Original Article

Implication of the nationwide emergency announcement on coronavirus disease 2019-related preventive behavioral change among Japanese residents—a cross sectional study

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Background: To prevent the deteriorating coronavirus disease 2019 (COVID-19) situation in Japan, a nationwide state of emergency was declared on April 16, 2020. This study explores the impact of the first nationwide emergency announcement on Japanese residents' COVID-19-related preventive behavioral change.

Methods: We conducted an online cross-sectional survey between May 12 and 13, 2020, using a self-reported questionnaire to capture individual preventive behaviors. Quota sampling method was used to represent of Japanese population regarding sex and age.

Results: In total, 4,127 responses were analyzed; 2,187 were from the nonemergency area, and 1,940 were from the emergency area. Overall, the participants changed behaviors before and after the declaration (P<0.001). Mask use had the highest proportion of difference (20.4; 95% CI: 18.4–22.4). In the emergency area, avoiding proximity (closeness) recorded the highest increase (20.9%; 95% CI: 18.9–22.9%); in the nonemergency area, it was avoiding being in an enclosed space with other people (19.7%; 95% CI: 16.6–21.7%). Regarding "go out only in case of essential or emergency need," responders from the emergency area increased 1.3-fold (OR, 1.3; 95% CI: 1.1–1.5) compared with those from the nonemergency area.

Conclusions: This study investigated timely and regional differences in behavioral changes during the COVID-19 pandemic in Japan, which turned dramatically after the first nationwide state of emergency. However, with the evolving pandemic, repeated surveys should be advanced to grasp the trigger of behavioral changes.

Keywords: Behavioral change; coronavirus disease 2019 (COVID-19); state of emergency; voluntary prevention; Japan

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Introduction

On January 9, 2020, a novel coronavirus was linked to the outbreak of pneumonia cases in Wuhan, China, rapidly spreading worldwide within months. The World Health Organization officially named this new coronavirus disease 2019 (COVID-19) (1).

The first wave of the COVID-19 epidemic in Japan was mainly going through three periods. The first reported COVID-19 case was on January 16; until the end of March, only sporadic outbreaks were identified. Afterwards, the daily polymerase chain reaction (PCR)-positive COVID-19 cases increased sharply and peaked at 708 positive cases per day on April 10. To control the deteriorating COVID-19 situation, on April 16, the Japanese government declared that all 47 prefectures were under the state of emergency. Furthermore, emergency measures were taken to prevent the further spread of infections. In early May, the daily reported cases remained high, thus, the Japanese government maintained the nationwide state of emergency. It was not until May 21, 2020, that a considerable downtrend of newly reported cases was observed, and the daily PCR confirmed cases remained below 50. Therefore, the implementation of emergency measures was cancelled in most prefectures, and on May 25, the lifting of the state of emergency was declared nationwide (data shown in *Figure 1*) (2).

The countermeasures implemented to control the spread of COVID-19 consist of three phases: domestic spread prevention, preventing the spread of infection, and preventing severe spread. Under the state of emergency, the prefectural governors would ask the residents to stay at home unless necessary to maintain daily life and health. Department stores were asked to close every floor except those selling essential items such as food and medicine. Small-scale stores were demanded to take preventive measures against the infection. Extensive facilities such as universities/schools, sports centers, and those related to gatherings and exhibitions were requested to remain closed. Daycare centers, nursing schools, and welfare institutes were conditionally closed according to local government judgments. Meanwhile, public transportation was not stopped owing to the declaration. The Japanese government also vigorously promoted the "new lifestyle" to control the spread of infection, including necessary measures such as keeping distance, wearing masks, washing hands frequently, and promoting the key message of avoiding "3 Cs". Avoiding the "3 Cs" is an important notice for preventing

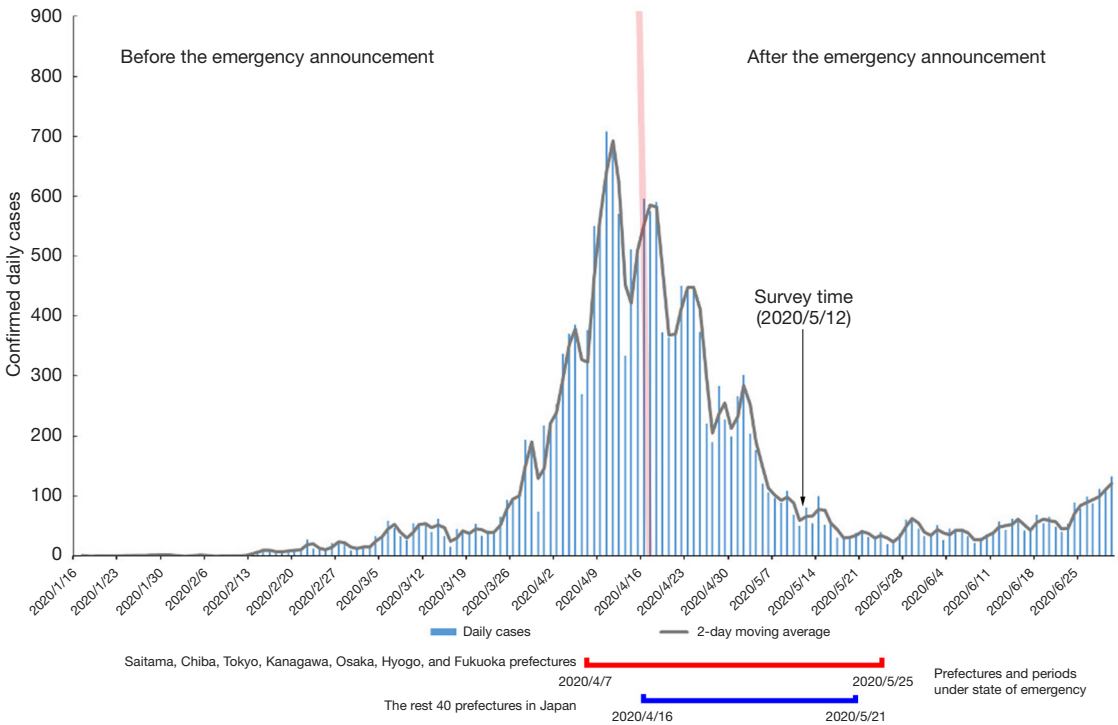

Figure 1 The trend of confirmed COVID-19 cases from January 16 to June 25, 2020, in Japan. COVID-19, coronavirus disease 2019.

COVID-19 outbreaks; keeping away from closed spaces with poor ventilation, crowded places with many people nearby, and close-contact settings (such as close-range conversation).

Up to mid-June 2020, the COVID-19 pandemic caused more than 7.7 million cases and nearly 430,000 deaths. Unlike other industrialized countries, no mandatory lockdowns were undertaken by either central or local governments throughout the ongoing epidemic, including during the state of emergency. However, the disease situation in Japan was comparatively mild.

Because of the limited number of intensive care unit (ICU) and PCR laboratory capacity per population (3), instead of performing extensive screening using the PCR test, the Japanese policies focused on the identification and response to infection clusters within the existing surveillance system, of a full collaboration of local health centers (approximately one per 200,000 population in average) (4). Meanwhile, to strengthen the citizens' awareness of self-restriction and behavioral change, the Japanese government actively sent a straightforward and clear message through the mass media to avoid the "3 Cs" (5).

Several published papers have discussed the potential reasons behind this low incidence and mortality rate. The Japanese culture was well adapted to social distance measures and hygiene practices (6,7). An online survey of Japanese citizens' behavioral changes (8) reported that approximately 85% of the population was practicing social distance measures. The high rate of facial mask use may significantly contribute to the low transmission of COVID-19 during the early stage of the pandemic.

Despite all measures taken, between April 16 and May 25, 2020, under the nationwide state of emergency requirement, restrictions on holding events and public places, travel within and outside prefectures, etc., were issued to prevent the accelerated increase in COVID-19 cases. A study finds that avoidance behaviors were the most significant behavior changes during the COVID-19 pandemic in the Japanese population (9). However, there is little knowledge regarding preventive behavioral changes at different emergency levels. Besides, though the declaration is nationwide, the epidemic's severity varies by region. The status of personal preventive behavior may differ depending on the severity of emergency levels.

Therefore, this study aimed to explore the COVID-19-related preventive behavior before and after the first declaration of the state of emergency among Japanese residents regarding different emergency levels. Furthermore, to investigate potential relative factors on behavioral change. Preventive behaviors are indispensable in the measures taken against the COVID-19 pandemic. Thus, investigating behavioral change would provide insight into future policymaking aiming at raising self-protective behaviors. We present the following article in accordance with the SURGE reporting checklist (available at https://jphe.amegroups.com/article/view/10.21037/jphe-22-43/rc).

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Research Ethics Committee of Nagasaki Prefectural Institute of Environment and Public Health (No. 2020-6-1). The survey participants were informed of the study's purpose before their participation, and they could withdraw from the survey at any time. The participants were notified that their participation was voluntary, and informed consent was obtained using an online consent form that the participant had to agree to actively. The ethics committee approved this method of consent. The data were entirely anonymous.

Survey design and participants

We conducted a cross-sectional survey based on a pool of approximately 2 million registered individuals residing in Japan, via an online research company, Cross Marketing Inc., Japan (https://www.cross-m.co.jp/en/), from May 12 to May 13, 2020. We recruited a total of 4,134 respondents aged from 20 to 70 years. In the recruitment process for current research, quota sampling was conducted so that the sample distributions between sex (male or female) and age group (20s, 30s, 40s, 50s, or 60s) were representative of the Japanese population, based on statistics from the Labor Force Survey (Ministry of Internal Affairs and Communications). There was a monetary incentive for participants who completed the survey.

Questionnaire design

The questionnaire was developed in Japanese, and local experts validated its content by inviting seven local people of different demographical backgrounds to test the questionnaires. We first asked the seven local people to finish the questionnaire and keep time for completing the questionnaire (maximum 15 minutes), then the local experts

(who speak both Japanese and English) discussed each question with each local people to ensure no ambiguous questions due to translation.

The questionnaire consisted of three parts: (I) demographic information, including sex, education, occupation, income, location, with or without underlying disease; (II) preventive measures against COVID-19 before and after April 16, 2020 (questions are detailed in *Tables 1*,*2*); (III) other behaviors related to the COVID-19 pandemic (detailed in *Table 3*). The preventive behaviors are measured in five dimensions: personal protection, respiratory etiquette/cough etiquette, contact precautions, voluntary quarantine, and prompt reporting. Also, participants are asked to evaluate the preventive activities taken by the central/local government by giving an overall score (maximum 100) and reasons for it. The results concerning anxiety symptoms in this survey were reported in our previous publication (10).

Data analysis

Before the first nationwide declaration of the state of emergency, the seven most affected prefectures (Saitama, Chiba, Tokyo, Kanagawa, Osaka, Hyogo, and Fukuoka) were already under this emergency circumstance from April 7. Therefore, we defined these areas as the emergency area, and the rest of the 40 prefectures were the nonemergency area. The preventive measures before and after the nationwide emergency announcement were compared using the chi-square (χ^2) test, and the differences between the emergency and nonemergency areas were compared using the generalized estimating equation (GEE) and univariate logistic regression analysis. Multivariate logistic regression was performed to determine the factors influencing preventive measures. Incomplete responses were those with one or more missing answers were excluded from the analysis.

The GEE was performed using Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA). The rest of the data analyses were conducted with STATA/MP version 15.0 for Mac (StataCorp, College Station, TX, USA).

Results

Demographic characteristics

A total of 4,134 respondents were recruited, and after data cleaning, 4,127 complete responses were analyzed in this study. Specifically, 2,187 respondents were from the nonemergency area, and 1,940 were from the emergency area. *Table 4* shows a summary of the characteristics of the respondents. There was a fairly equal distribution of age groups between the nonemergency and emergency areas, as well as the sex and occupation groups. The participants from the emergency area had higher educational levels and annual household income, and a greater majority of the respondents did not have a history of underlying disease ($P<0.05$).

Differences in preventive measures

Table 1 shows the summary of responses related to the preventive measures before and after the emergency announcement. The difference in the preventive measures before and after the national emergency announcement (April 16, 2020) was statistically significant ($P<0.001$) in both the emergency and nonemergency areas.

According to the personal protection measures carried out among the participants from the emergency area, "wear a mask when going out" had the highest proportion of the increase in taking this measure after the announcement of state emergency (20.3%; 95% CI: 18.4–22.2%), followed by "go out only in case of essential or emergency need" (19.6%; 95% CI: 17.7–21.5%). Similar findings were found in the respondents from the nonemergency area; the proportion of increased participants in "wear a mask when going out" was 20.4% (95% CI: 18.4–22.4%), and that of "go out only in case of essential or emergency need" was 15.8% (95% CI: 13.8–17.7%). Moreover, "wash hands with soap (or disinfect hands) immediately after a cough or sneeze" had the most considerable proportion of the increase in respiratory etiquette/cough etiquette carried out by the participants from the emergency area (11.8%; 95% CI: 10.3–13.4%) and nonemergency area (10.5%; 95% CI: 8.9–12.0%). In terms of contact precaution measures, in the emergency area, it was the "avoid proximity (closeness) with other people" recorded the highest increase (20.9%; 95% CI: 18.9–22.9%), followed by "avoid being in an enclosed space with other people" (20.8%; 95% CI: 18.9–22.7%). On the other hand, in the nonemergency area, "avoid being in an enclosed space with other people" (19.7%; 95% CI: 16.6–21.7%) had the highest increase in the proportion of differences, followed by "avoid proximity (closeness) with other people" (19.2; 95% CI: 17.2–21.2).

Table 1 Difference in preventive measures during the last week and before April 16, 2020, in Japan (N=4,127)

Preventive measures	All (before April 16)		All (last week)		Emergency area (N=2,187)			Nonemergency area (N=1,940)		
	n	% (95% CI)	n	% (95% CI)	Differences % (95% CI)	c^2	P	Differences % (95% CI)	c^2	P
Personal protection										
Go out only in case of essential or emergency need					19.6 (17.7–21.5)	353.64	<0.001	15.8 (13.8–17.7)	232.93	<0.001
Yes	2,757	66.8 (65.3–68.2)	3,491	84.6 (83.5–85.7)						
No	1,370	33.2 (31.8–34.7)	636	15.4 (14.3–16.5)						
Wear a mask when going out					20.3 (18.4–22.2)	385.03	<0.001	20.4 (18.4–22.4)	337.97	<0.001
Yes	2,940	71.2 (69.8–72.6)	3,780	91.6 (90.7–92.4)						
No	1,187	28.8 (27.4–30.2)	347	8.4 (7.6–9.3)						
Wear an eye protector when going out					4.7 (3.6–5.7)	75.39	<0.001	4.4 (3.4–5.5)	69.77	<0.001
Yes	368	8.9 (8.1–9.8)	556	13.5 (12.4–14.6)						
No	3,759	91.1 (90.2–91.9)	3,571	86.5 (85.4–87.6)						
Washing hand with soap frequently					10.1 (8.6–11.5)	179.26	<0.001	10.6 (9.0–12.2)	161.02	<0.001
Yes	3,068	74.3 (73.0–75.7)	3,493	84.6 (83.5–85.7)						
No	1,059	25.7 (24.3–27.0)	634	15.4 (14.3–16.5)						
Avoid touching the eyes, nose and mouth					15.9 (14.1–17.6)	286.01	<0.001	14.1 (12.3–15.9)	220.81	<0.001
Yes	2,130	51.6 (50.0–53.1)	2,751	66.7 (65.2–68.1)						
No	1,997	48.4 (46.9–49.9)	1,376	33.3 (31.9–34.8)						
Respiratory etiquette/cough etiquette										
Cover your mouth and nose with a tissue or other goods when coughing or sneezing					6.8 (5.5–8.0)	116.51	<0.001	6.3 (5.0–7.7)	84.52	<0.001
Yes	3,311	80.2 (79.0–81.4)	3,582	86.8 (85.7–87.8)						
No	816	19.8 (18.6–21.0)	545	13.2 (12.2–14.3)						
Dispose of tissues or other goods used for coughing immediately after a cough or sneeze					4.1 (3.0–5.2)	59.56	<0.001	2.9 (1.9–4.0)	30.94	<0.001
Yes	3,492	84.6 (83.5–85.7)	3,639	88.2 (87.2–89.1)						
No	635	15.4 (14.3–16.5)	488	11.8 (10.9–12.8)						
Wash hands with soap (or disinfect hands) immediately after a cough or sneeze					11.8 (10.3–13.4)	218.50	<0.001	10.5 (8.9–12.0)	170.99	<0.001
Yes	1,602	38.8 (37.3–40.3)	2,064	50.0 (48.5–51.5)						
No	2,525	61.2 (59.7–62.7)	2,063	50.0 (48.5–51.5)						

Table 1 (*continued*)

Table 1 (*continued*)

Preventive measures	All (before April 16)		All (last week)		Emergency area (N=2,187)			Nonemergency area (N=1,940)		
	n	% (95% CI)	n	% (95% CI)	Differences % (95% CI)	c^2	P	Differences % (95% CI)	c^2	P
Perform hand hygiene (e.g., handwashing with soap or antiseptic handwash) after having contact with respiratory secretions or contaminated objects					10.4 (8.9–11.8)	190.14	<0.001	8.6 (7.1–10.1)	126.19	<0.001
Yes	2,117	51.3 (49.8–52.8)	2,511	60.8 (59.3–62.3)						
No	2,010	48.7 (47.2–50.2)	1,616	39.2 (37.7–40.7)						
Contact precautions										
Avoid proximity (closeness) with other people					20.9 (18.9–22.9)	364.48	<0.001	19.2 (17.2–21.2)	310.28	<0.001
Yes	2,637	63.9 (62.4–65.4)	3,466	84.0 (82.8–85.1)						
No	1,490	36.1 (34.6–37.6)	661	16.0 (14.9–17.2)						
Avoid group gathering					18.9 (17.0–20.8)	337.39	<0.001	17.4 (15.4–19.3)	279.04	<0.001
Yes	3,024	73.3 (71.9–74.6)	3,775	91.5 (90.6–92.3)						
No	1,103	26.7 (25.4–28.1)	352	8.5 (7.7–9.4)						
Avoid being in an enclosed space with other people					20.8 (18.9–22.7)	381.26	<0.001	19.7 (16.6–21.7)	311.80	<0.001
Yes	2,900	70.3 (68.8–71.7)	3,737	90.6 (89.6–91.4)						
No	1,227	29.7 (28.3–31.2)	390	9.4 (8.6–10.4)						
Voluntary quarantine										
If I am feeling unwell, I distance myself from others					10.6 (9.1–12.1)	192.23	<0.001	9.9 (8.4–11.4)	158.90	<0.001
Yes	3,435	83.2 (82.1–84.4)	3,859	93.5 (92.7–94.2)						
No	692	16.8 (15.6–17.9)	268	6.5 (5.8–7.3)						
Prompt reporting										
If I am feeling unwell with any COVID-19-related symptoms, I will immediately declare my symptoms to the authority/healthcare providers					18.0 (16.1–19.8)	318.45	<0.001	17.1 (15.2–19.1)	270.16	<0.001
Yes	2,701	65.4 (64.0–66.9)	3,426	83.0 (81.8–84.1)						
No	1,426	34.6 (33.1–36.0)	701	17.0 (15.9–18.2)						

Table 2 Difference in preventive measures during the last week and before April 16, 2020, stratified by location in Japan

Preventive measures	Nonemergency area (N=1940)					Emergency area (N=2187)					OR (95% CI)	P
	Before April 16		Last week		Differences	Before April 16		Last week		Differences		
	Yes (n)	No (n)	Yes (n)	No (n)	% (95% CI)	Yes (n)	No (n)	Yes (n)	No (n)	% (95% CI)		
Personal protection												
Go out only in case of essential or emergency need	1,303	637	1,609	331	15.8 (13.8–17.7)	1,454	733	1,882	305	19.6 (17.7–21.5)	1.309 (1.115–1.531)	0.001
Wear a mask when going out	1,365	575	1,761	179	20.4 (18.4–22.4)	1,575	612	2,019	168	20.3 (18.4–22.2)	1.127 (0.909–1.397)	0.276
Wear an eye protector when going out	159	1,781	245	1,695	4.4 (3.4–5.5)	209	1,978	311	1,876	4.7 (3.6–5.7)	0.969 (0.833–1.127)	0.683
Washing hand with soap frequently	1,392	548	1,597	343	10.6 (9.0–12.2)	1,676	511	1,896	291	10.1 (8.6–11.5)	1.084 (0.948–1.239)	0.239
Avoid touching the eyes, nose and mouth	961	979	1,235	705	14.1 (12.3–15.9)	1,169	1,018	1,516	671	15.9 (14.1–17.6)	1.102 (0.993–1.224)	0.067
Respiratory etiquette/cough etiquette												
Cover your mouth and nose with a tissue or other goods when coughing or sneezing	1,530	410	1,653	287	6.3 (5.0–7.7)	1,781	406	1,929	258	6.8 (5.5–8.0)	1.104 (0.968–1.260)	0.140
Dispose of tissues or other goods used for coughing immediately after a cough or sneeze	1,643	297	1,700	240	2.9 (1.9–4.0)	1,849	338	1,939	248	4.1 (3.0–5.2)	1.116 (0.985–1.265)	0.084
Wash hands with soap (or disinfect hands) immediately after a cough or sneeze	746	1,194	949	991	10.5 (8.9–12.0)	856	1,331	1,115	1072	11.8 (10.3–13.4)	1.055 (0.968–1.151)	0.225
Perform hand hygiene (e.g., handwashing with soap or antiseptic handwash) after having contact with respiratory secretions or contaminated objects	988	952	1,155	785	8.6 (7.1–10.1)	1,129	1,058	1,356	831	10.4 (8.9–11.8)	1.079 (0.993–1.172)	0.074
Contact precautions												
Avoid proximity (closeness) with other people	1,219	721	1,591	349	19.2 (17.2–21.2)	1,418	769	1,875	312	20.9 (18.9–22.9)	1.209 (1.032–1.415)	0.018
Avoid group gathering	1,434	506	1,771	169	17.4 (15.4–19.3)	1,590	597	2,004	183	18.9 (17.0–20.8)	1.112 (0.898–1.378)	0.331
Avoid being in an enclosed space with other people	1,359	581	1,741	199	19.7 (16.6–21.7)	1,451	646	1,996	191	20.8 (18.9–22.7)	1.171 (0.953–1.439)	0.133
Voluntary quarantine												
If I am feeling unwell, I distance myself from others	1,614	326	1,806	134	9.9 (8.4–11.4)	1,821	366	2,053	134	10.6 (9.1–12.1)	1.131 (0.905–1.414)	0.279
Prompt reporting												
If I am feeling unwell with any COVID-19-related symptoms, I will immediately declare my symptoms to the authority/ healthcare providers	1,279	661	1,611	329	17.1 (15.2–19.1)	1,422	765	1,815	372	18.0 (16.1–19.8)	1.037 (0.895–1.202)	0.627

Table 3 Difference in other behaviors during last week and before April 16, 2020, stratified by location in Japan

Behaviors	Nonemergency area (N=1,940)		Emergency area (N=2,187)		OR (95% CI)	P
	Yes (n)	No (n)	Yes (n)	No (n)		
Time for exercise (sports)						
Increase	165	1,775	207	1,980	1.125 (0.908–1.394)	0.283
Decrease	668	1,272	952	1,235	1.468 (1.294–1.665)	<0.001
Same	1,107	833	1,028	1,159	0.667 (0.590–0.755)	<0.001
Take vitamin supplement						
Increase	106	1,834	135	2,052	1.138 (0.876–1.479)	0.333
Decrease	98	1,842	123	2,064	1.120 (0.853–1.471)	0.415
Same	1,736	204	1,929	258	0.879 (0.723–1.068)	0.193
Intake of healthy food (fruits and vegetables)						
Increase	244	1,696	358	1,829	1.361 (1.141–1.622)	0.001
Decrease	161	1,779	204	1,983	1.137 (0.916–1.411)	0.246
Same	1,535	405	1,925	262	0.763 (0.660–0.882)	<0.001
Get adequate sleep						
Increase	318	1,622	495	1,692	1.492 (1.276–1.745)	<0.001
Decrease	232	1,708	290	1,897	1.125 (0.936–1.354)	0.210
Same	1,390	550	1,402	785	0.707 (0.619–0.806)	<0.001
Opportunity to meet people other than family						
Increase	26	1,914	42	2,145	1.441 (0.880–2.360)	0.145
Decrease	837	1,103	1,136	1,051	1.424 (1.260–1.610)	<0.001
Same	1,077	863	1,009	1,178	0.686 (0.607–0.776)	<0.001

As shown in *Table 2*, the number of participants who "go out only in case of essential or emergency need" in the emergency area increased 1.3-fold (95% CI: 1.1–1.5) compared with those from the nonemergency area. Respondents from the emergency area were more likely to have an increase in "avoid proximity (closeness) with other people" (OR, 1.2; 95% CI: 1.0–1.4).

Differences in daily life behaviors

Table 3 shows the differences in other behavioral changes between the emergency and nonemergency areas. Respondents from the emergency area were more likely to decrease their time for sports (1.5; 95% CI: 1.3–1.7) and the opportunity to meet people other than family members (1.4; 95% CI: 1.3–1.6). On the other hand, intake of healthy food (fruits and vegetables) and adequate sleep carried out by participants from the emergency area increased (OR, 1.4; 95% CI: 1.1–1.6, and OR, 1.5; 95% CI: 1.3–1.7, respectively).

Factors associated with preventive measures

Univariate and multivariable analyses of the factors associated with the improvement of preventive measures after the nationwide emergency announcement are shown in *Table 5*. People ages 41–50 (OR, 0.8; 95% CI: 0.6–0.9) and ages 51–60 (OR, 0.7; 95% CI: 0.6–0.9) were less likely to make preventive behaviors. The participants with an annual household income between the "500 to 800 ten thousand JPY" group and "more than 800 ten thousand JPY" group were more likely to take preventive measures; the OR values were 1.5 (95% CI: 1.2–1.8) and 1.3 (95% CI: 1.1–1.7), respectively.

Table 4 Demographic characteristics of the study population stratified by location in Japan, 2020 (N=4,127)

Sociodemographic variable	n (%)	Nonemergency area (N=1,940), n (%)	Emergency area (N=2,187), n (%)	c^2	P
Age (years)				1.432	0.839
20–30	675 (16.4)	306 (15.8)	369 (16.9)		
31–40	800 (19.4)	381 (19.6)	419 (19.1)		
41–50	985 (23.9)	474 (24.4)	511 (23.4)		
51–60	822 (19.9)	385 (19.9)	437 (20.0)		
61–70	845 (20.4)	394 (20.3)	451 (20.6)		
Sex				0.022	0.883
Male	2,043 (49.5)	958 (49.4)	1,085 (49.6)		
Female	2,084 (50.5)	982 (50.6)	1,102 (50.4)		
Highest educational level				24.698	<0.001
Primary school and below	10 (0.2)	5 (0.3)	5 (0.2)		
Secondary and senior high school	1,222 (29.6)	647 (33.3)	575 (26.3)		
Junior college or vocational school and above	2,895 (70.2)	1,288 (66.4)	1,607 (73.5)		
Occupation				5.395	0.067
Informal occupation	1,618 (39.2)	749 (38.6)	869 (39.7)		
Formal occupation	1,885 (45.7)	871 (44.9)	1,014 (46.4)		
Unemployed and others	624 (15.1)	320 (16.5)	304 (13.9)		
Annual household income (10,000 JPY)				40.883	<0.001
<200	671 (16.3)	351 (18.1)	320 (14.6)		
200–500	1,660 (40.2)	823 (42.4)	837 (38.3)		
500–800	1,056 (25.6)	491 (25.3)	565 (25.8)		
>800	740 (17.9)	275 (14.2)	465 (21.3)		
History of chronic disease				7.643	0.006
Have chronic disease	1,381 (33.4)	691 (35.6)	690 (31.5)		
No chronic disease	2,746 (66.6)	1,249 (64.4)	1,497 (68.5)		

Discussion

Behavioral change is significant in the preventive measures against novel coronavirus disease. During the study periods, based on the COVID-19 situation in different regions, the Japanese government has taken different disease countermeasures. Including the request for shortening business hours (restaurants, public facilities, etc.), refraining from holding events and non-urgent and unnecessary going out are issued during the state of emergency period, and enhancement of personal protection.

Our study investigated the public's preventive measures against COVIDD-19; the results showed that, before and after the first declaration of the state of emergency (April 16), our participants had changed their behaviors in the aforementioned five dimensions.

Before the first state of emergency declaration, approximately three-quarters of the participants had taken necessary preventive measures and contact precautions. These findings were in accordance with another study (8) conducted at the end of March 2020. On this basis, after the first state of emergency declaration, we observed that

Table 5 Factors associated with differences in total preventive measure scores in Japan, 2020

Variable	Univariate analysis				Multivariable analysis	
	n (%)	Preventive behavior have not improved (score last week ≤ score before emergency announcement) (N=2,355)	Preventive behavior have improved (score last week > score before emergency announcement) (N=1,772)	P	OR (95% CI)	P
Age, years				0.026		
20–30	675 (16.4)	357 (15.2)	318 (17.9)		Ref	
31–40	800 (19.4)	449 (19.1)	351 (19.8)		0.844 (0.686–1.039)	0.110
41–50	985 (23.9)	576 (24.5)	409 (23.1)		0.772 (0.633–0.942)	0.011
51–60	822 (19.9)	500 (21.2)	322 (18.2)		0.714 (0.580–0.880)	0.002
61–70	845 (20.4)	473 (20.1)	372 (21.0)		0.922 (0.748–1.136)	0.424
Sex				0.105		
Male	2,043 (49.5)	1,140 (48.4)	903 (51.0)			
Female	2,084 (50.5)	1,215 (51.6)	859 (49.0)			
Highest educational level				0.003		
Primary school and below	10 (0.2)	3 (0.1)	7 (0.4)		Ref	
Secondary and senior high school	1,222 (29.6)	741 (31.5)	481 (27.1)		0.296 (0.075–1.162)	0.081
Junior college or vocational school and above	2,895 (70.2)	1,611 (68.4)	1,284 (72.5)	s	0.342 (0.087–1.341)	0.124
Occupation				0.024		
Informal occupation	1,618 (39.2)	943 (40.0)	675 (38.1)		Ref	
Formal occupation	1,885 (45.7)	1,035 (44.0)	850 (48.0)		1.098 (0.954–1.265)	0.193
Unemployed and others	624 (15.1)	377 (16.0)	247 (13.9)		0.988 (0.811–1.202)	0.902
Annual household income (10,000 JPY)				<0.001		
>200	671 (16.3)	425 (18.1)	246 (13.9)		Ref	
200–500	1,660 (40.2)	961 (40.8)	699 (39.4)		1.211 (0.997–1.470)	0.053
500–800	1,056 (25.6)	558 (23.7)	498 (28.1)		1.476 (1.192–1.827)	<0.001
>800	740 (17.9)	411 (17.4)	329 (18.6)		1.334 (1.059–1.682)	0.015
Location				0.530		
Emergency area	2,187 (53.0)	1,238 (52.6)	949 (53.6)			
Nonemergency area	1,940 (47.0)	1,117 (47.4)	823 (46.4)			
Chronic disease				0.639		
No	2,746 (66.5)	1,574 (66.8)	1,172 (66.1)			
Yes	1,381 (33.5)	781 (33.2)	600 (33.9)			
Evaluated score of the preventive activities by the government				0.166		
Score <60	2,923 (70.8)	1,688 (71.7)	1,235 (69.7)			
Score ≥60	1,204 (29.2)	667 (28.3)	537 (30.3)			
Evaluated score of the preventive activities of the government				0.850		
Score <60	2,308 (55.9)	1,320 (56.0)	988 (55.8)			
Score ≥60	1,819 (44.1)	1,035 (44.0)	784 (44.2)			

all participants had reinforced their preventive measures, especially for mask use of personal protection and "3 Cs" of contact precautions; a separate 20% rise of positive answers was observed in "wear a mask when going out", "avoid proximity (closeness) with other people", "avoid group gathering", and "avoid being in an enclosed space".

Before and after the first emergency announcement, regardless of emergency/nonemergency area, our results showed that the proportion of taking preventive measures had significantly increased. Above all preventive measures, our results showed that more participants from the emergency area were going out only in case of essential or emergency needs compared with those from the nonemergency area, and the participants from the emergency area had better performance in avoiding proximity (closeness) with other people. We also found that participants from the emergency areas reported less time for exercise and gathering with friends but more time for adequate sleep and more intake of healthy food.

It was worth discussing why Japanese citizens cooperated well in self-refraining and reached the goal of reducing contact among people by 80% in one month (11), despite the fact that the prefectural government has no legal power to force people to stay home or businesses to close. Japanese people suffer from hay fever and seasonal influenza every year, and wearing face masks seems to have become a common hygiene practice in daily life (12,13). Moreover, the completed public health system provides convenient access to sanitizer or handwashing soap in public places. The discipline of washing hands to prevent infectious diseases such as cholera and dysentery was deeply implanted in the Japanese lifestyle (14). Moreover, Japanese greeting does not involve close contacts such as handshaking, kissing, or hugging. Social norms are an essential factor influencing people's behavior (15), and people may conform to what others are doing and learn from the majority. Three knowledge and behavior studies on COVID-19 in the USA and Italy found adequate citizen awareness of the infection and basic preventive methods; however, fewer people have changed their behaviors (16-18). Japan and other Asian countries, such as China and Singapore, have tight cultural societies compared with most Western European and North American countries, which means those tight culture countries have strict social norms and punishments regarding deviance (19). Therefore, despite the fact that no mandatory provisions or punishments were published, individuals and businesses generally comply with preventive measures and policies by the Japanese government. On the other hand, participants from the emergency area showed higher vigilance toward COVID-19 than those from the nonemergency area. Nowadays, multi-communication channels (TV, Internet, or SMS) allow individuals to synchronize disease information and provide instant responses following preventive instructions. The deteriorating infection situation and the increasing number of confirmed COVID-19 cases, plus continually tightening policies in those areas, may prompt an individual's behavioral change. The anxiety level may motivate people to take more preventive measures against COVID-19. Our previous study (10) found that 86% of the participants reported moderate to severe anxiety during the study period. Moreover, a previous study (20) elaborated on how social and cultural contexts significantly influence the extent and speed of behavioral change responding to the COVID-19 pandemic. Japan is a typical tight and interdependent cultural (21) Asian country; experiences from various historical threats (earthquake, typhoon, influenza season, and atomic bomb attacks) have led to a social consensus to prioritize public security over an individual's interest.

Overall, the participants had changed their preventive behaviors after the declaration of the nationwide state of emergency, and significant differences in behaviors exist in participants from emergency and nonemergency areas. Moreover, the results of univariate and multivariable analyses found that participants aged between 41 and 60 years were less likely to take preventive measures against COVID-19, and the participants with higher incomes had better performance in preventive behaviors. These findings suggest that government authorities could reinforce the preventive measures implemented in the middle age population and enhance the publicity of health measures in nonemergency areas.

Our study is not devoid of some limitations. First, this study used a self-reported questionnaire, and the actual behavioral changes could not be guaranteed. Second, the data were collected by an online research company. Although the company managed to recruit participants representing the population, some selection bias was inevitable. For example, the Internet-based survey would favor those who were younger and familiar with the Internet and those intrigued by monetary incentives. Third, our study was conducted in mid-May 2020; while the COVID-19 pandemic, countermeasures against COVID-19 (e.g., vaccination rate) have significantly changed in Japan. Despite the limitations mentioned above, this study was

carried out within the first state of the emergency period; the large sample size of participants from the emergency/nonemergency areas allowed us to have a sight of public responses toward SARS-CoV-2 infection in Japan. Moreover, provide details of differences in behavioral changes regarding emergency levels during the nationwide state of emergency period.

Conclusions

This study investigated the timely and regional differences in behavioral changes during the early stage of the COVID-19 pandemic in Japan. The public's behavior changed dramatically after the first declaration of the state of emergency. The proportion of taking preventive measures increased in all 47 prefectures, although people from the emergency areas were more willing to avoid proximity with other people and wear a mask when going out. This study indicated several factors associated with Japanese people's behavioral changes during the COVID-19 outbreak. However, with the evolving pandemic, the repeated survey should be advanced to grasp the trigger of behavioral changes to help set up effective policies for pandemic prevention.

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Footnote

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