

Original Research

## Risk and Protective Factors for Poorer Overall Health, Increased Psychological Distress, and Suicidal Ideation Due to SARS-CoV-2 outbreak in the General Japanese Population

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### Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) outbreak is expected to have harmed the mental health of numerous people worldwide. Therefore, the present study was aimed to explore the effects of the SARS-CoV-2 outbreak on the overall health of the general Japanese population, with a particular focus on identifying the factors associated with a requirement for mental health treatment. Japanese residents aged 18 years and above were surveyed online, and among the 1,500 obtained responses included for analysis, 14% reported severe psychological distress, and 8.9% indicated high suicidal ideation. A multiple regression analysis of the collected data revealed that “insufficient exercise” could significantly predict physical health ( $\beta = -0.23$ ,  $SE = 0.03$ ), while the life event stressors that could significantly predict mental health were the personality trait “neuroticism” ( $\beta = -0.16$ ,  $SE = 0.03$ ), and the life stressors of “outbreak-related mental health problems” ( $\beta = -0.22$ ,  $SE = 0.03$ ) and “uncertainty regarding the future” ( $\beta = -0.12$ ,  $SE = 0.03$ ). The personality traits of



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“agreeableness” ( $\beta = -0.08$ ,  $SE = 0.02$ ) and “neuroticism” ( $\beta = 0.22$ ,  $SE = 0.02$ ), and the factors “social support” ( $\beta = -0.12$ ,  $SE = 0.02$ ), “outbreak-related mental health problems” ( $\beta = 0.21$ ,  $SE = 0.02$ ), “uncertainty regarding the future” ( $\beta = 0.14$ ,  $SE = 0.02$ ), and “declining duration and quality of sleep” ( $\beta = 0.10$ ,  $SE = 0.02$ ) could predict psychological distress. Suicidal ideation was predicted by “neuroticism” ( $\beta = 0.11$ ,  $SE = 0.03$ ), “social support” ( $\beta = -0.27$ ,  $SE = 0.03$ ), and “having a psychiatric disorder” ( $\beta = 0.18$ ,  $SE = 0.03$ ). The results of the present study suggest that due to the spread of SARS-CoV-2, much of the Japanese population could be in requirement of psychiatric care. In particular, the individuals who rated high for the risk factors and low for the protective factors might require proactive support.

### **Keywords**

COVID-19 pandemic; SARS-CoV-2; mental health; physical fitness; psychological distress; suicidal ideation; regression analysis; stressors; coping; community

## **1. Introduction**

As of June 1, 2020, the number of people infected with COVID-19 (SARS-CoV-2 virus) globally has surpassed 6 million [1]. In Japan, the weekly increases in the daily numbers of new cases of infection peaked at a figure of 560.1 on April 14, 2020, after which it has decreased to 73.1 on May 15. Consequently, on May 25, 2020, the Government of Japan lifted the state of emergency, and the restrictions imposed on outside visit, travel, and commercial activity were also expected to be lifted. It appears that the first wave of SARS-CoV-2 infections in Japan is currently under control. However, the prevalence of outbreak-related mental health problems in the Japanese population and whether these problems would require psychiatric treatment remain unclear. An early-stage review of the impact of COVID-19 on human mental health suggested that the outbreak may have caused a general increase in the prevalence of anxiety, depression, and stress [2]. In addition, a large-scale Chinese survey study reported psychological distress in almost 35% of the respondents and that this distress was associated with age, being female, being more educated, certain occupations, and the area of residence [3]. Other studies have reported associations among the psychological health of the general population, social support, and coping mechanisms [4, 5]. Conversely, to the author’s knowledge, although personality traits are usually reported to predict the wellbeing of an individual [6], no studies assessing this association in relation to the SARS-CoV-2 outbreak are reported so far. However, in certain outbreak-related situations, such as when socializing is restricted, people who score high in extraversion are expected to experience greater psychological stress. Moreover, there are limited reports on the increase in suicidal risk, which is regarded as the worst outcome of outbreak-related mental health problems in general populations. A study conducted in Colombia reported 7.6% of the participants having high scores ( $>9$ ) on the Depression Scale of the Center for Epidemiological Studies, which indicates a high suicidal risk [7].

The present study was conducted in the Japanese resident population immediately after the Government of Japan lifted the state of emergency. The study explored the effects of demographic factors, COVID-19-related factors, personality traits, coping measures, social support, and life event stressors on the overall mental health, psychological distress, and suicidal ideation in the general

population of Japan. An assessment of the factors that could influence the psychosomatic responses of people from a comprehensive perspective, encompassing everything from residential situations to coping behaviors (as in the present study), may provide useful information for developing an integrative and complementary treatment approach that would consider individuals as whole beings and utilize their self-healing abilities.

## **2. Materials and Methods**

### **2.1 Procedure**

The present study was designed as a retrospective study for analyzing the impact of the lockdown implemented in Japan for the prevention of the spread of COVID-19 infection from April 7, 2020 to May 21, 2020. The study was conducted at the end of May, 2020 through an online survey. The data collected from the survey was used for examining the impact of the characteristics of the participants (demographic information, employment status, living environment, and COVID-19-related factors), the life event-related stressors, coping behaviors, personality traits, and social support on four outcome measures (physical fitness, mental health, psychological distress, and suicide ideation). The physical and mental states at the time of the survey were measured for the outcome measures, and reflections on the information during the lockdown were sought and collected for the explanatory variables. The present study is a hypothesis-testing study based on the hypothesis that the characteristics of the participants, the life event-related stressors, coping behaviors, personality traits, and social support could predict the mental and physical responses of the residents to the COVID-19 outbreak. Participation in the online survey was voluntary, and written informed consent was obtained from all participants. The study design was approved by the Research Ethics Review Committee of the Practical Psychology Institute, LLC (No. 2020001).

### **2.2 Sample Selection**

The online survey was conducted from May 26, 2020 to May 27, 2020 for a sample population of Japanese residents aged 18 years or above who were members of the survey panel of the online survey service company named Crowd Works, Inc. A total of 2,594 panel members viewed the survey, among which 1,500 individuals responded, resulting in an acceptance rate of 57.8%. The possibility of a portion of respondents lacking the requisite cognitive functioning or literacy skills to complete an online survey was considered and, therefore, screening for such respondents was performed based on the exclusion criteria of evidently random and/or consistently contradictory responses. Since no responses met the exclusion criteria, the data from all responses were included in the analysis. Further information regarding the basic characteristics of the participants may be obtained by referring to a previously reported short study [8].

### **2.3 Survey Items**

#### **2.3.1 Participant Characteristics**

In order to obtain the demographic information, the respondents were inquired regarding their age group, gender (male, female, other), the highest level of education (middle school, high school, junior college/vocational school, university, post-graduate diploma), marital status (never married,

divorced or widowed, married and living with a partner, married and living separately), ethnicity (non-Chinese Asian, African/Black, mixed, Caucasian/White, Chinese, Middle Eastern/Arab, other), pre-COVID-19 employment status (student, self-employed, management, full-time employee (including agency hires with open-ended contracts), part-time employee, contract worker, housewife/househusband, on leave (educational leave, sick leave, etc.), unemployed), and health status (pregnancy, psychiatric treatment, underlying conditions).

In regard to the employment factors related to the SARS-CoV-2 outbreak, the respondents were inquired regarding their frequency of going to work during the state of emergency (almost never, half-a-week or less, more than half-a-week, every day), whether they worked remotely, the kind of work (went to their workplace every day, worked remotely during the emergency, had always worked remotely, business temporarily closed, lost job/business permanently, were already unemployed); and their household income prior to and after the state of emergency (<18600 USD, 18600 USD to 37200 USD, 37300 USD to 74500 USD, 74600 USD to 111800 USD, 111900 USD to 149000 USD, and  $\geq 149000$  USD).

The living environment-related factors inquired were the type of residence (house, apartment, student dormitory/shared housing/group facility, other), the number of rooms in residence (excluding spaces such as bathrooms, toilets, or kitchen), amenities, and surrounding environment (garden or balcony, park or botanical garden, convenience stores, supermarkets, and other food stores, restaurants, other stores to purchase the daily necessities and goods for the household), and the number of adults and children under 18, under 12, and in the pre-school age within the household.

The COVID-19-related factors inquired were the COVID-19 infection status of the participants (cured, under treatment, suspected, none), if they had come in contact with an infected person in the previous week (yes, possibly, no), the degree of voluntary isolation (did not leave the home at all, only went out when necessary such as for exercise, grocery shopping, or work, did not self-isolate although practiced social distancing (2 meters) when outside, did not self-isolate or practice social distancing).

### 2.3.2 Life Event-Related Stressors and Coping Measures Practiced During the State of Emergency

The respondents were asked if they had experienced any of the potential life events (E1–E30) listed in Table 1 during the state of emergency, and, if so, to rate that experience as “not stressful/distressing”, “a little stressful/distressing”, or “extremely stressful/distressing”. In addition, the respondents were asked to select from a list (C1–C17), which of the possible coping measures, i.e., the diversions and mental health maintenance measures listed in Table 2 (multiple responses allowed), had they practiced intentionally during the state of emergency.

**Table 1** Correlations between life events and each of the variables.

| Life events  | Median | ID | PCS  | MCS  | K6  | SBQ | Extraver<br>sion | Agreeab<br>leness | Conscie<br>ntiousne<br>ss | Neurotic<br>ism | Openne<br>ss | Social<br>Support | Age | Female | Male | Other | Asian | Educatio<br>n | junior<br>college | Unmarri<br>ed |
|--|--------|----|------|------|-----|-----|------------------|-------------------|---------------------------|-----------------|--------------|-------------------|-----|--------|------|-------|-------|---------------|-------------------|---------------|
| E1 I lost my job (unable to work at all, lost all income).   | 1      | 0  | -.13 | -.12 | .17 | .11 |                  |                   |                           |                 |              |                   |     |        |      | .09   | -.10  | -.13          |                   |               |
| E2 I had less work (went to work less due to workplace shutdowns, income decreased).   | 1      | 2  | -.10 | -.19 | .22 | .13 |                  |                   |                           |                 |              | -.12              |     |        |      |       |       |               |                   | .15           |
| E3 My household income significantly decreased (by 40% or more).   | 1      | 1  |      | -.18 | .22 | .14 |                  |                   |                           |                 |              |                   |     |        |      |       |       | -.13          |                   | .13           |
| E4 I could not pay the rent/make the mortgage payment, etc.  | 1      | 0  | -.11 | -.10 | .17 | .14 |                  |                   |                           |                 |              | -.12              |     |        |      |       | -.11  | -.13          |                   |               |
| E5 I had to move out of where I was renting/staying and became homeless.   | 1      | 0  | -.13 |      | .11 | .10 |                  |                   | -.10                      | -.10            |              | -.12              |     |        |      |       | -.19  |               |                   |               |
| E6 I could not get enough food.  | 1      | 0  | -.12 | -.14 | .19 |     |                  |                   |                           |                 |              | -.10              |     |        |      |       |       |               |                   |               |
| E7 I could not get masks or disinfectant.  | 2      | 1  |      | -.17 | .20 |     |                  |                   |                           |                 |              |                   |     |        |      |       |       |               |                   |               |
| E8 I lost someone close to me (due to the novel coronavirus or other causes).  | 1      | 0  | -.11 |      | .11 | .12 |                  |                   |                           |                 |              | -.12              |     |        |      |       | -.09  |               |                   |               |
| E9 I began worrying I would likely catch the novel coronavirus or become severely ill.   | 2      | 1  |      | -.21 | .26 | .17 |                  | .12               |                           |                 |              |                   |     | .18    | -.17 |       |       |               |                   |               |
| E10 I could not get the information I needed about the novel coronavirus.  | 1      | 1  | -.10 | -.18 | .23 | .15 |                  | .10               |                           |                 |              |                   |     |        |      |       |       |               |                   |               |
| E11 I could not get tested, even though I asked to be.   | 1      | 0  | -.11 |      | .10 | .11 |                  |                   |                           |                 |              | -.10              |     |        |      |       | -.13  |               |                   |               |
| E12 I had difficulty getting a consultation with a doctor for the treatment of a chronic disease I have.                               | 1      | 0  | -.14 | -.13 | .24 | .20 |                  |                   |                           |                 |              | -.10              |     |        |      |       |       |               |                   |               |
| E13 I had to do things that put me at risk of infection (e.g., commute to work, do my job, go shopping).                               | 2      | 2  |      | -.22 | .26 | .19 |                  |                   |                           |                 |              |                   |     | .12    | -.12 |       |       |               |                   |               |
| E14 My workload increased quantitatively (e.g., increased overtime).   | 1      | 0  | -.10 | -.09 | .11 |     |                  |                   |                           |                 |              |                   |     |        |      |       | -.09  |               |                   |               |
| E15 My workload increased qualitatively (e.g., number of clients decreased, had new responsibilities related to infection prevention). | 1      | 1  |      | -.11 | .13 |     |                  |                   |                           |                 |              |                   |     |        |      |       |       |               |                   |               |
| E16 I worried about relationships at work (e.g., everyday relationships, differences of opinion regarding infection prevention).       | 1      | 1  |      | -.18 | .23 | .14 |                  | .10               |                           |                 |              | -.12              |     |        |      |       |       |               |                   |               |



|     |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |
|-----|-----|------------|-----|--|-------------|------------|------|------|-------------|------------|------|------|------|------|--|------|------|------|--|--|------------|------------|------------|-----|-----|------|--|------|
| E1  |     | -.14       | .10 |  | -.11        |            | .28  | -.13 | -.17        | .12        | -.10 | -.10 |      |      |  | .10  |      | .12  |  |  | .10        |            |            |     |     |      |  |      |
| E2  |     | -.17       | .21 |  | <u>-.31</u> | -.11       | .13  | .16  | -.10        | -.20       |      |      |      |      |  | -.15 | -.13 | -.14 |  |  |            | .10        |            |     |     |      |  |      |
| E3  |     | -.14       | .21 |  | -.17        |            | .19  | -.15 | <u>-.30</u> |            |      |      |      |      |  | -.10 |      |      |  |  |            |            |            |     |     |      |  |      |
| E4  | .09 | -.10       |     |  |             |            | .12  | -.10 | -.16        |            | -.10 | -.11 | -.10 |      |  |      |      |      |  |  | .14        | .10        | .09        | .13 |     |      |  |      |
| E5  |     | -.11       |     |  |             |            |      |      |             | .10        |      | -.14 | -.10 | -.10 |  |      |      |      |  |  | .22        | .17        | .15        | .19 |     |      |  |      |
| E6  |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  | .09        |            | .10        |     |     |      |  |      |
| E7  |     |            |     |  | .11         |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |
| E8  |     |            |     |  |             |            |      |      |             |            |      | -.10 |      |      |  |      |      |      |  |  | .15        |            | .10        | .11 |     |      |  |      |
| E9  |     |            |     |  | -.11        | .13        |      | -.11 |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            | .13 |     |      |  |      |
| E10 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            | .10 |     |      |  |      |
| E11 |     |            |     |  |             |            |      |      |             |            |      | -.16 | -.11 |      |  |      |      |      |  |  | .20        | .22        | .14        | .19 |     |      |  |      |
| E12 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  | .09        |            |            | .11 | .17 | .19  |  |      |
| E13 |     |            |     |  |             | -.12       |      |      | -.09        | .15        |      |      |      |      |  |      |      |      |  |  |            |            |            | .10 |     | -.17 |  |      |
| E14 |     |            |     |  |             | .25        | -.15 | -.12 | <u>.30</u>  |            |      | .11  |      |      |  |      |      |      |  |  | .09        |            |            | .12 |     | -.22 |  |      |
| E15 |     |            |     |  |             | <u>.30</u> | -.25 | -.17 | <u>.40</u>  |            |      |      |      |      |  |      |      |      |  |  |            |            |            | .09 |     | -.26 |  |      |
| E16 |     |            |     |  |             | -.10       | .29  | -.23 | -.16        | <u>.36</u> |      |      | -.09 |      |  |      |      |      |  |  |            |            |            | .13 |     | -.20 |  |      |
| E17 |     |            |     |  |             |            |      |      |             |            |      | -.11 |      |      |  |      |      |      |  |  |            | .09        |            | .10 |     | .17  |  |      |
| E18 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |
| E19 |     | .16        |     |  |             | -.13       | .19  |      | -.15        |            |      |      |      |      |  |      |      |      |  |  | .18        | .19        | .22        |     |     |      |  |      |
| E20 |     | <u>.46</u> |     |  |             | -.09       | .29  | -.11 | -.12        |            | .28  | .26  |      | .10  |  | .17  | .09  |      |  |  | <u>.62</u> | <u>.59</u> | <u>.47</u> | .10 |     |      |  | -.09 |
| E21 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            | .10        |            | .11 |     | .12  |  |      |
| E22 |     | -.16       | .09 |  |             |            | -.10 |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            | .13        | .11 | .10 | .14  |  | .13  |
| E23 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |
| E24 |     |            |     |  |             |            |      | -.10 | -.10        |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     | .11 |      |  |      |
| E25 |     |            |     |  |             | -.12       |      |      | -.10        | .12        |      | -.09 |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |
| E26 |     |            |     |  |             |            |      |      | .10         |            |      | -.11 |      |      |  |      |      |      |  |  |            |            |            |     |     | .09  |  | .12  |
| E27 |     |            |     |  |             | .16        |      | -.09 | .13         |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     | .12  |  | -.10 |
| E28 |     |            |     |  |             |            |      |      |             |            |      |      |      |      |  |      |      |      |  |  |            |            |            |     |     |      |  |      |

E29 .14 .10 -.12 -.15 -.12 .18 .10 .12 .13  
 E30 -.09

Note: Only correlations significant at  $p < .0001$  are shown. Correlations are in bold and underlined when  $|\rho| \geq .30$ .

ID: interquartile deviation.

**Table 2** Correlations between coping measures and each of the variables.

| Coping | N   | %    | PCS  | MCS  | K6  | SBQ | Extr | Agr | Con  | Neuro  | Ope | Social | Age  | Femal | Mal  | Other | Asian | Educati | junior | Un  | Div | Living |
|--------|-----|------|------|------|-----|-----|------|-----|------|--------|-----|--------|------|-------|------|-------|-------|---------|--------|-----|-----|--------|
|        |     |      |      |      |     |     | aver | ee  | scie | ticism | nne | Suppo  |      | e     | e    |       |       |         |        | mar | or  |        |
|        |     |      |      |      |     |     | sion | ess | ntio | ss     | rt  |        |      |       |      |       |       |         | ried   | wid | ow  | r      |
| C1     | 67  | 4.5  |      | -.16 | .20 | .21 |      |     |      |        |     | -.11   |      |       |      |       |       |         |        |     |     |        |
| C2     | 50  | 3.3  | -.11 | -.14 | .19 | .18 |      |     |      |        |     | -.12   |      |       |      |       |       |         |        |     |     |        |
| C3     | 47  | 3.1  |      |      | .11 | .12 |      |     |      |        |     |        |      |       |      |       | -.12  |         |        |     |     |        |
| C4     | 18  | 1.2  |      |      |     |     |      |     |      |        |     |        |      |       |      |       |       |         |        |     |     |        |
| C5     | 232 | 15.5 |      | -.14 | .17 | .10 |      |     | .09  |        | .16 |        | .11  |       | -.11 |       |       |         |        |     |     |        |
| C6     | 11  | 0.7  |      |      |     |     |      |     |      |        |     |        |      |       |      |       |       |         |        |     |     |        |
| C7     | 183 | 12.2 |      |      |     | .13 |      |     |      |        |     |        | -.13 |       |      |       |       |         |        |     |     |        |





### 2.3.3 Psychological Measures

The personality trait indicator was assessed using the Ten Item Personality Inventory [9], which assesses an individual's personality based on a five-factor model named "the Big Five personality traits". Each of the five factors, namely, extraversion (EXT), agreeableness (AGR), conscientiousness (CON), neuroticism (NEU), and openness (OPE), was measured based on two items rated on a 7-point scale, and accordingly, the scores for each of the five factors ranged from 0 to 14. The Japanese version (TIPI-J) of this tool was developed and validated by Oshio et al. [10].

The social support indicator was measured using a brief form of the Japanese version of the Multidimensional Scale Of Perceived Social Support [11], which comprised 7 items with the highest factor loadings [12] rated on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). The total scores for the scale, therefore, ranged from 7 to 49.

The SF-8TM Health Survey was used for assessing the overall health of the participants [13]. The Japanese version of this tool was developed by Fukuhara and Suzukamo [14]. The survey comprised 8 items rated on a 5-point or 6-point scale. Two component health indicators, a physical component summary (PCS), and a mental component summary (MCS) were calculated to generate a mean score of 50 and a standard deviation of 10. Higher scores indicated better physical and mental health.

The psychological distress indicator was assessed using the K-6 Distress Scale developed by Kessler et al. [15]. This scale measures psychological distress based on the symptoms of both depression and anxiety. The Japanese version of the scale was developed by Furukawa et al. [16]. The items are rated on a 5-point scale ranging from "not at all" to "always", generating total scores ranging from 0 to 24, with higher scores indicating greater psychological distress. The mean  $\pm$ SD score for the study sample comprising a total of 85,154,382 Japanese individuals aged 15 years or above was determined to be  $3.34 \pm 3.39$  [17]. In the case of Japanese people, a score ranging between 5 and 12 is considered to indicate moderate distress, while a score of 13 or above indicates severe distress [18].

Suicidal ideation was assessed using the Suicidal Behaviors Questionnaire-Revised (SBQ-R) [19], which comprised 4 items rated on 5-point to 7-point scales unique to each item. The total scores ranged from 3 to 18. A study on the Spanish version of this questionnaire estimated a positive predictive value (PPV) of 98.3% and a negative predictive value (NPV) of 8.7% for a suicide attempt within one month for the psychiatric outpatients when a threshold score of 11 was used [20]. The scale was translated into Japanese in the present study, and its accuracy was verified through back-translation.

## 2.4 Statistical Analysis

IBM SPSS 26 was employed for the statistical analyses. The categorical variables were converted to binary variables for analysis, while a few continuous variables were treated as both continuous and binary when certain response levels, such as junior college graduate, university graduate, living with one other adult, living with 5 other adults, living with 3 pre-school children, self-isolation, and no preventative measures, had demonstrated the characteristics of an independent category in a previous analysis [8]. Significant associations among the variables were assessed by determining the Spearman's rank correlation coefficient ( $\rho$ ) to obtain the basic information for developing multiple regression models, such as the risk of multicollinearity and the strength of the one-to-one correlation. Next, a multiple regression was performed using the scores from the PCS, MCS, K6, and

SBQ-R as the response variables, while the personality traits, social support, demographic variables, factors related to employment during the state of emergency, and COVID-19-related factors were used as explanatory variables. The significance threshold was set at  $p < 0.0001$ .

### **3. Results**

The sample's characteristics are listed in Table 3 and the descriptive statistics for the psychological measures are presented in Table 4. Over 60% of the participants were female, and almost all were non-Chinese Asians. There was a certain diversity in age, the highest level of education, employment status, and income level. In the K-6 Distress Scale assessment, 867 (58.1%) participants obtained scores of 5 or above, indicating moderate distress, while 208 (14%) obtained scores of 13 or above, indicating severe distress. In the suicidal ideation assessment, where a score of 11 was the threshold for predicting a suicide attempt, 409 (27.3%) participants obtained a score of 3 (no suicidal ideation), and 134 (8.9%) obtained a score of 11 or above (indicating suicidal ideation).

**Table 3** Participant characteristics.

|                    | N   | %    |   | N   | %    |  | N    | %    |
|--------------------|-----|------|---|-----|------|--|------|------|
| Age                |     |      | Workplace commutation during epidemic   |     |      | Number of adults cohabitating in the same domicile     |      |      |
| 18 or 19           | 23  | 1.5  | unemployed at the onset of the epidemic | 445 | 29.7 | 1  | 319  | 21.3 |
| 20-24              | 138 | 9.2  | nearly none                             | 430 | 28.7 | 2  | 732  | 48.8 |
| 25-29              | 240 | 16   | half of the week or less                | 183 | 12.2 | 3  | 246  | 16.4 |
| 30-34              | 314 | 20.9 | more than half of the week              | 118 | 7.9  | 4  | 154  | 10.3 |
| 35-39              | 256 | 17.1 | almost every day                        | 324 | 21.6 | 5  | 38   | 2.5  |
| 40-44              | 232 | 15.5 | Mode of work                            |     |      | 6  | 10   | 0.7  |
| 45-49              | 125 | 8.3  | almost daily work                       | 324 | 21.6 | ≥7   | 1    | 0.1  |
| 50-54              | 95  | 6.3  | shifted to remote work                  | 263 | 17.5 | Number of youth (17 years old or under)                |      |      |
| 55-59              | 42  | 2.8  | remote work even before the epidemic    | 125 | 8.3  | 0  | 948  | 63.2 |
| 60-64              | 20  | 1.3  | leave status                            | 300 | 20   | 1  | 286  | 19.1 |
| 65-69              | 10  | 0.7  | dismissal/discontinuance                | 43  | 2.9  | 2  | 205  | 13.7 |
| ≥70                | 5   | 0.3  | unemployed at the onset of the epidemic | 445 | 29.7 | 3  | 48   | 3.2  |
| Gender             |     |      | Annual household income before epidemic |     |      | 4  | 11   | 0.7  |
| female             | 969 | 64.6 | <18600 USD                              | 292 | 19.5 | ≥5   | 2    | 0.1  |
| male               | 524 | 34.9 | 18600 USD to 37200 USD                  | 425 | 28.3 | Number of children of elementary school-age or younger |      |      |
| other              | 7   | 0.5  | 37300 USD to 74500 USD                  | 598 | 39.9 | 0  | 1066 | 71.1 |
| Education          |     |      | 74600 USD to 111800 USD                 | 146 | 9.7  | 1  | 246  | 16.4 |
| junior high school | 28  | 1.9  | 111900 USD to 149000 USD                | 27  | 1.8  | 2  | 151  | 10.1 |
| high school        | 330 | 22   | ≥149100 USD                             | 12  | 0.8  | 3  | 32   | 2.1  |

|                            |      |      |  |      |      |  |      |      |
|----------------------------|------|------|--|------|------|--|------|------|
| junior college             | 355  | 23.7 | Annual household income after epidemic         | 4    | 4    | 0.3  |      |      |
| university                 | 718  | 47.9 | <18600 USD                                     | 337  | 22.5 | ≥5   | 1    | 0.1  |
| graduate degree            | 69   | 4.6  | 18600 USD to 37200 USD                         | 444  | 29.6 | Number of preschool-age children                 |      |      |
| Marital status             |      |      | 37300 USD to 74500 USD                         | 558  | 37.2 | 0  | 1181 | 78.7 |
| unmarried                  | 659  | 43.9 | 74600 USD to 111800 USD                        | 121  | 8.1  | 1  | 221  | 14.7 |
| divorced/widowed           | 64   | 4.3  | 111900 USD to 149000 USD                       | 29   | 1.9  | 2  | 87   | 5.8  |
| married [separated]        | 50   | 3.3  | ≥149100 USD                                    | 11   | 0.7  | 3  | 11   | 0.7  |
| living with partner        | 727  | 48.5 | Type of house                                  |      |      |  |      |      |
| Ethnicity                  |      |      | house  | 683  | 45.5 | Comorbidity, pregnancy or high risk cohabitants  |      |      |
| Asian                      | 1489 | 99.3 | apartment or condominium                       | 803  | 53.5 | primary illness                                  | 152  | 10.1 |
| Black                      | 1    | 0.1  | student dormitory                              | 6    | 0.4  | psychiatric outpatient                           | 119  | 7.9  |
| multiracial                | 3    | 0.2  | share house                                    | 8    | 0.5  | pregnancy  | 49   | 3.3  |
| White                      | 2    | 0.1  | Number of rooms                                |      |      | high-risk cohabitants                            | 381  | 25.4 |
| Han Chinese                | 3    | 0.2  | 1  | 187  | 12.5 | Respondents' own COVID-19 infection status       |      |      |
| Middle Eastern/Arab        | 1    | 0.1  | 2  | 207  | 13.8 | fully recovered                                  | 3    | 0.2  |
| other                      | 1    | 0.1  | 3  | 389  | 25.9 | undergoing treatment                             | 13   | 0.9  |
| Employment before epidemic |      |      | 4  | 295  | 19.7 | suspected to be infected                         | 1484 | 98.9 |
| student                    | 75   | 5    | 5  | 234  | 15.6 | Recent contact with infected persons             |      |      |
| self-employed              | 157  | 10.5 | 6  | 99   | 6.6  | none   | 1392 | 92.8 |
| company manager            | 9    | 0.6  | ≥7   | 89   | 5.9  | suspected of having contact                      | 70   | 4.7  |
| full-time                  | 528  | 35.2 | Housing facilities and surrounding environment |      |      | yes  | 38   | 2.5  |
| part-time                  | 180  | 12   | garden or balcony                              | 1184 | 78.9 | Extent of voluntary restriction                  |      |      |
| temporary workers          | 158  | 10.5 | parks and botanical gardens                    | 1129 | 75.3 | going out and did not practice social distancing | 30   | 2    |
| housewives/husbands        | 254  | 16.9 | convenience stores                             | 1270 | 84.7 | going out but practiced social distancing        | 67   | 4.5  |
|                            |      |      |  |      |      | went out for work in addition to when needed     | 481  | 32.1 |

|                  |     |     |                                    |      |      |                                      |     |      |
|------------------|-----|-----|------------------------------------|------|------|--------------------------------------|-----|------|
| leave of absence | 36  | 2.4 | supermarkets                       | 1142 | 76.1 | only exercising or shopping for food | 862 | 57.5 |
| unemployed       | 103 | 6.9 | food stores or restaurants         | 904  | 60.3 | did not leave home at all            | 60  | 4    |
|                  |     |     | shops selling other everyday items | 532  | 35.5 |                                      |     |      |
|                  |     |     | None of the above                  | 15   | 1    |                                      |     |      |

**Table 4** Psychological measures - Descriptive statistics.

|                   | Min   | Max   | Mean  | SD   |
|-------------------|-------|-------|-------|------|
| TIPI-J            |       |       |       |      |
| Extraversion      | 2     | 14    | 7.22  | 2.87 |
| Agreeableness     | 2     | 14    | 9.69  | 2.22 |
| Conscientiousness | 2     | 14    | 7.18  | 2.61 |
| Neuroticism       | 2     | 14    | 8.79  | 2.67 |
| Openness          | 2     | 14    | 7.70  | 2.59 |
| Social Support    | 7     | 49    | 35.18 | 9.19 |
| SF-8              |       |       |       |      |
| PCS               | 19.91 | 68.27 | 51.04 | 6.70 |
| MCS               | 13.69 | 62.30 | 43.43 | 8.14 |
| K6                | 0     | 24    | 6.49  | 5.34 |
| SBQ               | 3     | 18    | 5.79  | 2.99 |

Note: *N* = 1500. TIPI-J: Ten Item Personality Inventory Japanese version, PCS: Physical component summary. MCS: mental component summary. SBQ: Suicide Behaviors Questionnaire-Revised Japanese version.

Table 1, Table 2 and Table 5 present the correlation matrices. Although multiple significant one-to-one correlations were observed between the variables, the sizes of these correlations varied widely. Table 6, Table 7, Table 8 and Table 9 present the results of the multiple regression analysis. E28 “insufficient exercise” was determined as the only significant predictor for PCS ( $\beta = -0.23$ , SE = 0.03), while neuroticism ( $\beta = -0.16$ , SE = 0.03), E17 “outbreak-related mental health problems” ( $\beta = -0.22$ , SE = 0.03), and E25 “uncertainty regarding the future” ( $\beta = -0.12$ , SE = 0.03) were identified as the significant predictors for MCS. The predictive factors for K6 were agreeableness ( $\beta = -0.08$ , SE = 0.02), neuroticism ( $\beta = 0.22$ , SE = 0.02), social support ( $\beta = -0.12$ , SE = 0.02), E17 “outbreak-related mental health problems” ( $\beta = 0.21$ , SE = 0.02), E25 “uncertainty regarding the future” ( $\beta = 0.14$ , SE = 0.02), and E26 “decline in the duration and quality of sleep” ( $\beta = 0.10$ , SE = 0.02), while the predictive factors for SBQ-R were neuroticism ( $\beta = 0.11$ , SE = 0.03), social support ( $\beta = -0.27$ , SE = 0.03), and having a psychiatric disorder ( $\beta = 0.18$ , SE = 0.03).

**Table 5** Correlations between the variables (one-to-one).

|                         | 1    | 2                  | 3                 | 4                  | 5                 | 6    | 7                  | 8    | 9    | 10   | 11                 | 12                 | 13                 | 14 | 15  | 16                 | 17   | 18                 | 19   | 20                | 21   | 22                 | 23                 | 24                 |
|-------------------------|------|--------------------|-------------------|--------------------|-------------------|------|--------------------|------|------|------|--------------------|--------------------|--------------------|----|-----|--------------------|------|--------------------|------|-------------------|------|--------------------|--------------------|--------------------|
| 1. PCS                  | 1    |                    |                   |                    |                   |      |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 2. MCS                  | -.16 | 1                  |                   |                    |                   |      |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 3. K6                   | -.12 | <b><u>-.62</u></b> | 1                 |                    |                   |      |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 4. SBQ                  | -.11 | -.28               | <b><u>.47</u></b> | 1                  |                   |      |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 5. Extraversion         |      |                    | -.18              | -.23               | 1                 |      |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 6. Agreeableness        |      | .13                | -.23              | -.21               |                   | 1    |                    |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 7. Conscientiousness    |      | .09                | -.16              | -.19               | .20               | .22  | 1                  |      |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 8. Neuroticism          |      | <b><u>-.34</u></b> | <b><u>.47</u></b> | <b><u>.34</u></b>  | -.27              | -.28 | <b><u>-.31</u></b> | 1    |      |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 9. Openness             |      |                    |                   |                    | <b><u>.35</u></b> | .15  | .22                | -.22 | 1    |      |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 10. Social Support      | .11  | .12                | -.29              | <b><u>-.38</u></b> | <b><u>.36</u></b> | .25  | .10                | -.18 | .14  | 1    |                    |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 11. Age                 |      | .09                |                   |                    |                   |      | .14                |      |      | -.20 | 1                  |                    |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 12. Female              |      | -.13               |                   |                    |                   |      |                    | .18  | -.12 | .16  | -.14               | 1                  |                    |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 13. Male                |      | .14                |                   |                    |                   |      |                    | -.18 | .12  | -.15 | .14                | <b><u>-.99</u></b> | 1                  |    |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 14. Other               |      |                    |                   |                    |                   |      |                    |      |      |      |                    | -.09               |                    | 1  |     |                    |      |                    |      |                   |      |                    |                    |                    |
| 15. Asian               |      |                    |                   |                    |                   |      |                    |      |      |      |                    |                    |                    |    | 1   |                    |      |                    |      |                   |      |                    |                    |                    |
| 16. Education           |      |                    |                   |                    |                   |      |                    |      |      |      |                    | -.09               | .10                |    |     | 1                  |      |                    |      |                   |      |                    |                    |                    |
| 17. junior college      |      |                    |                   |                    |                   |      |                    |      |      |      |                    | .20                | -.20               |    |     | <b><u>-.30</u></b> | 1    |                    |      |                   |      |                    |                    |                    |
| 18. Unmarried           |      |                    | .09               | .12                | -.12              |      |                    |      |      | -.20 | <b><u>-.31</u></b> | -.14               | .13                |    |     |                    | -.12 | 1                  |      |                   |      |                    |                    |                    |
| 19. Divorced or widowed |      |                    |                   |                    |                   |      |                    |      |      | -.10 | .11                |                    |                    |    |     |                    |      | -.19               | 1    |                   |      |                    |                    |                    |
| 20. Living with partner |      |                    | -.09              | -.15               | .10               |      |                    |      |      | .24  | .25                | .10                | -.10               |    |     |                    | .11  | <b><u>-.86</u></b> | -.21 | 1                 |      |                    |                    |                    |
| 21. Self-employed       |      |                    |                   |                    |                   |      |                    |      |      | -.10 | .13                | -.14               | .14                |    |     |                    |      | .12                |      | -.13              | 1    |                    |                    |                    |
| 22. Full-time           |      |                    |                   |                    | .13               |      |                    | -.13 |      |      |                    | <b><u>-.31</u></b> | <b><u>.31</u></b>  |    | .13 |                    |      |                    |      |                   |      | -.25               | 1                  |                    |
| 23. Housewives/husbands |      |                    |                   |                    |                   |      |                    | .12  | -.14 | .13  |                    | <b><u>.30</u></b>  | <b><u>-.30</u></b> |    |     |                    |      | <b><u>-.38</u></b> |      | <b><u>.38</u></b> | -.15 | <b><u>-.33</u></b> | 1                  |                    |
| 24. Unemployed          |      |                    |                   |                    | -.14              |      |                    |      |      | -.13 | .09                |                    |                    |    |     |                    |      | .16                |      | -.16              | -.09 | -.20               | -.12               | 1                  |
| 25. Commutation         |      |                    |                   |                    |                   |      |                    | -.14 |      |      |                    | -.26               | .26                |    |     |                    |      |                    |      | -.10              |      | <b><u>.53</u></b>  | <b><u>-.56</u></b> | <b><u>-.32</u></b> |



|  | 25   | 26   | 27         | 28         | 29  | 30  | 31  | 32         | 33         | 34  | 35  | 36  | 37         | 38         | 39  | 40  | 41  | 42  | 43 | 44 | 45 | 46 | 47 | 48 |  |
|--|------|------|------------|------------|-----|-----|-----|------------|------------|-----|-----|-----|------------|------------|-----|-----|-----|-----|----|----|----|----|----|----|--|
| 48. Extent of voluntary restriction              |      |      |            |            |     |     |     |            |            |     | -09 | .11 | -.12       |            |     |     |     |     |    |    |    |    |    |    |  |
| 49. No social distancing                         |      |      |            |            |     |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 25. Commutation                                  | 1    |      |            |            |     |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 26. dismissal/discontinuance                     |      | 1    |            |            |     |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 27. Annual household income before epidemic      | .10  |      | 1          |            |     |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 28. Annual household income after epidemic       | .11  | -.12 | <u>.85</u> | 1          |     |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 29. Student dormitory, share house etc.          |      |      |            |            | 1   |     |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 30. garden or balcony                            |      |      |            |            |     | 1   |     |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 31. parks and botanical gardens                  |      |      | .11        | .11        |     | .23 | 1   |            |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 32. food stores or restaurants                   |      |      |            |            |     | .14 | .27 | 1          |            |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 33. shops selling other everyday items           |      |      |            |            |     | .11 | .23 | <u>.43</u> | 1          |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 34. Number of rooms                              |      |      | .09        | .11        |     | .22 |     | -.14       | 1          |     |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 35. Number of adults                             |      |      |            |            |     | .13 |     | -.11       | <u>.59</u> | 1   |     |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 36. 5 adults                                     |      |      |            |            |     |     |     |            | .20        | .29 | 1   |     |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 37. Number of youth                              | -.10 |      | <u>.31</u> | <u>.32</u> |     | .11 |     |            | .24        | .09 |     | 1   |            |            |     |     |     |     |    |    |    |    |    |    |  |
| 38. Number of children                           | -.12 |      | .27        | .27        |     |     | .09 |            | .18        |     |     |     | <u>.85</u> | 1          |     |     |     |     |    |    |    |    |    |    |  |
| 39. Number of preschool-age                      | -.18 |      | .20        | .19        |     |     |     |            | .11        |     |     |     | <u>.69</u> | <u>.82</u> | 1   |     |     |     |    |    |    |    |    |    |  |
| 40. 3 preschool-age children                     |      |      |            |            | .12 |     |     |            |            |     |     |     | .17        | .18        | .21 | 1   |     |     |    |    |    |    |    |    |  |
| 41. Infected (recovered or undergoing treatment) |      |      |            |            |     |     |     |            |            |     |     |     |            |            | .10 | .17 | 1   |     |    |    |    |    |    |    |  |
| 42. Suspected to be infected                     |      |      |            |            | .11 |     |     |            |            |     |     |     |            |            |     |     |     | 1   |    |    |    |    |    |    |  |
| 43. Recent contact                               |      |      |            |            | .12 |     |     |            |            |     |     |     |            |            |     |     | .18 | .12 | 1  |    |    |    |    |    |  |



preschool-age children, Infected (recovered or undergoing treatment), Suspected to be infected, Recent contact, Suspected of having contact, Primary illness, High-risk cohabitants, Extent of voluntary restriction, No social distancing, Event 1-30 and Coping 1-16.

**Table 7** Multiple regression results for the effects of demographic variables, COVID-19-related factors, life event stressors, coping measures, personality traits, and social support on MCS.

|                         | b     | SE   | t-test | p value | 95% CI         |
|-------------------------|-------|------|--------|---------|----------------|
| Neuroticism             | -0.48 | 0.08 | -6.00  | <0.0001 | -0.64 to -0.32 |
| Openness                | -0.17 | 0.08 | -2.26  | 0.0242  | -0.32 to -0.02 |
| Social support          | 0.05  | 0.02 | 2.25   | 0.0246  | 0.01 to 0.1    |
| Junior college          | -1.07 | 0.43 | -2.50  | 0.0125  | -1.9 to -0.23  |
| Number of preschool-age | -1.07 | 0.52 | -2.07  | 0.0386  | -2.08 to -0.06 |
| E13                     | -0.47 | 0.23 | -2.05  | 0.0401  | -0.92 to -0.02 |
| E14                     | -0.67 | 0.30 | -2.25  | 0.0245  | -1.25 to -0.09 |
| E17                     | -1.84 | 0.23 | -7.89  | <0.0001 | -2.29 to -1.38 |
| E18                     | -0.47 | 0.23 | -2.00  | 0.0452  | -0.92 to -0.01 |
| E20                     | -0.62 | 0.24 | -2.55  | 0.0108  | -1.1 to -0.14  |
| E24                     | -0.79 | 0.25 | -3.18  | 0.0015  | -1.28 to -0.3  |
| E25                     | -0.95 | 0.23 | -4.09  | <0.0001 | -1.4 to -0.49  |
| E26                     | -0.62 | 0.21 | -2.98  | 0.0029  | -1.02 to -0.21 |
| C1                      | -2.72 | 1.02 | -2.68  | 0.0076  | -4.72 to -0.73 |
| C11                     | 1.17  | 0.58 | 2.03   | 0.0421  | 0.04 to 2.3    |

Note:  $F(91, 1408) = 10.16$ ,  $p < 0.0001$ ;  $R^2_{adj} = 0.36$ . Only variables significant at  $p < 0.05$  are shown. b = unstandardized regression coefficient. Other variables included in the model were Extraversion, Agreeableness, Conscientiousness, Age, Female, Other, Asian, Education, Unmarried, Divorced or widowed, Living with partner, Self-employed, Full-time, Housewives/husbands, Unemployed, Commutation, Dismissal or discontinuance, Income before epidemic, Income after epidemic, Student dormitory, etc., Garden or balcony, Parks and botanical gardens, Food stores or restaurants, Shops selling other everyday items, Number of rooms, Number of adults, 5 adults, Number of youth, Number of children, 3 preschool-age children, Infected

(recovered or undergoing treatment), Suspected to be infected, Recent contact, Suspected of having contact, Primary illness, Psychiatric outpatient, High-risk cohabitants, Extent of voluntary restriction, No social distancing, Event 1-30 and Coping 2-17.

**Table 8** Multiple regression results for the effects of demographic variables, COVID-19-related factors, life event stressors, coping measures, personality traits, and social support on K6.

|                             | b     | SE   | t test | p value | 95% CI         |
|-----------------------------|-------|------|--------|---------|----------------|
| Extraversion                | -0.11 | 0.04 | -2.76  | 0.0059  | -0.19 to -0.03 |
| Agreeableness               | -0.20 | 0.05 | -4.11  | <0.0001 | -0.29 to -0.1  |
| Neuroticism                 | 0.44  | 0.04 | 9.84   | <0.0001 | 0.35 to 0.53   |
| Social support              | -0.07 | 0.01 | -5.12  | <0.0001 | -0.09 to -0.04 |
| Unemployed                  | 1.05  | 0.47 | 2.21   | 0.0276  | 0.12 to 1.98   |
| Garden or balcony           | -0.65 | 0.25 | -2.58  | 0.0100  | -1.15 to -0.16 |
| Psychiatric outpatient      | 1.58  | 0.46 | 3.47   | 0.0005  | 0.69 to 2.48   |
| Suspected to be infected    | 3.88  | 1.11 | 3.49   | 0.0005  | 1.7 to 6.06    |
| Suspected of having contact | -1.35 | 0.64 | -2.10  | 0.0359  | -2.6 to -0.09  |
| No social distancing        | 2.17  | 0.82 | 2.63   | 0.0087  | 0.55 to 3.78   |
| E16                         | 0.30  | 0.13 | 2.40   | 0.0167  | 0.06 to 0.55   |
| E17                         | 1.19  | 0.13 | 9.23   | <0.0001 | 0.94 to 1.44   |
| E22                         | 0.45  | 0.20 | 2.23   | 0.0259  | 0.05 to 0.84   |
| E25                         | 0.72  | 0.13 | 5.63   | <0.0001 | 0.47 to 0.98   |
| E26                         | 0.51  | 0.11 | 4.42   | <0.0001 | 0.28 to 0.73   |
| E30                         | 0.37  | 0.15 | 2.43   | 0.0153  | 0.07 to 0.67   |
| C1                          | 1.53  | 0.56 | 2.71   | 0.0068  | 0.42 to 2.64   |
| C5                          | 0.64  | 0.29 | 2.21   | 0.0274  | 0.07 to 1.21   |
| C6                          | 2.41  | 1.17 | 2.06   | 0.0400  | 0.11 to 4.70   |
| C10                         | -0.73 | 0.24 | -3.00  | 0.0027  | -1.20 to -0.25 |

Note:  $F(91, 1408) = 20.47$ ,  $p < 0.0001$ ;  $R^2_{adj} = 0.54$ . Only variables significant at  $p < 0.05$  are shown. b = unstandardized regression coefficient. Other variables included in the model were Conscientiousness, Openness, Age, Female, Other, Asian, Education, Junior college, Unmarried, Divorced or

widowed, Living with partner, Self-employed, Full-time, Housewives/husbands, Commutation, Dismissal or discontinuance, Income before epidemic, Income after epidemic, Student dormitory etc., Parks and botanical gardens, Food stores or restaurants, Shops selling other everyday items, Number of rooms, Number of adults, 5 adults, Number of youth, Number of children, Number of preschool-age, 3 preschool-age children, Infected (recovered or undergoing treatment), Recent contact, Primary illness, High-risk cohabitants, Extent of voluntary restriction, Event 1-29 and Coping 2-17.

**Table 9** Multiple regression results for the effects of demographic variables, COVID-19-related factors, life event stressors, coping measures, personality traits, and social support on SBQ-R.

|                          | b     | SE   | t test | p value | 95% CI         |
|--------------------------|-------|------|--------|---------|----------------|
| Extraversion             | -0.06 | 0.03 | -2.31  | 0.0210  | -0.11 to -0.01 |
| Conscientiousness        | -0.08 | 0.03 | -2.78  | 0.0054  | -0.13 to -0.02 |
| Neuroticism              | 0.12  | 0.03 | 4.15   | <0.0001 | 0.06 to 0.18   |
| Social support           | -0.09 | 0.01 | -10.27 | <0.0001 | -0.11 to -0.07 |
| Age                      | -0.11 | 0.04 | -2.66  | 0.0078  | -0.19 to -0.03 |
| Female                   | 0.38  | 0.17 | 2.24   | 0.0250  | 0.05 to 0.7    |
| 3 preschool-age children | 1.69  | 0.83 | 2.03   | 0.0428  | 0.06 to 3.32   |
| Psychiatric outpatient   | 2.03  | 0.30 | 6.76   | <0.0001 | 1.44 to 2.61   |
| Suspected to be infected | 2.24  | 0.73 | 3.07   | 0.0022  | 0.81 to 3.67   |
| E8                       | 0.43  | 0.13 | 3.26   | 0.0012  | 0.17 to 0.69   |
| E12                      | 0.20  | 0.10 | 1.99   | 0.0472  | 0 to 0.39      |
| E17                      | 0.22  | 0.09 | 2.61   | 0.0091  | 0.06 to 0.39   |
| E18                      | 0.25  | 0.08 | 2.98   | 0.0029  | 0.09 to 0.42   |
| E22                      | 0.43  | 0.13 | 3.27   | 0.0011  | 0.17 to 0.69   |
| E25                      | 0.21  | 0.08 | 2.49   | 0.0128  | 0.05 to 0.38   |
| C1                       | 1.03  | 0.37 | 2.78   | 0.0056  | 0.3 to 1.76    |
| C5                       | 0.38  | 0.19 | 1.99   | 0.0464  | 0.01 to 0.75   |
| C7                       | 0.74  | 0.21 | 3.57   | 0.0004  | 0.33 to 1.15   |

Note:  $F(91, 1408) = 10.70$ ,  $p < 0.0001$ ;  $R^2_{adj} = 0.37$ . Only variables significant at  $p < 0.05$  are shown. b = unstandardized regression coefficient. Other variables included in the model were, Agreeableness, Openness, Other, Asian, Education, Junior college, Unmarried, Divorced or widowed, Living with

partner, Self-employed, Full-time, Housewives/husbands, Unemployed, Commutation, Dismissal or discontinuance, Income before epidemic, Income after epidemic, Student dormitory etc., Garden or balcony, Parks and botanical gardens, Food stores or restaurants, Shops selling other everyday items, Number of rooms, Number of adults, 5 adults, Number of youth, Number of children, Number of preschool-age, Infected (recovered or undergoing treatment), Recent contact, Suspected of having contact, Primary illness, High-risk cohabitants, Extent of voluntary restriction, No social distancing, Event 1-30 and Coping 2-17.

#### 4. Discussion

The present study concerned the assessment of the factors affecting the overall health of the general population in Japan immediately after the lifting of the state of emergency imposed earlier in response to the SARS-CoV-2 outbreak. The assessment results revealed the possible risk factors for developing mental and physical health issues and the factors that might offer protection against these risks. Although the nature of the relationship between the identified factors and the SARS-CoV-2 outbreak could not be elucidated in the present study, high levels of psychological distress and suicidal ideation were reported by a few participants, indicating a requirement for psychiatric care.

The only factor revealed to be significantly predictive of physical health (PCS) was “insufficient exercise”. This suggested that a greater decline in physical health occurred in the participants who were stressed regarding not getting enough exercise. However, the amount of variance in the PCS explained by this regression model was only 14%, with most of the variance being accounted for by certain other unknown factors.

The significant predictors of mental health (MCS) were “neuroticism” and the life event stressors of “outbreak-related mental health problems” and “uncertainty regarding the future”. This suggested that during the SARS-CoV-2 outbreak in Japan, stress-related mental health problems may have ultimately damaged the mental health of certain individuals. In particular, “uncertainty regarding the future” appeared to have had such an effect. Furthermore, having a strongly neurotic personality appeared to be a risk factor for mental health problems, even during normal times.

Participants characteristically scored high in the assessment of psychological distress. The risk factors identified in the assessment were “neuroticism” and the life event stressors of “outbreak-related mental health problems”, “uncertainty regarding the future”, and “decline in the duration and quality of sleep”. In addition, the results suggested that agreeableness and social support could serve as protective factors against psychological distress. Conversely, when agreeableness and social support were low, they could act as risk factors. Therefore, it is important to proactively recommend specialized psychiatric care to individuals who, besides having the risk factors for psychological distress, rate low in agreeableness and social support.

In terms of suicidal ideation, the study participants rated relatively high, similar to psychological distress, although it was not possible to compare these observations to the situation prior to the outbreak. In a previous study on the general Japanese population, the prevalence of suicidal ideation was determined to be 30% [21]. In the present study, a total of 1,092 (72.8%) participants reported having considered suicide in some way (SBQ-R  $\geq$  4), while 134 (8.9%) participants scored 11 or above, which identified these individuals as being at a high risk of attempting suicide. This suggested that in the general population of Japan, a certain number of individuals may not be receiving appropriate psychiatric care, even though they are experiencing suicidal ideation. The risk factors identified for suicidal ideation were neuroticism and having a psychiatric disorder, while social support was determined to be a protective factor.

Although none of the life event stressors were revealed as significant predictors of the response variables in the regression analysis, significant correlations were observed between several variables, which were not reflected in those findings. The “frequency of going to work during the state of emergency” correlated positively with the “quantitative increase in the workload”,

“qualitative increase in the workload”, and “interpersonal relationship problems at work”, while “increased workload related to childcare/eldercare/household chores” correlated positively with “married (living together)”, “number of children under 18 living at home”, “number of children under 13 living at home”, and “number of children in pre-school age living at home”. In addition, there was a positive correlation between the “qualitative increase in the workload” and “full-time employment”. Negative correlations, to a certain extent, were observed between “increased workload related to childcare/eldercare/housework” and “never having been married”, “loss of job/income” and “being a housewife/husband”, and “significant reduction in the household income” and “annual income after the SARS-CoV-2 outbreak”. The fact that losing one’s job and having one’s household income significantly reduced had exerted no impact on the mental health, let alone causing psychological distress or suicidal ideation, was particularly surprising. It appeared that the effects of life event stressors, rather than being individually and directly related to the psychological symptoms, must have been buffered in a certain way.

Furthermore, in the correlation analysis for physical health, E28 “insufficient exercise” presented the largest correlation, with  $r = -0.23$ , although this was not significantly different compared to the other stressors. In addition, the multiple regression analysis revealed “insufficient exercise” as the only variable that maintained a significant effect when conditioned on the other variables. Conditioning on the other variables might have highlighted the strength of the association between stressed inactivity and physical ill-health. In regard to mental health, neuroticism, E17 “outbreak-related mental health problems”, and E25 “uncertainty regarding the future” were identified in both correlation analysis and multiple regression analysis. Alternatively, the association between E26 “decline in the duration and quality of sleep” and mental health was observed in the correlation analysis, but not in the multiple regression analysis. In regard to psychological distress, E17, E25, and E26 demonstrated a significant relationship in both correlation analysis and multiple regression analysis. Although the effect of E26 on mental health was not completely unconfirmed in the multiple regression analysis ( $b = -0.62$ ,  $p = 0.0029$ ) and one should remain cautious of extreme interpretations, a difference in the decline in the sleep duration and quality of sleep could represent a qualitative factor for distinguishing mental health illness from psychological distress. Moreover, neuroticism, social support, and E17 were correlated, to a certain extent, with suicidal ideation. However, in the multiple regression analysis, the association of E17 was not significant ( $p = 0.0091$ ), while the effect of being under psychiatric treatment was significant. E17 demonstrated a negative correlation with social support ( $r = -0.16$ ), indicating that a lack of social support was associated more with suicidal ideation rather than with stressful outbreak-related mental health problems. In addition, the fact that these were patients treated for mental illness could be a unique characteristic. Although being treated for a mental illness correlated slightly with mental health or psychological distress ( $r = -0.16$ ,  $r = 0.22$ ), there was no significant correlation between the mental illness patients and E17, while among the stressors only E12 “difficulty receiving a consultation for a chronic disease” was observed to be correlated with the mental illness patients. Being a psychiatric patient did not necessarily imply that the individual would experience a decline in mental health or an increase in psychological distress. Although these individuals were stressed regarding not being able to receive the treatment as usual for their illness, it did not suggest suicidal ideation. Perhaps this is a normal feature of the patients with mental illness unrelated to the COVID-19 outbreak.

Although being unmarried is a known risk factor for suicide [22], it was not observed to have a marked significant correlation with the outcome measures in the present study. Moreover, the

items such as annual household income prior to/after the outbreak and the number of preschool-age children, which were assumed to be negatively related to the COVID-19 outbreak, also did not demonstrate a strong correlation with the outcome measures. Previous studies have reported group differences for these items in the same outcome measures [8]. It could be that the differences in marital status, level of income, and the number of children result in different degrees of physical and mental responses, although these differences cannot necessarily be captured in a linear relationship. An approach that examines the risk factors based on the assumption of a linear relationship between the concepts might overlook the risk of certain people in unique situations. In regard to the variables that were observed not to be associated with the outcome measures in the present study, it is necessary to re-examine the requirement for actions in the care of communities under the spread of SARS-CoV-2 infection using a method that focuses on group differences.

The results of the present study did not reveal any useful coping measures for dealing with outbreak-related mental and physical health problems. Therefore, further studies examining the differences arising in the mental and physical responses to the outbreak situation due to the overall coping style are required to identify useful intervention and prevention strategies.

Despite no information revealed regarding the useful coping measures, the overall results of the present study are promising for the implementation of an integrative and complementary treatment approach. Neuroticism, which was revealed to exert a significant impact on the outcome measures related to mental health, psychological distress, and suicidal ideation even after adjusting for comprehensive factors, is a personality trait that cannot be treated using conventional medicine. Therefore, it is imperative to develop an integrative and complementary treatment approach that would enable individuals with a high propensity for neuroticism to have a better health status in high-risk environments. Furthermore, social support emerged as a protective factor for psychological distress and suicidal ideation which suggests that the possible causes of mental health problems and suicidal ideation should not be limited to the factors related to the individual only and should include the problems in the relationship with the community, the organizations, and the other groups to which the individual belongs. An integrative and complementary treatment approach, in addition to considering the wholeness of the individual, would emphasize the wholeness of the community as well as the relationship and connection between the practitioner and the patient, particularly under this scenario of SARS-CoV-2 outbreak. Moreover, the experience of mental ill-health, uncertainty regarding the future, and sleep deprivation, along with perceiving these factors as stress, were indicated to have a greater influence on mental health and psychological distress compared to the other socioeconomic stressors. The spread of novel infectious diseases renders it inevitable that people would undergo deterioration in their economic situation. However, even in such a situation, it might be possible to maintain a normal mental health status by avoiding feeling an internal sense of unwellness and not perceiving the illness as excessive stress. Enhancing the coping ability and adaptability of individuals in this manner is the expected role of the psychosocial care groups and integrative and complementary medicine. Finally, regarding physical health, the only stressor that was observed to have a significant impact was the lack of physical activity. It is expected that an integrative and complementary treatment approach involving physical activity would promote the physical health of individuals, particularly during the lockdown period.

Despite the important suggestions provided regarding the mental and physical responses of the Japanese residents to the outbreak, the present study had certain limitations. First, there could be

a potential sample selection bias as the survey was conducted online and the participants recruited were from a specific group of panel members of a specific online survey company. Although the characteristics of the respondents were not evidently biased compared to those of the Japanese population aged 18 years or above, caution would be advisable when generalizing the results to all Japanese residents. Second, as the present research was designed as a cross-sectional study, its results cannot be used for demonstrating cause and effect relationships and a longitudinal study would be required to corroborate these findings. Third, the statistical models used in the present study assumed adjusted relationships between explanatory and response variables and did not deny the existence of mediation or moderation in the relationships between the variables. Identification of such a relationship could indicate additional risk factors and protective factors. Similarly, only the models of unidirectional influence relationships from explanatory variables to objective variables were used in the present study. Therefore, deciphering the dynamic relationship between mental and physical health and the psychological distress and suicidal ideation, as well as revealing the combined effects of human responses and behaviors such as perceived stress and coping on these relationships, remains a challenge for future research. Finally, several variables in the present study, although assumed to be associated with the outcome variables, did not demonstrate a strong or even a moderate correlation. It is recommended that these variables, such as marital status, income, and the number of young children, be re-examined for their effects on the body and mind of people in the scenario of COVID-19 outbreak using a method that focuses on group differences.

## **5. Conclusions**

The present study indicated that in the period immediately after the lifting of the SARS-CoV-2 outbreak-related state of emergency, several individuals in the general Japanese population may require psychiatric care. It was suggested, albeit indirectly, that such health conditions could have originated from outbreak-related stress. Furthermore, neuroticism, recognition of one's mental health problems, and uncertainty regarding the future were identified as the risk factors, while agreeableness and social support were revealed as protective factors. A proactive recommendation and provision of integrative and complementary medicine and other psychosocial care to the members of the general population who rated high in these risk factors could reduce the decline in overall health.

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None

## **Author Contributions**

Kanto Araki contributed to conceptualization, methodology, validation, writing the draft and visualization. Keita Kiuchi contributed to conceptualization, methodology, formal analysis, investigation, reviewing and editing the draft, and project administration. Katsumasa Kishi contributed to conceptualization, methodology, validation, and reviewing and editing the draft.

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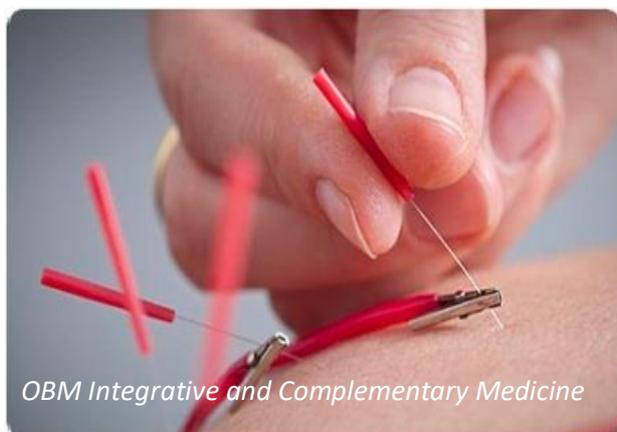
## Competing Interests

The authors have declared that no competing interests exist.

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