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Research Article

Behavioral Responses of Pregnant Women to the Early Stage of COVID-19 Pandemic in the Network Era in China: Online Questionnaire Study

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A B S T R A C T

Purpose: The aim of this study was to examine the behavioral responses of pregnant women during the early stage of Coronavirus Disease 2019 (COVID-19) outbreak.
Methods: We recruited 1,099 women to complete an online questionnaire survey from February 10 to February 25, 2020. The subjects were divided into two groups (the pregnant women group and the control group).
Results: Concerns about infection: most of the participants watched the COVID-19 news at least once a day. Protective behaviors: the utilization rate of pregnant women (often using various measures) was higher than that of nonpregnant women. Exercise: 30.6% of the pregnant women continued to exercise at home, whereas in the control group, this percentage was 8.4%. Spouse relationship: 38.8% of the subjects' relationship improved, whereas only 2.3% thought the relationship was getting worse.
Conclusion: Pregnant women had some unique behavioral responses different from that of nonpregnant women. It is important to understand the behavioral responses of pregnant women in this network era.
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Introduction

Coronavirus disease (COVID-19) has spread quickly and evolved into a pandemic since December 2019 when it first emerged in Wuhan, China [1]. The World Health Organization (WHO) declared the coronavirus outbreak to be a public health emergency on January 31, 2020 [2]. As of mid-November 2020, COVID-19 has infected more than 54 million people and resulted in the deaths of more than 1.3 million people.

The concerning features of COVID-19 are its apparent ability to spread readily and its propensity to cause severe disease or even death [3,4], which can cause fear and panic in society [5,6]. Nevertheless, the panic of the pregnant women could be doubled due to worries about the safety of themselves and their fetus.

The COVID-19 outbreak occurred 17 years after the 2003 epidemic of severe acute respiratory syndrome (SARS) in China. Currently, with the popularity of smart phones and the development of the network, in addition to the traditional means of obtaining information, such as television, radio, and newspapers, young people are more likely to use smartphones and tablets. The rapid and timely information dissemination has now become the new normal.

News and information can influence people's behavior [7]. Petrie et al. conducted a cross-sectional telephone survey and found that the public perceptions could influence the members' behavioral responses in Ebola outbreak [8]. A BBC News posited that hearing a lot of information and news about COVID-19 had affected the public on daily life [9]. However, behavioral studies of

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epidemic outbreaks tend to focus on nonpregnant women [10—12]. There have been few studies on pregnant women's behavioral responses during disease outbreaks, including SARS, middle east respiratory syndrome coronavirus (MERS), and Ebola. Recent studies found that pregnant women had changes in behavior including self-isolating, changing their method of transportation, and so on in COVID-19 pandemic [13,14]. However, those studies only focused on pregnant women without a control group of nonpregnant women. We wondered if pregnant women would have some special behavior changes different from nonpregnant women.

Therefore, we aimed to investigate the behavioral responses of COVID-19 on pregnant women in this network era in mainland China. Its related lifestyle and quality of life among pregnant women within 1 month after travel restrictions were imposed by the Chinese government. The results may assist clinicians in considering pregnant women's behavioral changes and offering early supports during the disease outbreaks.

Methods

Study design

This study used a cross-sectional design and convenience sampling.

Setting and samples

Participants were recruited from online consultation according to the following criteria: each individual 1) agreed to participate in the study and gave digital informed consent; 2) ordinarily resided in Hangzhou; 3) was a married woman and living with her husband; 4) first marriage; and 5) had no history of mental diseases.

People can participate in online consultations through WeChat app (one of the most popular apps in China) or another app called the "Mother and Child Health Handbook App," which is popular among pregnant women. People using the two apps were prompted to answer whether they were willing to complete the psychometric evaluation and the questionnaire. If the participants had any questions during the administration of the questionnaire, they could pose these questions online to the investigator.

The subjects were divided into two groups (the pregnant women group and the control group) according to whether they were pregnant or not. We matched the age and parity to select the control participants after we recruited pregnant women. The pregnant women were further divided into three subgroups: first trimester subgroup ($0\text{-}13^{+6}$ weeks), second trimester subgroup ($14\text{-}27^{+6}$ weeks), and third trimester subgroup (≥ 28 weeks).

Ethical considerations

All the study procedures were approved by the ethics committee of Hangzhou Women's Hospital (Hangzhou Maternity and Child Health Care Hospital) (Approval no. 202002-16). The participants gave written consent and were informed about the study objectives, the possibility of discontinuing the study at any time without penalty, and the protection of the confidentiality of personal information.

Measurements

The questionnaire was designed to determine the pregnant women's behavioral responses to the early stage of COVID-19 pandemic. Before designing the questionnaire, we used

qualitative methods to examine the experiences of pregnant women during the outbreak.

We conducted a descriptive qualitative study and semi-structured individual interviews were conducted at a time convenient for the participants. The Consolidated Criteria for Reporting Qualitative Research (COREQ) were used to report the method used and findings obtained [15]. A purposeful sampling method combined with the maximum variation strategy (for instance, age, trimester, parity, employment status, education level) was used to recruit eligible participants in our hospital. The sample size was determined by data saturation, that is, we stopped data collection at the point where no new themes from participants were emerging [16].

A total of nine women participated in the interviews, which lasted approximately 45 min per person. The audio recordings were transcribed verbatim by two researchers within 24 h of the interviews to ensure the accuracy of the information. The data were analyzed using thematic content analysis. There themes were emerged after data analysis: 1) increasing demand for comprehensive information; 2) more cautious self-protection behavior; and 3) changes in the relationship between spouse.

Based on the themes that were identified, a questionnaire was constructed to be used in the later quantitative survey. The questionnaire included six items in total: a. the frequency of watching the COVID-19 news (single-choice question: "hardly ever," "1-2 times a week," "once a day," or "more than once a day"); b. preferred social media platform (single-choice question: "WeChat," "Weibo (a platform similar to Facebook)," "Video apps (youku etc.)," "Zhihu," "Douban," or "Others"); c. the methods they used for preventing COVID-19 infection (multiple-choice question: "wearing masks," "wearing gloves," "wearing eyewear," "wearing protective clothing," and/or "using disinfectants"); d. the most commonly used means of transportation when going out (single-choice question: "driving a car," "taxi," "public transportation," or "walking or cycling"); e. continuing exercise habits (single-choice question: "keep doing," "reduce," or "hardly ever"); and f. relationship between spouse (single-choice question: "better," "worse," or "same").

Data collection

Data were collected between February 10, 2020 and February 25, 2020 in Hangzhou City, Zhejiang Province. This was a study to explore potential differences between the two groups, and there was no quantifiable hypothesis to test in advance. It seemed impossible to directly estimate the sample size. Thus, we referred to a rough estimation method with 5-10 times the number of variables to calculate the sample size [17]. A total of 14 variables were included in the study; therefore, the required sample size was 70 (14×5). Considering a sample loss of 20.0%, the minimum sample size required for this study was 88 participants. We recruited as many eligible subjects as possible. In total, 1,099 respondents who completed the questionnaires were included in the final analysis (1,099/1,200, 91.6% response rate), including 565 pregnant women and 534 controls.

Data analysis

Continuous data were compared using the independent-sample t-test and analysis of variance. Chi-squared analysis was used for categorical variables. A one-sample, Kolmogorov—Smirnov test was used to test nonparametric variables. We used the SAS System for Windows 9.4 software (SAS Institute Inc, Cary, NC), and $p < .05$ was considered to indicate a significant difference. All tests were two-tailed analyses.

Results

Characteristics of the study population

A total of 1,099 participants completed all the procedures in the study. As shown in Table 1, of 565 pregnant women, 146 were in the first trimester, 212 were in the second trimester, and 207 were in the third trimester. Overall, no significant differences were observed between the pregnant women and control groups in terms of mean age, parity, employment status, education level, and time taken to complete the questionnaire. There were also no significant differences in those characteristics among the three subgroups (Table 1). No one was infected with COVID-19 at the end of the study.

Behavioral responses to the COVID-19 pandemic

We used Cronbach' α to determine the reliability of the questionnaire. The value was .76, which indicated that the study questionnaire is reliable.

Response of watching the COVID-19 news

Most of the participants (91.3% in the pregnant women group vs. 92.5% in the control group) watched the COVID-19 news at least once a day. There was no significant difference in the frequency of watching the COVID-19 news between the two groups ($p > .05$) (Table 2).

All of the participants chose smart devices, including smart phones and tablets, as the preferred way of getting news. Therefore, we further investigated their preferred social media platform. As shown in Table 2, WeChat was the most popular platform to acquire information about COVID-19, followed by Weibo. There was no significant difference between the two groups ($p > .05$).

Response of the protection methods selection

To mitigate the risk of infection, 100.0% of the subjects wore masks, and 40.0% of the pregnant women wore gloves, which was higher than the percentage in the control group ($p < .001$). The number of participates who wore eyewear or protective clothing was higher in both the pregnant women group than in the control group ($p < .001$, $p < .05$). Additionally, 53.1% of the pregnant women used disinfectants, which was also a higher portion than that in the control group ($p < .001$) (Table 3).

Response of the transportation means selection

There were 79.5% of the participants used self-driving car to reduce the risk of contracting the virus when going out. The use of cars was higher, while walking or cycling was lower, in the pregnant women group than in the control group. There was significant difference between the two groups ($p < .01$) (Table 4).

Response of exercising

People spent most of their time at home during the outbreak in China, which would affect their exercise. There was significant difference between the two groups ($p < .001$) (Table 4). There were 30.6% of the pregnant women continued to exercise at home, whereas in the control group, this percentage was 8.4%. Among those who hardly ever exercise, the rate in the pregnant women group (about 30%) was lower than that in the control group (about 40%).

Response of the spouse relationship

Staying at home may also affect relationships between the spouse. We found that 38.8% of the subjects' relationship improved, whereas only 2.3% thought the relationship was getting worse. There were no significant differences between the two groups ($p > .05$) (Table 4).

Behavioral responses to the COVID-19 pandemic in different trimesters

Among the three subgroups of the pregnant women, there were no significant differences in all those items showed above (Table 5).

Table 1 Participants Characteristics.

	Pregnant women group (n = 565)	Different trimesters			Control group (n = 534)	t or χ^2	p
		First trimester subgroup (n = 146)	Second trimester subgroup (n = 212)	Third trimester subgroup (n = 207)			
Age (years)	29.96 ± 3.37	30.02 ± 3.31	29.84 ± 3.44	30.05 ± 3.35	29.90 ± 3.38	0.10	.747
Gestational age (weeks)	22.62 ± 10.56	8.12 ± 2.24	21.88 ± 4.11	33.61 ± 3.70			
Parity [n (%)]:							
Nulliparous	372 (65.8)	93 (63.7)	140 (66.0)	139 (67.1)	358 (67.0)	0.18	0.674
Married [n (%)]	565 (100.0)	146 (100.0)	212 (100.0)	207 (100.0)	534 (100.0)	NA	NA
Marriage length (years):						3.89	0.143
<5	440 (77.9)	114 (78.1)	162 (76.4)	164 (79.2)	410 (76.8)		
5 to 9	105 (18.6)	26 (17.8)	46 (21.7)	33 (16.0)	114 (21.3)		
≥10	20 (3.5)	6 (4.1)	4 (1.9)	10 (4.8)	10 (1.9)		
Employment status [n (%)]:						0.84	.657
Full-time	445 (78.8)	116 (79.4)	168 (79.3)	161 (77.8)	430 (80.5)		
Part-time	86 (15.2)	22 (15.1)	31 (14.6)	33 (15.9)	78 (14.6)		
Unemployed	34 (6.0)	8 (5.5)	13 (6.1)	13 (6.3)	26 (4.9)		
Education [n (%)]:						0.60	.897
Less than middle school	28 (5.0)	9 (6.2)	12 (5.7)	12 (5.8)	30 (5.6)		
Middle school	57 (10.1)	13 (8.9)	19 (8.9)	22 (10.7)	49 (9.2)		
Bachelor	451 (79.8)	117 (80.1)	169 (79.7)	163 (78.7)	430 (80.5)		
More than bachelor	29 (5.1)	7 (4.8)	12 (5.7)	10 (4.8)	25 (4.7)		
Time for completing the questionnaire (seconds)	321.02 ± 125.11	311.83 ± 131.59	321.21 ± 127.55	327.33 ± 117.91	330.05 ± 128.03	1.40	.238

The value of t, χ^2, and p: Pregnant women group versus control group. NA: Not applicable as the percentages are 100.0% for each group.

Discussion

Through the present study, we found that epidemic and pandemics of COVID-19 can have behavioral effects on the population, especially on pregnant women. Our findings could be used as fundamental data for the government to pay close attention to pregnant women (a vulnerable group) in this epidemic and also provide some important information for medical workers to offer early interventions and supports by online manners. To the best of our knowledge, our study was among one of the first studies to investigate behavioral responses of pregnant women to the early stage of COVID-19 pandemic in mainland China.

Studies focus on pregnant women's behavioral state during a disease outbreak has been rare. Lee et al. reported that women in the SARS cohort adopted behavioral strategies, including wearing masks and cleaning hands vigilantly, to mitigate their risk of contracting infection [18]. However, this study compared the changes without a control group of nonpregnant women. A phenomenological research in Hong Kong during the SARS outbreak found that new mothers disrupted daily routines as they tried to eliminate their risk of contracting this disease including information gathering, avoiding places of risk, and washing bags, clothes, and hair after leaving the house [19]. Corbett et al. recruited patients in the second and third trimester of pregnancy and demonstrated that they had major changes in behavior including self-isolating, changing their primary method of transportation, bulk-buying, and so on in COVID-19 pandemic [13]. A cross-sectional, Web-based survey between March 3 and 10, 2020, in China showed that 55.7% of the participants protected themselves from contracting COVID-19 with self-efficacy [14].

However, behavioral studies of epidemic outbreaks still tend to focus on nonpregnant women. A study in Iranian residents demonstrated that social media increase perceived risk and safety behaviors [10]. Zhang et al. investigated the quality of life among local residents in Liaoning Province, China, and found that the participants changed exercising time and relax time in the COVID-19 pandemic [11]. Another study in China showed that the three most commonly used prevention measures were making fewer trips outside and avoiding contact, wearing a mask, and hand hygiene, which was similar to the results of our control group [12]. Among college students, a wide variety of behaviors, including increased phone usage, decreased physical activity, and fewer locations visited, were associated with fluctuations in COVID-19 news reporting in the United States [20]. Similar results were observed in children and adolescents. The data revealed a substantial decrease in physical activity increase in screen time during the COVID-19 pandemic [21]. However, compared with the youngers, older men

reported relatively less worry and the fewest total number of behavior changes [22]. The issues related to this emerging global event may evolve into long-lasting health problems, which merits further investigation.

Epidemics and pandemics, such as those of SARS and MERS, have unique characteristics in terms of progression and control measures. The Spring Festival holiday occurred during 24–30 January, 2020, in China. The Chinese government–imposed traffic restrictions and extended the national holidays to control the outbreak during this time. At the time when this study was conducted, our city, Hangzhou, Zhejiang Province was also locked down. As of February 25, the deadline of our study enrollment, Zhejiang Province was one of the second-high epidemic areas in mainland China. Additionally, at that time, there was insufficient understanding of the new coronavirus and the epidemic situation. People were staying at home and self-isolating to avoid contracting or spreading the disease, which inevitably disrupted daily routines and decreased the quality of life. Staying at home with family and reducing recreational activities were considered to be safer ways to prevent virus infection. Our study investigated the changes in exercise and the relationship with spouse. Surprisingly, nearly one-third of pregnant women continued to exercise at home, which was obviously higher than that of nonpregnant women. Currently, using health education and popular science news, doctors suggest that pregnant women exercise properly, which is beneficial to both mothers and fetuses. Therefore, for the sake of fetal health, pregnant women themselves and their families may supervise and urge them to keep exercising. The time couples spent together increased during the epidemic period. The results were similar in the pregnant women and the control group and showed that about 40% of the subjects' relationships became better, whereas only about 3%

Table 3 Response of the Protection Method Selection (multiple-choice question).

	Pregnant women group (n = 565)	Control group (n = 534)	χ^2	p
Methods of preventing the COVID-19 infection [n (%)] :				
Wearing masks	565 (100.0)	534 (100.0)	NA	NA
Wearing gloves	226 (40.0)	111 (20.8)	47.67	<.001**
Wearing eyewear	35 (6.2)	11 (2.1)	11.70	<.001**
Wearing protective clothing	8 (1.4)	1 (0.2)	5.10	.024*
Using disinfectants	300 (53.1)	222 (41.6)	14.62	<.001**

*p < .05, **p < .01.
NA: Not applicable as the percentages are 100.0% for each group.

Table 2 Response of Watching the COVID-19 News (single-choice question).

	Pregnant women group (n = 565)	Control group (n = 534)	χ^2	p
Frequency of watching the COVID-19 news [n (%)]:			5.63	.131
Hardly ever	5 (0.9)	11 (2.1)		
1-2 times a week	44 (7.8)	29 (5.4)		
Once a day	256 (45.3)	258 (48.3)		
More than once a day	260 (46.0)	236 (44.2)		
Preferred social media platform [n (%)]:			1.91	.862
WeChat	425 (75.2)	398 (74.5)		
Weibo	83 (14.7)	84 (15.7)		
Video apps (youku etc.)	48 (8.4)	39 (7.3)		
Zhihu	5 (0.9)	6 (1.1)		
Douban	2 (0.4)	4 (0.8)		
Others	2 (0.4)	3 (0.6)		

Table 4 Response of the Transportation Means Selection, Exercising, and the Spouse Relationship (single-choice question).

	Pregnant women group (n = 565)	Control group (n = 534)	χ^2	p
Means of transportation [n (%)] :			12.68	.005**
Self-driving car	449 (79.5)	382 (71.5)		
Taxi	48 (8.5)	49 (9.2)		
Public transportation	31 (5.5)	39 (7.3)		
Walking or cycling	37 (6.5)	64 (12.0)		
Exercise [n (%)] :			86.14	<.001**
Keep doing	173 (30.6)	45 (8.4)		
Reduce	228 (40.4)	267 (50.0)		
Hardly ever	164 (29.0)	222 (41.6)		
Relationship between the spouse [n (%)] :			3.98	.136
Better	219 (38.8)	231 (43.2)		
Same as before	333 (58.9)	285 (53.4)		
Worse	13 (2.3)	18 (3.4)		

*p < .05, **p < .01.

Table 5 *Behavioral Responses to the COVID-19 Pandemic in Different Trimesters.*

	First trimester subgroup (n = 146)	Second trimester subgroup (n = 212)	Third trimester subgroup (n = 207)	χ^2	p
Frequency of watching the COVID-19 news [n (%)] : (single-choice question)				5.10	.531
Hardly ever	1 (0.7)	2 (0.9)	2 (1.0)		
1-2 times a week	8 (5.5)	18 (8.5)	18 (8.7)		
Once a day	63 (43.1)	90 (42.5)	103 (49.7)		
More than once a day	74 (50.7)	102 (48.1)	84 (40.6)		
Preferred social media platforms [n (%)] : (single-choice question)				6.17	.801
WeChat	108 (74.0)	160 (75.5)	157 (75.8)		
Weibo	24 (16.4)	34 (16.0)	25 (12.1)		
Video apps (youku etc.)	10 (6.8)	17 (8.0)	21 (10.1)		
Zhihu	2 (1.4)	1 (0.5)	2 (1.0)		
Douban	1 (0.7)	0 (0.0)	1 (0.5)		
Others	1 (0.7)	0 (0.0)	1 (0.5)		
Methods of preventing the COVID-19 infection [n (%)] : (multiple-choice question)					
Wearing masks	146 (100.0)	212 (100.0)	207 (100.0)	NA	NA
Wearing gloves	64 (43.8)	85 (40.1)	77 (37.2)	1.57	.455
Wearing eyewear	8 (5.5)	17 (8.0)	10 (4.8)	2.01	.367
Wearing protective clothing	4 (2.7)	2 (0.9)	2 (1.0)	2.47	.291
Using disinfectants	82 (56.2)	111 (52.4)	107 (51.7)	0.76	.565
Means of transportation [n (%)] : (single-choice question)				3.77	.708
Self-driving car	114 (78.1)	176 (83.0)	159 (76.8)		
Taxi	14 (9.6)	15 (7.1)	19 (9.2)		
Public transportation	8 (5.5)	8 (3.8)	15 (7.2)		
Walking or cycling	10 (6.8)	13 (6.1)	14 (6.8)		
Exercise [n (%)] : (single-choice question)				2.26	.689
Keep doing	45 (30.8)	60 (28.3)	68 (32.8)		
Reduce	54 (37.0)	91 (42.9)	83 (40.1)		
Hardly ever	47 (32.2)	61 (28.8)	56 (27.1)		
Relationship between the spouses [n (%)] : (single-choice question)				1.51	.825
Better	54 (37.0)	81 (38.2)	84 (40.6)		
Same as before	87 (59.6)	127 (59.9)	119 (57.5)		
Worse	5 (3.4)	4 (1.9)	4 (1.9)		

NA: Not applicable as the percentages are 100.0% for each group.

thought their relationships were getting worse. However, Dodgson et al. demonstrated relationship difficulties in the women who became mothers during the SARS outbreak with their spouse [19], which was not consistent with our findings.

Overall, the Internet was currently the first choice for health information acquisition by the general public during the COVID-19 epidemic in China. A retrospective analysis showed that the peak of Internet searches and social media data about the COVID-19 outbreak occurred 10—14 days earlier than the peak of daily incidences, with which Internet searches and social media data had high correlation with daily incidences in China [23]. In our study, more than 90% of the subjects paid close attention to the latest information on the number of cases in the local area, the availability and effectiveness of medicines, the advice on prevention and so on. As something unthinkable, most social media platforms had not yet been born 20 years ago. Now people used social media platforms to gain information about COVID-19 for its convenience, and WeChat has become one of the most popular apps on smartphones in our participants.

The experiences of the SARS epidemic changed the attitude of the general public towards precautionary measures. The official guidance of the Chinese government advises that people should wear masks if they are going out and use disinfectants in a timely manner. People began to care more about their health. Nevertheless, they were more likely to read information from their friends through WeChat or Weibo, instead of using the official webpage [24]. Many people were also unable to discern, which information on social media was true. Research has shown that fake news and misinformation can have detrimental effects on public health [11,25]. In China, the genuine or fake news of "the increasing number of patients and suspected cases nearby," "the shortage of masks and disinfectants," etc. influenced people's behavior. The utilization rate of pregnant women (often using various measures) was higher than that of nonpregnant women. One hundred percent of the subjects wore masks. This finding was anticipated because wearing masks is a common practice when people are sick or to counter urban pollution or haze in China [26,27]. In terms of transportation, more than 70% of the participants used cars to minimize their contact with others. Pregnant women seldom walked or rode, possibly because pregnancy made those options inconvenient.

The possible reason for those behavioral responses might have been related to the fear of COVID-19 infection, which may be related to the body's normal protective responses. We also found that pregnant women were most concerned about their fetus being infected, followed by their family members and themselves. In the control group, the trends of worrying were similar (data not shown). Although there was no evidence of in utero transmission [28], pregnant women were naturally concerned about the safety of their fetuses. However, related data on COVID-19 are still rare. We

may infer that if the pregnant women themselves were infected, they would further worry about spreading to the fetus, which would result in more protection responses.

The prevalence of prenatal psychological reaction could be different during the trimesters of pregnancy [29,30], which may lead to different behavioral responses. It is also controversial whether perinatal anxiety or depression is higher in a particular trimester during pregnancy [31,32]. In our study, there were no significant differences in all the behavioral items among the pregnant women in the three trimesters. This finding may be because the impact of epidemic stress on pregnant women exceeds the stress of the trimester itself, although a further study is necessary.

Study limitation

This study also has some limitations. First, the participants who wished to participate in this study were recruited though online consultation manner, which might narrow the recruitment of participants. Second, the questionnaire was designed by our team, and there was no other research to measure the effectiveness of the questionnaire. However, the questionnaire was designed based on a qualitative study and it was a collection of questions on how people react to COVID-19. The questionnaire has contributed to this research and merits use. Third, the study lacks longitudinal follow-up. The arduous situation would gradually improve, and the behavioral state of the pregnant women might also improve. Thus, we will further investigate the of long-term follow-up of the participants, including pregnancy outcomes.

Conclusion

Pregnant women had some unique behavioral responses different form that of nonpregnant women. It is important to understand the behavioral responses of pregnant women in this network era. This will then provide some important information for government and medical workers to provide early interventions and supports by online manners.

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Conflict of interest

The authors reported no conflict of interest. All authors have contributed significantly.

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