# Longitudinal Study of Psychological Status during the COVID-19 Pandemic

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# Abstract

Researchers believe that the impact of repeated trauma on mental health is incrementally more significant than the simple additive effect of one event. This study questioned whether this repetition only further worsens people's mental health. We found that they may report more positive changes than those who haven't. Thus, we hypothesized that repeatedly experiencing difficult situations and suffering might increase post-traumatic growth (PTG). PTG can be defined as "positive psychological changes experienced due to coping with very difficult life situations," leading to positive outcomes and feelings of well-being. We found that those who experienced a disaster in the past were more depressed, anxious, and stressed than those who had never experienced a disaster and now experienced the COVID-19 pandemic. Additionally, past disaster experience led to a more psychological response to the COVID-19 pandemic, which, in turn, led to an increase PTG. Globally, we found that supportive social interactions, including those with family members, could develop PTG during the COVID-19 pandemic and achieve better well-being during the continuation of the pandemic in the future.

# Introduction

When a person experiences difficult situations multiple times, Depression, anxiety, and stress increase more than they would in response to an isolated experience. For example, in a study conducted in Haiti, violent traumatic experiences prior to the 2010 earthquake were cited as a risk for post-traumatic stress disorder (PTSD) and major depressive disorder (MDD) [1]. However, like typhoons in Japan occur almost every year, it is rare for the same person to experience a disaster more than once. Post-traumatic growth (PTG) is defined as positive transformational changes people may experience due to psychological struggle with highly stressful and potentially traumatic life events [2,3]. If people with repeated painful experiences have a poor mental state than those with a single event, their PTG would likely increase significantly. However, only a few studies have verified this. Jirek et al. examined university students and found that cumulative adversity was positively correlated with PTG [4]. However, this relationship may differ depending on the nature of trauma [5] and demands further research.

This study aimed to examine psychological distress and PTG in people who experienced difficult situations twice, treating disasters they experienced in the past as the first situation and the COVID-19 pandemic as the second. As shown in Fig. 1A, we surveyed 1,000 individuals (500 men and 500 women) in three periods (June 25–26, 2020; September 25–26, 2020; February 10–12, 2021) during the COVID-19 pandemic in Japan. The phases were: Phase 1 (average age: 45.5; SD: 15.0), Phase 2 (average age: 45.5; SD: 12.9), and Phase 3 (average age: 45.2; SD: 14.7). During the same period as phase 3 in Japan, we also surveyed the United States to confirm cross-cultural applicability of results.

# Results

### Three surveys in Japan

Figure 1 shows the results of the three surveys conducted in Japan. Self-reported assessment scales measured the severity of stress, anxiety, and depression. These are as follows: Depression, Anxiety, Stress Scales-21 (DASS-21) [6], which evaluates the emotional states of depression (scores equal or higher than 7 indicate moderate to severe depression), anxiety (scores equal or higher than 6 indicate moderate to severe anxiety), and stress (scores equal or higher than 10 indicate moderate to severe stress) [4]. Depression, anxiety, and stress, as measured by the DASS-21, were all significantly higher, that is, poorer mental state, in the group that experienced the pre-COVID disaster, except for anxiety in the second survey. On the other hand, PTG was higher for the group that had previously experienced a disaster than the group that had
not in all three surveys.

## Results of the study in the US

We conducted a survey in the US simultaneously as the third survey in Japan to examine whether the results were cross-culturally applicable. Figure 2 shows the results of the survey conducted in the US.

Depression, anxiety, and stress, as indicated by the DASS-21 score, were significantly higher in those who had previously experienced a disaster than those who had not in the US.

PTG was also significantly higher for those who had previously experienced a disaster than for those who had not, based on the Mann−Whitney U Test (P<0.05).

### Impact of Event Scale − Revised (IES-R) scores based on the pre-COVID disasters and PTGI-SF scores with COVID-19

Figure 3 shows IES-R scores during a survey concerning previous disaster experience in both Japan and the United States, with a score noted for each disaster, along with the PTGI-SF scores of experiencing COVID-19 pandemic.

# Discussion

## Factors that may be associated with PTG

We examined the correlations between PTG and other potentially related factors. Figure 4 shows the results of three Japanese surveys and a US survey on factors contributing to the levels of PTG. Prediction One (Sony Network Communications Inc. Japan) was used to create a predictive model of PTGI-SF scores using all variables examined in the web survey. First, the entire data set was read and randomly split in half as an internal training and cross-validation data set. Internal cross-validation was performed to create the best predictive model.

We created three predictive models from the Japanese study and one predictive model from the US study. In all models, the factor contributing to the PTG score the most was the Lubben Social Network Scale-6 (LSNS-6) score.

Secondary factors and those with lower contributions to PTGI-SF scores varied across surveys. In the first survey in Japan, the number of people living together contributed to the PTGI-SF scores after anxiety. In contrast to the first and second surveys, the third survey showed age, depression, and the number of disasters experienced as the fourth most essential contributors to PTGI-SF scores. Depression, which contributed little to the PTG levels in the first survey, was the prime factor in the second and third surveys.

The US survey was conducted at almost the same time as the third survey in Japan. However, only the first factor contributing to the PTG was the same (anxiety), and stress contributed to PTGI-SF scores as the second or third factor. The fourth factor contributing to PTG levels was the location where the survey participants lived. However, since there were only 200 participants in the US survey, versus the 1,000 participants in the Japanese study, individual characteristics may be reflected in the results. The relative geographical size of the US may also have contributed to location as a factor.

# Methods

## Ethics statement

This study was approved by the Ethics Committee of International Research Institute of Disaster Science, Tohoku University (ID: 2020-040), and research was performed in accordance with relevant guidelines/regulations. All study participants were informed that they would be conducting a disaster-related study and gave their voluntary informed consent to participate in the study. The study adhered to ethical standards for research on human subjects (informed consent and right to information, protection of personal information and guarantee of privacy, non-discrimination, rewards, and the ability to withdraw from the study at any stage).

## Survey period

We conducted three surveys: June 25–26, 2020; September 25–26, 2020; February 10–12, 2021. A combined graph displaying the spread of COVID-19 infections in Japan and the survey period is shown in Fig. 1 A.

## Participants

Overall, 1,000 Japanese participants were included (500 men and 500 women). In the first survey, their ages ranged from 20 to 89 years, with a mean age of 45.5 years (standard deviation: 15.02) and a median of 46.0 years (25th percentile: 32 and 75th percentile: 57). In the second survey, their ages ranged from 21 to 86 years, with a mean age of 54.2 years (standard deviation: 12.95) and a median of 54.2 years (25th percentile: 44 and 75th percentile: 64). In the third survey, their ages ranged from 20 to 86 years, with a mean age of 45.2 years (standard deviation: 14.71) and a median of 46 years (25th percentile: 33 and 75th percentile: 57).

Of the total participants in Japan, 500 (50%) experienced a natural disaster prior to the COVID-19 pandemic and 500 (50%) did not. Of the total participants in the US, 127 (63%) experienced a natural

disaster prior to the COVID-19 pandemic and 73 (37%) did not. The natural disasters experienced are shown in Figure 3. The participant profile data are shown in Supplementary Figure S1.

Overall, 200 participants were included (100 men and 100 women) as the US sample. Their ages ranged from 23 to 70 years, with a mean age of 43.2 years (standard deviation: 12.7) and a median of 40.0 years (25th percentile: 33 and 75th percentile: 52).

## Assessments

### Depression Anxiety Stress Scales-21 (DASS-21)

The DASS-21 [7] is a measure of distress commonly caused by anxiety, depression, and stress, and characterised as a distinct syndrome. As the measure is not specific to diagnosis, it is appropriate for use in broad clinical populations. This measure is suitable in a wide range of clinical and research settings where it is necessary to measure the interplay of different forms of emotional distress [8]. In this study, participants were asked to choose how each of the items on the DASS-21 applied to them over the past week. The items are scored on a 4-point scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Higher scores indicate more frequent symptomatology. Seven items are included in each scale: depression (such as, "I couldn't seem to experience any positive feeling at all"), anxiety (such as, "I experienced breathing difficulty"), and stress (such as, "I found it hard to wind down") [7].

### Impact of Event Scale-Revised (IES-R)

The IES-R is a 22-item scale that measures how distressing each item was during the past week. It is rated from 0 (not at all) to 4 (extremely). The scale has three subscales: intrusion, avoidance, and hyper-arousal. The Japanese-translated version, which has been evaluated among different populations, has sensitivity and specificity values that range 0.75–0.89 and 0.71–0.93, respectively, at a cut-off of 25 for partial PTSD diagnosis [9]. In this study, this value was used to define participants who were significantly symptomatic from disasters they experienced in the past.

### Lubben Social Network Scale–6 (LSNS-6)

Over the past 30 years, the LSNS has gained popularity as a valid and efficient tool for assessing social networks and isolation risks (https://www.bc.edu/content/bcweb/schools/ssw/sites/lubben/description.html). The LSNS-6 has been a viable tool for the assessment of social networks [10].

### Posttraumatic Growth Inventory Short-form Japanese version (PTG-SF-J)

The Posttraumatic Growth Inventory [9] was developed to assess positive psychological changes reported by persons who have experienced traumatic events. This scale includes the following factors: New Possibilities, Relating to Others, Personal Strength, Spiritual Change, and Appreciation of Life. The

Posttraumatic Growth Inventory is modestly related to optimism and extroversion. This scale is useful to determine how individuals perceive their own growth when reflecting on past trauma, which includes reconstructing or strengthening their perceptions of self, others, and the meaning of events [11]. The translation and validation were conducted by Taku et al. [12] Responses are rated on a 6-point Likert-type scale ranging from 0 (did not experience) to 5 (to a very great degree) [11]. Owing to qualitative differences among the subscales [11], subscale scores were used in the analyses.

In the present study, we used a form of this scale with fewer question items, the PTGI-SF-J [9]. We asked participants, "To what extent have the following changes occurred to your own way of life (or values) as a result of the new coronavirus epidemic? Please choose the option that best applies to you." We also asked, "To what extent has your life (or values) changed as a result of the epidemic?"

### Correlation between PTGI-SF scores and other factors

Supplementary Figure S2a shows Spearman's correlation analysis of age and PTG score, which was $R^2$ = 0.0003 in the first study. In the second survey, the correlation between age and PTG score was $R^2$ = 0.0017. In the third survey, the correlation was $R^2$ = 0.0011.

The correlation coefficients were low and not significant. Supplementary Figure S2b shows the correlation between social ties and PTG by LSNS-6 score in all three surveys. Spearman's correlation analysis showed that the correlation between LSNS-6 score and PTGI-SF score was $R^2$ = 0.0498 in the first survey, $R^2$ = 0.0632 in the second survey, and $R^2$ = 0.0777 in the third survey. The correlation coefficients were also low and not significant.

Supplementary Figures S2c and S2d show the relationship between the number of family members living together and the PTGI-SF scores. Although there was no significant difference between the first and second surveys, the PTGI-SF scores seemed to increase with the number of family members living together. In the third survey, the PTGI-SF score was significantly higher when participants lived by themselves or when the number of people living with them was six or more rather than three to five. It is unclear, however, whether the increase in number of family members directly caused the increase in PTG or whether it caused the increase in depression and anxiety, which in turn caused the increase in PTG, as indicated by the Kruskal-Wallis test. Further, it is unclear whether PTG increased directly because of the increase in number of family members or secondarily because of the increase in depression and anxiety.

Supplementary Figures S2c and S2d show the results of correlations among the study variables based on the US sample, suggesting that PTG is reported higher as participants are younger, need more support, and live with 3-5 family members rather than alone.

### Statistics

Non-parametric testing was used for comparison. Prediction One (Sony Network Communications Inc. Japan) was used to create a predictive model of PTG scores using all variables examined in the web

survey. First, the entire data set was read and randomly split in half as an internal training and cross-validation data set. Internal cross-validation was performed to create the best predictive model.

## Declarations

## Competing interest declaration

The authors declare no competing interests

## Author contributions

J.O. developed the concept and design of the study, contributed substantially to the analysis, interpretation of the data, and critically revised the manuscript; S.S., Y.F. performed the analysis, interpreted the data, and contributed substantially to the conception of the work; K.T., M.W., K.I. performed the analysis, interpreted the data, and substantially revised the manuscript. contributed to substantial revisions; S.I., F.I. revised the final version of the manuscript before submission. All authors read the manuscript and approved its content.

## Acknowledgements

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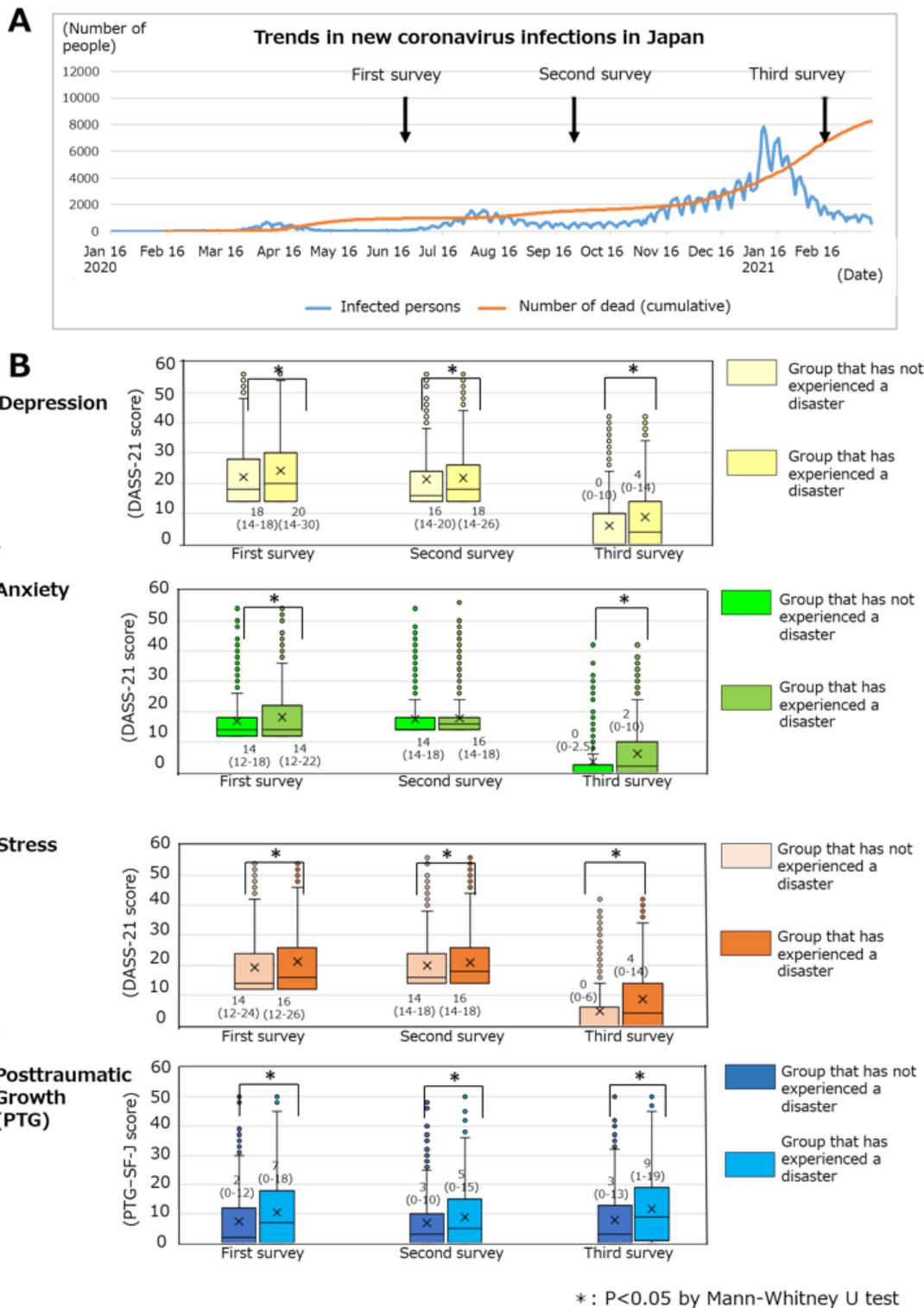
# Figures

Figure 1

Psychological changes under the COVID-19 pandemic in Japan Figure 1 shows the number of COVID-19 infections and deaths (cumulative) in Japan with the date of each survey. The graphs below show the scores from the DASS-21 and Post-Traumatic Growth Inventory-Short Form (PTGI-SF) scales. The Mann–Whitney U Test (5% level) was used to study significant differences between the group with no previous disaster experience and the group that previously experienced a disaster.
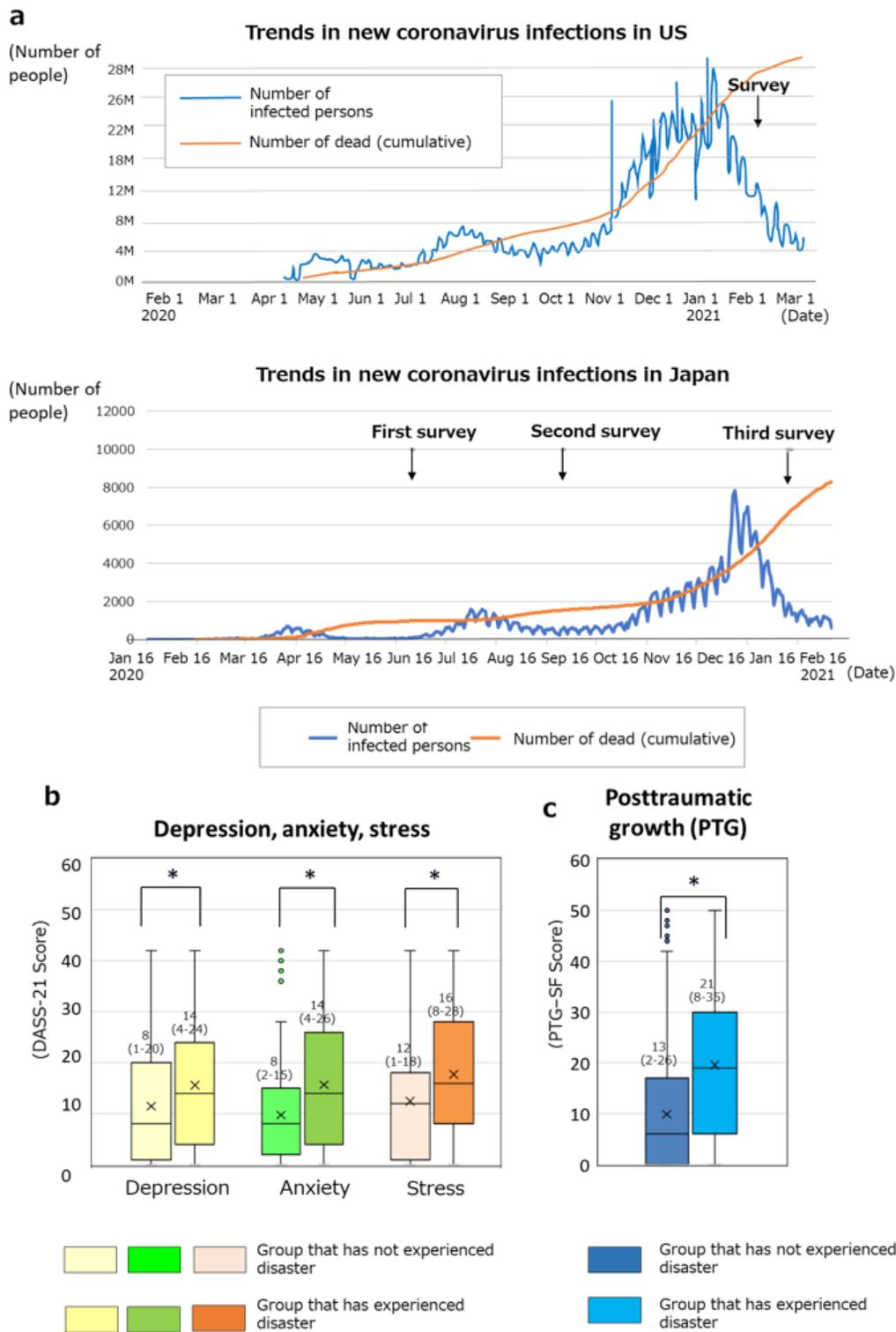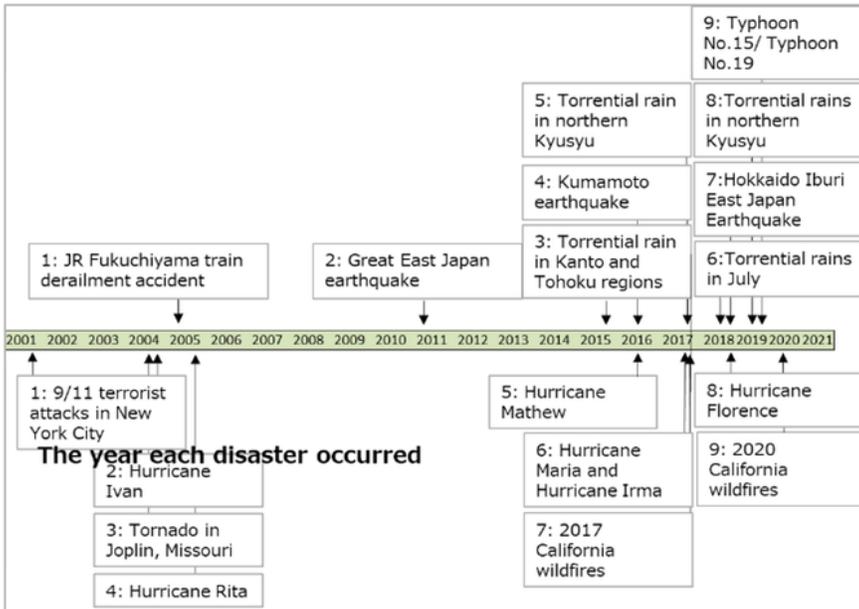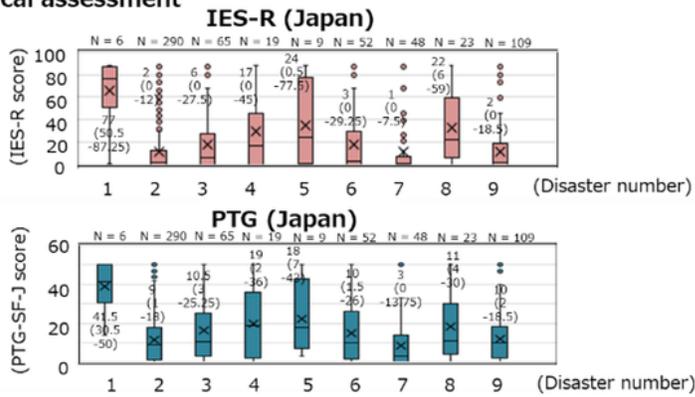
**Figure 2**

Psychology under the COVID-19 pandemic in the United States. a: shows the number of COVID-19 infections and deaths (cumulative) in the US and Japan. b: shows the scores obtained from the respective DASS-21 scales. c: shows the PTGI-SF score. The Mann–Whitney U test (5% level) was used to test differences between the scores of the two groups.

## Psychological assessment

### IES-R (Japan)

N = 6  N = 290  N = 65  N = 19  N = 9  N = 52  N = 48  N = 23  N = 109

(IES-R score) axis: 0, 20, 40, 60, 80, 100

1 2 3 4 5 6 7 8 9 (Disaster number)

### PTG (Japan)

N = 6  N = 290  N = 65  N = 19  N = 9  N = 52  N = 48  N = 23  N = 109

(PTG-SF-J score) axis: 0, 20, 40, 60

1 2 3 4 5 6 7 8 9 (Disaster number)

| | | 9: Typhoon No.15/ Typhoon No.19 |
|---|---|---|
| | 5: Torrential rain in northern Kyusyu | 8:Torrential rains in northern Kyusyu |
| | 4: Kumamoto earthquake | 7:Hokkaido Iburi East Japan Earthquake |
| 1: JR Fukuchiyama train derailment accident | 2: Great East Japan earthquake | 3: Torrential rain in Kanto and Tohoku regions / 6:Torrential rains in July |

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

**The year each disaster occurred**

| 1: 9/11 terrorist attacks in New York City | | 5: Hurricane Mathew | 8: Hurricane Florence |
|---|---|---|---|
| 2: Hurricane Ivan | | 6: Hurricane Maria and Hurricane Irma | 9: 2020 California wildfires |
| | 3: Tornado in Joplin, Missouri | 7: 2017 California wildfires | |
| | 4: Hurricane Rita | | |

## Psychological assessment

### IES-R (US)

N = 35  N = 20  N = 14  N = 24  N = 29  N = 44  N = 45  N = 46  N = 23

(IES-R score) axis: 0, 20, 40, 60, 80, 100

1 2 3 4 5 6 7 8 9 (Disaster number)

### PTG (US)

N = 35  N = 20  N = 14  N = 24  N = 29  N = 44  N = 45  N = 46  N = 23

(PTG-SF-J score) axis: 0, 20, 40, 60
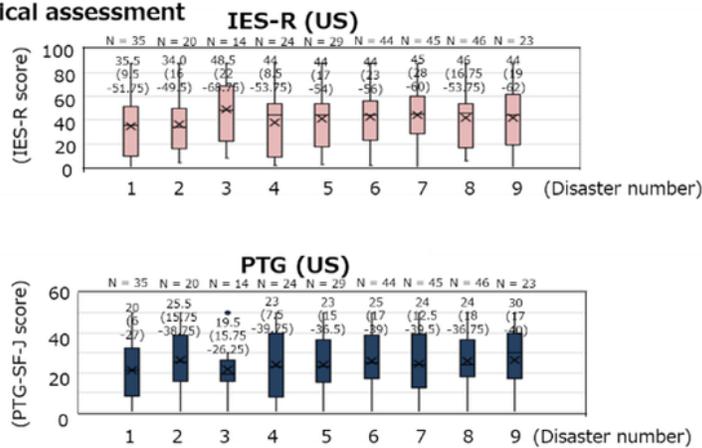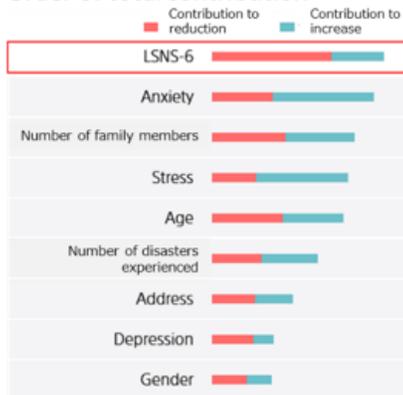
1 2 3 4 5 6 7 8 9 (Disaster number)

## Figure 3

The top two graphs show the IES-R and PTG results for Japan, and the bottom two graphs show the results for the US by the disaster. The central timeline shows the name of each disaster and the year of occurrence.
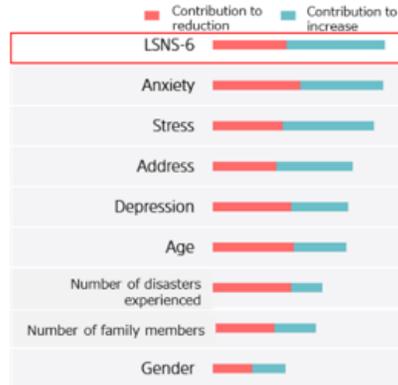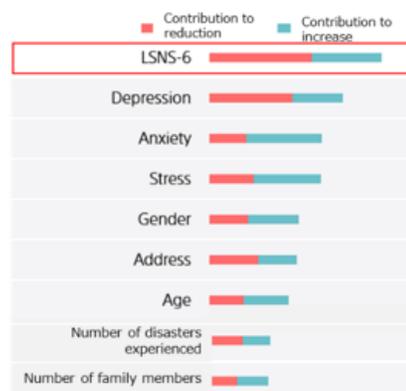
**First survey**

Order of total contribution

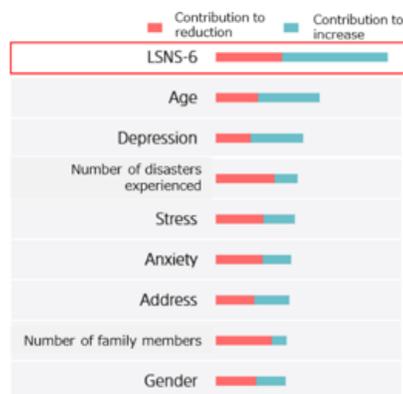**Survey in US**

Order of total contribution

**Second survey**

Order of total contribution

:the factor that contribute most to Posttraumatic Growth (PTG) score

LSNS-6: the score of the Lubben Social Network Scale–6 (LSNS-6)

Anxiety: the anxiety score of the depression, anxiety, stress scale-21 (DASS-21)

Number of family members: the number of family members living together

Stress: the stress score of the depression, anxiety, stress scale-21 (DASS-21)

Age: the age of survey participants

Number of disasters experienced: the number of times they have experienced the disasters in the past

Address: the address of survey participant

Depression: the depression score of the depression, anxiety, stress scale-21 (DASS-21)

Gender: the gender of survey participants

**Third survey**

Order of total contribution

## Figure 4

The results of three Japanese surveys and a US survey on factors contributing to the levels of PTG

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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