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Research Article

Impact of SARS-CoV-2 Outbreak on Physical and Mental Health, Psychological Distress, and Suicidal Ideation, and the Mediating Role of Stressors

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Abstract

This study investigated the physical and psychological impacts of elements related to coronavirus disease (COVID-19) and demographic data in Japan both directly and as mediated by stressors, immediately following the rescinding of the state of emergency declaration accompanying the severe acute respiratory syndrome coronavirus 2 outbreak. An online survey was administered to 1,500 Japanese registered with an online outsourcing service. Data were analyzed with structural equation modeling using Mplus. Relatively large total effects were observed for "insufficient exercise" on physical health (β = –0.24, *SE* = 0.03), "mental health issues related to COVID-19" on mental health (β= –0.25, *SE* = 0.03) and psychological distress (β= 0.24, *SE* = 0.03), neuroticism on mental health (β= –0.30, *SE* = 0.02) and psychological distress (β= 0.36, *SE* = 0.02), and social support on suicidal ideation (β= –0.32, *SE* = 0.03). Thus, mitigating the harm resulting from the ongoing impact of the COVID-

19 infection outbreak by raising awareness of risk factors and promoting social support is feasible.

Keywords
COVID-19; SARS-CoV-2; mental health; physical fitness; psychological distress; suicidal ideation; mediation; stressor; coping; community

1. Introduction

Studies have been published in many countries regarding the psychological impact of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) outbreak. An early-stage review of four cross-sectional studies from China suggests that anxiety, depression, stress, and sleep disorders may be observed during the coronavirus disease (COVID-19) pandemic [1]. Following this review, there have been several studies reporting the results of general public surveys. For example, a large-scale study from the United States found that fear was particularly high in areas with many reported cases of COVID-19, and observed a correlation between being socially vulnerable (female, Asian, Hispanic, born abroad, family with children) and fear [2]. Also, longitudinal studies from China and Australia initiated before the SARS-CoV-2 outbreak demonstrated the occurrence of psychological responses owing to the outbreak [3, 4]. Further, serum 25-hydroxyvitamin D concentrations, assumed to be related to mental health [5], have also been reported to be decreased in patients with emotional disorders under extended COVID-19 infection [6].

The negative impact of the SARS-CoV-2 outbreak on mental health is gradually becoming clear. Thus, the current challenge for research is the determination of the elements impacting these negative psychological responses. Further, the risk of suicide, which is the worst possible psychological response in a disaster situation, is unclear.

Considering a stress model of psychological response during a disaster suggests that social support and coping style can influence the psychological response level. Studies have shown that social support reduces anxiety and depression amid the SARS-CoV-2 outbreak [7, 8]. Negative thinking and avoidant behavior accompanying negative coping have been reported to be associated with depression and psychological distress [9, 10].

Although there is limited research about the SARS-CoV-2 outbreak, personality traits may also impact a stress response. A past meta-analysis found a negative association between neuroticism and mental health [11]. As for predictors of psychological distress, cyclothymic, depressive, and anxious temperaments in personality with a need for approval in attachment style were reported as risk factors and confidence and discomfort with closeness in attachment style as protective factors [12]. Further, people with high extraversion experience have been hypothesized with greater psychological stress amid circumstances limiting social interaction, such as the SARS-CoV-2 outbreak.

People cannot live without stressors, the factors that produce mental and physical stress responses. Excessive exposure to stressors can lead to hyper and chronic stress reactions, which in turn can worsen physical and mental health-related outcomes such as physical and mental deterioration, psychological distress, and suicidal ideation. In contrast, appropriate coping can reduce perceived stress and improve physical and mental health. Such an association between

stressors, coping, and physical and mental health outcomes have also been reported under the influence of COVID-19 [13, 14]. Even under the spread of COVID-19 infection, appropriate coping will likely have a positive effect, both directly through the improvement of physical and mental health-related outcomes and indirectly through the reduction of perceived stress on stressors such as unemployment.

From the aforementioned discourse, it is clear that there is insufficient detailed research on psychological responses to the SARS-CoV-2 outbreak in the general public focusing on the Japanese population. Moreover, many studies from other countries and regions have used adjusted correlations between variables; however, only a few focused on mediated correlations between variables. Thus, this study aimed to investigate both the direct and stressor-mediated impact of demographic data, elements related to COVID-19 infection, personality, social support, and coping on physical and psychological status using structural equation modeling (SEM).

2. Materials and Methods

2.1 Participants

An online survey was administered to the Japanese who were 18 years or older registered with an online outsourcing service provided by Crowd Words, Inc. The responses were received from 1,500 participants between May 26 and May 27, 2020 (viewed by 2,594 individuals, acceptance rate: 57.8%). Only the participants lacking literacy or cognitive function were excluded. The participants were screened based on responses that were carefully examined to identify random or consistently contradictory responses. No responses fulfilling the exclusion criteria were identified, and all data were used for analysis. More detailed information on the basic characteristics of the participants has been reported in our existing short report [15].

2.2 Survey Items

2.2.1 Basic Demographic Information

Participants were inquired about the basic demographic information, including age (multiple choices from under 19 years to 70 years or older); sex (female, male, other); prefecture of residence; the highest level of education completed (middle school graduate, high school graduate, junior college/vocational school/technical school graduate, college graduate, graduate school graduate); marital status (unmarried, divorced/widowed, married [do not live with a partner], married [live with a partner]); ethnicity (Asian, black, multi-ethnic, white, Chinese, Middle Eastern/Arab, other); employment status before the outbreak (student, self-employed/sole proprietorship, operating a company, full-time, part-time, contract worker, housewife/househusband, on leave [childcare leave, sick leave, unemployed]); and annual household income before the outbreak (selected from <18600 USD, 18600 USD to 37200 USD, 37300 USD to 74500 USD, 74600 USD to 111800 USD, 111900 USD to 149000 USD, and ≥149000 USD).

Regarding the SARS-CoV-2 outbreak, participants were enquired about how often they went to their workplace under the state of emergency declaration (almost never, half the week or less, more than half the week, almost every day); amenities in their residence and the surrounding environment (whether they had a garden, balcony, parks, or botanical gardens); the number of

preschool-age children in the home; whether they had underlying physical or psychiatric disorders; whether they had been infected with COVID-19 (recovered, recovering, infection suspected, not infected); about contact with infected persons in the past week (had contact, suspected contact, no contact); and extent of voluntary restriction of outside activity (did not leave home at all, did not leave home unless exercising or shopping for food, went out for work in addition to shopping when needed, did not refrain from going out but practiced social distancing, or did not refrain from going out and did not practice social distancing).

Concerning stressors, participants were asked to assess 15 items regarding life events likely to occur under the state of emergency declaration on a four-point scale of "did not happen," "happened, but was not stressful or difficult," "was a little stressful or difficult," or "was very stressful or difficult" (see Table 1 for the list of items). Each item was scored from 0 to 3 points.

Lastly, participants were asked about whether they performed any of the seven intentional behaviors intended to bolster mental health or change the mood to evaluate "coping" (see Table 1 for the list of items).

Table 1 Frequency of life events, stressors, and coping.

Life Events and Stressors		Not happen		Not stressful		A little stressful		Very stressful	
NO.	Contents	N	%	N	%	N	%	N	%
E1	My household income significantly decreased (by 40% or more).	1022	68.1	148	9.9	201	13.4	129	8.6
E2	I lost someone close to me (due to the novel coronavirus or other causes).	1393	92.9	39	2.6	41	2.7	27	1.8
E3	I had difficulty getting a consultation with a doctor for the treatment of a chronic disease I have.	1190	79.3	140	9.3	137	9.1	33	2.2
E4	I had to do things that put me at risk of infection (e.g., commute to work, do my job, go shopping).	438	29.2	578	38.5	357	23.8	127	8.5
E5	My workload increased quantitatively (e.g., increased overtime).	1258	83.9	85	5.7	112	7.5	45	3.0
E6	I worried about relationships at work (e.g., everyday relationships, differences of opinion regarding infection prevention).	1097	73.1	148	9.9	162	10.8	93	6.2
E7	I began to experience mental health issues resulting from the coronavirus outbreaks' effects.	885	59.0	246	16.4	285	19.0	84	5.6
E8	Concerns about my relationship with my boyfriend/girlfriend/a close friend (e.g., unable to get in contact with them, not getting along, concerns about infection).	961	64.1	253	16.9	209	13.9	77	5.1
E9	My responsibilities at home increased, e.g., more childcare, eldercare, housework.	912	60.8	229	15.3	243	16.2	116	7.7
E10	Concerns about online relationships (hassles, arguments, abuse).	1352	90.1	61	4.1	66	4.4	21	1.4
E11	Being unable to meet people.	251	16.7	566	37.7	435	29.0	248	16.5
E12	Uncertainty about the future.	209	13.9	311	20.7	540	36.0	440	29.3
E13	I slept less, and the quality of my sleep decreased.	817	54.5	245	16.3	315	21.0	123	8.2
E14	Insufficient exercise.	326	21.7	631	42.1	381	25.4	162	10.8
E15	The time I spent social networking, surfing the web, gaming, or shopping online increased.	359	23.9	891	59.4	185	12.3	65	4.3

Coping		Implemented	
NO.		N	%
C1	Taking medication to improve my mental health, such as sleeping pills or antidepressants.	67	4.5
C2	Talking about my mental health with friends and family.	232	15.5
C3	Participating in an online mental health program (cognitive behavioral therapy, etc.)	11	0.7
C4	Talking with others via social networking services, online bulletin boards or forums.	183	12.2
C5	Reading for enjoyment.	317	21.1
C6	Playing games with children (board games and cards, etc.)	240	16.0
C7	Taking 15-minute naps, lying around.	566	37.7

Note. *N* = 1500.

2.2.2 Psychological Scales

The ten-item personality inventory [16] was used as a personality index. This scale measures an individual's personality based on the five-factor model (the Big Five). The Japanese version (TIPI-J) was developed, and its validity was confirmed by Oshio [17]. Participants' responses to two questions for each of the five factors were rated on a seven-point scale (Extraversion [EXT], Agreeableness [AGR], Conscientiousness [CON], Neuroticism [NEU], Openness [OPE]). Each factor was scored from 0 to 14 points.

A shortened version [18] of the Japanese edition of the Multidimensional Scale of Perceived Social Support [19], comprising of seven items with high factor loadings taken from the original scale, was used as an index of social support. The participants responded to items such as "my family lends a hand to support me mentally when I need it" rated on a seven-point scale. The total score ranged from 7 to 49 points.

The SF-8TM was used as an index of mental and physical health [20]. The Japanese version of the SF-8TM was developed by Fukuhara [21]. A standard physical component summary (PCS) and mental component summary (MCS) with a mean score of 50 and standard deviation (SD) of 10 were calculated based on an algorithm derived from the standard scores of 2,284 Japanese individuals [21]. A higher score indicated better health for both summary scores.

The Kessler (K6) scale was used as an index of psychological distress[22]. The Japanese version of the K6 was developed by Furukawa [23]. Scores on the six-item scale range from 0 to 24 points. A higher score indicates higher psychological distress. The mean ±SD from a community sample of 85,154,382 Japanese individuals aged 15 or older was 3.34 ±3.39 [24].

The Suicide Behaviors Questionnaire-Revised (SBQ) was used as an index of suicidal ideation [25]. This scale measures the level of suicidal ideation and comprises four questions, each assessed on a five-to-seven-point scale. The total score ranges from 3 to 18 points. This scale was translated into Japanese using back-translation.

2.3 Statistical Analysis

All variables used in this analysis are enlisted in Table 2. Categorical variables were converted into binary. The following responses were entered as 1 while any other response was entered as 0. Sex: Female; the highest level of education: junior college graduate; comorbidity: psychiatric outpatient; employment status: full-time employed or unemployed (excluding student); housing facilities: garden or balcony; preschool-age children in the home: 3; having been infected with COVID-19: infection suspected; contact with infected persons: had to contact; the extent of voluntary restriction of outside activity: did not refrain from going out and did not practice social distancing. First, Spearman's rank correlation coefficient was calculated using IBM SPSS 26, and a two-tailed significance test was performed to explore correlations between variables. The significance level was $p < 0.0001$. Subsequently, a mediation model was considered SEM using Mplus 8.4. A hypothetical model of the direct and indirect effects mediated by stressors of demographic characteristics, COVID-19-related elements, coping, personality, and social support was created on PCS, MCS, K6, and SBQ, respectively, as objective variables. Paths that did not reach the significance level ($p < 0.0001$) were temporarily removed after which, the paths deemed necessary based on $\chi 2$ value were reincorporated to obtain the optimal model. The standards for model fitting were standardized root mean squared residual (SRMR) ≤ 0.08, the comparative fit index (CFI) ≥ 0.95, and the root mean square error of approximation (RMSEA) ≤ 0.06 [26].

Table 2 Correlation between the variables.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	PCS	1																					
2	MCS	-.16	1																				
3	K6	-.12	**-.62**	1																			
4	SBQ	-.11	-.28	**.47**	1																		
5	Extraversion			-.18	-.23	1																	
6	Agreeableness		.13	-.23	-.21		1																
7	Conscientiousness		.09	-.16	-.19	.20	.22	1															
8	Neuroticism		**-.34**	**.47**	**.34**	-.27	-.28	**-.31**	1														
9	Openness					**.35**	.15	.22	-.22	1													
10	Social Support	.11	.12	-.29	**-.38**	**.36**	.25	.10	-.18	.14	1												
11	Age		.09					.14			-.20	1											
12	Gender: Female		-.13						.18	-.12	.16	-.14	1										
13	Education: Junior college												.20	1									
14	Psychiatric outpatient	-.11	-.16	.22	.27	-.15			.19		-.12				1								
15	Employment: Full-time					.13			-.13				**-.31**			1							
16	Employment: Unemployed					-.14					-.13	.09			.13	-.20	1						
17	Workplace commutation								-.14				-.26			**.53**	**-.32**	1					
18	Housing facilities: Garden											.14				-.10			1				
19	Number of preschool children					.10					.17	-.10	.11				-.12	-.18		1			
20	Preschool children: Three																			.21	1		
21	COVID-19 infection: Suspected			.11	.12																	1	
22	Recent contact with patients: Yes																					.12	1
23	Voluntary restriction: None																						
24	E1		-.18	.22	.14																		
25	E2	-.11		.11	.12						-.12												.10
26	E3	-.14	-.13	.24	.20		-.12		.14		-.10				.19						.09		
27	E4		-.22	.26	.19		-.10		.17				.12				-.09	.15					
28	E5	-.10	-.09	.11												.25	-.12	**.30**					
29	E6		-.18	.23	.14		-.10				-.12					.29	-.16	**.36**					
30	E7	-.14	**-.44**	**.53**	**.31**		-.11		.28		-.16		.13		.17							.09	
31	E8		-.26	.25	.15				.11			-.13	.12										
32	E9		-.16	.13								.15	.17	.09		-.09	-.11	-.12	.10	**.47**	.10		
33	E10	-.14	-.12	.22	.24		-.14				-.16	-.09			.13							.11	.10
34	E11		-.27	.18		.22					.27	-.22	.18				-.10	-.10		.11			
35	E12		**-.40**	**.43**	.18				.26			-.10	.22			-.12		-.10					
36	E13	-.16	**-.37**	**.44**	.26			-.09	.23		-.14				.12								
37	E14	-.23	-.26	.28	.10		-.12		.12														
38	E15		-.21	.25	.09				.11			-.19	.11										
39	C1		-.16	.20	.21				.14		-.11				**.49**								
40	C2		-.14	.17	.10						.16		.11		.11	-.13		-.11					
41	C3																						
42	C4				.13					.09		-.13											

43	C5			-.11																			
44	C6				-.11						.16						-.10		.10	**.42**			
45	C7										.11												
		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
23	No voluntary restriction	1																					
24	E1		1																				
25	E2		.15	1																			
26	E3		.16	.13	1																		
27	E4				.21	1																	
28	E5			.13		.19	1																
29	E6		.10		.11	.24	**.32**	1															
30	E7		.20	.12	.23	.26	.12	.26	1														
31	E8		.12	.10	.15	.20	.15	.19	**.31**	1													
32	E9				.10	.16	.10		.14	.10	1												
33	E10		.14	.20	.23		.15	.15	.20	.17		1											
34	E11					.11			.18	**.37**	.15		1										
35	E12		.24		.10	.24		.11	**.37**	.27	.15		**.47**	1									
36	E13		.22	.14	.19	.20	.12	.19	**.42**	.22	.16	.16	.20	**.37**	1								
37	E14		.12		.13	.16	.09	.15	.25	.22	.09	.13	**.35**	**.30**	.28	1							
38	E15		.10		.11	.13			.20	.24	.10	.19	.28	.27	.25	**.33**	1						
39	C1				.15				.13			.09			.14			1					
40	C2								.16	.15			.21	.20	.17	.13	.15	.13	1				
41	C3								.10	.13		.11								1			
42	C4											.17					.13		.11		1		
43	C5																					1	
44	C6										.41												1
45	C7													.11	.10	.10	.13		.13		.11	.10	

Note: Correlations significant only at $p < 0.0001$ are shown. Correlations are in bold and underlined when $|\rho| \geq 0.30$. Abbreviations: PCS, physical component summary; MCS, mental component summary; SBQ, Suicide Behaviors Questionnaire-Revised Japanese version.

2.4 Ethics

The participants voluntarily cooperated with the survey based on informed consent with written explanations. The research design was approved by the Research Ethics Review Committee of the Practical Psychology Institute, LLC (No. 2020001).

3. Results

A minimum of one response was collected for each of the 47 prefectures of Japan. The participant characteristics are shown in Tables 1, Table 3 and Table 4. According to Japan's February 2020 Labour Force Survey, 51.7% of the population aged 15 years or older are female and 4.5% are self-employed/sole proprietors [27]. Compared to the Japanese workforce population, there were slightly more females and self-employed/sole proprietors among the participants in this study. Further, mean scores for MCS and K6 (43.43 and 6.49, respectively) were less than the standard scores in Japan under ordinary circumstances.

Table 2 shows the correlation coefficients between each variable. Several significant one-to-one relationships were observed between the variables.

Table 3 Characteristics of the study participants.

	N	%		N	%
Age			Employment before epidemic		
18 or 19	23	1.5	student	75	5
20–24	138	9.2	self-employed	157	10.5
25–29	240	16	company manager	9	0.6
30–34	314	20.9	full-time	528	35.2
35–39	256	17.1	part-time	180	12
40–44	232	15.5	temporary workers	158	10.5
45–49	125	8.3	housewives/husbands	254	16.9
50–54	95	6.3	leave of absence	36	2.4
55–59	42	2.8	unemployed	103	6.9
60–64	20	1.3	Annual household income		
65–69	10	0.7	<18600 USD	292	19.5
≥70	5	0.3	18600 USD to 37200 USD	425	28.3
Sex			37300 USD to 74500 USD	598	39.9
female	969	64.6	74600 USD to 111800 USD	146	9.7
male	524	34.9	111900 USD to 149000 USD	27	1.8
other	7	0.5	≥149100 USD	12	0.8
Education			Workplace commutation		
junior high school	28	1.9	unemployed	445	29.7
high school	330	22	nearly none	430	28.7
junior college	355	23.7	half of the week or less	183	12.2
university	718	47.9	more than half of the week	118	7.9
graduate degree	69	4.6	almost every day	324	21.6
Marital status			Housing facilities and surrounding environment		
unmarried	659	43.9	garden or balcony	1184	78.9
divorced/widowed	64	4.3	Number of preschool-age children		
married [separated]	50	3.3	0	1181	78.7
living with partner	727	48.5	1	221	14.7
Ethnicity			2	87	5.8
Asian	1489	99.3	3	11	0.7
Black	1	0.1	Respondents' own COVID-19 infection status		
multiracial	3	0.2	fully recovered	2	0.1
White	2	0.1	undergoing treatment	1	0.1
Han Chinese	3	0.2	suspected to be infected	13	0.9
Middle Eastern/Arab	1	0.1	none	1484	98.9
other	1	0.1	Recent contact with infected persons		
Comorbidity			none	1392	92.8
primary illness	152	10.1	suspected of having contact	70	4.7
psychiatric outpatient status	119	7.9	yes	38	2.5

Extent of voluntary restriction of outside activity		
did not practice social distancing	30	2
practiced social distancing	67	4.5
went out for work	481	32.1
only exercising or shopping	862	57.5
did not leave home at all	60	4

Note: *N* = 1500

Table 4 Psychological measures: Descriptive statistics.

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

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

Tables 5 and 6 show the results of SEM. AGR (total/indirect *b* = 0.1, confidence interval [CI] [99.99%]: 0.01 to 0.18), social support (total/indirect *b* = 0.03, CI: 0.01 to 0.06), and psychiatric disorder (total *b* = –2.69, CI: –5.32 to –0.07; indirect *b* = –0.3, CI: –0.78 to 0.19 ns; direct *b* = –0.14, CI: –0.39 to 0.11 ns) had significant total effects on PCS.

Table 5 Unstandardized path coefficients (b) estimated using structural equation modeling.

	E1		E2		E3		E4		E5		E6		E7		E8		E9		E10	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Extraversion	0.04	0.01	-	-	-	-	-	-	-	-	-	-	-	-	0.03	0.01	-	-	-	-
Agreeableness	-	-	-	-	-0.02	0.01	-	-	-	-	-0.02	0.01	-	-	-	-	-	-	-0.03	0.01
Conscientiousness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Neuroticism	0.03	0.01	-	-	0.02	0.01	0.06	0.01	-	-	0.03	0.01	0.08	0.01	0.04	0.01	0.03	0.01	-	-
Openness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Social Support	-0.01	0	-0.01	0	-0.01	0	-	-	-0.01	0	-0.01	0	-0.01	0	-	-	-	-	-0.01	0
Age	-	-	-	-	0.02	0.01	-	-	-	-	-	-	-	-	-0.05	0.01	0.09	0.01	-0.02	0.01
Female	-	-	-	-	-	-	0.25	0.05	0.12	0.04	0.16	0.05	0.21	0.04	0.14	0.04	0.29	0.04	-	-
Junior college	0.15	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psychiatric outpatient	-	-	-	-	0.31	0.10	-	-	-	-	-	-	0.38	0.09	0.19	0.09	-	-	0.20	0.07
Full-time	-0.14	0.05	-	-	-	-	-	-	0.23	0.05	0.32	0.06	-	-	-	-	-	-	-	-
Unemployed	-	-	-	-	-	-	-	-	-	-	-0.15	0.05	-	-	-	-	-0.24	0.09	-	-
Commutation	-	-	-	-	-0.03	0.01	0.14	0.02	0.11	0.02	0.15	0.02	-	-	-	-	-0.03	0.02	-	-
Garden	-0.16	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N of Preschool children	-0.11	0.04	0.05	0.02	-	-	-	-	0.08	0.03	-	-	-	-	-	-	0.60	0.05	-	-
Three preschool children	0.90	0.32	-	-	0.55	0.29	-	-	-	-	-	-	-	-	-	-	-0.65	0.29	-	-

Suspected COVID-19 infection	0.45	0.24	0.32	0.22	-	-	-	-	-	-	-	-	0.47	0.19	-	-	-	-	0.34	0.21
Recent contact with patients	-	-	0.23	0.10	0.25	0.13	-	-	-	-	-	-	-	-	-	-	-	-	0.23	0.11
No voluntary restriction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	-	-	-	-	0.21	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C2	0.23	0.08	-	-	0.13	0.06	0.19	0.07	0.11	0.05	0.20	0.06	0.34	0.07	0.28	0.07	-	-	-	-
C3	0.64	0.31	-	-	-	-	-	-	-	-	-	-	0.92	0.21	1.12	0.23	0.69	0.23	0.70	0.31
C4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.27	0.06
C5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.58	0.07	-	-
C7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.03

	E11		E12		E13		E14		E15		PCS		MCS		K6		SBQ	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Extraversion	0.05	0.01	0.03	0.01	-	-	0.02	0.01	0.01	0.01	-	-	-	-	-0.07	0.03	-0.05	0.02
Agreeableness	-	-	-	-	-	-	-0.04	0.01	-	-	-	-	-	-	-0.16	0.05	-	-
Conscientiousness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.09	0.03
Neuroticism	0.04	0.01	0.09	0.01	0.08	0.01	0.04	0.01	0.03	0.01	0.18	0.07	-0.5	0.07	0.44	0.04	0.14	0.03
Openness	-	-	-	-	0.02	0.01	-	-	-	-	-	-	-0.12	0.06	-	-	0.05	0.03
Social Support	0.02	0	-	-	-0.02	0	-	-	-	-	-	-	0.07	0.02	-0.07	0.01	-0.09	0.01
Age	-0.06	0.01	-	-	-	-	-0.02	0.01	-0.05	0.01	-0.16	0.08	-	-	-	-	-	-
Female	0.18	0.05	0.29	0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.13
Junior college	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psychiatric outpatient	-	-	-	-	-	-	-	-	-	-	-2.40	0.67	-	-	1.16	0.46	1.81	0.37
Full-time	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unemployed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.79	0.35	-	-
Commutation	-	-	-	-	-	-	-	-	-	-	0.31	0.10	-	-	-	-	-	-
Garden	-	-	-	-	-	-	-	-	-	-	0.96	0.40	0.80	0.42	-0.82	0.23	-	-
N of Preschool children	0.08	0.03	0.12	0.03	0.17	0.04	-	-	-	-	-	-	-0.56	0.29	-	-	-	-
Three preschool children	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.59	0.74
Suspected COVID-19 infection	-	-	-	-	-	-	-	-	-	-	-5.57	2.24	-	-	3.70	1.30	2.41	0.49
Recent contact with patients	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1.70	0.58	-	-
No voluntary restriction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.12	0.88	0.91	0.53
C1	-	-	-	-	0.37	0.13	-	-	-	-	-	-	-3.58	0.95	1.85	0.64	0.94	0.50
C2	0.37	0.06	0.4	0.06	0.43	0.07	0.26	0.06	0.20	0.05	-	-	-	-	0.48	0.25	0.33	0.18
C3	0.61	0.29	0.57	0.23	-	-	0.32	0.27	-	-	-	-	-	-	2.47	1.17	-	-
C4	-	-	-	-	-	-	-	-	0.18	0.05	-	-	-	-	-	-	0.71	0.20
C5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.79	0.19	-	-
C6	-	-	-	-	-0.14	0.06	-	-	-	-	-	-	-	-	-	-	-	-
C7	-	-	0.12	0.04	0.16	0.05	0.13	0.04	0.13	0.04	0.84	0.31	-	-	-	-	-	-
E1	-	-	-	-	-	-	-	-	-	-	-	-	-0.5	0.19	0.32	0.11	0.12	0.07
E2	-	-	-	-	-	-	-	-	-	-	-0.52	0.28	-	-	-	-	0.46	0.14
E3	-	-	-	-	-	-	-	-	-	-	-0.55	0.25	-	-	0.34	0.13	0.23	0.11
E4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E5	-	-	-	-	-	-	-	-	-	-	-0.60	0.25	-0.44	0.24	-	-	-	-
E6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.21	0.11	-	-
E7	-	-	-	-	-	-	-	-	-	-	-	-	-2.12	0.23	1.30	0.14	0.26	0.09
E8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.16	0.08
E9	-	-	-	-	-	-	-	-	-	-	-	-	-0.30	0.17	-	-	-0.21	0.06
E10	-	-	-	-	-	-	-	-	-	-	-0.64	0.34	-	-	0.63	0.20	0.46	0.14
E11	-	-	-	-	-	-	-	-	-	-	0.53	0.22	-0.94	0.21	-	-	-	-
E12	-	-	-	-	-	-	-	-	-	-	0.38	0.19	-1.04	0.21	0.75	0.12	0.17	0.07
E13	-	-	-	-	-	-	-	-	-	-	-0.67	0.19	-0.76	0.22	0.60	0.12	0.14	0.08
E14	-	-	-	-	-	-	-	-	-	-	-1.77	0.21	-0.41	0.22	0.32	0.12	-	-
E15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.32	0.14	-0.15	0.10

Note: Paths removed from the model are marked with a "-". Model fit indices: $\chi 2$ (605) = 638.48, p = 0.168, CFI = .996, RMSEA = .006, SRMR = .025.

Table 6 Standardized total effects (β) estimated using the structural equation modeling.

	E1		E2		E3		E4		E5		E6		E7		E8		E9		E10	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Extraversion			-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-
Agreeableness	-	-	-	-			-	-	-	-			-	-	-	-	-	-		
Conscientiousness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Neuroticism			-	-			0.18	0.02	-	-			0.23	0.02					-	-
Openness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Social Support							-	-					-0.13	0.02	-	-	-	-	-0.14	0.03
Age	-	-	-	-			-	-	-	-	-	-	-	-	-0.11	0.02	0.18	0.02		
Female	-	-	-	-	-	-	0.13	0.02					0.11	0.02			0.14	0.02	-	-
Junior college			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psychiatric outpatient	-	-	-	-			-	-	-	-	-	-	0.11	0.03			-	-		
Full-time			-	-	-	-	-	-	0.15	0.03	0.17	0.03	-	-	-	-	-	-	-	-
Unemployed	-	-	-	-	-	-	-	-	-	-			-	-	-	-			-	-
Commutation	-	-	-	-			0.22	0.02	0.23	0.03	0.26	0.03	-	-	-	-			-	-
Garden			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N of Preschool children					-	-	-	-			-	-	-	-	-	-	0.36	0.03	-	-
Three preschool children			-	-			-	-	-	-	-	-	-	-	-	-			-	-
Suspected COVID-19 infection					-	-	-	-	-	-	-	-			-	-	-	-		
Recent contact with patients	-	-					-	-	-	-	-	-	-	-	-	-	-	-		
No voluntary restriction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-
C2			-	-									0.13	0.03	0.11	0.03	-	-	-	-
C3			-	-	-	-	-	-	-	-	-	-								

C4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.16	0.03
C5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.22	0.03	-	-
C7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

	E11		E12		E13		E14		E15		PCS		MCS		K6		SBQ	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Extraversion	0.16	0.03			-	-							-0.04	0.01				
Agreeableness	-	-	-	-	-	-			-	-	0.03	0.01			-0.08	0.02		
Conscientiousness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Neuroticism	0.11	0.03	0.24	0.03	0.21	0.02			0.11	0.03			-0.30	0.02	0.36	0.02	0.17	0.02
Openness	-	-	-	-			-	-	-	-								
Social Support	0.17	0.02	-	-	-0.14	0.02	-	-	-	-	0.05	0.01	0.11	0.02	-0.19	0.02	-0.32	0.03
Age	-0.12	0.02	-	-	-	-			-0.15	0.02								
Female			0.14	0.02	-	-	-	-	-	-			-0.06	0.01	0.05	0.01		
Junior college	-	-	-	-	-	-	-	-	-	-	-	-						
Psychiatric outpatient	-	-	-	-	-	-	-	-	-	-							0.19	0.03
Full-time	-	-	-	-	-	-	-	-	-	-								
Unemployed	-	-	-	-	-	-	-	-	-	-	-	-						
Commutation	-	-	-	-	-	-	-	-	-	-								
Garden	-	-	-	-	-	-	-	-	-	-								
N of Preschool children					0.10	0.02	-	-	-	-								
Three preschool children	-	-	-	-	-	-	-	-	-	-								
Suspected COVID-19 infection	-	-	-	-	-	-	-	-	-	-							0.09	0.02
Recent contact with patients	-	-	-	-	-	-	-	-	-	-			-	-				
No voluntary restriction	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
C1	-	-	-	-			-	-	-	-								
C2	0.14	0.02	0.14	0.02	0.15	0.03	0.10	0.03					-0.09	0.01	0.12	0.02		
C3					-	-			-	-								
C4	-	-	-	-	-	-	-	-					-	-				
C5	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-
C6	-	-	-	-			-	-	-	-								
C7	-	-													0.03	0.01		
E1	-	-	-	-	-	-	-	-	-	-	-	-						
E2	-	-	-	-	-	-	-	-	-	-			-	-	-	-		
E3	-	-	-	-	-	-	-	-	-	-			-	-				
E4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E5	-	-	-	-	-	-	-	-	-	-					-	-	-	-
E6	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-
E7	-	-	-	-	-	-	-	-	-	-	-	-	-0.25	0.03	0.24	0.03		
E8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
E9	-	-	-	-	-	-	-	-	-	-	-	-			-	-		
E10	-	-	-	-	-	-	-	-	-	-			-	-				
E11	-	-	-	-	-	-	-	-	-	-			-0.11	0.03	-	-	-	-
E12	-	-	-	-	-	-	-	-	-	-			-0.13	0.03	0.14	0.02		
E13	-	-	-	-	-	-	-	-	-	-					0.12	0.02		
E14	-	-	-	-	-	-	-	-	-	-	-0.24	0.03					-	-
E15	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Note: Paths removed from the model are marked with a "-". Only coefficients significant at p < 0.0001 are shown. Model fit indices: $\chi 2$ (605) = 638.48, p = 0.168, CFI = .996, RMSEA = .006, SRMR = .025.

EXT (total/indirect *b* = –0.1, CI: –0.18 to –0.03), NEU (total *b* = –0.9, CI: –1.19 to –0.61; indirect *b* = –0.4, CI: –0.55 to –0.25), social support (total *b* = 0.1, CI: 0.02 to 0.18; indirect *b* = 0.03, CI: 0 to 0.07), being female (total/indirect *b* = –1.05, CI: –1.64 to –0.45), psychiatric disorder (total/indirect *b* = –0.82, CI: –1.61 to –0.03), C1 (total *b* = –3.86, CI: –7.58 to –0.14; indirect *b* = –0.28, CI: –0.79 to 0.22 ns.; direct *b* = –3.58, CI: –7.28 to 0.12 ns.), C5 (total/indirect *b* = –2.09, CI: –3.16 to –1.01), and C7 (total/indirect *b* = –3.76, CI: –6.9 to –0.62) had significant total effects on MCS.

AGR (total *b* = –0.19, CI: –0.37 to –0.02; indirect *b* = –0.04, CI: –0.08 to 0), NEU (total *b* = 0.7, CI: 0.52 to 0.88; indirect *b* = 0.26, CI: 0.17 to 0.36), social support (total *b* = –0.11, CI: –0.16 to –0.06; indirect *b* = –0.04, CI: –0.06 to –0.02), being female (total/indirect *b* = 0.52, CI: 0.2 to 0.84), psychiatric disorder (total *b* = 1.89, CI: 0.05 to 3.73; indirect *b* = 0.73, CI: 0.11 to 1.35), C5 (total *b* = 1.78, CI: 0.69 to 2.88; indirect *b* = 1.3, CI: 0.62 to 1.98), C7 (total *b* = 4.84, 99.99% CI: 0.36 to 9.31; indirect *b* = 2.37, CI: 0.68 to 4.05), C16 (total/direct *b* = –0.79, CI: –1.55 to –0.04), and C30 had significant total effects on K6.

NEU (total *b* = 0.19, CI: 0.08 to 0.29; indirect *b* = 0.05, CI: 0.01 to 0.09), social support (total *b* = –0.1, CI: –0.14 to –0.07; indirect *b* = –0.01, CI: –0.03 to 0 ns.; direct *b* = –0.09, CI: –0.12 to –0.05), psychiatric disorder (total *b* = 2.1, CI: 0.67 to 3.53; indirect *b* = 0.29, CI: –0.02 to 0.6 ns.; direct *b* =

1.81, Cl: 0.37 to 3.25), suspected COVID-19 infection (total *b* = 2.89, Cl: 0.77 to 5.01; indirect *b* = 0.48, Cl: –0.28 to 1.24 ns.; direct *b* = 2.41, Cl: 0.51 to 4.32), and C8 (total *b* = 0.8, Cl: 0.03 to 1.58; indirect *b* = 0.1, Cl: –0.09 to 0.28 ns.; *b* = 0.71, Cl: –0.08 to 1.49 ns.) had significant total effects on SBQ.

Figure 1 shows a path diagram of the main part of the SEM results. The stressors with a significant impact on the four outcome measures were E7, E11, E12, E13, and E14. Three of the personality subscales (extraversion, agreeableness, and neuroticism); social support; age; sex (female); psychiatric hospitalization; garden residence; the number of infants; suspected COVID-19 infection; and copings (except C6) had significant indirect and/or direct effects on the four outcome measures.

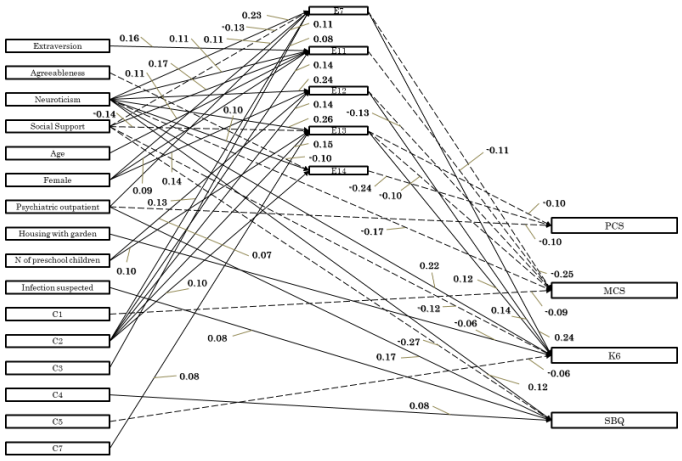

Figure 1 Standardized direct effects (β) estimated using structural equation modeling. Model fit indices: χ2 (605) = 638.48, p = 0.168, CFI = .996, RMSEA = .006, SRMR = .025. Only variables and paths that directly and indirectly affected the four outcome measures are shown. The unstandardized coefficients are illustrated in Table 5 for direct influence relationships for all variables. Abbreviations: PCS, physical component summary; MCS, mental component summary; SBQ, Suicide Behaviors Questionnaire-Revised Japanese version; C1, Taking medication; C2, Talking about mental health with friends and family; C3, Participating in an online program; C4, Talking with others via social networking services and so on; C5, Reading for enjoyment; C7, Taking 15-minute naps; E7, Experiencing mental health issues; E11, Being unable to meet people; E12, Uncertainty about the future; E13, Sleep problems; E14, Insufficient exercise.

4. Discussion

This study investigated the effects of demographic characteristics, elements related to SARS-CoV-2, coping, personality, and social support on physical and mental health, psychological distress, and suicidal ideation in Japan immediately after the rescinding of the 7 weeks of restrictions on outings, inter-prefectural travel, and business activities, which begun on April 7, 2020, due to the state of emergency declaration. The results identified several direct and indirect relationships presumed to be due to the influence of the outbreak.

Physical health was found to have a positive relationship with AGR and social support, and a negative relationship with a psychiatric disorder. The effects of AGR and social support were completely mediated by stressors. AGR was suggested to promote physical health by weakening

"difficulty in receiving medical care for a chronic disease," "problems with interpersonal relationships online," and "insufficient exercise," while social support did the same by weakening "problems with interpersonal relationships online," "reduction in sleep time and quality," and through "being unable to meet people,", respectively.

Mental health was found to have a positive relationship with social support, and a negative relationship with EXT, NEU, being female, psychiatric disorder, "using psychotropic drugs," "talking about one's mental health," and "participating in remote programs." The effects of social support and NEU were partially mediated by stressors, while the effects of EXT, being female, psychiatric disorder, "talking about one's mental health," and "participating in remote programs" were completely mediated. The mental health was most impacted by "mental health issues related to COVID-19." This factor was in turn influenced by NEU, social support, being a junior college graduate, and so forth, psychiatric disorder, and "talking about one's mental health." Increasing awareness in people about these characteristics and offering social support may be useful in promoting mental health.

Psychological distress was found to have a negative relationship with AGR, social support, and "reading for pleasure," and a positive relationship with NEU, being female, "talking about one's mental health," "participating in remote programs," and "15-min naps." The effects of NEU, psychiatric disorder, "talking about one's mental health," and "participating in remote programs" were partially mediated, while the effects of being female and "15-min naps" were completely mediated by stressors. NEU and "mental health issues related to COVID-19" had relatively large impacts on psychological distress. The effects of NEU were partially mediated by "large reduction in household income," "difficulty in receiving medical care for a chronic disease," "problems with interpersonal relationships in the workplace," "mental health issues related to COVID-19," "uncertainty about the future," "reduction in sleep time and quality," "insufficient exercise," and "increased time online." People with high NEU were more likely to perceive life events accompanying the SARS-CoV-2 outbreak as stressors. "Mental health issues related to COVID-19" were impacted by NEU, social support, being female, psychiatric disorder, and "talking about one's mental health." Calling attention to people with high NEU and offering support to people experiencing these stressors may help to alleviate psychological distress.

Suicidal ideation was found to have a negative relationship with social support, and a positive relationship with NEU, psychiatric disorder, suspected infection with SARS-CoV-2, and "talking with others online." Although the total effects of the stressors "increased responsibilities at home" and "increased time online" were not significant, each of them was shown to reduce suicidal ideation in the optimal model (Table 5). Although neither of them is generally considered factors that promote health, they likely worked to lessen suicidal ideation by preserving connections with others.

A positive total effect was found for "talking with others online." The positive effect through the mediator "concerns about online relationships" and the negative effect through "increased time online" coupled with the positive direct effect was surmised to ultimately increase suicidal ideation.

Social support had the greatest effect on suicidal ideation and was concluded to directly reduce suicidal ideation as no mediating effects were observed. Loss of connection is in some perspectives seen as a vital factor facilitating suicidal ideation [28]. In contrast, experiencing social support signifies a connection between the self and others and social support in this way may reduce suicidal ideation.

Although significant correlations between the independent variables and objective variables were identified, the extent of the correlations did not undermine the validity of conducting SEM, including all variables to the model independently. From the comparison between Table 2 with Table 6 and Figure 1, the influence of many independent variables was smaller in the SEM than the one-to-one correlation coefficient. This suggests that the effect of a particular independent variable on an outcome can be predicted more accurately by considering the effects of other variables. For example, the correlation between Neuroticism and SBQ was r = 0.34 (Table 2), while the overall effect of neuroticism on SBQ was β = 0.17 (Table 6). In contrast, the relationship between social support and SBQ was r = –0.38 and β = –0.32. Looking at the correlation coefficients alone, neuroticism and social support appear to have the same strength of relationship to suicidal ideation; however, assuming the overall relationship of other variables, the effect of social support is observed to be greater. Similarly, although some copings showed undesirable correlations with outcome measures (negative correlation with MCS, positive correlation with K6 and SBQ), these effects appeared to be quite small (C2 to MCS, β = –0.09; C2 to K6, β = 0.19; C7 to K6, β = 0. 03).

This study revealed novel findings of social support. Namely, the effects of social support were compared to other factors, and factors mediating the effects of social support were clarified. The present results suggest that social support has a particularly marked effect on reducing suicidal ideation. Further, the results suggest that the effects of social support impact mental and physical health and psychological distress by reducing the stressors accompanying "problems with interpersonal relationships online," "reduction in sleep time and quality," "reduction in household income," and "mental health issues related to COVID-19," as well as increasing the stressors accompanying "being unable to meet people."

This study has provided many insights into the effects of the SARS-CoV-2 outbreak on the mental and physical health of the general public. However, some limitations must be considered. First is the limited number of participants. Responses were collected from all over Japan, and looking at the participants' attributes, sex, and employment status does not reveal any evident deviation from the attributes of the country as a whole. However, as data were collected from 1,500 patients to represent all persons aged 18 and older in Japan, with a population of approximately 108 million, and as participants were recruited through an online outsourcing service, we must be careful in deciding that the results of this study represent the characteristics of all Japanese. Also, as a cross-sectional study design was applied, the results cannot be used to confirm causal relationships. For example, coping not only influences stressors but experiencing stressors also results in coping. Thus, the order of these relationships should be considered. Longitudinal research or analysis of adjusted effects could deepen our understanding of this point. Moreover, the distinction between a stressor and perceived stress was not clear in this study. A detailed study is required to distinguish between each of them, the stressor purely as an event and the perceived stress, which represents the degree to which the stressor is perceived, and how coping is involved in the degree and relationship between these two. Finally, the present study does not adequately examine the biological aspects behind the stressor or perceived stress-causing serious mental health problems such as psychological distress and suicidal ideation. Measuring in vivo information such as serum 25-Hydroxyvitamin D levels will bring us closer to uncovering the mechanisms of psychosocial-biological human responses under spreading COVID-19 infection.

5. Conclusions

This study investigated the complex relationships of demographic characteristics, factors related to SARS-CoV-2, personality, social support, coping, and stressors with mental and physical health in the Japanese immediately after the request for voluntary restrictions of outings and business activities due to the SARS-CoV-2 outbreak was rescinded. The strength of the impact of each factor differed for physical health, mental health, psychological distress, and suicidal ideation. However, in all cases, the results suggested that some attributes such as sex and personality, and some elements related to infection such as suspected infection with SARS-CoV-2 had direct effects on physical and mental health and that there may also be effects mediated by stressors such as "insufficient exercise" or "mental health issues related to COVID-19." As the effects of the SARS-CoV-2 pandemic continue globally, it is essential to prioritize resources and provide support to those at particularly high risk and offer effective evidence-based psychosocial interventions.

Author Contributions

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

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Competing Interests

The authors have declared that no competing interests exist.

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