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Factors affecting worriedness: A study of the COVID-19 pandemic in Japan

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ABSTRACT

The global effect of COVID-19 is no longer simply a public health issue; it is causing an economic crisis that has a significant impact on the job market and people's lives. The disease has led to 43% of businesses temporarily closing, and almost all these closures are due to COVID-19. Organizations that have temporarily suspended their activities have pointed mainly to a decline in demand and employee health issues as the reasons for closure. In emergency and disaster management, perception often helps shape personality and how people act in certain situations. This study aims to examine personal risk perception of COVID-19 from many viewpoints and whether it affects motivation with regard to improving personal preparedness. We collected data from three major Japanese cities through a questionnaire survey and analyzed the results of the survey through factor analysis and multiple regression analysis by using the Partial Least Square Structural Equation Modeling (PLS-SEM). The three study areas include (1) the most damaged regions from the 2011 Great East Japan earthquake and tsunami, (2) the capital city and surrounding areas of Tokyo, and (3) Kumamoto, which has recently experienced an earthquake. The findings show a correlation between the nature of the information received during COVID-19 and worriedness and the necessity for adequate information. The expected benefit of this study is to provide guidelines for the government or organizations to make a suitable emergency management plan based on pertinent factors for future pandemics.

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1. Introduction

A pandemic is a widespread outbreak of an infectious disease. Past pandemics include “swine flu” (H1N1) in 2009 [1], “avian flu” (H5N1) in 2011 [2], and the 2003 outbreak of severe acute respiratory syndrome (SARS). COVID-19 is one of the biggest recent pandemics and its effects have been vast and widespread. Also, pandemics disrupt daily life and reveal a lack of awareness and preparedness [3].

In December 2019, the novel coronavirus (2019-nCoV) was identified in cases of viral pneumonia in Wuhan, Hubei Province, China, and the disease was named on January 12, 2020, by the World Health Organization (WHO). During the following month, the 2019-nCoV spread rapidly both inside and outside the province of Hubei and to other countries. Moreover, the sudden rise in the number of cases triggered widespread fear among people [4]. On March 11, 2020, the WHO characterized COVID-19—which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)—as a pandemic, after 118,000 cases and 4291 deaths were reported in 114 countries [5].

The COVID-19 pandemic has led to a huge loss of human life worldwide and poses an unparalleled threat to public health, food systems, and business, causing around half of the world’s 3.3 billion workers to be at risk of losing their livelihoods. As a result, many people are unable to support themselves and their families. Furthermore, the pandemic has negatively affected global economic growth unlike anything experienced in nearly a century. Global economic growth reduced from an estimated annualized rate of −4.5% to −6.0% in 2020. Meanwhile, from mid to late 2021, outbreaks of infectious cases in Europe, the United States, Japan, Brazil, India, and other developing economies have summoned calls for lockdowns and curfews, which have threatened to weaken or postpone potential sustained economic recovery [6]. Some countries decided to partially close their international borders and only allowed selected travel entries, such as in the case of Indonesia. Regardless of the method of containing the pandemic, economic fallout from the pandemic may result in continuing interruptions in the labor market as a result of abnormally high levels of unemployment not seen since the Great Depression in the 1930s. Moreover, high levels of debt in developing economies result in the cost of living permanently affecting global economic growth in addition to the rising costs associated with poverty, lives being upended, careers derailed, and increased social unrest. On the other hand, the International Monetary Fund has predicted global growth of 5.2% in 2021. In India and China, growth is forecast to grow by 8.8% and 8.2% respectively, while it is expected to be low in the UK and Italy since these countries have been hit hard by the pandemic [7].

On the bright side, many vaccines received positive reports in clinical trials and have since become available, such as Pfizer-BioNTech, the first COVID-19 vaccine to receive US Food & Drug Administration and Emergency Use Authorization. This has been up to 95% successful at preventing COVID-19. However, there are difficulties associated with its transport since it must be shipped in ultra-cold temperature-controlled units (−94° Fahrenheit) commonly found in pharmaceutical refrigerators and freezers. So, far, the Pfizer-BioNTech vaccine has been found to protect against the variant that was first detected in Great Britain (B.1.1.7), but it could be less effective against the variant first detected in South Africa (B.1.351) [8]. Current vaccines were designed around earlier versions of COVID-19, while a recent study stated that the Brazilian variant may resist antibodies in people with COVID-19 immunity. All viruses naturally mutate over time, which might make them more contagious, and vaccines thus have lower efficacy. Sars-CoV-2 is an exception. Since the virus was first identified a year ago, thousands of mutations have arisen.

In Japan, the state of emergency has been eased too early as the rate of in-country contacts is not as low as it should be. Before the government took action during the early period of COVID-19 when Japanese people were infected, not many large-scale tests had been conducted. For example, the Diamond Princess cruise ship was quarantined for two weeks before passengers and crew could disembark. However, some had reported positive at airports in Australia and elsewhere. Before the state of emergency was eased, the situation had settled and improved over time. However, the second wave of the outbreak originated among workers and teenagers who frequented overcrowded places such as gyms or nightclubs, especially crowded clubs or bars, which were potential locations for COVID-19 exposure. In addition, a third wave has attacked Japan leading to the four-tier scale of alert as many prefectures in Japan lack equipment, hospitals, and beds as the number of infected people has increased dramatically every day [9]. A recent study used a questionnaire as a tool to quantitatively assess the impact of COVID-19 on Japanese society after the start of the third wave [10]. Some of the questionnaire items used in the research (i.e., information, risk perception, and social impact) used a questionnaire performed by the European Commission’s Joint Research Centre (EU-JRC) and University College London to facilitate international comparisons for similar research. This research highlighted that Japanese people tend to use the Internet and TV as their two primary sources of information, but social media was not a significant resource. The research also stated that their experience of disasters did not help individuals better prepare for a disaster such as the COVID-19 pandemic. Levels of satisfaction with work, mental health, and the economy also decreased. As such, the following research will extend that questionnaire by further examining how Japanese popular perceptions have changed during COVID-19, especially regarding their motivation to improve personal preparedness.

Medical experts urged the central government of Japan to declare a fourth wave of COVID-19 as daily new cases rose to a new high in January 2021, as shown in Fig. 1. New clusters of disease among indoor sports teams, such as volleyball and basketball, spread rapidly in Osaka, resulting in online schooling and avoidance of unnecessary outings until May 05. The Osaka Prefecture medical system began to collapse, resulting in difficulties in receiving proper treatment as 97.8% of hospital beds for severely ill coronavirus patients in the prefecture were occupied. Like Osaka, the metropolitan region, including Tokyo, where the state of emergency was lifted on March 22, 2021, could also be affected.

In some areas of the world, coronavirus infection rates are getting worse. A question causing concern all over the world seems to be about when the pandemic will end. Being in lockdown for more than a month causes people to feel stress, anxiety, and other emotional issues. Relationship breakdowns have increased dramatically. The stress caused by the pandemic may have occasioned abuse in
homes where it may not have previously been a problem. Domestic violence can have harmful health and mental health consequences, such as an increased risk of chronic disease, depression, post-traumatic stress disorder, and unsafe sex and drug use habits.

To avoid the spread of COVID-19, infection prevention and control are important. Japan uses the tracking COCOA that is provided by the Ministry of Health, Labor, and Welfare. This app notifies users of close contacts with COVID-19 positive people and helps the government and healthcare organizations contain the spread of the disease [11]. To spread the information on the COVID-19 prevention, Videos are an effective medium to directly engage people as they search for ways to educate themselves about infection prevention [12]. People may make decisions and implement healthy behaviors to protect themselves and their family members from diseases like COVID-19 when they receive credible, timely, and up-to-date information in a language they understand via reliable sources [13]. Understanding infection management provides the resources needed to help prevent the spread of COVID-19.

Similar research has been conducted in the past. This study is intended to fill the remaining research gaps in this field. Scholars have conducted questionnaire-based surveys on the experience and preparedness of the general community toward COVID-19. These studies are similar to each other in that they are aimed at providing early evidence about the level of knowledge, risk perceptions, and preparedness toward COVID-19 among the general public [14,15]. The present study delves deeper into the factors that have affected people’s level of worriedness during the pandemic and during the government-mandated state of emergency period in Japan. Another problem concerns tools such as drones, tracking applications, and infection prevention videos, which may also affect worriedness. One study mentioned the use of technology to promote connectedness, mainly among the older age group, but did not mention if the use of technology might affect people's level of worriedness during the pandemic [16]. While many studies have already examined the perceived information provision during the COVID-19 state of emergency, not many have mentioned the perceived usefulness of tools; hence, we include this topic in our scope.

The significance of this study is that it examines the various factors affecting worriedness during COVID-19, including preparedness, experience, and information, as well as the importance of the potential tool’s perceived usefulness. As a result of this study, it is hoped that the government can provide some guidelines for future pandemic outbreaks or disaster prevention. This research focuses on the COVID-19 experience in four areas of Japan, which consist of the major Japanese cities that experienced various natural hazards. The areas are the metropolitan area, Miyagi area, Iwate area, and Kyushu/Kumamoto area. The questionnaire surveys were distributed only within these areas.

2. Literature review

2.1. Worriedness

Worriedness is a feeling of stress and anxiety which can also exhibit physical changes, such as increased blood pressure, sweating, or a rapid heartbeat [17]. Worriedness occurs when something bad happens or there is an unrealistic concern about future events. It can refer to problematic thoughts about the future, motivate people to search for solutions [18–20]. Worriedness levels vary during different phases of a pandemic or disaster. When the COVID-19 outbreak took place, one of the main factors for worriedness was the economic recession [19]. In addition, people worry about social and political disastrous events and also terrorist attacks during disasters [21,22]. During a pandemic, exceeding normal levels of worriedness will weaken the immune system and, as a result, the risk of infection will increase. Furthermore, people’s anxiety causes traffic problems as they rush to supermarkets, wellness centers, and hospitals, causing health supplies to become unavailable and affecting the country’s health care service providers [23]. The level of anxiety in the 21–40 age group is considerably high, suggesting that the main reasons are future and economic consequences, since this age group is directly impacted by unemployment, inflation, and company closures. Moreover, the increased rates of coronavirus infection have increased levels of worriedness [23]. Previous research in 3 countries, Turkey, Serbia, and Macedonia showed that for young adults the disasters most feared and worried about is earth quakes and epidemics [24]. What causes this fear is that, young adults felt more afraid of the well-being of their family members, especially the parent’s health more than anything, including their own health. In correlation to the age, it is shown that stress and overall emotional reactions increased with age [25]. This paper also
states that genders perceived different reactions too, in terms of the psychological reaction caused by experience in effect of COVID-19. Lastly, many countries, especially in low- and middle-income areas, face difficulties when accessing online mental health resources. There is a lack of coverage for vulnerable groups and also uncertainty over the effectiveness of online treatments due to the absence of evidence to back up these services [26].

According to the name of the researcher(s) or report [27], worriedness is increased by the type of information received during the pandemic, people’s perception of risk during the pandemic, trust, which affects personal preparedness before the pandemic, and also experiences during the pandemic [28,29]. The needs for the assessment of fear and worriedness during COVID-19 will have great implications. As it can be used by the decision makers to use these findings to identify better strategic opportunities for pandemic disaster risk management [30].

One study observed that public fear increased substantially during the 22-day period in parallel with the escalation of the pandemic [31]. In April 2020, a corresponding decrease in public fear was recorded after cases peaked [32]. Sadikovic et al. [33] indicated a decrease in the examined emotional states caused by the pandemic (e.g., worry, fear, boredom, and anger) over time, with the most significant decreases recorded for worry, followed by fear and boredom. Significant predictors of people’s emotional reactions included personality dimensions and specific behaviors that were only observed during the pandemic, according to Sadikovic et al. A significant association was found between arousal of the activation system with worry, fear, boredom, and the fight against boredom and anger, on the one hand, and activation of the behavioral inhibition system with anger, on the other.

2.2. Preparedness before COVID-19

Disaster preparedness refers to actions taken to reduce the impacts of disasters, and effectively cope with their consequences. Individual preparedness can be assessed based on knowledge of the hazards, understanding of the contingency plan, warnings, and resource mobilization [34]. Along with risk prevention strategies, they mitigate disasters and allow the impacted population to return to resume its activities as soon as possible [35]. General disaster preparedness was assessed using a list of 15 items such as first-aid kit, mess kit or paper cups and plates, plastic utensils, antibacterial wipes or gel, and personal hygiene items [36]. The Federal Emergency Management Agency and the National Emergency Management Association identified 13 elements that need to be addressed by states in their preparedness efforts, such as hazard identification and risk assessment, hazard mitigation, direction, control and coordination, communications, warnings, exercises, evaluations, corrective actions, crisis communications, public education, information, and finance and administration [37]. Emergency preparedness such as non-pharmaceutical interventions were used because of the urgency caused by COVID-19, for example, lockdowns, the closure of schools and universities and their shift to online classes, the closure of non-essential businesses, and restrictions on both domestic and international travel. Also, there is a significant impact of information technology (IT) on emergency preparedness and planning [38].

2.3. Experiences during the COVID-19 state of emergency

Early international research examined activity and travel behavior patterns influenced by COVID-19 [39]. Adults have increased their internet usage. They ranged from an increase in dependence on internet usage and spending more time online, to severe addiction to the internet [40]. Distance learning has been facilitated by technology such as the internet (high speed internet i.e., fiber connection or 5 g, Wi-Fi), smartphone, TV, and email. Aside from the fact that many children need to access online learning, some parents are concerned about the standard of education their children may receive in a virtual environment, especially in families without access to the internet. Additionally, psychoactive substances and other behaviors (i.e., gambling, playing video games, watching TV shows, using social media, or surfing the internet) are often employed to ease the stress and anxiety caused by lockdowns, but spending too much time on these kinds of activities may result in increased worriedness as well as it will become a coping mechanism [41]. Meanwhile, consumer behavior has been influenced by the pandemic in terms of restricting physical contact through the use of cash. There was a rise in the registration of bank accounts with digital banks in South-East Asia and the limit on contactless payments was elevated in the United Kingdom [42].

In addition, some basic needs were more difficult to meet, particularly having enough food to eat. Moreover, people were only allowed to leave their homes for necessary activities, or they had to stay within their local areas [43]. When the pandemic broke out, people were concerned about empty stores because of forecasts about food scarcity, meat plant closures, and ruptures to supply chains. Furthermore, some hospitals have banned visitors, thus increasing patients’ worriedness. Psychosocial or mental stress, such as worriedness, was found to be prevalent due to experiences during lockdown, for example, changes in eating habits [44].

2.4. Perceived information provision during the COVID-19 state of emergency

Hazard and preparation information includes guidelines for household responses and preparedness activities such as preparing a family plan and stocking items (i.e., canned food, flashlights, and batteries) during a catastrophe [45]. An example would be social media as it is used as a source of information by younger generations and it facilitates the gathering of information regarding major public concerns during the pandemic. This includes public fears and trending topics by analyzing the content of a platform such as Twitter. A recent study shows that the main trend in social media in a certain area will be followed by a global trend, especially breaking news and major news that is happening in the area (i.e., the cruise quarantine in Japan, etc.) [46]. Another finding suggests that efforts by social media and networks to monitor and address government representatives entail difficulties that are apparent in complying with the intended measures in Serbia, particularly in the first few weeks leading up to the state of emergency. More than likely, this is the byproduct of the changes in perspective that occurred in this period of less than a month, which could lead to confusion among the general public [47].
People expressed many negative emotions and feelings about hazards and disasters (e.g., earthquakes, floods, pandemics), which were often prompted by seeing reporting on a disaster in the media [48]. In addition, the efficacy of information sources will increase a person’s sense of danger and make them more likely to evacuate; therefore, recognizing the impact of information sources and the perceived risk on evacuation behavior is critical in preventing deaths. The study was designed to study the psychological, sociological, and socioeconomic factors that are generally linked to risk perception and evacuation behavior [49]. Another study showed that people who were not strongly affected by disasters (e.g., floods) underestimated the negative effects associated with them and had less fear of such disasters [50].

Public gatherings and other activities were canceled when the first infections in the United States were declared outside Seattle. The news caused anxiety and concern among citizens. Employees were instructed to work from home while colleges transferred their courses online, and elementary schools closed to sanitize the entire building. Public anxiety has been much reported by psychologists and public health specialists. Cities all over the world have imposed major bans on public transportation as the number of reported cases of COVID-19 has increased. Moreover, due to curfews, most low-income people have no choice but to walk or bike home, and their access to work and social services is extremely disrupted. People who follow news on COVID-19 will experience more worriedness, and worriedness levels among people who have someone within their personal network infected by COVID-19 can be higher due to the increased risk of contracting the disease or worriedness about the health of their family and friends.

2.5. Perceived usefulness of tools

Social networking services, drones, satellite imagery via GIS, real-time hazard simulation, and widespread communication result in more effective and required information. For example, China has implemented AI-powered security cameras, drone-borne cameras, and compact digital recorders to track and restrict public gatherings [51]. Recently, drones have become important tools in the fight against the COVID-19 pandemic, supporting the development of more resilient supply chains and socially distanced distribution services. Drones have been used during disasters in Japan. In 2011, quadcopters helped to evaluate the damage to the Fukushima Daiichi nuclear plant, following the earthquake and tsunami of that year [52]. During the era of COVID-19, the need to avoid social contact has strengthened the case for using drones. Since the outbreak of the disease, they have been used to distribute medical supplies, gather or dispatch lab samples, deliver household goods to confined people, track social distancing, make public announcements, and maintain public spaces [53].

Drones food delivery services play a critical role in introducing contactless food services to customers during COVID-19, eliminating face-to-face interactions between suppliers and consumers, thereby lowering the risk of virus transmission [54]. Drones can search wider areas to assess the impact of a problem more quickly and accurately, and they can be incredibly beneficial in disease prevention, such as transporting vaccines and drugs to affected areas without infecting other humans in the process, which can limit the transmission of the disease [55]. Also, to learn more about the pathology and transmission of the virus, researchers use mobile technology to gather data on patient-reported symptoms and integrate it with other databases such as clinical and genomic sequencing data.

To assist infectious disease monitoring, preparedness, and reaction, the tracking platform verifies whether users have had any recent close contact with infected people. The tracking application’s primary purposes are to notify users whether they have come into contact with people who have reported positive and to help health officials track them. When combined with adequate monitoring, or when the testing strategy prioritizes symptomatic cases, contact tracing apps may significantly lower infection rates in the population. Indeed, the infection rate declines as the number of users increases [56]. In addition, a pandemic preparedness plan is needed to evaluate human perceptions, to find approaches to improving the rate of satisfaction, and to help plan for natural disasters. Such plans are important for eliminating negative outcomes.

As a result of additional data from the tracking application, worriedness was higher among those who perceived COVID-19 information that could threaten either themselves or their close relationships and was higher in people who had a higher perceived usefulness of the tracking application and who tended to follow pandemic preparedness guidelines during lockdown, such as minimizing risk (i.e., wearing a mask, washing hands frequently, and social distancing) [57]. People within the outbreak area and whose reported cases are in their personal networks tend to use the tracking application since they are worried. As a result, their public transportation usage, visits to friends and family, and visits to restaurants and bars decrease. Willingness to use the tracking application during a pandemic is strongly associated with potential health effects. In addition, YouTube, as a free VDO, with its courses to learn good practice in infection prevention, is one of the most influential methods to raise awareness of COVID-19 in the community because of its universal influence and the low education levels of many people [58].

3. Research design and methodology

3.1. Questionnaire design

This study focuses on the research problem of people’s worriedness, which is affected by various factors, including preparedness, experience, and information. The objective is to study these factors affecting worriedness during COVID-19 and the importance of the potential tool’s perceived usefulness. This research focuses on COVID-19 in four areas of Japan, consisting of major Japanese cities that experienced different natural hazards, as explained in detail in subsection “3.3 Data Collection,” which describes the area of focus of this study. This research model is expected to identify factors affecting people’s worriedness and the positive or negative relationships between factors. It is also expected to guide the government in managing public facilities and appropriately inform its efforts to reduce public concerns, to plan pandemic preparedness efforts to allocate resources, to develop potential solutions, and to help fellow researchers who want to use this research model for further study.
The questionnaire was developed through the collaboration of the International Research Institute of Disaster Science from Tohoku University in Japan, the Graduate School of Engineering of Tohoku University in Japan, the Institute for Risk and Disaster Reduction in the United Kingdom, the Disaster and Risk Management Information Systems Research Unit of Chulalongkorn University in Thailand, and the Tsunami and Disaster Mitigation Research Centre (TDMRC) of Universitas Syiah Kuala in Indonesia [59]. The questionnaire included a total of 50 questions, including 15 questions on personal demographic details (i.e., age, gender, educational level, and living area). Some sections of the questionnaire (i.e., knowledge, risk perception, and social consequences) referred to a previously conducted questionnaire survey conducted by the Joint Research Centre-European Commission (EU-JRC) to perform international comparisons in the future. Most of the measurement items (i.e., For worriedness, preparedness before COVID-19, experiences during the COVID-19 state of emergency, and perceived information provision during the COVID-19 state of emergency) was taken from the related literature with little modification to the wording to make it fit the context of the study. Some of the items were added based on the current field of research. Every construct was evaluated by respondents on a 5-point Likert scale varying from 1 “strongly disagree” to 5 “strongly agree.”

To supplement the quality of our statistical analysis, the Cronbach’s alpha and composite reliability values should be equal to or greater than 0.7 [57]. In addition, the average variance extracted (AVE) is defined as the grand mean value of the squared loadings of the items related to the construct and the common measure for establishing convergent validity. A value of 0.5 or greater for the AVE indicates that the construct elucidates more than half of the variance of its items. However, according to Ref. [60], even if the AVE is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate. As shown in Table 4, although AVE values are slightly less than 0.5, Cronbach’s alpha and composite reliability values are greater than 0.6. Thus, convergent validity is established.

3.2. Proposed hypotheses

On the basis of the literature review, this study proposes factors that have affected worriedness during COVID-19, including preparedness, experience, and information, as well as the importance of the potential tool’s perceived usefulness. Based on the findings of the literature review, the following hypotheses are proposed:

H1. Preparedness before COVID-19 has a negative impact on worriedness.

H2. Experiences during the COVID-19 state of emergency have a positive impact on worriedness.

H3. Perceived information provision during the COVID-19 state of emergency has a positive impact on worriedness.

H4. In the perceived high usefulness of the drones group, preparedness, experience, and information increase worriedness more than in the low usefulness group.

H5. In the perceived high usefulness of the displacement tracking application group, preparedness, experience, and information increase worriedness more than in the low usefulness group.

H6. In the perceived high usefulness of free VDO and courses to learn good practice for the infection prevention group, preparedness, experience, and information increase worriedness more than in the low usefulness group.

Based on these hypotheses, Fig. 2 illustrates the proposed research model.

3.3. Data Collection

For this research, three fields of study were chosen based on disasters as experienced by online surveys. First, Miyagi and Iwate are the two most damaged regions due to the earthquake and tsunami in 2011. Fukushima was not chosen as the responses can be affected by the Fukushima Daiichi nuclear disaster. Second, the capital cities (i.e., Tokyo Metropolitan, Saitama Prefecture, Kanagawa

![Diagram](image-url)

**Fig. 2.** Proposed research model.
Prefecture, and Chiba Prefecture) were selected as they are less experienced in disasters. Third, Kyushu Prefecture was chosen since it experienced the Kumamoto earthquake in 2016 and also floods in 2020 during the COVID-19 pandemic. To evaluate the current situation in Japan, a questionnaire survey was conducted for rapid collection of data and to ensure the quality of the responses. The survey was conducted by Rakuten Insight from November 5 to 9, 2020, with a total of 600 participants, 200 in each region. The data have been used previously by Suppasri et al. [10] in research that highlighted the role of a questionnaire as a tool to quantitatively assess the impact of COVID-19 on Japanese society after the start of the third wave; we used the data from this publication and used a different model in our research. All the questions were in the Japanese language.

3.4. Data analysis-structural equation modeling (SEM)

Many researchers prefer the SEM approach because it allows them to evaluate complex models with a large number of constructs, indicator variables, and structural paths [61,62]. The SEM method is a combination of factor analysis and multiple regression analysis, which can analyze multiple layers of a construct in a single analysis. SEM is a statistical method that combines confirmatory factor analysis and path analysis. Confirmatory factor analysis is used to evaluate latent psychological characteristics, such as attitude and satisfaction [63].

PLS is a modeling approach to SEM without making distributional assumptions on the data [64]. It is particularly useful when we need to predict a set of dependent variables from a large set of independent variables (i.e., predictors). Thus, PLS-SEM becomes a suitable alternative as the following conditions cause [65]:

- The objective is to predict key target constructs or to define key driver constructs.
- The structural model is complex (many constructs and many indicators).
- The model uses latent variables in subsequent analyses.

PLS-SEM has been applied in a variety of areas, such as human behavior, marketing, enterprise, information management, business strategy, as well as disaster management [66].

This study used the Smart PLS version 3 for data analysis.

4. Results

4.1. Descriptive statistics for Respondent's answer

The samples demonstrate the responses collected from 600 Japanese people. Table 1 shows the demographic information of the participants. The target for the participants was to consist of females constituting 50% of the collected data and 50% were males, so it represents both gender points of view equally. This survey groups people's ages in ranges of 10 years, from their 20s until their 60s,
Table 1
Demographic information.

| Value                                           | Frequency | Percentage |
|------------------------------------------------|-----------|------------|
| **1 Gender**                                   |           |            |
| Female                                         | 300       | 50%        |
| Male                                           | 300       | 50%        |
| **2 Age**                                      |           |            |
| 20s                                            | 56        | 9%         |
| 30s                                            | 134       | 22%        |
| 40s                                            | 175       | 29%        |
| 50s                                            | 154       | 26%        |
| 60s                                            | 81        | 14%        |
| **3 Location**                                 |           |            |
| Iwate Prefecture                               | 100       | 17%        |
| Kyushu/Kumamoto region                         | 200       | 33%        |
| Metropolitan area                              | 200       | 33%        |
| Miyagi Prefecture                              | 100       | 17%        |
| **4 Family structure**                         |           |            |
| Couple                                         | 126       | 21%        |
| Couple with children (over 18 years old)       | 112       | 19%        |
| Couple with children (under 18 years old)      | 150       | 25%        |
| One parent with children (over 18 years old)   | 30        | 5%         |
| One parent with children (under 18 years old)  | 9         | 2%         |
| Single                                         | 116       | 19%        |
| Three generations                              | 35        | 6%         |
| Others                                         | 22        | 4%         |
| **5 Having family members who need special care (i.e., children, elderly persons)** | | |
| No                                             | 374       | 62%        |
| Yes                                            | 226       | 38%        |
| **6 Having a pet**                             |           |            |
| No                                             | 451       | 75%        |
| Yes                                            | 149       | 25%        |
| **7 Occupation**                               |           |            |
| Employee                                       | 368       | 61%        |
| Housewife                                      | 87        | 15%        |
| Retired                                        | 18        | 3%         |
| Self-employed                                  | 47        | 8%         |
| Student                                        | 12        | 2%         |
| Unemployed                                     | 31        | 5%         |
| Others                                         | 37        | 6%         |

Based on the respondents' ages as indicated on the surveys. Furthermore, most participants are aged between 40 and 50 years, which represent 55% of the sample. In terms of their location, 33% of participants are from the area of Tokyo, 17% are from Miyagi Prefecture, and 17% are from Iwate Prefecture, and 33% are from the Kyushu/Kumamoto region. Concerning family structure, it is clearly shown that 25% of participants are a couple with children (under 18 years old), followed by 21% consisting of couples without children, and 19% who are single or a couple with children (over 18 years old).

Among the participants, only 38% belong to a family needing special care. 75% of participants do not have pets while only 25% of participants have pets. Furthermore, the results indicate that most participants (61%) are employees, followed by 15% who are housewives, 8% self-employed, and 5% unemployed.

Nevertheless, the usable responses after removing outliers were 599. Table 2 demonstrates the mean, minimum, maximum, standard deviation, excess kurtosis, and skewness of each item.

4.2 Measurement model assessment

To measure the reliability of each item, the factor loading must be measured. According to these criteria, an outer loading of 0.7 or higher is considered highly satisfactory [67,68]. While a loading value of 0.5 is regarded as acceptable, the variables with a loading value of less than 0.5 should be deleted [69]. As can be seen in Table 3, all items are reliable and satisfy the set criteria with the exception of PP1, PP5, EX2, EX3, EX4, EX5, WR3, and IF6 whose factor loadings were below 0.5 and were therefore removed from the construct's structure.

To establish discriminant validity, the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT) should be examined [69,70]. In terms of the Fornell–Larcker criterion, the square root of the AVE (diagonal value) for each variable should exceed the correlation of latent variables, which is met in the present study, as described in Table 5. Regarding HTMT, a value of less than 0.85 should be confirmed. According to Table 6, it can be deduced that the HTMT criterion is met. Thus, discriminant validity is established.
Table 2
Descriptive statistics.

| Variables                                             | Item | Median | Min | Max | Standard Deviation |
|-------------------------------------------------------|------|--------|-----|-----|--------------------|
| Preparedness before COVID-19 (PP)                     | PP1  | 2      | 1   | 4   | 0.748              |
|                                                        | PP2  | 2      | 1   | 4   | 0.752              |
|                                                        | PP3  | 2      | 1   | 4   | 0.831              |
|                                                        | PP4  | 2      | 1   | 4   | 0.815              |
|                                                        | PP5  | 1      | 1   | 4   | 0.751              |
|                                                        | PP6  | 1      | 1   | 4   | 0.826              |
| Experience with COVID-19 during the state of emergency (EX) | EX1  | 3      | 1   | 5   | 0.654              |
|                                                        | EX2  | 3      | 1   | 5   | 0.833              |
|                                                        | EX3  | 3      | 1   | 5   | 0.809              |
|                                                        | EX4  | 3      | 1   | 5   | 0.718              |
|                                                        | EX5  | 3      | 1   | 5   | 0.6               |
|                                                        | EX6  | 3      | 1   | 5   | 0.75               |
| Worriedness (WR)                                       | WR1  | 3      | 1   | 5   | 1.192              |
|                                                        | WR2  | 4      | 1   | 5   | 1.142              |
|                                                        | WR3  | 3      | 1   | 5   | 1.103              |
|                                                        | WR4  | 3      | 1   | 5   | 1.087              |
|                                                        | WR5  | 3      | 1   | 5   | 1.133              |
| Perceived information provision during the state of emergency (IF) | IF1  | 2      | 1   | 4   | 0.737              |
|                                                        | IF2  | 2      | 1   | 4   | 0.744              |
|                                                        | IF3  | 2      | 1   | 4   | 0.716              |
|                                                        | IF4  | 2      | 1   | 4   | 0.695              |
|                                                        | IF5  | 3      | 1   | 4   | 0.758              |
|                                                        | IF6  | 2      | 1   | 4   | 0.695              |
|                                                        | IF7  | 2      | 1   | 4   | 0.725              |
|                                                        | IF8  | 2      | 1   | 4   | 0.741              |

Table 3
Outer loading.

| Experience with COVID-19 during the state of emergency | Perceived information provision during the state of emergency | Preparedness before COVID-19 | Worriedness |
|-------------------------------------------------------|---------------------------------------------------------------|----------------------------|-------------|
| PP1                                                   | 0.300                                                         |                             |             |
| PP2                                                   | 0.653                                                         |                             |             |
| PP3                                                   | 0.859                                                         |                             |             |
| PP4                                                   | 0.825                                                         |                             |             |
| PP5                                                   | 0.352                                                         |                             |             |
| PP6                                                   | 0.581                                                         |                             |             |
| EX1                                                   | 0.753                                                         |                             |             |
| EX2                                                   | 0.261                                                         |                             |             |
| EX3                                                   | 0.189                                                         |                             |             |
| EX4                                                   | 0.319                                                         |                             |             |
| EX5                                                   | 0.163                                                         |                             |             |
| EX6                                                   | 0.853                                                         |                             |             |
| WR1                                                   |                                                              |                             | 0.695       |
| WR2                                                   |                                                              |                             | 0.920       |
| WR3                                                   |                                                              |                             | 0.480       |
| WR4                                                   |                                                              |                             | 0.721       |
| WR5                                                   |                                                              |                             | 0.582       |
| IF1                                                   | 0.774                                                         |                             |             |
| IF2                                                   | 0.733                                                         |                             |             |
| IF3                                                   | 0.826                                                         |                             |             |
| IF4                                                   | 0.829                                                         |                             |             |
| IF5                                                   | 0.729                                                         |                             |             |
| IF6                                                   | 0.416                                                         |                             |             |
| IF7                                                   | 0.543                                                         |                             |             |
| IF8                                                   | 0.593                                                         |                             |             |

4.3. Structural model assessment

In terms of path analysis, the $R^2$ and the path coefficients are essential measures for assessing the structural model. As shown in Fig. 3, the model has an $R^2$ of 0.25 of worriedness, the path coefficient between preparedness before COVID-19 and worriedness is 0.108, the path coefficient between the experience of COVID-19 during the state of emergency and worriedness is 0.414, and the path coefficient between perceived information provision during the state of emergency and worriedness is 0.130.

PLS-SEM analysis is used to test the path significance of the hypothesis. Table 7 demonstrates the $p$-values for each hypothesis. H1 ($p < 0.05$) describes the path between the experience of COVID-19 during the state of emergency and worriedness, indicating that
Table 4
Cronbach's alpha, Composite reliability, and AVE.

|                                      | Cronbach's Alpha | Composite Reliability | Average Variance Extracted (AVE) |
|--------------------------------------|------------------|-----------------------|---------------------------------|
| Experience with COVID-19 during the state of emergency | 0.619            | 0.620                 | 0.451                           |
| Perceived information provision during the state of emergency | 0.871            | 0.865                 | 0.487                           |
| Preparedness before COVID-19         | 0.778            | 0.786                 | 0.486                           |
| Worriedness                         | 0.778            | 0.772                 | 0.465                           |

Table 5
Fornell–Larcker criterion.

|                             | Experience with COVID-19 during the state of emergency | Perceived information provision during a state of emergency | Preparedness before COVID-19 | Worriedness |
|-----------------------------|--------------------------------------------------------|-----------------------------------------------------------|-----------------------------|-------------|
| Experience with COVID-19    | 0.504                                                   |                                                           |                             |             |
| during the state of emergency |                                        |                                                           |                             |             |
| Perceived information provision during a state of emergency | 0.187                                                   | 0.694                                                    |                             |             |
| Preparedness before COVID-19 | 0.122                                                   | 0.293                                                    | 0.632                       |             |
| Worriedness                 | 0.355                                                   | 0.252                                                    | 0.174                       | 0.695       |

Table 6
Heterotrait-Monotrait ratio (HTMT).

|                                      | Experience with COVID-19 during the state of emergency | Perceived information provision during a state of emergency | Preparedness before COVID-19 | Worriedness |
|--------------------------------------|--------------------------------------------------------|-----------------------------------------------------------|-----------------------------|-------------|
| Experience with COVID-19 during the state of emergency | 0.173                                                   |                                                           |                             |             |
| Perceived information provision during a state of emergency |                                                           |                                                           |                             |             |
| Preparedness before COVID-19         | 0.155                                                   | 0.301                                                    |                             |             |
| Worriedness                         | 0.249                                                   | 0.242                                                    | 0.173                       |             |

Table 7
p-values for each hypothesis.

| Hypotheses       | Path                                                                 | T-Statistic | P-value | Result |
|------------------|----------------------------------------------------------------------|-------------|---------|--------|
| H1               | Experience of COVID-19 during the state of emergency - > Worriedness | 7.833       | 0.000   | Rejected |
| H2               | Perceived information provision during the state of emergency - > Worriedness | 3.349       | 0.001   | Accepted |
| H3               | Preparedness before COVID-19 - > Worriedness                          | 2.664       | 0.008   | Accepted |

the experience of COVID-19 during the state of emergency has a positive impact on worriedness. H2 ($p < 0.05$) describes the path between perceived information provision during the state of emergency and worriedness, indicating that the perceived information provision during the state of emergency has a positive impact on worriedness. H3 ($p < 0.05$) describes the path between preparedness before COVID-19 and worriedness, indicating that preparedness before COVID-19 has a positive impact on worriedness.

The moderating effect was determined based on group comparisons by multi-group analysis to determine the effects of categorical variables in the relationship of the hypotheses. With the testing of bootstrapping, the t-statistic and the path coefficient can be calculated.

Based on Tables 8–10, drones for aerial monitoring did not moderate the experience of COVID-19 during the state of emergency, perceived information provision during the state of emergency, and preparedness before COVID-19 regarding worriedness.

Based on Tables 11–13, displacement tracking applications did not have a moderate experience of COVID-19 during the state of emergency, perceived information provision during the state of emergency, and preparedness before COVID-19 with regards worriedness.

As shown in Tables 14–16, free videos and courses to learn good practice with regard to infection prevention had no significant effect as a moderator of the relationship between perceived information provision during the state of emergency and worriedness. Nev-

Table 8
Moderating effects of drone for aerial monitoring: Drone (low).

| Hypotheses | Path | Drone (low) |
|------------|------|-------------|
| H4         |      |             |
| H4a        | 0.056| 0.936       | 0.350      |
| H4b        | 0.343| 7.462       | 0.000      |
| H4c        | 0.135| 2.347       | 0.019      |
Table 9
Moderating effects of drone for aerial monitoring: Drone (high).

| Hypotheses | Path | Drone (high) |
|-------------|------|--------------|
|             | Path coefficient | t-statistic | p-value |
| H4          | H4a  | 0.217        | 2.819 | 0.005 |
|             | H4b  | 0.228        | 2.688 | 0.007 |
|             | H4c  | 0.176        | 2.393 | 0.017 |

Table 10
Moderating effects of drone for aerial monitoring: Drone (low) vs Drone (high).

| Hypotheses | Path | Drone (low) versus drone (high) |
|-------------|------|-------------------------------|
|             | Path coefficients different | p-value | Result |
| H4          | H4a  | 0.160                        | 0.079 | Rejected |
|             | H4b  | −0.115                       | 0.234 | Rejected |
|             | H4c  | −0.041                       | 0.655 | Rejected |

Table 11
Moderating effects of displacement tracking application: Tracking Application (low).

| Hypotheses | Path | Tracking Application (low) |
|-------------|------|----------------------------|
|             | Path coefficient | t-statistic | p-value |
| H5          | H5a  | 0.036                       | 0.575 | 0.565 |
|             | H5b  | 0.313                       | 6.671 | 0.000 |
|             | H5c  | 0.147                       | 2.768 | 0.006 |

Table 12
Moderating effects of displacement tracking application: Tracking Application (high).

| Hypotheses | Path | Tracking Application (high) |
|-------------|------|----------------------------|
|             | Path coefficient | t-statistic | p-value |
| H5          | H5a  | 0.253                       | 1.040 | 0.299 |
|             | H5b  | 0.246                       | 2.146 | 0.032 |
|             | H5c  | 0.168                       | 0.651 | 0.515 |

Table 13
Moderating effects of displacement tracking application: Tracking application (low) vs. tracking application (high).

| Hypotheses | Path | Tracking Application (low) vs Tracking Application (high) |
|-------------|------|--------------------------------------------------------|
|             | Path coefficients different | p-value | Result |
| H5          | H5a  | 0.217                                                  | 0.285 | Rejected |
|             | H5b  | −0.067                                                 | 0.588 | Rejected |
|             | H5c  | 0.022                                                  | 0.625 | Rejected |

Table 14
Moderating effects of free videos and courses to learn good practice regarding infection prevention: Free video and courses (low).

| Hypotheses | Path | Free video and courses (low) |
|-------------|------|-----------------------------|
|             | Path coefficient | t-statistic | p-value |
| H6          | H6a  | 0.010                       | 0.113 | 0.910 |
|             | H6b  | 0.367                       | 7.458 | 0.000 |
|             | H6c  | 0.059                       | 0.869 | 0.385 |

Nevertheless, free videos and courses to learn good practice with regard to infection prevention moderated the relationship between the experience of COVID-19 during the state of emergency and preparedness before COVID-19, with worriedness at a significant difference of 5% between low and high levels.

A summary of the results is shown in Table 17.
Table 15
Moderating effects of free videos and courses to learn good practice regarding infection prevention: Free video and courses (high).

| Hypotheses | Path   | Free videos and courses (high) |
|------------|--------|--------------------------------|
|            | Path coefficient | t-statistic | p-value |
| H6         | H6a    | 0.259                         | 3.193   | 0.001 |
|            | H4b    | 0.153                         | 1.683   | 0.093 |
|            | H6c    | 0.149                         | 1.108   | 0.268 |

Table 16
Moderating effects of free videos and courses to learn good practice regarding infection prevention: Free video and courses (low) vs Free video and courses (high).

| Hypotheses | Path       | Free video and courses (low) vs Free video and courses (high) |
|------------|------------|---------------------------------------------------------------|
|            | Path coefficients different | p-value | Result |
| H6         | H6a        | 0.249                          | 0.026   | Accepted |
|            | H6b        | −0.214                         | 0.041   | Accepted |
|            | H6c        | 0.090                          | 0.301   | Rejected |

Table 17
Summary of results.

| Hypotheses | Results |
|------------|---------|
| H1         | Preparedness before COVID-19 has a negative impact on worriedness |
| H2         | Experiences during the COVID-19 state of emergency have a positive impact on worriedness |
| H3         | Perceived information provision during the COVID-19 state of emergency has a positive impact on worriedness |
| H4         | In the perceived high usefulness of the drones group, preparedness, experience, and information increase worriedness more than in the low usefulness group |
| H5         | In the perceived high usefulness of the displacement tracking application group, the preparedness, experience, and information increased worriedness more than in the low usefulness group |
| H6         | In the perceived high usefulness of free VDO and courses to learn good practice regarding infection prevention group, preparedness, experience, and information increase worriedness more than in the low usefulness group |

5. Discussion

Regarding the six hypotheses that have been tested based on the concept of PLS-SEM for finding the factors that affected the worriedness level, some have been rejected, but some of them have been accepted. On this basis, H2 and H3 are accepted, but H6 is partially accepted. In contrast, H1, H4, and H5 are rejected.

5.1. Family structure

The descriptive statistics in Table 1 show that most of the samples have a family structure of couples and children that will make evacuation more difficult. Children, regardless of age, can be upset or have other intense emotions as a result of an emergency. The way a child responds and their general signs of anxiety vary depending on age, past experiences, and how the child normally copes with stress [71]. According to The American Academy of Child & Adolescent Psychiatry, it is recommended that parents talk to their children before facing a natural disaster so the children have some knowledge beforehand, but these conversations may be difficult, as children are afraid.

5.2. Preparedness before COVID-19

The result of H1 is that preparedness before COVID-19 significantly increases worriedness, which is opposed to our findings. One interesting discovery from the study was that some people seem worried as a form of preparedness. Cognitive dissonance, the frustration that comes from having two conflicting values, will occur when people are overprepared [72]. There are some issues with preparation and people need to be careful to get the right balance. Too much preparation can desensitize people. People fear taking action because they do not want to make a mistake, and by not taking action, nothing happens. In addition, COVID-19 was considered to be the new global pandemic. Therefore, it can create high levels of worriedness because COVID-19 is the black swan event or unpredicted disaster [73].

5.3. Experiences during the COVID-19 state of emergency

The result of H3 is that experiences during the COVID-19 state of emergency significantly increase worriedness. As an example, most countries after the first COVID-19 case was discovered in their country took measure to have large public gatherings and major events were canceled, resulting in people being worried and panicked by this news. Employees were told to work from home, universities moved all classes online, and elementary schools were closed for sanitizing. As a result, psychologists and public health experts said that public anxiety was high. Kılıç et al. also stated that home quarantine and school closing can create a high level of anxiety [74] As the number of confirmed cases of illness grew, the stock market saw meteoric crashes and cities across the world had to en-
force many restrictions on the public. Most low-income residents had no choice but to walk or cycle and, because of curfews and outdoor time limits, access to work and social services were severely impeded.

5.4. Perceived information provision during the COVID-19 state of emergency

The result of H3 is that perceived information provision during the COVID-19 state of emergency significantly increases worriedness. After the first US case was announced outside Seattle, large public gatherings and major events were canceled, resulting in people being worried and panicked by this news. Employees were told to work from home, universities moved all classes online, and elementary schools were closed for sanitizing. As a result, psychologists and public health experts said that public anxiety was high. As the number of confirmed cases of illness grew, the stock market saw meteoric crashes and cities across the world had to enforce many restrictions on the public. Most low-income residents had no choice but to walk or cycle and, because of curfews and outdoor time limits, access to work and social services were severely impeded. Furthermore, the conclusion by Sherman et al. is also in line with this research result due to statement that greater exposure to the information, the higher of anxiety is [75].

5.5. Perceived usefulness of tools

The results (see Table 7) indicate that in the perceived high usefulness of the drone group, preparedness before COVID-19, experiences during COVID-19, and information during COVID-19 did not increase worriedness more than in the low usefulness group. This finding shows that drones are not a factor that influences worriedness during COVID-19. Drones are mainly used to transport lab samples or medical supplies to reduce time and minimize virus exposure since they have been shown to be very effective in the fight against disease, for example, with the transportation of vaccines and drugs to infection areas without the possibility of becoming infected, the spraying of public areas to disinfect potentially contaminated places, and the monitoring of public spaces during lockdown and quarantine. For example, China has begun to use technology, including cameras and facial recognition, to keep an eye on citizens’ behavior in Chengdu in Sichuan province, where drones have been used to disperse a group of elders playing mahjong, and in Shanghai, drones have been used to supervise traffic. Meanwhile, in Wuhan, drones were used as a night light during the construction of a hospital [76]. Drones require trained staff and continuous monitoring from the ground and, unlike commercial planes and helicopters, they cannot carry heavier payloads or deliver goods over long distances, only 2–4 kg [77]. Also, the safety and efficiency of drones are not well developed. In conclusion, drones may not function well due to their civilian and commercial use being limited, and their development requires time.

Next, the results regarding moderator testing (see Table 9) show that in the perceived high usefulness of the displacement tracking application group, preparedness before COVID-19, experiences during COVID-19, and information during COVID-19 did not increase worriedness more than in the low usefulness group. The finding shows that tracking applications are not a factor that influences worriedness during COVID-19. The effectiveness of tracking applications depends on their sufficient and correct usage. Previous studies have found that usage by at least 60% of the population will lead to effective tracking applications [78]. Even assuming sufficiently high application usage, effectiveness also depends on the speedy response of users. If users do not respond to alert immediately, tracking applications are not fast enough to restrict the pandemic. Access to tracking applications is unequal, for example, the elderly who may not have access to smartphones are excluded from using this technology [79]. Tracking applications might not work due to obstacles such as effectiveness and inequality, and also, developing and using this sort of technology takes time.

Finally, the results regarding moderator testing (Table 10) show that in the perceived high usefulness of free videos and courses used to learn good practice regarding infection prevention group, preparedness before COVID-19 and experiences during COVID-19 increase worriedness more than in the low usefulness group, while information during COVID-19 did not increase worriedness more than in the low usefulness group. This finding shows that free videos and courses used to learn good practice with regard to infection prevention partially influence worriedness during COVID-19. During the pandemic, people have searched for home cooking, gardening, how to cut hair, religious services, and beauty tips on YouTube. As a result, information that people choose to perceive is not related to infection prevention at all but, in contrast, people do experience changes as a result of COVID-19, such as changes in consumption and an increase in internet surfing. Still, the government official guidelines might be the reason why information from free videos and courses to learn good practice with regard to infection prevention does not work.

5.6. Limitations and future plans

The main research limitation arises from the personal mindset bias of the questionnaire. The mindset of respondents can affect their perception of questions and lead to biased answers. In addition, some answers were not considered because this study did not conduct in-depth interviews with the respondents. Next, the sample that we selected for collecting data might not cover all the potential stakeholders in the study areas, which can further bias the results. Furthermore, the study was carried out only in the metropolitan area, Miyagi area, Iwate area, and Kyushu/Kumamoto area, Japan, which can lead to geometric bias because of the different environments and societies in each area. Future studies should be conducted such as in-depth interviews or observations to study people’s actual worriedness during the pandemic. In addition, consideration should be given to including participants from various other countries.

6. Conclusion

6.1. Conclusion

The COVID-19 pandemic has led to a huge loss of human life worldwide and poses an unparalleled threat to public health, food systems, and businesses, causing around half of the world’s 3.3 billion workers to be at risk of losing their livelihoods. As a result,
many people are unable to support themselves and their families. To avoid the spread of coronavirus, infection prevention and control are important. A questionnaire was designed to collect general information and important findings. According to the literature review, worriedness is a feeling of stress and anxiety, and can also manifest through physical changes, such as increased blood pressure, sweating, or a rapid heartbeat. Anxiety can cause traffic issues when people rush to supermarkets, wellness centers, and hospitals, causing health supplies to become unavailable and affecting the country’s health care service providers. From the reviewed research, three potential factors that affected people’s worriedness were found, namely, preparedness before COVID-19, experiences during the COVID-19 state of emergency, and perceived information provision during the COVID-19 state of emergency. Therefore, this study aims to review the factors affecting worriedness during COVID-19, and the potential tools affecting the relationship with these factors were observed by using the PLS-SEM method.

Based on the data from this study, we can conclude that preparedness before COVID-19, experiences during COVID-19, and information during COVID-19 have a positive impact on worriedness. To decrease people’s worriedness during COVID-19, preparedness, experience, and information should be reduced. Tracking applications may not be suitable tools to moderate worriedness during COVID-19, so further studies should be conducted after the pandemic has ended. At this point, tracking applications will be fully developed, which will allow users to know whether the applications are useful or not.

The research findings have scientific and social implications. They underscore the importance of conducting further analyses of public fear and worriedness during the COVID-19 epidemic to strengthen the empirical basis and to better understand the impact of demographic and socioeconomic factors on people’s fears during disastrous epidemics [80–82]. Furthermore, the findings can be used to help other researchers in related areas to develop a method of psychological intervention in case similar epidemics occur in the future, to improve the mental health and psychological resilience of patients or other people in cases of infection, in the form of cognitive behavior therapy and mindfulness-based therapy [83]. This study indicates the factors that affect the worriedness of people during the pandemic period and the form of worriedness perceived. In terms of societal perspective, the research results may prompt the decision-makers or the government to create and implement scientific strategies to better manage the regulations or programs intended to address the epidemic, whether in the form of medical aid or intervention or in form of counseling to support the psychosocial consequences to the public. By understanding how epidemics affect people’s fear of disasters, policymakers and stakeholders can design and adapt strategies, adopt tactical and operational interventions for disaster risk communications, and implement public mental health or other related medical policies.

This research aims to study factors affecting worriedness during COVID-19 and the importance of the perceived usefulness of potential tools. Consequently, the study results show that each factor impacts worriedness positively or negatively, and also provides answers as to whether the impact is significant or not. In addition, this study shows the difference in impact between the perceived usefulness of each tool.

6.2. Contributions
The research highlights factors which affect people’s worriedness by identifying what affects them, and the model shows positive or negative relationships between each factor and worriedness. In addition, results show tools that can moderate those relationships. Thus, the government can manage public facilities during COVID-19 based on the findings of experience. The government should also reduce changes to public facilities in citizens’ daily lives if they want to reduce public concerns. Also, the government can declare what information is appropriate to reduce public concerns following the findings of perceived information. Official institutes should only announce news and information to people as necessary during a state of emergency. In addition, the government can plan for pandemic preparedness by allocating resources to citizens by using guidelines from preparedness insights. Furthermore, with respect to technology, the government can use insights from the findings regarding tools as guidelines to develop potential solutions to reduce the spread of COVID-19.

Based on the findings of this study with regard to lowering worriedness levels, it is suggested that people should stop engaging in personal overpreparation, as too much preparation may lead them to take the wrong action. Thus, people should only stock food or medicine as necessary, only read official news and information, and not read from sources that may lead to misunderstandings. To decrease public concerns, the government should reduce the extent to which citizens experience change in their daily lives. For instance, the government should manage and provide sufficient public transportation, offer accessible health and hospital services, and expand internet services to rural areas. To reduce people’s nervousness and fear, official institutes should only announce necessary news and information, and check the reliability and accuracy of information sources before making declarations. Moreover, before the government announces any restrictions, they should thoroughly consider the consequences, because restrictions will make people’s lives more difficult. To enhance people’s infection prevention efforts, proper and well-communicated videos and courses are necessary. These may include prevention, equipment guidelines, and manuals; though influencer channels will also help people engage more and understand better. Thus, the government should upload these media to help citizens build resilience during pandemics and natural disasters. Finally, further studies or government bodies can use this research to develop personal perception studies.

Declaration of competing interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability
Data will be made available on request.
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