

Full Length Article

Relationship between perception and anxiety about COVID-19 infection and risk behaviors for spreading infection: A national survey in Japan

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ABSTRACT

Background: The novel corona virus infection (COVID-19) quickly became a pandemic state. Identifying characteristics of “possible super spreaders”, suggested as a dominant cause of rapid spreading transmission, will help us to design proper prevention strategies.

Methods: We conducted a nation-wide online survey to investigate the relationship of perception and anxiety levels about COVID-19 to the possible risk behaviors for spread of the virus in Japan. We recruited a total of 4,000 citizens, who responded to the questionnaire including several questions regarding the level of fear and anxiety about COVID-19, infection preventive behaviors and access to media with trust level about the virus as well as some demographic and socioeconomic data during March 27th and 28th, 2020.

Findings: Thirteen-point-three percent of the participants rated “1” on a nine-point Likert with respect to the knowledge about COVID-19. Ten-point-one percent and 11.7% presented no anxiety of being infected and transmission to others. Ten-point-eight percent showed no worry about symptomatic aggravation. Eight-point-one percent had no serious concern about expanding infection. The distribution of these items was highly correlated with each other. Participants with the low level of knowledge about COVID-19 were likely to less frequently access any information sources and neither trust them. They were less anxious about their health status, and less likely to put precautionary behaviors such as washing hands and avoiding crowded spaces, suggested by statistical analyses.

Interpretation: The present study suggests that it is greatly important to enlighten those have no concerns about this crisis of COVID-19 and modify their risk behavior via various ways, in order to prevent and control this viral pandemic.

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1. Introduction

A novel species of corona virus was identified as a cause of lethal pneumonia in December 2019 in China. This virus rapidly expanded all over world. In response to this deteriorating situation, the World Health Organization (WHO) declared a pandemic state on March 11, 2020. Citizens in many countries are still facing the risk of serious diseases

caused by the corona virus (COVID-19). The development of strategies for preventing the spread of this virus is needed.

According to the WHO (2020b), COVID-19 virus is transmitted during close contact through respiratory droplets (such as coughing) and by fomites. Therefore, to limit virus transmission, the WHO (2020b) continues to recommend performing frequent hand hygiene, using respiratory protection, regularly cleaning and disinfecting surfaces, maintaining

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physical distances, and avoiding people with fever or respiratory symptoms. The authorities have asked citizens to engage in several strategies as follows. At the individual level, frequent hand-washing is recommended. Facial protection (e.g., a surgical mask) and the use of disinfectant (e.g., alcohol-based) are also suggested. In addition, risky behaviors, such as going to crowded spaces or traveling to endemic areas, should be highly discouraged. Despite these efforts, several cities have been locked down ([Business Insider, 2020](#)). In Japan, Yuriko Koike, the Tokyo governor, has repeatedly called on residents to avoid going out on weekday evenings and on weekends since March 25, 2020 ([Reuters, 2020](#)).

Facing uncertain situations can increase people's anxiety levels, especially when there is potential risk for mortality. This may lead to both healthy and vulnerable individuals engaging in protective behaviors ([Shigemura et al., 2020](#)). Cao et al. reported that approximately one-fourth of college students demonstrated at least mild anxiety because of the COVID-19 outbreak ([Cao et al., 2020](#)). It is expected that fear of COVID-19 will have a major impact on public mental health ([Torales et al., 2020](#)). [Jones and Salathé \(2009\)](#) reported that engagement in protective behaviors varies from person to person, and may be affected by several factors (e.g., self-reported anxiety over the epidemic).

Recent studies have suggested the existence of "super spreaders" as the dominant source of the transmission of the novel corona virus ([Li et al., 2020](#)). It is hypothesized that some super spreaders unintentionally carry the virus from place to place because of their hyper-activity ([Kamel et al., 2020](#)). Estimation of the potential risk-proportion in the community and understanding their cognitive and behavioral characteristics may help in developing epidemic control strategies. However, to our knowledge, no report has investigated the proportion and characteristics of people who show risk behaviors, including super spreaders.

We hypothesized that individuals with low levels of understanding and anxiety about the infection would not to exercise protective behaviors and therefore may be potential super spreaders. Clarifying the proportion of these super spreaders in the community and the sources of information they use regarding COVID-19 infection will help in the development of strategies (e.g., how to modify these behaviors) to prevent further expansion of the epidemic.

2. Materials and methods

On the basis of the research questions above, we conducted a web-based cross-sectional study to clarify citizens' perceptions and behaviors in the current COVID-19 risk situation.

We asked Cross Marketing Inc. to recruit 4,000 people. Participants had to have been a monitor of Cross Marketing Inc. at the beginning of the survey. People who had been infected by COVID-19, people whose relative was an employee of our institution, and people who worked in a marketing industry were excluded. Cross Marketing Inc. sent an invitation email to potential candidates of the survey. People who were willing to participate spontaneously visited the website to answer the questionnaire with first-in-first-served basis. Completers were rewarded with cashable coupons. Duplicated answers were blocked by checking unique ID of each participant. See the Appendix in which we disclosed the condition of this survey according to Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

We adopted the questions used in a previous report ([Jones and Salathé, 2009](#)) but included new questions about anxiety levels regarding symptomatic aggravation and virus transmission to others. In addition to the demographic information, the questionnaire included several items covering the level of fear and anxiety about COVID-19-related issues, frequency of media exposure, trust in each media source, and frequency of anti-infection behaviors. Participants rated on scales from 1 (none/never) to 9 (extremely/strongest) for the items regarding the knowledge about the symptoms, preventive methods, management and consulting services when infected, the level of fear and anxiety, and the frequency of anti-infection behaviors. Items regarding the frequency of

media exposure and degree of trust in each media source were rated on scales from 1 (almost none/not at all) to 5 (very/greatly). Participants' health anxiety, depression, and general anxiety were assessed by the Japanese versions of the Short Health Anxiety Inventory (SHAI) ([Yamauchi et al., 2009](#)), Patient Health Questionnaire-9 (PHQ-9) ([Muramatsu et al., 2007](#)), and Generalized Anxiety Disorder-7 (GAD-7) ([Muramatsu et al., 2009](#)).

This study protocol was approved by the Ethics Committee of Chiba University Graduate School of Medicine and the Ethics Committee of the International University of Health and Welfare before implementation. Participants were informed that their participation was voluntary. We did not gather any personal information about the responders. Participants were rewarded according to the regulations of Cross Marketing Inc. The data analysis was conducted using SPSS for Windows version 24 (IBM Corp., Armonk, NY, United States).

This study was conducted with a management grant provided by the Ministry of Education, Culture, Sport, Science and Technology [MECSST] to Chiba University Graduate School of Medicine and the Japan Society for the Promotion of Science [JSPS] KAKENHI grants [to T.N., no. JP19K08066]. The MECSST and JSPS had no role or control on the execution of this study.

3. Results

Between March 27 and 28, 2020, a total of 4,000 participants stratified by age (20s, 30s, 40s, 50s, over 60 years) and gender (400 in each group) took part in this study. Participants' demographic data are presented in [Table 1](#). Citizens in all 47 prefectures in Japan participated in this survey. Occupations of the participants were various. Approximately 10% of the participants were engaged in education/healthcare. Only 1%

Table 1

Participants' demographic characteristics. Population data are extracted from official website of the Ministry of Internal Affairs and Communications, estimated in 2017.

		N	%
Educational background	Junior high school/Secondary school	107	2.7
	High school/A-level or equivalent	1,229	30.7
	Diploma course or vocational school	879	22.0
	University degree or above	1,785	44.6
Marital status	Single	1,601	40.0
	Married, separated, or widowed	2,399	60.0
Children	Yes	1,801	45.0
	No	2,199	55.0
Prefecture	Tokyo (13,724,000 population)	611	15.3
	Kanagawa (9,159 population)	361	9.0
	Osaka (8,823,000 population)	361	9.0
	:	:	:
	Tottori (565,000 population)	13	0.3
	Kochi (714,000 population)	12	0.3
Occupation	Employee/manager/executive	1,341	33.5
	Official	159	4.0
	Self-employment/Small office	213	5.3
	Temporary/Part-time job	758	1.9
	Agriculture	19	0.5
	Professional	108	2.7
	Housewife/Househusband	643	16.1
	Student	135	3.4
	Jobless	535	13.4
	Others	89	2.2
	Job category: Education/healthcare	Yes	453
No		3,547	88.7
Infected family members	Yes	17	0.4
	No	3,803	94.1
	Not sure	180	4.5
Infected acquaintances	Yes	45	1.1
	No	3,760	94
	Not sure	195	4.9

or less had some family members or acquaintances who were infected by COVID-19.

Prior to the statistical analyses, we excluded invalid answers from the analysis because there might be some participants who took non-serious answers considering that participating in this survey would be rewarded. We excluded the data of whom answered “1” on all 30 items of the main questions. As a result, 19 (0.48%) participants were excluded. The remaining 3,981 participants were subjected to the analysis.

The main findings from the results were as follows. First, 528 participants (13.3%) had a low understanding of COVID-19 (i.e., rated “1” on the nine-point Likert scale). Similarly, 404 (10.1%) reported no anxiety of being infected. In total, 468 participants (11.7%) were unconcerned about the risk they would transmit COVID-19 to others, and 430(10.8%) participants showed no worry about developing a serious condition if they were infected. In addition, 321 (8.1%) participants were not at all anxious about spreading infection (Fig. 1). The Spearman’s correlation coefficients of the knowledge of COVID-19 to anxiety about being infected with COVID-19, anxiety about infecting someone with COVID-19, anxiety about severity when infected with COVID-19, and anxiety about the spread of COVID-19 infection were 0.458, 0.438, 0.423, and 0.488, respectively ($P < 0.001$ for all).

We examined the difference of perception and anxiety between age groups. Over 60 y. o. group was more likely to understand COVID-19

(ANOVA, $P < 0.001$). They were also more anxious about worsening physical status when they got infected (ANOVA, $P < 0.001$). Similarly, they were more anxious about the spread of COVID-19 infection (ANOVA, $P < 0.001$). On the other hand, there were no statistically significant difference between age groups regarding the anxiety about being infected or infecting someone with COVID-19. These results are shown in Fig. 2.

On the other hand, participants who had someone infected by COVID-19 understood more about COVID-19 (t-test, $P < 0.05$). As well, participants whose occupation category was education/healthcare understood more about COVID-19 (t-test, $P = 0.001$).

At the time of the survey, Hokkaido was the most affected prefecture, where 31.8 per thousand were reported to be infected by COVID-19, while Iwate, Yamagata, Toyama, Tottori, and Shimane prefecture had experienced no cases. We examined the difference between regions in citizen’s understanding of COVID-19. We employed a correlation analysis to evaluate the association between the mean score of knowledge of COVID-19 of the participants living in each prefecture and the number per capita of the reported patients infected by COVID-19. As a result, however, there was no specific relationship found (Pearson’s Correlation = -0.2, $P = 0.283$).

The dominant source of information about COVID-19 was TV, followed by online news and official announcements by the government. In

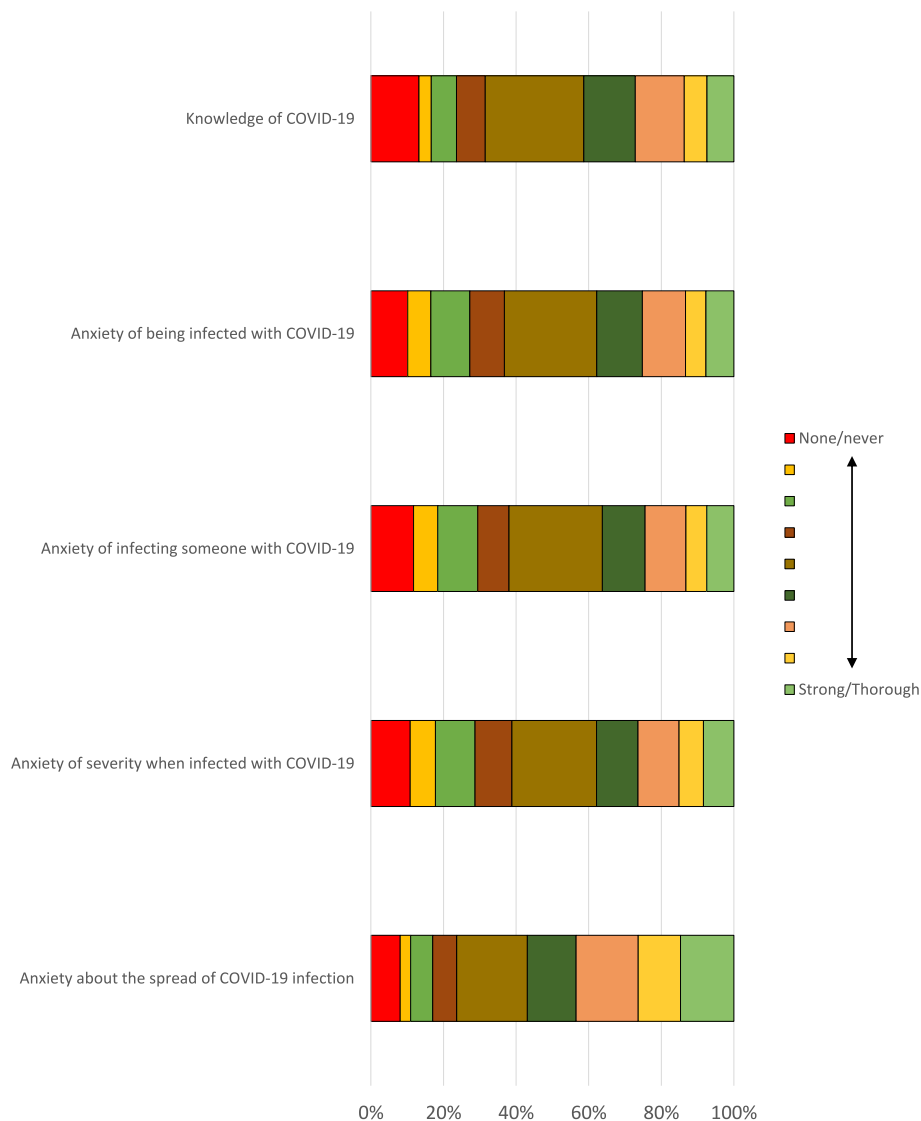


Fig. 1. Knowledge and anxiety about COVID-19. The level of each item was graded from 1 to 9, with larger values indicating higher levels of that factor.

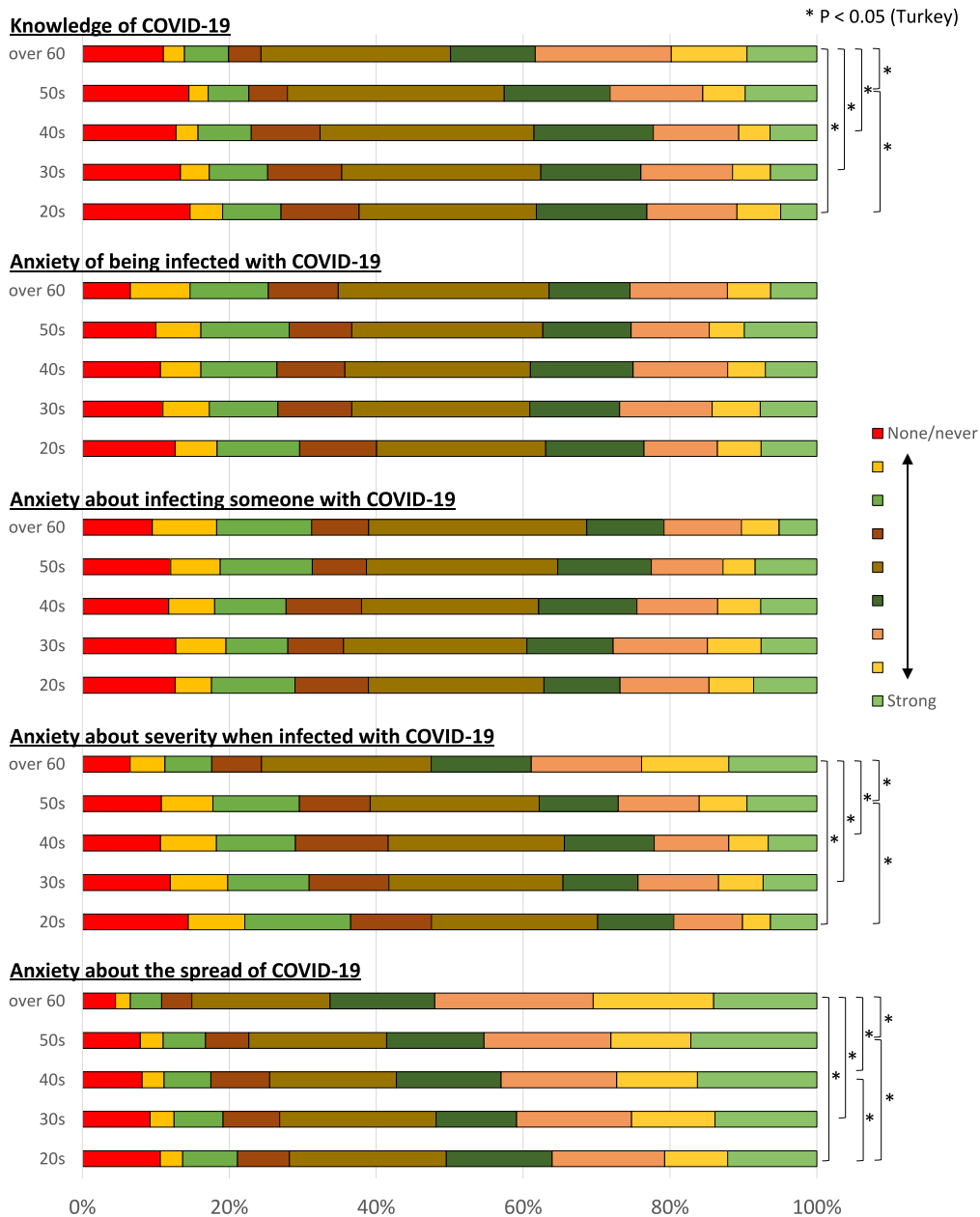


Fig. 2. Difference in perception and anxiety between age groups the level of each item was graded from 1 to 9, with larger values indicating higher levels of that factor.

contrast, radio and counseling by a specialist were rarely used. Regarding the credibility of each information source, participants were likely to distrust social network services, and also placed little trust in other information sources (Fig. 3).

Regarding the frequency of precautionary behaviors reported by participants, most of the participants frequently washed their hands but 81 (2.0%) rated this item 1 or 2 on a scale from 1 (not at all) to 9 (many times). Finally, 168 participants (4.2%) rated 1 or 2 on a scale from 1 (never) to 9 (avoid greatly) for the item “avoiding crowded places” (Fig. 4).

The mean SHAI total score was 14.6 (standard deviation [SD] = 9.7). In addition, the mean PHQ-9 total score was 5.1 (SD = 5.9), and the mean GAD-7 total score was 3.4 (SD = 4.7).

We conducted secondary analyses to clarify the characteristics of people who were not concerned about COVID-19. We divided the participants into three groups according to their answer of the knowledge of COVID-19 by their rating 1 – 3 (low), 4 – 6 (mid), and 7 – 9 (high) and

compared their scores with those of other groups. Compared to other participants, the low understanding group used any information sources listed in the questionnaire less frequently, with the difference being statistically significant (ANOVA, P < 0.001). In addition, they tended not to trust information from any media, organizations, or individuals, compared with other participants (ANOVA, P < 0.001). Most importantly, they were significantly less likely to exercise protective behaviors than other participants (ANOVA, P < 0.001), other than avoiding work or school compared to the mid understanding group (ANOVA with Games Howell correction, P = 0.625). These results are shown in Fig. 5.

Compared with other groups, the low understanding group was less anxious about their own health, as suggested by the difference in SHAI total scores (13.3 vs. 14.5 vs. 15.9, ANOVA, P < 0.001). In PHQ-9 total score, there was also statistical significance between groups (5.6 vs 5.1 vs 4.6, ANOVA, P = 0.001), but there were no statistically significant differences between the three groups in GAD-7 scores (3.49 vs. 3.40 vs 3.25, ANOVA, P = 0.499).

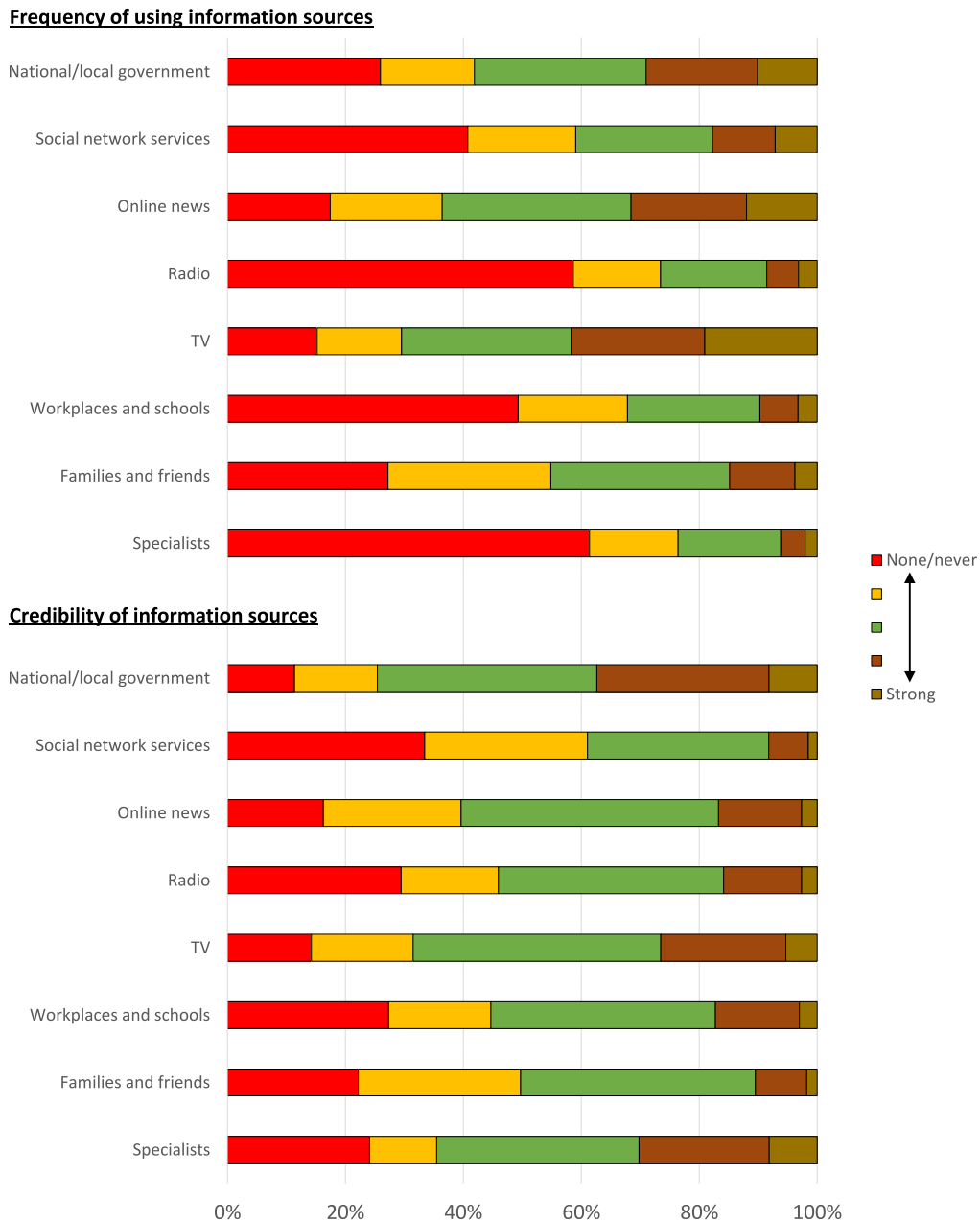


Fig. 3. Attitude toward information sources. The level of each item was graded from 1 to 5, with larger values indicating higher frequency/credibility.

Additionally, we used a linear regression analysis with stepwise method to clarify the factors associated with the perception of COVID-19. We set the degree of knowledge of COVID-19 as the dependent variable. Age period, educational history, kinds of anxiety about COVID-19, frequency of using and credibility of information sources, and several protecting behaviors were set as independent variables. The result is shown in Table 2. Each kind of anxiety and sensitiveness to some information sources were associated with the level of knowledge of COVID-19. Also, participants with deep knowledge of COVID-19 were likely to wash hands frequently.

4. Discussion

We conducted a nation-wide online survey involving 4,000 citizens to investigate their understanding, anxiety, protective behaviors, and access to information regarding COVID-19 during March 27 and 28, 2020. At the time of this investigation, the spread of COVID-19 in Japan was

limited to several areas, but after a few days, the number of the infected cases nationwide had begun to rise steeply. We also evaluated participants' levels of distress and functional impairment with the PHQ-9, their perceptions of health anxiety with the SHAI, and their general anxiety with the GAD-7.

A previous study on the spread of infection suggested that media reports about the epidemic affected anxiety levels, which in turn mediated protective behaviors (Jones and Salathé, 2009). From the perspective of risk behavior for the spread of COVID-19, we focused on participants who reported low understanding and anxiety regarding virus infection, and found that they accounted for about 10% of all participants. Among these participants, which were relatively young but included in all age groups, we observed significantly higher proportions that reported adopting little protective behavior and rarely accessing (with low levels of trust) information sources, compared with other participants. Furthermore, this group showed a significantly lower level of health anxiety than the other participants, although there were no

Positive precautionary actions

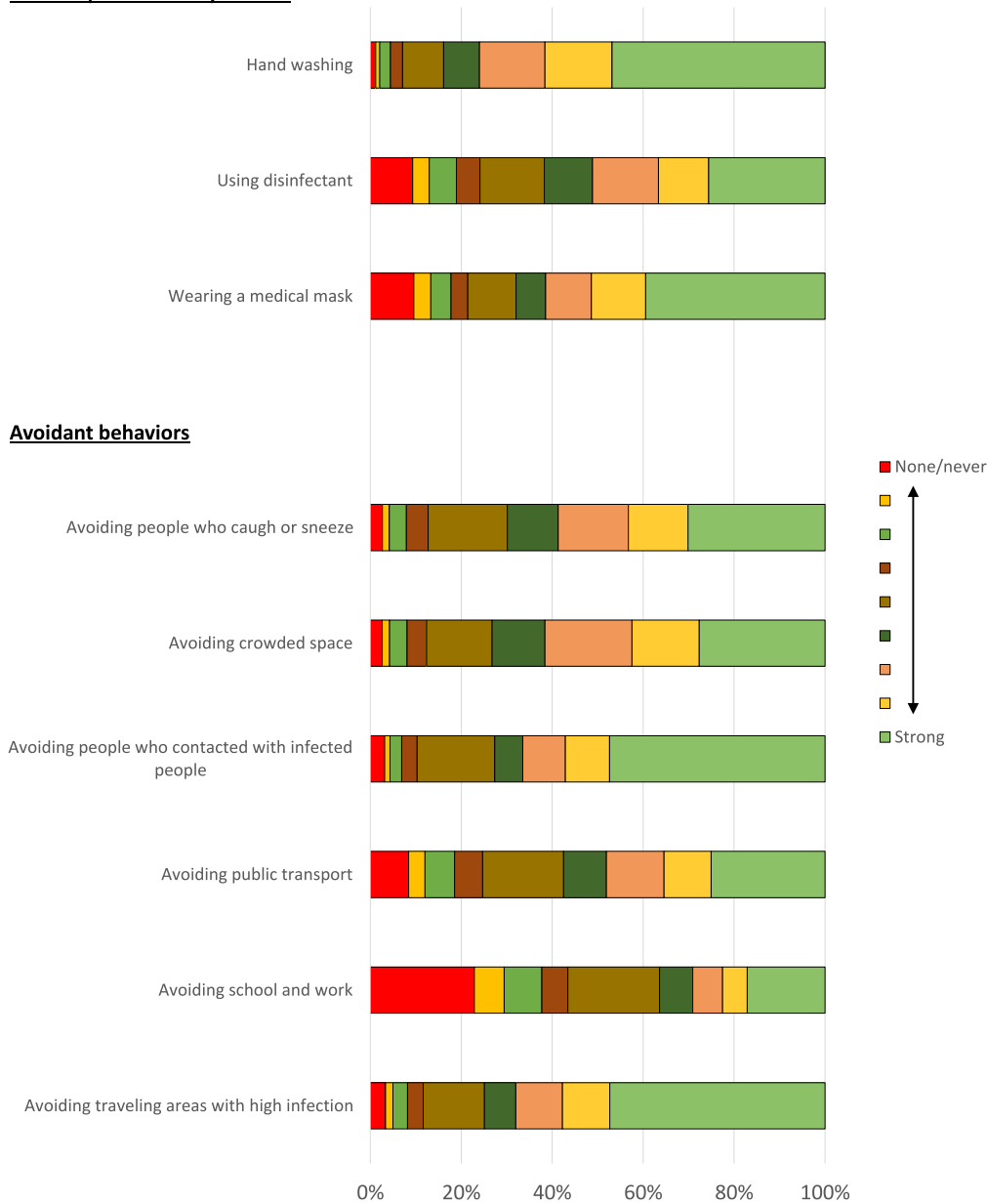


Fig. 4. Frequency of precautionary behaviors The level of each item was graded from 1 to 9, with larger values indicating higher levels of that factor.

differences in the levels of general anxiety between groups. In contrast, positive association between the degree of knowledge of COVID-19 and anxiety about COVID-19 related issues suggests the benefit for being anxious for precautionary behaviors, though the relationship between them is complex (Wirtz, 2019). Positive association between the degree of understanding of COVID-19 and washing hands suggests that proper knowledge is essential for people to motivate proper positive precautionary behaviors. The fact personal protective equipment was being exhausted at the time of survey may explain why wearing a mask and using disinfectants were not associated with the degree of knowledge of COVID-19 in the linear regression analysis.

The present findings showed the cycle of some citizens' cognitive and behavioral profile in reference to health anxiety as a juxtaposed model (Rachman, 2012). They were less likely to access news sources. Even if they were informed about the risks associated with COVID-19, they tended not to trust information sources. Therefore, they were less likely to worry about their health, as suggested by the difference in the SHAI scores between the groups. It may be that the lack of accurate

information prevented these participants from being concerned about COVID-19. Due to lack of knowledge and anxiety, they did not adopt precautionary behaviors such as hand washing and failed to recognize risks for infection or transmission. In addition, no experience of actually getting ill following risky behaviors may make this group more reckless. Furthermore, even if such people were actually infected, they may not modify their behaviors, because 80% of carriers are asymptomatic or only show mild symptoms, as noted by the WHO (2020a).

This is the first report on the estimation of the potential risk-proportion in the community and the related cognitive and behavioral characteristics. If our hypothesis is correct, enlightening individuals with low understanding properly is important to prevent further expansion of COVID-19 infection. Our findings suggest that lack of accurate knowledge regarding the danger of COVID-19 may be responsible for inappropriate behaviors. Education and information are necessary to modify risky behaviors in this context. However, they are less likely to access information sources. Therefore, we have to fill this information gap using any means (official and unofficial) for protection against the pandemic.

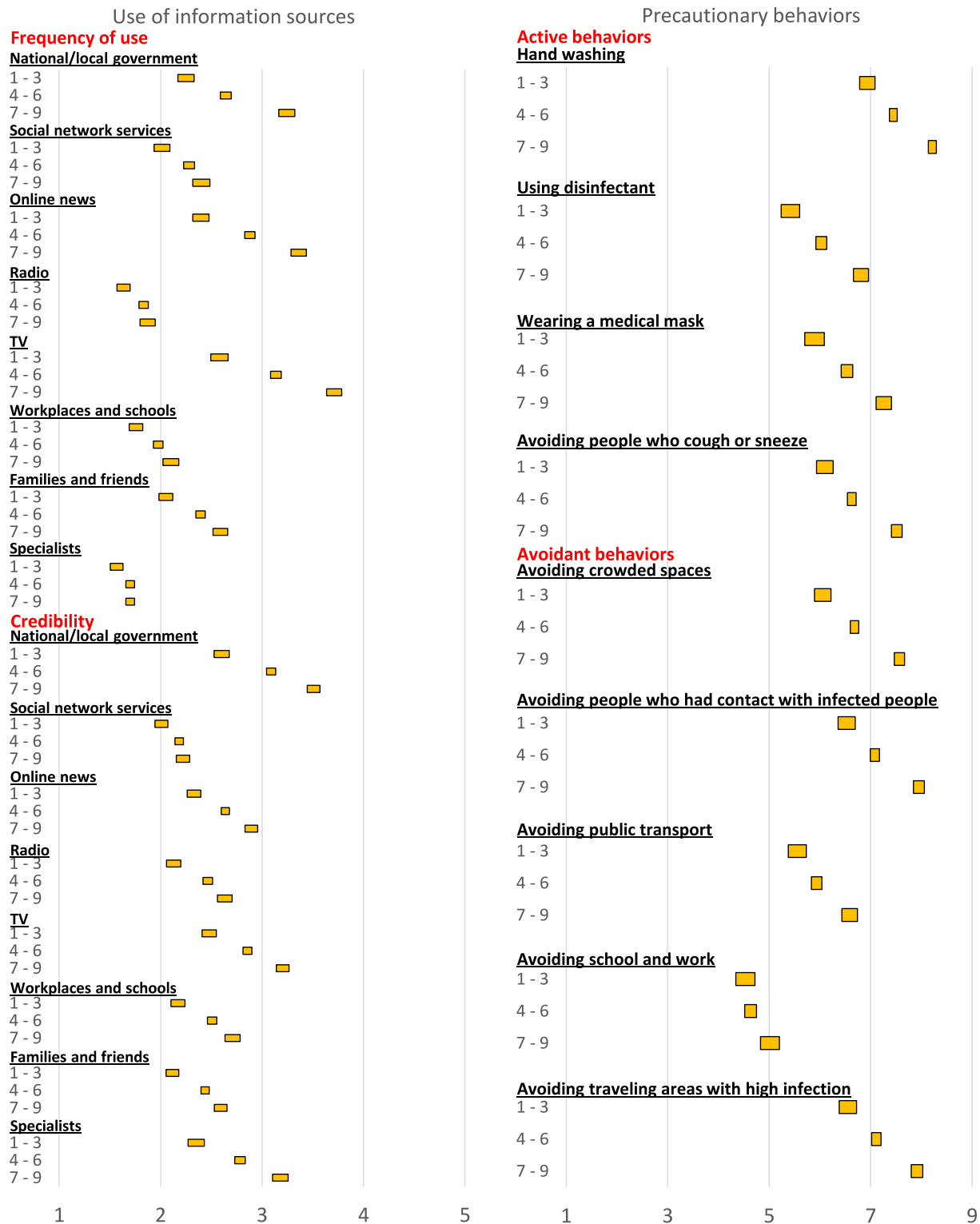


Fig. 5. Comparison between groups by the degree of knowledge of COVID-19 regarding use of information and precautionary behaviors. Each bar shows the 95% confidence interval of the mean for each item.

There may be several limitations in this study. This survey was conducted in the last weekend of March 2020, just before Japan encountered explosive rising numbers of COVID-19 infection. In March 28, there were only 1,452 patients of COVID-19 reported. But, one week after it became doubled (Nippon.com, 2020). The variation of the level of understanding in the community might have changed over the epidemic. Furthermore, it is uncertain whether our results are applicable to countries other than

Japan. Our findings that older adult and highly educated groups were more anxious about COVID-19 were consistent with a previous survey conducted in China (Qiu et al., 2020). We are planning to conduct similar surveys in other regions. Moreover, as this study was a web-based survey, participants were limited to internet users. In addition, as we used convenience sampling, the sample might have been biased to those who were willing to answer the questionnaire. Also, some items of the

Table 2
The result of linear regression analysis.

	Unstandardized B	Coefficients Standard Error	Standardized Coefficients Beta	t	Significance
Constant	−0.118	0.190		−0.621	0.535
Anxiety about the spread of COVID-19 infection	0.238	0.020	0.243	11.785	<0.001
Anxiety of being infected with COVID-19	0.145	0.027	0.143	5.426	<0.001
Credibility of information from national/local government	0.139	0.036	0.067	3.871	<0.001
Frequency of using information from TV	0.101	0.027	0.058	3.742	<0.001
Educational history	0.157	0.032	0.063	4.914	<0.001
Hand washing	0.063	0.017	0.052	3.715	<0.001
Anxiety of infecting someone with COVID-19	0.117	0.024	0.117	4.855	<0.001
Age period	0.093	0.020	0.062	4.644	<0.001
Frequency of using information from national/local government	0.129	0.027	0.074	4.838	<0.001
Credibility of information from specialists	0.092	0.028	0.051	3.232	0.001
Credibility of information from SNS	−0.094	0.032	−0.042	−2.941	0.003

questionnaire were introduced by us without any preceding studies. Their reliability and validity might be limited. In Japan, some surveys similar to ours have also been conducted. The reasons are unknown, but Cross Marketing Inc. (2020) reported that only 3% of participants rated “1 (very low concern)” on a seven-point Likert scale regarding “concern about COVID-19.” As the criteria and condition of participation and the content of the questionnaire in that survey differed from ours, it is not possible to directly compare these results.

Our results did not identify any super spreaders themselves, but the possibility of them. How many people of the participants are actually spreading the virus is uncertain. But we anticipate it is certain that they include some non-symptomatic carriers according to the WHO report (2020a).

Also, we focused on their anxiety and behavioral characteristics as elements to identify potential super spreaders in this study. Reckless behaviors are also suggested to be highly associated with several biological factors (Isles, 2019). But we have not examined any biomarkers of the participants. Further studies are needed to link our results to previous findings to clarify the role of biological factors in the pandemic situation.

Even considering these limitations, we believe our results are informative and worthy of consideration in policy making as soon as possible to control the current pandemic situation. It should be emphasized that a considerable percentage of citizens can take risk behaviors without anxiety of infection. Continuous notification and enlightenment are indispensable for mitigating the risk of spreading virus for most nations. We also should pay attention to awareness of social distance, protective behaviors in public health, modify the perception of infections, potential risk behaviors of “super spreaders”.

Declaration of competing interest

This study was conducted with a management grant provided by the Ministry of Education, Culture, Sport, Science and Technology [MECSST] to Chiba University Graduate School of Medicine and the Japan Society for the Promotion of Science [JSPS] KAKENHI grants [to T.N., no. JP19K08066]. The MECSST and JSPS had no role or control on the execution of this study.

We have no conflict of interests regarding this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.bbih.2020.100101>.

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