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# Loneliness in Japan during the COVID-19 pandemic: Prevalence, correlates and association with mental health

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## ABSTRACT

Loneliness, which is increasingly recognised as an important public health problem, may have increased during the COVID-19 pandemic in the wake of social distancing measures. This study examined loneliness in Japan during the ongoing pandemic and its association with mental health. Cross-sectional online survey data that were collected at monthly intervals from April to December 2020 were analysed. Loneliness was assessed with the Three-Item Loneliness Scale. Information was also obtained on depressive (PHQ-9) and anxiety (GAD-7) symptoms. Logistic regression analysis was used to examine associations. For the combined sample ( $N = 9000$ ), 41.1% of the respondents were categorised as lonely when using  $\geq 6$  as a cutoff score, and 16.5% when the cutoff was  $\geq 7$ . The prevalence of loneliness changed little across the period. Younger age, male sex and socioeconomic disadvantage (low income, deteriorating financial situation, unemployment) were associated with loneliness. In fully adjusted analyses, loneliness was linked to depressive (odds ratio [OR]: 5.78, 95% confidence interval [CI]: 5.08–6.57) and anxiety symptoms (OR: 5.34, 95% CI: 4.53–6.29). Loneliness is prevalent in Japan during the COVID-19 pandemic and associated with socioeconomic disadvantage and poorer mental health. A focus on loneliness as a public health issue in Japan is now warranted.

## 1. Introduction

Loneliness, which has been described as “a distressing state indicating that one’s basic need for social connection is not being met” (Inagaki et al., 2016) is common in society. Studies from across the world have shown that the extent of loneliness varies between countries, age groups and men and women and that for some country-age groups the prevalence of loneliness may range between 10% and 30% (Stickley et al., 2013; Yang and Victor, 2011). There is also some evidence that loneliness may be increasing in some societies (Cacioppo et al., 2015). This is worrying given the growing recognition of the detrimental effect that loneliness can have on public health (Cacioppo and Cacioppo, 2018). In particular, a rapidly growing body of research has not only linked loneliness to worse physical and psychological health (Meltzer et al., 2013; Stickley and Koyanagi, 2018) but also shown that loneliness may be associated with an increased mortality risk (Holt-Lunstad et al., 2015).

The current study will examine loneliness and its association with mental health in Japan during the ongoing COVID-19 pandemic. This

research may be particularly apposite given that one of the principal means of preventing the transmission of coronavirus — social distancing — may also result in both poorer mental health (Tran et al., 2020) and increased loneliness (Smith and Lim, 2020). This latter notion is supported by some research which has indicated that loneliness may have increased during the pandemic (Losada-Baltar et al., 2021; van der Velden et al., 2021), with a recent study from the United States showing that loneliness not only increased significantly in April to September 2020, but was especially elevated in individuals placed under stay-at-home/shelter-in-place/lockdown orders (Killgore et al., 2020b). Other research has also indicated that levels of loneliness may be high during the ongoing pandemic (Bu et al., 2020a; Groarke et al., 2020) and that the risk of loneliness may have increased even more in those already at risk of feeling lonely (e.g., adults living alone) (Bu et al., 2020b).

The importance of researching population loneliness has also been highlighted by the fact that its pre-pandemic association with worse mental health outcomes such as depression and anxiety, (possibly as a result of a maladaptive chronic stress response, which has been hypothesised to link loneliness to adverse health outcomes more

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generally) (Park et al., 2020), has also been replicated during the ongoing pandemic. Specifically, loneliness has been associated with psychological distress (Liu et al., 2021), anxiety and depressive symptoms (Groarke et al., 2021; Hoffart et al., 2020; Horigian et al., 2021; Jaspal and Breakwell, 2020; van der Velden et al., 2021) as well as anxiety and depression comorbidity (Palgi et al., 2020). In turn, other research has indicated that poorer mental health may itself be linked to other detrimental outcomes during the pandemic, including the severity of substance use (Horigian et al., 2021) as well as lower engagement in COVID-19 preventive behaviours (Stickley et al., 2020). Given this, more research on the loneliness-mental health association may have significant implications for ongoing COVID-19 public health efforts.

As yet, there has been comparatively little research on loneliness in Japan either before or after the onset of the pandemic. Nonetheless, some prior research has indicated that loneliness might also be prevalent in this setting (DiJulio et al., 2018), while a more recent study has shown its potentially detrimental effects on COVID-19 preventive behaviours in Japanese adults (Stickley et al., 2021). Importantly, research from early during the pandemic has also indicated that the prevalence of depression and anxiety may be elevated in the Japanese population (Ueda et al., 2020b), while a recent study found that loneliness was linked to poorer mental health in both medical workers and the general population in Japan (Kotera et al., 2021). However, as that study included only 280 participants and the data were collected via Facebook groups, it is unclear whether its findings would hold in a larger and more diverse sample of the general population.

Thus, the aim of this study was to use data from a large cross-sectional sample of the Japanese population to examine: (i) the prevalence of loneliness among individuals in Japan during the COVID-19 pandemic; (ii) factors associated with loneliness; and (iii) whether loneliness is associated with poorer mental health in Japanese individuals.

## 2. Methods

### 2.1. Participants

The information in this study comes from nine rounds of an online survey of the Japanese population aged 18 and above undertaken each month from April to December 2020. The survey was administered by a commercial survey company, the Survey Research Centre. Every month the company selected approximately 10,000 respondents from its commercial web panel and then sent them a set of screening questions. These questions were used to construct a sample of 1000 respondents based on their demographic characteristics. In every round each new set of participants was representative of the Japanese general population in terms of residency area, sex, and age distribution. Respondents were asked to complete an online questionnaire which covered topics relating to their demographic characteristics, economic situation, mental well-being and the ongoing COVID-19 pandemic. Across the nine rounds the final sample size was 9000 people. Ethical permission for the study was obtained from the Ethics Committee of Waseda University (approval case number: 2020-050) and Osaka School of International Public Policy, Osaka University. Before they began the survey, participants were informed of the purpose of the study and that they had the right to discontinue their participation at any time. Respondents provided consent that their information could be used for the purpose of the study. All data were anonymised when provided to the final author (M.U.).

### 2.2. Measures

*Loneliness* was assessed with the Three-Item Loneliness Scale (Hughes et al., 2004). This measure examines a lack of companionship, feeling left out, and feeling isolated from others. Each item has three possible answer options, hardly ever (scored 1), some of the time (scored 2), and often (scored 3). The total score ranges between 3 and 9 with

higher scores indicating greater levels of loneliness. In accordance with prior research using this measure, a score of 6 and above was used to categorise loneliness (Steptoe et al., 2013; Victor and Pikhartova, 2020). An earlier study showed that this scale is reliable and has concurrent and discriminatory validity (Hughes et al., 2004). Two recent studies have reported that the Japanese version of this measure is similarly valid and reliable (Igarashi, 2019; Saito et al., 2019). The internal consistency of the scale was good (Cronbach's alpha = 0.82).

Past 2-week *depressive symptoms* were assessed with the PHQ-9 (Kroenke et al., 2001). This nine-item self-report depression scale is from the Patient Health Questionnaire. Each item has 4 response options that range from not at all (scored 0) to nearly every day (scored 3). The total score can range from 0 to 27 with higher scores indicating greater depression. In this study a dummy variable was created with a score of 10 and above being used to indicate the presence of at least moderate depression. Cronbach's alpha for the scale was 0.91 Past 2-week *anxiety symptoms* were assessed with the Generalised Anxiety Disorder-7 (GAD-7) (Spitzer et al., 2006). This self-report seven-item scale has the same response options as the PHQ-9 with the total score ranging between 0 and 21, with higher scores indicating more anxiety. In this study we used a score of 10 and above to signify the presence of at least moderate anxiety. Cronbach's alpha for the scale was 0.92

Information was also obtained on the demographic and socioeconomic characteristics of the participants. Besides sex (male, female), respondents were classified into six *age* categories, 18–29, 30–39, 40–49, 50–59, 60–69 and 70 and above. *Education* level was dichotomised into having a college degree and above or having less than a college degree. There were also two categories for *living arrangements*, people who lived alone in single person households and people who lived in 2 or more person households. *Household income* was divided into 3 categories: < 4 million yen, ≥ 4 million but < 8 million yen, and ≥ 8 million yen. To keep as many participants in the analysis as possible a fourth 'missing' category was also created to account for the 18% of the sample that did not provide information on their household's income. Respondents also provided information on how their *household financial situation* had changed in the past year. Two categories were created (i) unchanged/improved; (ii) worsened. Finally, employment status was classified using 5 categories: (i) permanent employee; (ii) part-time/temporary worker; (iii) self-employed; (iv) unemployed/laid off/on leave; (v) not in the labour force (e.g. homemakers, students).

### 2.3. Statistical analysis

Descriptive statistics for the combined sample ( $N = 9000$ ) stratified by the prevalence of loneliness were first calculated with Chi-square statistics used to assess differences between the categories. After calculating the prevalence of loneliness across the period, a logistic regression analysis using the combined sample was undertaken to examine which factors are associated with loneliness. Two analyses were performed. The first analysis examined the bivariate association between each of the potential correlates and loneliness. All of the variables were then entered into a fully adjusted multivariable analysis. Next, we examined the association between loneliness and mental health (anxiety and depressive symptoms) for the combined sample. Two analyses were also undertaken. In the first analysis the bivariate association between loneliness and anxiety/depression was examined. In the second analysis the association between loneliness and anxiety and depression was examined while controlling for demographic and socioeconomic characteristics. In all regression analyses loneliness was categorised using the ≥ 6 cutoff score. Analyses were adjusted for prefecture and survey round, and were performed with the Statistical Package for the Social Sciences (SPSS) version 24. Results are presented as odds ratios (OR) with 95% confidence intervals (CI). The level of statistical significance was  $p < 0.05$  (two-tailed).

### 3. Results

With the exception of education, there were significant differences between all of the variables for the prevalence of loneliness. Specifically, male sex, younger age, living in a single person household, having a lower income, experiencing a worsening household financial situation in the previous year and being unemployed/laid off/on leave were all associated with a significantly higher prevalence of loneliness (Table 1). For the combined sample, 41.1% of the respondents were categorised as lonely when the  $\geq 6$  cutoff score was used, while the corresponding figure was 16.5% when using a 7 and above cutoff. The mean (SD) loneliness score was 4.98 (1.77). The prevalence of loneliness changed little across the nine-month period. When a cutoff score of 6 and above was used it ranged from 40.1% in August to 41.7% in October (Table 2). When a higher cutoff score was used, 7 and above, the comparable figures were 14.9% (September) and 17.9% (June). The mean (SD) score for the Three-Item Loneliness Scale (range 3–9) varied between 4.92 (1.72) (September) and 5.04 (1.76) (October).

In the logistic regression analysis there were significant differences between all of the categories in the multivariable model (Table 3). Female sex was associated with a 20% reduction in the odds for loneliness (OR: 0.80, 95% CI: 0.72–0.89). Participants aged under 70 had significantly higher odds for loneliness compared to adults aged 70 and above, with ORs of between 3.1 and 3.7 among those aged 18–49, 2.6 for respondents in their 50s and 1.8 for those aged 60–69. Having a college education was associated with a 11% reduction in the odds for loneliness in the multivariable analysis. In contrast, participants living in single person households had 19% higher odds for loneliness compared to those with other living arrangements. Having a lower household income and experiencing a worsening of one’s household financial situation in the previous year were both linked to higher odds for loneliness. In the bivariate analysis, permanent employees, part-time or temporary workers and those who were unemployed/laid off/on leave all had

**Table 1**  
Sample characteristics by loneliness status\*.

Variable	Total N	Not lonely N (%)	Lonely N (%)	P-value
Sex				<0.001
Male	4464	2540 (56.9)	1924 (43.1)	
Female	4536	2763 (60.9)	1773 (39.1)	
Age				<0.001
18–29	1368	727 (53.1)	641 (46.9)	
30–39	1350	671 (49.7)	679 (50.3)	
40–49	1710	868 (50.8)	842 (49.2)	
50–59	1539	882 (57.3)	657 (42.7)	
60–69	1593	1041 (65.3)	552 (34.7)	
$\geq 70$	1440	1114 (77.4)	326 (22.6)	
Education				.105
Less than college degree	4972	2892 (58.2)	2080 (41.8)	
College degree and above	4028	2411 (59.9)	1617 (40.1)	
Living arrangement				<0.001
Single person household	1841	976 (53.0)	865 (47.0)	
$\geq 2$ -person household	7159	4327 (60.4)	2832 (39.6)	
Household income				<0.001
< 4 million yen	2758	1555 (56.4)	1203 (43.6)	
$\geq 4$ but < 8 million yen	3100	1835 (59.2)	1265 (40.8)	
$\geq 8$ million yen	1527	991 (64.9)	536 (35.1)	
Missing information	1615	922 (57.1)	693 (42.9)	
Household financial situation				<0.001
Unchanged/improved	7043	4366 (62.0)	2677 (38.0)	
Worsened	1957	937 (47.9)	1020 (52.1)	
Employment status				<0.001
Permanent employee	3368	1838 (54.6)	1530 (45.4)	
Part-time/temporary worker	966	523 (54.1)	443 (45.9)	
Self-employed	340	215 (63.2)	125 (36.8)	
Unemployed/laid off/on leave	500	246 (49.2)	254 (50.8)	
Not in the labour force	3826	2481 (64.8)	1345 (35.2)	

\* Loneliness was categorised as a score of  $\geq 6$  on the Three-Item Loneliness Scale.

higher odds for loneliness when compared with those who were not in the labour force. However, in the multivariable analysis only unemployment continued to be associated with loneliness (OR: 1.27, 95% CI: 1.04–1.55).

Respondents who were lonely had over 6.5 times higher odds for both depression and anxiety in the bivariate logistic regression analyses (Table 4). Adjusting the analysis for demographic and socioeconomic variables slightly attenuated the association but loneliness continued to be associated with over 5 times higher odds for depression (OR: 5.78, 95% CI: 5.08–6.57) and anxiety (OR: 5.34, 95% CI: 4.53–6.29).

### 4. Discussion

This study used data from nine rounds of a monthly online survey collected in April to December 2020 to examine the prevalence and correlates of loneliness and its association with mental ill health among individuals in Japan during the ongoing coronavirus pandemic. Results showed that loneliness was prevalent across the period with over 40% of individuals being categorised as lonely every month. Loneliness was associated with male sex, younger age and various forms of socioeconomic disadvantage (lower education, income, worsening household finances and being unemployed). Lonely individuals were more likely to experience worse mental health (anxiety and depressive symptoms) compared to their non-lonely counterparts.

Although caution should be exercised given the different ways in which loneliness has been classified and because there has been little previous research on loneliness in Japan, the results of our study nevertheless may indicate that loneliness is elevated among Japanese adults during the ongoing pandemic. Specifically, an earlier multi-country study that used a single-item question to measure loneliness in Japan, the United Kingdom (UK) and United States (US) in 2018 reported that 9% of Japanese adults often or always felt lonely — a figure less than half of that in the UK (23%) and US (22%) (DiJulio et al., 2018) and less than one-quarter of the figure in the current study (41.1%) or just over half if a more conservative ( $\geq 7$ ) cutoff score is used. The mean loneliness score in this study (4.98) is also higher than in a recent small-scale study from Japan that examined loneliness among medical workers (4.73) and the general population (4.33) during the pandemic (Kotera et al., 2021). However, although possibly elevated, the level of loneliness in Japan may be comparable to, or even lower than that in some other countries. In a nationally representative sample of 18–35 year old adults from the US, 43% of respondents exceeded the high loneliness cutoff in April 2020 (Killgore et al., 2020a), while a study that used the same loneliness measure as in this study found 39.3% of UK adults scored 6 or above in March–May 2020 (Bu et al., 2020b) (our calculation). Another UK study reported that 27% of adults were lonely in March–April 2020 when using a cutoff score of 7 and above (Groarke et al., 2020), compared to only 16.5% in the current study.

The prevalence of loneliness remained comparatively stable among the Japanese population in April to December 2020. Studies have provided conflicting results concerning changes in the prevalence of loneliness during the COVID-19 pandemic. While some research has indicated that loneliness may have increased in the general population (Killgore et al., 2020b), other studies have reported that there has been no change in overall population loneliness in the pre- and pandemic period (Hansen et al., 2021; Luchetti et al., 2020). It is uncertain what underlies these differences across studies and whether they relate to methodological factors such as the loneliness measures used, the different time periods examined/used for comparison, or differences in the COVID-19 situation in different countries and preventive measures implemented and/or the extent of their enforcement. In terms of this study, our findings most closely correspond with those from an earlier UK study which reported stable but high levels of loneliness for many people during the early phase of the pandemic in March to May 2020 (Bu et al., 2020a). Indeed, our finding that over 40% of Japanese individuals may be lonely during the COVID-19 pandemic provides

**Table 2**  
Prevalence of loneliness and mean loneliness score among Japanese individuals in April to December 2020.

	Month									
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Loneliness ≥ 6 (%)	41.5	41.4	41.3	41.1	40.1	40.4	41.7	40.6	41.6	
Loneliness ≥ 7 (%)	17.5	17.3	17.9	16.3	16.3	14.9	15.6	17.1	16.0	
Mean (SD)	5.00 (1.79)	4.98 (1.81)	5.00 (1.81)	4.97 (1.76)	4.94 (1.75)	4.92 (1.72)	5.04 (1.76)	4.95 (1.77)	4.98 (1.74)	
N	1000	1000	1000	1000	1000	1000	1000	1000	1000	

**Table 3**  
Factors associated with loneliness among individuals in Japan during the coronavirus pandemic (N = 9000).

Variable	Bivariate analysis OR (95% CI)	Multivariable analysis OR (95% CI)
Sex		
Female	0.85 (0.78–0.93)***	0.80 (0.72–0.89)***
Age group		
≥70	Ref.	Ref.
18–29	3.04 (2.58–3.58)***	3.08 (2.58–3.68)***
30–39	3.47 (2.94–4.09)***	3.71 (3.09–4.44)***
40–49	3.33 (2.84–3.89)***	3.47 (2.92–4.12)***
50–59	2.55 (2.17–2.99)**	2.61 (2.19–3.10)***
60–69	1.81 (1.54–2.13)***	1.82 (1.54–2.15)***
Education		
≥ College degree	0.94 (0.86–1.02)	0.89 (0.81–0.98)*
Single-person household (Yes)	1.38 (1.24–1.53)***	1.19 (1.06–1.33)**
Household income		
≥ 8 million yen	Ref.	Ref.
≥ 4 but < 8 million yen	1.27 (1.12–1.45)***	1.24 (1.09–1.42)**
< 4 million yen	1.43 (1.26–1.63)***	1.57 (1.35–1.82)***
Missing information	1.39 (1.20–1.60)***	1.53 (1.31–1.78)***
Household financial situation		
Worsened	1.77 (1.59–1.95)***	1.69 (1.53–1.89)***
Employment status		
Not in the labour force	Ref.	Ref.
Permanent employee	1.54 (1.40–1.69)***	1.04 (0.92–1.18)
Part-time/temporary worker	1.55 (1.34–1.79)***	1.14 (0.98–1.33)
Self-employed	1.07 (0.85–1.35)	0.84 (0.66–1.08)
Unemployed/laid off/on leave	1.91 (1.58–2.30)***	1.27 (1.04–1.55)*

OR: Odds ratio; CI: Confidence interval; Ref: reference category.

All analyses were adjusted for prefecture and survey round.

- \* p < 0.05;
- \*\* p < 0.01;
- \*\*\* p < 0.001.

support for the notion that loneliness should now be regarded as a serious public health problem in Japan — especially as there is some evidence that the severity of the loneliness experience may be worse in Japan than in some other countries (DiJulio et al., 2018).

Several demographic and socioeconomic factors were associated with higher odds for loneliness. The finding that individuals who were younger than 70 years old were more likely to be lonely accords with the results from a number of studies that have highlighted younger age as a risk factor for loneliness during the pandemic (Bu et al., 2020b; Groarke et al., 2020; Hoffart et al., 2020; Li and Wang, 2020; Wickens et al.,

**Table 4**  
Association between loneliness and mental health in Japan during the COVID-19 pandemic (N = 9000).

Variable	Depression <sup>‡</sup>		Anxiety <sup>‡</sup>	
	Model 1 <sup>†</sup>	Model 2 <sup>‡</sup>	Model 1 <sup>†</sup>	Model 2 <sup>‡</sup>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Loneliness	6.95 (6.14–7.88)***	5.78 (5.08–6.57)***	6.64 (5.65–7.80)***	5.34 (4.53–6.29)***

<sup>‡</sup> All analyses were adjusted for prefecture and survey round.

<sup>†</sup> Bivariate analysis.

<sup>‡</sup> Multivariable analysis adjusted for sex, age, education, living arrangement, household income, household financial situation, employment status.

OR: Odds ratio; CI: Confidence interval.

\*\*\* p < 0.001.

2021). In connection with this, it is possible that policies designed to prevent the spread of coronavirus such as lockdowns, remote learning, teleworking, furloughing and travel restrictions might have disproportionately impacted younger adults in terms of increased social isolation and greater loneliness (Groarke et al., 2020). In contrast, the finding that men were more likely to be lonely conflicts with the results from several other studies which have reported that women are lonelier during the pandemic (Bu et al., 2020b; Hoffart et al., 2020; Li and Wang, 2020; Wickens et al., 2021). It is unclear what accounts for this difference although our finding is in line with an earlier study which showed a higher prevalence of loneliness in Japanese men in the pre-pandemic period (DiJulio et al., 2018). Results also showed that those respondents who were socioeconomically disadvantaged in terms of having less education, lower income, deteriorating household finances and unemployment had higher odds for loneliness. Research from the UK has shown that some of these factors were associated with loneliness before the emergence of coronavirus but that their effects may have been exacerbated during the COVID-19 pandemic (Bu et al., 2020b). Our finding supports the supposition that those who are economically disadvantaged might have been disproportionately affected by measures taken to control the spread of coronavirus (Holmes et al., 2020) and therefore potentially more susceptible to their negative psychological effects.

Respondents who were lonely had significantly increased odds for anxiety and depressive symptoms. This finding accords with a recent study from Japan which found that loneliness was linked to worse mental health in medical workers and a small sample of the general population during the COVID-19 pandemic (Kotera et al., 2021). It is also in line with the results from other studies during the pandemic that have found an association between loneliness and anxiety and depression (Jaspal and Breakwell, 2020; Jia et al., 2020; McQuaid et al., 2021; Palgi et al., 2020). Although some research has suggested that the association between loneliness and depression may be stronger than the association with anxiety (Hoffart et al., 2020), in the current study the odds were similar for depression and anxiety. The finding that lonely individuals in Japan may be at increased risk for worse mental health is a cause for concern. Depression and anxiety have not only been linked to worse COVID-19-related outcomes (decreased use of preventive behaviours) in this setting (Stickley et al., 2020) but poorer mental health may also exacerbate the effects of loneliness on other detrimental outcomes such as suicidal behaviour (Stickley and Koyanagi, 2016), while there is evidence that suicide mortality may have risen in some population subgroups in Japan during the pandemic (Ueda et al., 2020a).

This study has several limitations. First, the data were cross-sectional and did not allow us to establish causality or determine the directionality of the observed associations. Second, we had no information on the length of time respondents had felt lonely and thus, the exact impact of the pandemic on loneliness. This may have been problematic as an earlier study from Japan reported that 35% of respondents who were lonely, had felt lonely/isolated from the people around them for more than 10 years (DiJulio et al., 2018). Third, we lacked information on potentially important variables that may be associated with loneliness. For example, previous research has linked disability or chronic disease to loneliness in Japan (DiJulio et al., 2018), while other studies have shown that factors such as social support may also be important for loneliness during the COVID-19 pandemic (Groarke et al., 2020). Fourth, self-reported items were used to measure mental health rather than a structured clinical interview which is considered the gold standard for establishing a psychiatric diagnosis. This might have resulted in cases being misclassified. Finally, our data came from a web-based survey which may have limited the ability of some people such as those with e.g. language/literacy issues, to participate, potentially affecting the overall representativeness of the sample. Conversely, a recent study has reported that web-based self-reports may have an advantage in terms of producing higher levels of self-disclosure on sensitive issues (Milton et al., 2017) such as loneliness.

In conclusion, this study has shown that a large number of Japanese individuals are feeling lonely during the COVID-19 pandemic, that loneliness is linked to socioeconomic disadvantage and that individuals who are lonely are more likely to have worse mental health. As an earlier study showed that almost half (48%) of Japanese adults do not talk to anyone about their feelings of loneliness, while 57% of those who are lonely think it is due to factors beyond their control (DiJulio et al., 2018) this highlights the necessity of efforts to increase public recognition and understanding of loneliness as a public health issue. Indeed, recent efforts in the UK to address the growing problem of loneliness as a strategic policy priority (Escalante et al., 2021) offer a possible blueprint for governmental action in this respect, with some indication that Japan may now be following this lead (Business Today, 2021). In addition, more research is needed on loneliness in Japan during the pandemic and beyond in order to formulate evidence-based interventions given that there is growing evidence that some forms of intervention may be effective in reducing loneliness (Williams et al., 2021) together with other mental health outcomes such as anxiety and depression (Kahlon et al., 2021). Indeed, recent research has highlighted the potential utility and cost-effectiveness of internet-based cognitive behaviour therapy to treat loneliness (Kall et al., 2020) and depression (Ho et al., 2020; Zhang and Ho, 2017) as well as associated conditions such as insomnia (Soh et al., 2020). This form of intervention may be especially beneficial in an environment where mobility is restricted in order to reduce coronavirus disease transmission.

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None.

#### Author contributions

AS had the study idea, performed the statistical analysis, wrote the main text; MU oversaw the data acquisition and preparation, commented on and revised the main text.

#### Declaration of Competing Interest

The authors declare no conflict of interest.

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