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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1 Demographic characteristics of participants.

Table S2 Results of univariate regression analysis of each Peritraumatic Distress Inventory item in participants for post-traumatic stress symptoms.

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Mental health status of the general population in Japan during the COVID-19 pandemic

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From late December 2019, a novel coronavirus (COVID-19) spread rapidly to countries throughout the world. In the absence of a vaccine, and given the high degree of transmissibility and potential lethality of COVID-19, social and physical distancing, including reducing/avoiding crowding, the closure of non-essential businesses/services, stay-at-home orders, and local/national movement restrictions, have been the main public health measures adopted to mitigate the transmission/detrimental effects of the virus.[1] Despite the potential benefits of such measures, they might also have negative short- and long-term consequences for mental health.[2] For example, financial loss and the socioeconomic distress that can result from quarantine may underpin the emergence of psychological disorders.[3] Against this backdrop, we examined the effects of the COVID-19 pandemic on the mental health of a national sample of the Japanese population (see Appendix S1 for a description of the situation in Japan).

We administered two rounds of an online survey of the Japanese population between 16 and 18 April (1st round) and 15 and 17 May (2nd round) 2020. A commercial survey company, the Survey Research Center, sent out a set of screening questions to approximately 10 000 respondents from its commercial web panel and then constructed a sample of 1000 respondents based on their demographic characteristics. A new set of respondents was drawn in the second round. The final sample of 2000 people comprised respondents who were representative of the Japanese general population in terms of the area of their residency, sex, and age distribution. This study was approved by the Ethics Review Committee on Human Research of Waseda University (approval #: 2020-050) and Osaka School of International Public Policy, Osaka University and conforms to the provisions of the Declaration of Helsinki. The respondents provided explicit consent and the data are completely anonymous.

The nine-item Patient Health Questionnaire[4] was used to measure depressive symptoms, while the 7-item Generalized Anxiety Disorder Scale[5] was used to measure anxiety symptoms (Appendix S2). We also obtained information on the age, sex, education, prefectural area of residence, employment status, household income, and household financial situation of the respondents. For the analysis we first calculated the prevalence of anxiety and depressive symptoms for each of the demographic and economic groups. Then logistic regression models were estimated with either the 7-item Generalized Anxiety Disorder Scale or nine-item Patient Health Questionnaire categories as the outcome and all the respondents' characteristics as the regressors.

The descriptive statistics of the sample stratified by the mental health variables are presented online in Table S1, while details of the mental health scores are presented in Appendix S3. In fully adjusted logistic regression models, the following factors were associated with significantly increased odds for both depressive and anxiety symptoms: being young or middle aged compared to older aged (≥60 years); having a worse household financial situation compared to the previous year; and being unemployed, laid off, or on leave. Being a part-time or temporary worker was associated with higher odds for depression while the association with anxiety was of borderline statistical significance (Figs S1 and S2).

Our results suggest that the mental health condition of some segments of the Japanese population may be particularly vulnerable during the ongoing COVID-19 crisis. In particular, individuals who were in an economically vulnerable situation, that is, those who were not currently working or who were employed as part-time or temporary contract-based workers, reported worse mental health. This is consistent with the notion that the effects of a faltering economy and reduction in business activities caused by COVID-19 are first and foremost likely to detrimentally affect workers without employment or without stable employment. Similarly, individuals who felt that their financial position had deteriorated in the past year also had greater odds for depression and anxiety. In addition, the mental health of young and middle-aged individuals was significantly poorer than that of older individuals. We can only speculate why the current crisis may be having an especially detrimental impact on the mental health of the working-age population. Besides financial worries, it is also possible for example, that COVID-19 may be currently giving rise to other stressors in younger age groups that might also impact their mental health, such as the need for parents to both telework from home while at the same time homeschool their children.

Our findings suggest that monitoring the mental health of younger and economically vulnerable individuals may be especially important moving forward. In addition, they also indicate that the general public's mental health during the pandemic might not only be affected by the direct health consequences of COVID-19, but also by the economic ramifications of the pandemic.

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Disclosure statement

The authors declare no conflict of interest.

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Supporting information

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Appendix S1 Situation in Japan in January to April 2020.

Appendix S2 Methods.

Appendix S3 Descriptive statistics of the mental health variables.

Figure S1 Logistic regression results for the prevalence of depression symptoms (nine-item Patient Health Questionnaire score > =10).

Figure S2 Logistic regression results for the prevalence of anxiety symptoms (7-item Generalized Anxiety Disorder Scale score > =10).

Table S1 Descriptive statistics of the sample stratified by the mental health variables.

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Forced social isolation due to COVID-19 and consequent mental health problems: Lessons from *hikikomori*

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The COVID-19 pandemic has forced a worldwide lockdown with huge numbers of citizens confined to their homes,[1] often resulting in social isolation, which may lead to mental health problems. One of the best examples of consequences of severe social isolation is the condition known as *hikikomori* – a form of severe social withdrawal that was originally described in Japan in the late 20th century and has more recently been found worldwide.[2–4] In the 2010 guideline on *hikikomori* by the Japanese Ministry of Health, Labour, and Welfare, the definition of *hikikomori* was described as an avoidance of social participation, which in principle has continued under the condition of being housebound for a period of more than 6 months.[5]

There are similarities and differences between *hikikomori* and COVID-19-related social isolation. Just recently, we developed a draft set of international *hikikomori* criteria, which defines the severity as mild, moderate, or severe depending on whether the person leaves home up to 3 days a week, one or fewer days per week, or rarely leaves a single room.[6] Individuals experiencing COVID-19-related social isolation may be measured using the same scale; however, it should be recognized that individuals with *hikikomori* avoid social situations voluntarily, while COVID-19-related social isolation may be enforced by government restrictions and/or due to an individual's fears of infection.

In the past two decades, numerous studies have investigated the psychological impact of quarantine (i.e., forced social isolation) due to epidemics, such as SARS and MERS, revealing that the experience of quarantine is associated with higher prevalence of stress-related mental disturbances, such as anxiety, depression, and especially avoidance behaviors.[7] Similarly, based on our clinical experiences, traumatic events, such as economic, social, or political crisis, can cause even previously healthy people to avoid social contact and enter a *hikikomori* state with psychiatric conditions.[3] Thus, we herein hypothesize that COVID-19-induced social isolation and the consequent economic crisis may be risk factors for *hikikomori* in the post-pandemic world.

At onset, individuals with *hikikomori* tend not to suffer and are satisfied because they have escaped real-world stresses. However, longer lasting social isolation gradually increases loneliness, which is a crucial risk factor for mental disturbances, including anxiety, depression, and addiction disorders.[3] Prolonged home confinement may lead to domestic discord, domestic violence, and in extreme cases even homicide.[2] If COVID-19-induced social isolation were to last more than several months, similar *hikikomori*-related problems might occur much more frequently among the huge numbers of individuals who are forced to stay at home. In fact, COVID-19-related family violence and homicides have already emerged.

The Internet and its related social media platforms are believed to be useful tools to combat social isolation and physical distance. However, there is little evidence about the effectiveness of substituting direct contact among people by communication via the Internet. In addition, it is highly probable that there are pathogenetic links between life in a society relying on Internet communication, social isolation, and mental health problems, including Internet addiction,[8] and that therefore social isolation and the reliance on the simple virtual tools widely used during the current crisis elevate the risk of Internet addiction and other disturbances of mental health. It is possible that the introduction of 'face-to-face'-like communication systems with innovative technologies, such as virtual reality and humanoid robotics, would prevent or reduce COVID-19-induced mental health problems.

Even though no statistical data exist, there are anecdotal examples of people in Japan and perhaps elsewhere who fear that their COVID-19-positive status might become known in their community and this makes them hesitate to take a polymerase chain reaction test – a behavior similar to that of individuals with *hikikomori* and their family members, who avoid contact with psychiatrists in order to avoid being given a psychiatric diagnosis. In Japan and some Asian countries, both fears are probably deeply rooted in traditional-culture-based shame (*haji*) and social ostracism (*murahachibu*), which have, during past epidemics and economic crises, often led those sick or financially ruined to commit suicide.[3, 9] Recent reports of COVID-19-related suicides might support this hypothesis.[9] Action against COVID-19 must therefore include a component addressing the prevention of stigmatization of the disease to avoid covert spread of the disease and other consequences of stigma related to the disease, such as depression and suicide.

Generally, *hikikomori* support programs are designed to change avoidance behaviors of persons with *hikikomori*.[5] We have recently developed a family-based educational program to reduce the stigma toward psychiatric disorders and the risk of family violence, suicide, and other mental disturbances due to *hikikomori*, using lectures and role-play sessions.[10] This program is based on the Mental Health First Aid, which aids