tests.

3. Results

Table 1 presents the participant characteristics. The average age was 75.1 years (standard deviation, 6.0), and the male and female proportions were equal (50.1% and 49.9%, respectively). The proportion of depressive symptoms (GDS-15 $\geq$ 5) increased from 20.6% to 25.9% before and during the COVID-19 pandemic. Supplementary Tables 1–3 summarize the characteristics of participants by each social contact (in-person, voice call, and video call). The most common change in the frequency of in-person contact was "keep" (37.5%), followed by "decrease" (31.9%). Regarding voice call and video call, the most common change was "keep" (67.1%) and "never" (76.8%), respectively.

Table 1
Characteristics of participants (n = 10,523).

Characteristics	Mean (SD), n (%)
Individual-level variables	
Depressive symptoms[a] at follow-up, n (%)	
GDS-15 $<$ 5	6694 (74.1%)
GDS-15 $\geq$ 5	2345 (25.9%)
Depressive symptoms[a] at baseline, n (%)	
GDS-15 $<$ 5	7093 (79.4%)
GDS-15 $\geq$ 5	1839 (20.6%)
Age (years), mean (SD)	75.1 (6.0)
Sex, n (%)	
Male	5269 (50.1%)
Female	5254 (49.9%)
Educational attainment, n (%)	
$\geq$10 years	8097 (79.2%)
$<$10 years	2122 (20.8%)
Household equivalized income, n (%)	
$\geq$2 million yen/year	5424 (57.1%)
$<$2 million yen/year	4081 (42.9%)
Occupational status, n (%)	
Unemployed	6991 (72.0%)
Employed	2721 (28.0%)
Marital status, n (%)	
Married	7528 (72.7%)
Unmarried	2828 (27.3%)
Living arrangement, n (%)	
Living together	8705 (83.7%)
Living alone	1691 (16.3%)
Current diseases, n (%)	
Exist	8037 (80.3%)
None	1975 (19.7%)
Activity of daily living, n (%)	
Independent	9647 (96.3%)
Dependent	368 (3.7%)
Higher-level functional capacity[b], mean (SD)	11.4 (1.7)
Emotional social support, n (%)	
Exist	9750 (94.2%)
None	598 (5.8%)
Instrumental social support, n (%)	
Exist	9733 (94.1%)
None	613 (5.9%)
Municipality-level variables	
Population density (person/km^2), mean (SD)	6804.8 (2950.7)
State of emergency declared, n (%)	
Never	824 (7.8%)
Once or more times	9699 (92.2%)

Abbreviations: SD, standard deviation; GDS-15, geriatric depression scale-15.
[a] We measured depressive symptoms using GDS-15 (score range: 0–15), and adopted a cut-off value of 5 for screening depression.
[b] We measured higher-level functional capacity using the Tokyo Metropolitan Institute of Gerontology Index of Competence (score range: 0–13).

Table 2 presents the associations of the change in the frequency of each social contact (in-person, voice call, and video call) with the incidence of depressive symptoms. The increased frequency of video call (i.e., "increase" in video call contact; see "2.3. Exposure variables" of "Methods") was not significantly associated with the incidence of depressive symptoms ("never" in video call contact: reference, RR = 0.89, 95% CI: 0.79–1.01, $p = 0.068$). The changes in the frequency of in-person contact were significantly associated with a lower incidence of depressive symptoms ("never" in in-person contact: reference; "keep" in in-person contact: RR = 0.92, 95% CI: 0.85–0.99, $p = 0.020$; "increase" in in-person contact: RR = 0.84, 95% CI: 0.77–0.91, $p < 0.001$), whereas the changes in the frequency of voice call were not significantly associated with the incidence of depressive symptoms.

Supplementary Tables 4–6 present the results of the sensitivity analyses. An increased frequency of video call ("increase" in video call contact) was significantly associated with a lower incidence of depressive symptoms ("never" in video call contact: reference; GDS-15 cutoff of 4: RR = 0.89, 95% CI: 0.82–0.98, $p = 0.015$; GDS-15 cutoff of 10: RR = 0.71, 95% CI: 0.53–0.97, $p = 0.029$; GDS-15 as a continuous variable: unstandardized coefficient (B) = −0.17, 95% CI: −0.33 to −0.002, $p = 0.048$).

Fig. 2 shows the results of subgroup analyses adjusted for covariates at baseline. The associations of an increased frequency of video call ("increase" in video call contact) with the incidence of depressive symptoms by age were as follows: "never" in video call contact: reference; 65–74 years: RR = 0.80, 95% CI: 0.67–0.96, $p = 0.015$; over 75 years: RR = 0.99, 95% CI: 0.87–1.13, $p = 0.900$; p for interaction = 0.016 (p-value cutoff for Bonferroni correction = 0.0031). Within the subgroup of decreased in-person contact, the association of an increased frequency of video call ("increase" in video call contact) with the incidence of depressive symptoms was as follows: "never" in video call contact: reference; RR = 0.87, 95% CI: 0.74–1.01, $p = 0.069$; p for interaction ("keep" in in-person contact: reference) = 0.531.

4. Discussion

Our primary and sensitivity analyses of video call showed mixed findings. The association of increased video call with the incidence of depressive symptoms among older adults during the COVID-19 pandemic was not significant in the primary analysis, whereas significant in the sensitivity analyses. In our subgroup analyses, the associations of increased video call with the incidence of depressive symptoms by age or a change in the frequency of in-person contact were not significant after Bonferroni correction for multiple testing. On the other hand, the maintained or increased in-person contact was significantly related to the lower incidence of depressive symptoms, whereas voice call was not. In summary, our results suggest that the evidence supporting video call as a way to protect against depressive symptoms among older adults appears weak compared to the evidence for in-person contact.

Table 2
Associations of the Changes in the Frequency of Each Social Contact with Depressive symptoms (GDS-15 ≥ 5) at Follow-up (n = 10,523).

	RR	95%CI	p-value
Change in frequency of in-person contact (Ref.: Never)			
Decrease	1.00	0.95–1.07	0.874
Keep	0.92	0.85–0.99	0.020
Increase	0.84	0.77–0.91	<0.001
Change in frequency of voice call contact (Ref.: Never)			
Decrease	1.08	0.98–1.19	0.114
Keep	0.96	0.89–1.02	0.195
Increase	1.05	0.97–1.12	0.208
Change in frequency of video call contact (Ref.: Never)			
Decrease	1.09	0.92–1.30	0.314
Keep	0.93	0.84–1.04	0.191
Increase	0.89	0.79–1.01	0.068

Note. Modified Poisson regression models adjusted for covariates at baseline: depressive symptoms (GDS-15 ≥ 5), age, sex, educational attainment, household equivalized income, occupational status, marital status, living arrangement, current diseases, activity of daily living, higher-level functional capacity, emotional social support, instrumental social support, population density, and state of emergency declared. Changes in the frequency of social contact indicated: non-contact (never), decreased-contact (decrease), maintained-contact (keep), and increased-contact (increase). Abbreviations: Ref, Reference; RR, risk ratio; CI, confidence interval; GDS-15, geriatric depression scale-15.

Contrary to hypothesis I, the primary analysis showed that video call was not significantly associated with the incidence of depressive symptoms among older adults during the COVID-19 pandemic. Our findings of each social contact (in-person, voice call, and video call) are similar to the results of a previous study during the COVID-19 pandemic, which showed that a retrospectively reported decrease in in-person contact was significantly related to the deterioration of depressive symptoms among older American adults, whereas a retrospectively reported increase in video call or voice call was not significantly related to depressive symptoms (Hawkley et al., 2021). We hypothesized that video call would be protective against late-life depression during the pandemic because video call features high social presence (i.e., "the feeling of being there with a 'real' person" (Oh et al., 2018)) and the ability to convey rich social cues, thereby closer to in-person contact than other online communication modes (e.g., voice call) (Fox and McEwan, 2017). However, our primary analysis showed that video call was not significantly associated with depressive symptoms among older adults. This suggests that video call is not equivalent or superior to in-person contact in preventing late-life depression during the pandemic.

On the other hand, our results of video call are inconsistent with a previous study before the COVID-19 pandemic that showed a robust association of video call with reduced depressive symptoms among American adults aged over 50 years (Teo et al., 2019). This inconsistency supports the possibility that the effect of video call to prevent late-life depression could differ before and during the pandemic. Given the insignificant findings of effect modifications after Bonferroni correction in this study, other effect modifiers that we have not investigated could exist. A possible candidate for the unmeasured effect modifiers is the interlocutors with whom older adults make video call. For example, previous studies before the pandemic reported that social contact with friends was associated with lower odds ratio for depression among older adults (Misawa and Kondo, 2019; Werner-Seidler et al., 2017). Although we failed to assess the interlocutors in terms of change because of the lack of data, with whom older adults increased video call could matter to prevent depression. The evidence during the pandemic is still scarce, thereby further investigations are warranted.

Contrary to hypothesis II, age-specific effect modification was not significant after Bonferroni correction, and video call was not significantly associated with depressive symptoms among those aged over 75 years. We hypothesized that older adults could particularly benefit from video call because of strict restrictions on in-person contact due to their vulnerability to COVID-19. Possible explanations include the barriers that older adults face while using advanced technology. As age increases, most of them are less likely to use the Internet (Hunsaker and Hargittai, 2018; Kondo et al., 2021) and have sufficient Internet skills (Hunsaker and Hargittai, 2018). Furthermore, they experience fear and anxiety while using new technology (O'Connell et al., 2022). Thus, older adults may benefit insufficiently from video call because of such barriers.

In this study, the change in the frequency of in-person contact showed no effect modification, and the associations of video call with depressive symptoms by the change in the frequency of in-person contact were insignificant. Thus, the results contradicted hypothesis II: older people with less in-person contact could particularly benefit from video call during the pandemic.

Our results on in-person contact corroborate previous studies

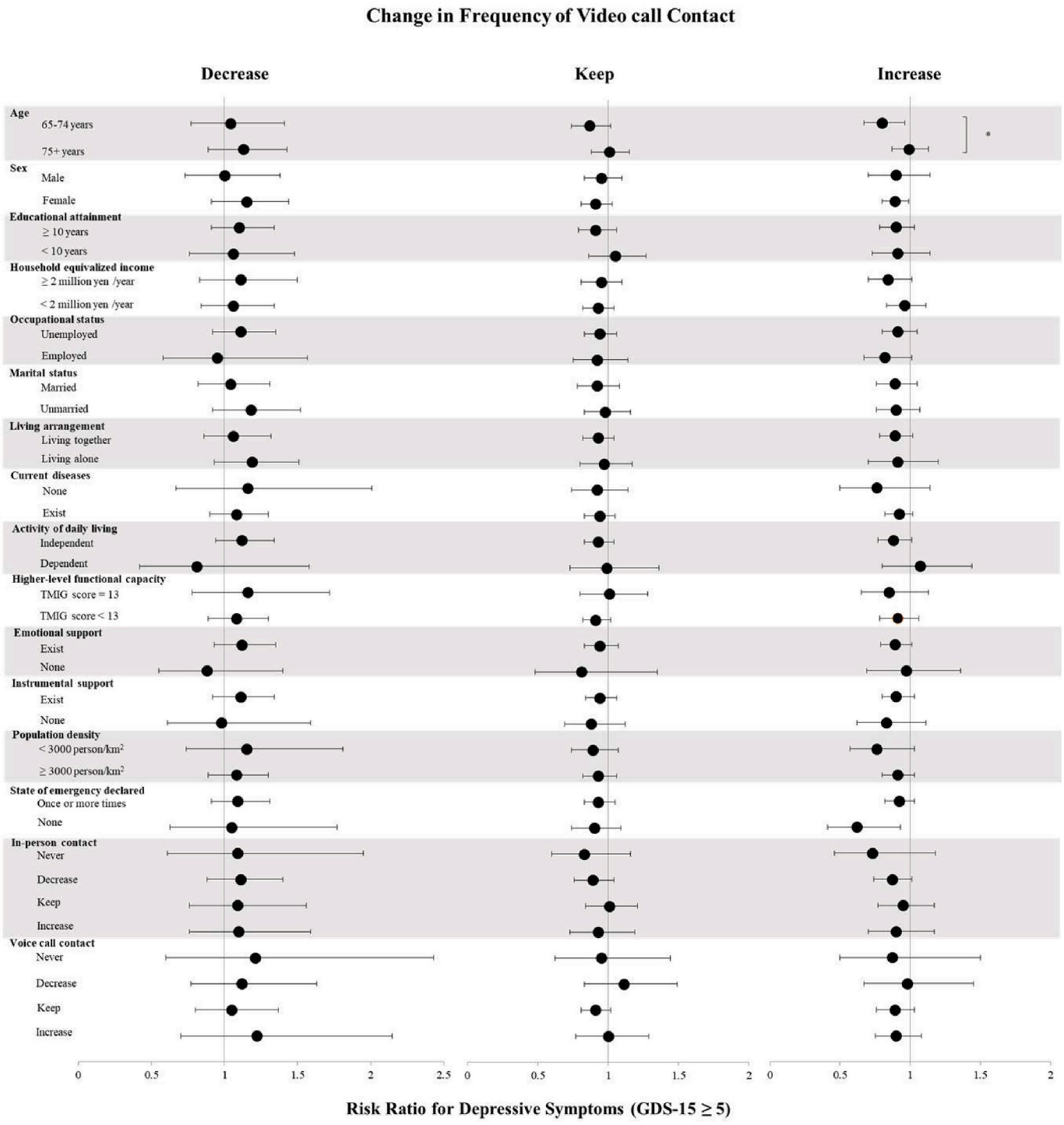

Fig. 2. Subgroup analyses on the associations of the changes in the frequency of video call with depressive symptoms (GDS-15 ≥ 5) by all confounders.
Modified Poisson regression models estimated risk ratios of the changes in the frequency of video call (non-contact (reference), never; decreased-contact, decrease; maintained-contact, keep; increased-contact, increase) for depressive symptoms (GDS-15 ≥ 5) adjusting for covariates at baseline: depressive symptoms (GDS-15 ≥ 5), age, sex, educational attainment, household equivalized income, occupational status, marital status, living arrangement, current diseases, activity of daily living, higher-level functional capacity, emotional social support, instrumental social support, population density, and state of emergency declared. Abbreviations: GDS-15, geriatric depression scale-15; TMIG, Tokyo Metropolitan Institute of Gerontology Index of Competence. *p for interaction = 0.016.

conducted during the COVID-19 pandemic (Hawkley et al., 2021; Noguchi et al., 2021), suggesting that in-person contact consistently matters for older adults to prevent depressive symptoms regardless of the pandemic.

This study has several limitations. First, we cannot exclude the possibility of reverse causation. For example, some participants might have increased their video call frequency because of their low levels of depressive symptoms. Second, residual confounding might remain because of unmeasured confounding (e.g., other contact modes such as social networking services). To address these issues, further studies (e.g., randomized control trials) are required. Third, we retrospectively reported the frequency of video call and voice call at baseline; thus,

misclassification could be possible (i.e., recall bias). Fourth, the question of in-person contact could have been misinterpreted: the term "How often do you meet friends?" could be interpreted as not only in-person contact but also voice/video call contact. Fifth, we cannot apply our results to older adults with long-term care certification because we excluded them from our survey. According to an annual report by the Ministry of Health, Labour and Welfare in Japan, 18.7% of older adults aged ≥65 years were certified as requiring long-term care insurance services in 2020. Finally, our findings, as with previous studies in the USA (Hawkley et al., 2021; Teo et al., 2019), are less generalizable because the surveys were only conducted in one country. However, this study is novel in terms of providing evidence in a different context (i.e., country and culture) from the previous studies. Furthermore, the response rates of our surveys were over 70%, which is higher than that of the similar study during the pandemic (58.1%) (Hawkley et al., 2021).

5. Conclusions

Our study provides crucial insights into public health policies/practices to maintain older adults' mental health during prolonged pandemics or newly emerging pandemics in the future. In this study, in-person contact showed a robust association with a lower incidence of depressive symptoms among older adults during the COVID-19 pandemic, whereas video call did not show such a robust association with depressive symptoms. As observed during the COVID-19 pandemic, the next emerging pandemic may strictly limit in-person contact among older adults because they are generally vulnerable to infectious diseases. In a situation that limits in-person contact, digital inclusion of older adults (e.g., providing opportunities for continued support and training among older adults will enhance their use of technology (Robinson et al., 2020)) is important because there is no option other than remote communication such as video call and voice call to maintain our social connections. However, policymakers/practitioners should bear in mind that the evidence supporting video call as a way to protect against depressive symptoms among older adults appears weak compared to the evidence for in-person contact and is still inconclusive at the moment. In the future, interventional studies evaluating the causality between video call and late-life depression and its effect modifiers are warranted.

Credit author statement

Ryunosuke Shioya: Conceptualization, Methodology, Formal analysis, Software, Writing – original draft. Atsushi Nakagomi: Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Funding acquisition. Kazushige Ide: Conceptualization, Methodology, Writing – review & editing. Katsunori Kondo: Investigation, Writing – review & editing, Supervision, Funding acquisition, Project administration. All authors approved the final manuscript.

Data availability

Data will be made available on request.

Acknowledgments

This study was supported by the Japan Society for the Promotion of Science (21K17302). This study used the data of JAGES which was supported by the Japan Society for the Promotion of Science (15H01972, 20H00557, 20K18931, 21K10323), National Center for Geriatrics and Gerontology (29–42, 30–22, 20–19, 21–20), Japan Agency for Medical Research and Development (JP18dk0110027, JP18ls0110002, JP18le0110009, JP19dk0110034, JP20dk0110034, JP21lk0310073, JP21dk0110037), Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP 1831) from the Japan Science and Technology (JST), and Japanese Ministry of Health, Labour and Welfare (H28-Chouju-Ippan-002, 19FA1012, 19FA 2001, 21GA0101, 22FA1010, 22FA 2001). Some of the municipalities where the study was conducted partially funded the surveys. The funding organizations had no role in the study design, data collection, analysis and interpretation of data, and preparation of the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2023.115777.

References

Arpino, B., Pasqualini, M., Bordone, V., 2021. Physically distant but socially close? Changes in non-physical intergenerational contacts at the onset of the COVID-19 pandemic among older people in France, Italy and Spain. Eur. J. Ageing 18 (2), 185–194. https://doi.org/10.1007/s10433-021-00621-x.

Bonsaksen, T., Thygesen, H., Leung, J., Ruffolo, M., Schoultz, M., Price, D., Østertun Geirdal, A., 2021. Video-based communication and its association with loneliness, mental health and quality of life among older people during the COVID-19 outbreak. Int. J. Environ. Res. Publ. Health 18 (12), 6284. https://doi.org/10.3390/ijerph18126284.

Briggs, R., McDowell, C.P., De Looze, C., Kenny, R.A., Ward, M., 2021. Depressive symptoms among older adults pre– and post–COVID-19 pandemic. J. Am. Med. Dir. Assoc. 22 (11), 2251–2257. https://doi.org/10.1016/j.jamda.2021.09.003.

Cornwell, E.Y., Waite, L.J., 2009. Social disconnectedness, perceived isolation, and health among older adults. J. Health Soc. Behav. 50 (1), 31–48. https://doi.org/10.1177/002214650905000103.

Cudjoe, T.K.M., Kotwal, A.A., 2020. "Social distancing" amid a crisis in social isolation and loneliness. J. Am. Geriatr. Soc. 68 (6) https://doi.org/10.1111/jgs.16527.

Fiske, A., Wetherell, J.L., Gatz, M., 2009. Depression in older adults. Annu. Rev. Clin. Psychol. 5 (1), 363–389. https://doi.org/10.1146/annurev.clinpsy.032408.153621.

Fox, J., McEwan, B., 2017. Distinguishing technologies for social interaction: the perceived social affordances of communication channels scale. Commun. Monogr. 84 (3), 298–318. https://doi.org/10.1080/03637751.2017.1332418.

Freedman, V.A., Hu, M., Kasper, J.D., 2022. Changes in older adults' social contact during the COVID-19 pandemic. J. Gerontol. B Psychol. Sci. Soc. Sci. 77(7), e160-e166. https://doi.org/10.1093/geronb/gbab166.

Galea, S., Merchant, R.M., Lurie, N., 2020. The mental health consequences of COVID-19 and physical distancing. JAMA Intern. Med. 180 (6), 817. https://doi.org/10.1001/jamainternmed.2020.1562.

Greenwood-Hickman, M.A., Dahlquist, J., Cooper, J., Holden, E., McClure, J.B., Mettert, K.D., Perry, S.R., Rosenberg, D.E., 2021. "They're going to zoom it": a qualitative investigation of impacts and coping strategies during the COVID-19 pandemic among older adults. Front. Public Health 9. https://doi.org/10.3389/fpubh.2021.679976.

Hajek, A., König, H.-H., 2021. Social isolation and loneliness of older adults in times of the COVID-19 pandemic: can use of online social media sites and video chats assist in mitigating social isolation and loneliness? Gerontology 67 (1), 121–124. https://doi.org/10.1159/000512793.

Hawkley, L.C., Finch, L.E., Kotwal, A.A., Waite, L.J., 2021. Can remote social contact replace in-person contact to protect mental health among older adults? J. Am. Geriatr. Soc. 69 (11), 3063–3065. https://doi.org/10.1111/jgs.17405.

Hunsaker, A., Hargittai, E., 2018. A review of Internet use among older adults. New Media Soc. 20 (10), 3937–3954. https://doi.org/10.1177/1461444818787348.

Kanamori, M., Hanazato, M., Takagi, D., Kondo, K., Ojima, T., Amemiya, A., Kondo, N., 2021. Differences in depressive symptoms by rurality in Japan: a cross-sectional multilevel study using different aggregation units of municipalities and neighborhoods (JAGES). Int. J. Health Geogr. 20 (1), 42. https://doi.org/10.1186/s12942-021-00296-8.

Kenward, M.G., Carpenter, J., 2007. Multiple imputation: current perspectives. Stat. Methods Med. Res. 16 (3), 199–218. https://doi.org/10.1177/0962280206075304.

Kondo, K., 2016. Progress in aging Epidemiology in Japan: the JAGES project. J. Epidemiol. 26 (7), 331–336. https://doi.org/10.2188/jea.je20160093.

Kondo, K., Rosenberg, M., World Health Organization, 2018. Advancing Universal Health Coverage through Knowledge Translation for Healthy Ageing: Lessons Learnt from the Japan Gerontological Evaluation Study. World Health Organization. Retrieved from. https://apps.who.int/iris/handle/10665/279010. (Accessed 28 June 2022).

Kondo, N., Koga, C., Nagamine, Y., Ota, A., Shobugawa, Y., Cable, N., Tajika, A., Nakagomi, A., Chishima, I., Ide, K., Ueno, T., Fujihara, S., Fujinami, Y., Yasufuku, Y., Ando, Y., 2021. Understanding the role of Internet access on health and health equity toward healthy ageing in the western pacific region. World Health Organization - Regional Office for the Western Pacific Retrieved from https://www.jages.net/project/wpro_en/. (Accessed 28 June 2022).

Koyano, W., Shibata, H., Nakazato, K., Haga, H., Suyama, Y., 1991. Measurement of competence: reliability and validity of the TMIG Index of Competence. Arch. Gerontol. Geriatr. 13 (2), 103–116. https://doi.org/10.1016/0167-4943(91)90053-s.

Lam, S.S.M., Jivraj, S., Scholes, S., 2020. Exploring the relationship between Internet use and mental health among older adults in England: longitudinal observational study. J. Med. Internet Res. 22 (7), e15683 https://doi.org/10.2196/15683.

Lee, C., Coughlin, J.F., 2015. PERSPECTIVE: older adults' adoption of technology: an integrated approach to identifying determinants and barriers. J. Prod. Innovat. Manag. 32 (5), 747–759. https://doi.org/10.1111/jpim.12176.

Markus, H.R., Kitayama, S., 1991. Culture and the self - implications for cognition, emotion, and motivation. Psychol. Rev. 98 (2), 224–253. https://doi.org/10.1037/0033-295x.98.2.224.

Ministry of Internal Affairs and Communications, 2022. The Communications Usage Trend Survey. https://www.soumu.go.jp/johotsusintokei/statistics/statistics05b1.html. (Accessed 27 January 2022).

Misawa, J., Kondo, K., 2019. Social factors relating to depression among older people in Japan: analysis of longitudinal panel data from the AGES project. Aging Ment. Health 23 (10), 1423–1432. https://doi.org/10.1080/13607863.2018.1496225.

Nakagomi, A., Shiba, K., Kondo, K., Kawachi, I., 2022. Can online communication prevent depression among older people? A longitudinal analysis. J. Appl. Gerontol. 41 (1), 167–175. https://doi.org/10.1177/0733464820982147.

National Academies of Sciences, E., & Medicine, 2020. Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System. National Academies Press.

Noguchi, T., Hayashi, T., Kubo, Y., Tomiyama, N., Ochi, A., Hayashi, H., 2021. Association between decreased social participation and depressive symptom onset among community-dwelling older adults: a longitudinal study during the COVID-19 pandemic. J. Nutr. Health Aging 25 (9), 1070–1075. https://doi.org/10.1007/s12603-021-1674-7.

O'Connell, M.E., Haase, K.R., Grewal, K.S., Panyavin, I., Kortzman, A., Flath, M.E., Cammer, A., Cosco, T.D., Peacock, S., 2022. Overcoming barriers for older adults to maintain virtual community and social connections during the COVID-19 pandemic. Clin. Gerontol. 45 (1), 159–171. https://doi.org/10.1080/07317115.2021.1943589.

Oh, C.S., Bailenson, J.N., Welch, G.F., 2018. A systematic review of social presence: definition, antecedents, and implications. Frontiers in Robotics and AI 5. https://doi.org/10.3389/frobt.2018.00114.

Park, S.-H., Kwak, M.-J., 2021. Performance of the geriatric depression scale-15 with older adults aged over 65 Years: an updated review 2000-2019. Clin. Gerontol. 44 (2), 83–96. https://doi.org/10.1080/07317115.2020.1839992.

Pew Research Center, 2022. Share of those 65 and older who are tech users has grown in the past decade. https://www.pewresearch.org/fact-tank/2022/01/13/share-of-those-65-and-older-who-are-tech-users-has-grown-in-the-past-decade/. (Accessed 27 January 2022).

Pocklington, C., Gilbody, S., Manea, L., McMillan, D., 2016. The diagnostic accuracy of brief versions of the Geriatric Depression Scale: a systematic review and meta-analysis. Int. J. Geriatr. Psychiatr. 31 (8), 837–857. https://doi.org/10.1002/gps.4407.

Robinson, L., Schulz, J., Khilnani, A., Ono, H., Cotten, S.R., McClain, N., Levine, L., Chen, W., Huang, G., Casilli, A.A., Tubaro, P., Dodel, M., Quan-Haase, A., Ruiu, M.L., Ragnedda, M., Aikat, D., Tolentino, N., 2020. Digital Inequalities in Time of Pandemic: COVID-19 Exposure Risk Profiles and New Forms of Vulnerability. First Monday. https://doi.org/10.5210/fm.v25i7.10845.

Rubin, D.B., 1996. Multiple imputation after 18+ years. J. Am. Stat. Assoc. 91 (434), 473–489. https://doi.org/10.1080/01621459.1996.10476908.

Santini, Z.I., Jose, P.E., York Cornwell, E., Koyanagi, A., Nielsen, L., Hinrichsen, C., Madsen, K.R., Koushede, V., 2020. Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. Lancet Public Health 5 (1), e62–e70. https://doi.org/10.1016/s2468-2667(19)30230-0.

Sato, K., Kondo, N., Kondo, K., 2022. Pre-pandemic individual- and community-level social capital and depressive symptoms during COVID-19: a longitudinal study of Japanese older adults in 2019-21. Health Place 74, 102772. https://doi.org/10.1016/j.healthplace.2022.102772.

Schwarzbach, M., Luppa, M., Forstmeier, S., König, H.-H., Riedel-Heller, S.G., 2014. Social relations and depression in late life-A systematic review. Int. J. Geriatr. Psychiatr. 29 (1), 1–21. https://doi.org/10.1002/gps.3971.

Sepúlveda-Loyola, W., Rodríguez-Sánchez, I., Pérez-Rodríguez, P., Ganz, F., Torralba, R., Oliveira, D.V., Rodríguez-Mañas, L., 2020. Impact of social isolation due to COVID-19 on health in older people: mental and physical effects and recommendations. J. Nutr. Health Aging 24 (9), 938–947. https://doi.org/10.1007/s12603-020-1500-7.

Szabo, A., Allen, J., Stephens, C., Alpass, F., 2019. Longitudinal analysis of the relationship between purposes of Internet use and well-being among older adults. Gerontol. 59 (1), 58–68. https://doi.org/10.1093/geront/gny036.

Teo, A.R., Markwardt, S., Hinton, L., 2019. Using skype to beat the blues: longitudinal data from a national representative sample. Am. J. Geriatr. Psychiatr. 27 (3), 254–262. https://doi.org/10.1016/j.jagp.2018.10.014.

Werner-Seidler, A., Afzali, M.H., Chapman, C., Sunderland, M., Slade, T., 2017. The relationship between social support networks and depression in the 2007 National Survey of Mental Health and Well-being. Soc. Psychiatr. Psychiatr. Epidemiol. 52 (12), 1463–1473. https://doi.org/10.1007/s00127-017-1440-7.

World Health Organization, 2017. Depression and Other Common Mental Disorders: Global Health Estimates. World Health Organization. Retrieved from. https://www.who.int/publications/i/item/depression-global-health-estimates. (Accessed 28 June 2022).

Xiu-Ying, H., Qian, C., Xiao-Dong, P., Xue-Mei, Z., Chang-Quan, H., 2012. Living arrangements and risk for late life depression: a meta-analysis of published literature. Int. J. Psychiatr. Med. 43 (1), 19–34. https://doi.org/10.2190/PM.43.1.b.

Yan, X.Y., Huang, S.M., Huang, C.Q., Wu, W.H., Qin, Y., 2011. Marital status and risk for late life depression: a meta-analysis of the published literature. J. Int. Med. Res. 39 (4), 1142–1154. https://doi.org/10.1177/147323001103900402.

Yesavage, J.A., Sheikh, J.I., 1986. Geriatric Depression Scale (GDS): recent evidence and development of a shorter version. Clin. Gerontol. 5 (1–2), 165–173. https://doi.org/10.1300/J018v05n01_09.

Zaninotto, P., Iob, E., Demakakos, P., Steptoe, A., 2022. Immediate and longer-term changes in the mental health and well-being of older adults in england during the COVID-19 pandemic. JAMA Psychiatr. 79 (2), 151. https://doi.org/10.1001/jamapsychiatry.2021.3749.

Zhang, J., Yu, K.F., 1998. What's the relative risk? JAMA 280 (19), 1690. https://doi.org/10.1001/jama.280.19.1690.

Zou, G., 2004. A modified Poisson regression approach to prospective studies with binary data. Am. J. Epidemiol. 159 (7), 702–706. https://doi.org/10.1093/aje/kwh090.