

## ORIGINAL ARTICLE

# Impact of overtime working and social interaction on the deterioration of mental well-being among full-time workers during the COVID-19 pandemic in Japan: Focusing on social isolation by household composition

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## Abstract

**Objectives:** The coronavirus disease (COVID-19) pandemic has forced many employees to alter both their work style and lifestyle. This study aimed to examine how the combination of changes in overtime working hours and social interaction affects the full-time employees' mental well-being, focusing on the difference in household composition.

**Methods:** In November 2020, we conducted a cross-sectional Internet survey that included 4388 Japanese men and women aged 25–64 years, who continued the same full-time job during the pandemic. We performed a logistic regression analysis using a combination of the changes in overtime working hours and social interaction as an independent variable, and the presence/absence of deterioration of mental well-being as the dependent variable.

**Results:** Overall, 44% of participants reported the deterioration of mental well-being compared to before the outbreak. The multivariate analysis revealed that the participants coded as “increased overtime/decreased interaction” were significantly associated with the deterioration of mental well-being compared to those with “unchanged overtime/unchanged interaction” (odds ratio [OR] 2.14, 95% confidence interval [CI] 1.59–2.89). Moreover, this association was relatively stronger among single-person households (OR 2.66, 95% CI 1.50–4.69).

**Conclusions:** The negative combination of increasing overtime working hours and decreasing social interaction may have an impact on the deterioration of mental well-being during the COVID-19 pandemic, and this association was comparably strong among single-person households. In the pandemic, it is necessary to pay close attention to both overtime working hours and the presence of social interaction to address the mental well-being among employees.

## KEYWORDS

COVID-19, full-time employees, mental well-being, overtime work, single-person household, social interaction

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## 1 | INTRODUCTION

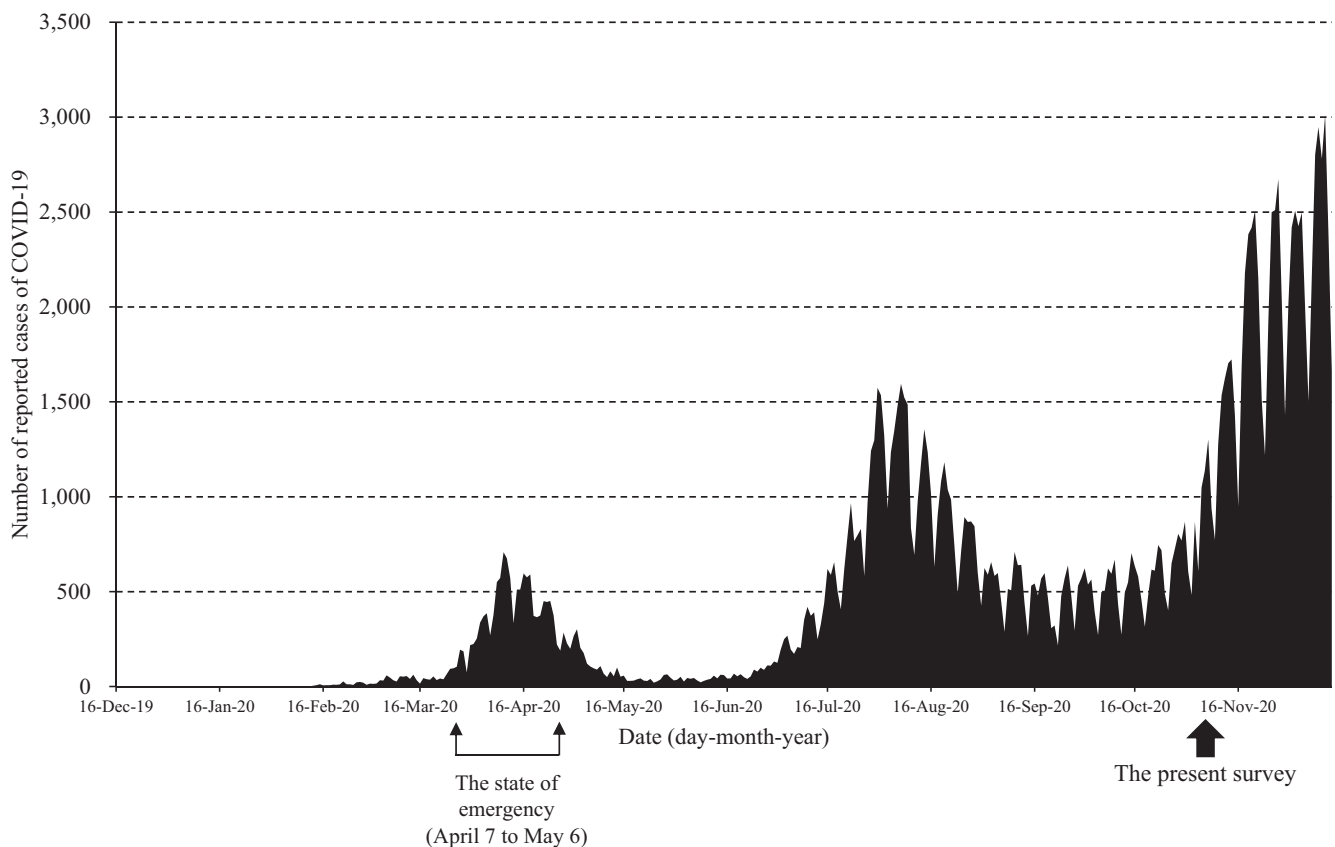
Mental well-being of employees is one of the major public and occupational health issues worldwide, especially in developed countries. Several studies have shown that there was a small to moderate association between long working hours and the onset of depressive symptoms.<sup>1,2</sup> In addition, regarding employees' mental health, it has been suggested that the transition of the amount of overtime work plays a crucial role in terms of the deterioration of mental well-being.<sup>3</sup>

Focusing on the coronavirus disease (COVID-19) pandemic, owing to the scientific and medical uncertainty of SARS-COV-2, public health policy has relied on non-pharmaceutical interventions to prevent spreading of the virus. Like many countries, the Japanese government also declared the state of emergency due to COVID-19 in April 2020 requiring residents to avoid going out (Figure 1). Although this political strategy may be effective in terms of infectiology, there was a drawback regarding mental well-being because of the lost connection with others. Recent studies reported that the loss of in-person social interaction in the pandemic crisis has led to psychological loss among adults.<sup>4,5</sup>

Recent studies have shown that not only work tasks/duties, but also several life-related factors, including a personal relationship with others, might have an impact on mental

health among workers.<sup>6,7</sup> According to these findings, it is crucial to analyze how the combination of job-related and life-related factors, namely overtime working hours and social interaction, respectively, affects the mental well-being of employees during the COVID-19 pandemic when both work style and lifestyle have been changing.<sup>4,5,8</sup> Moreover, among single-households, there is a greater chance to lose the connection with others under the “stay-home” requirement because of the absence of cohabitants, compared to those who live in a multi-person household. Thus, we hypothesized household composition (ie, single-person households vs multi-person households) would play an important role as a moderator which influences the level of strength of the relation between the combination of overtime working hours and social interaction and the deterioration of mental well-being.

To sum up, the psychological well-being of employees has been associated with the complexity of both work-related and life-related issues, especially during the COVID-19 pandemic. While, to our best knowledge, no previous studies have examined the effects of the combination between overtime working hours and social interaction on the deterioration of mental well-being, this study aimed to investigate the association between overtime working hours, social interaction, and deterioration of mental well-being by household composition



**FIGURE 1** Trend of the number of confirmed cases of COVID-19 in Japan

among full-time employees during the COVID-19 pandemic in Japan, using data from a web-based questionnaire survey conducted in Japan in November 2020 (i.e., approximately 9 months following the beginning of the COVID-19 outbreak in Japan in February). In our study, we developed a conceptual model among overtime working hours, social interaction, deterioration of mental well-being, and household composition (Figure 2). By shedding light on the link between overtime work, social interaction, and deterioration of psychological well-being, this study contributes to raising awareness regarding this unique vulnerability of employees under a catastrophic situation, including a pandemic.

## 2 | METHODS

### 2.1 | Participants and study design

In November 2020, a web-based survey was conducted among Japanese men and women aged 25–64 years, who lived in the metropolis of Tokyo and the three surrounding prefectures (Kanagawa, Saitama, and Chiba). Participants were recruited from a web-based research panel maintained by a leading research company in Tokyo, Japan (Rakuten Insight Inc.). Recruitment emails were sent to 61 129 randomly selected registrants of Japanese nationals. Applicants for participation in the survey were accepted in the order of receipt until the number of participants reached the quotas for gender and age groups (25–34, 35–44, 45–54, and 55–64 years old), and a total of 9247 responses (15.1%) were obtained over the 2-day recruitment. After excluding 121 respondents those who gave incomplete/inconsistent answers (i.e., those who answered the same option throughout the questionnaire and those who completed answering it too soon) from 9247 potential participants, 8000 subjects on the quotas for sex and age group were

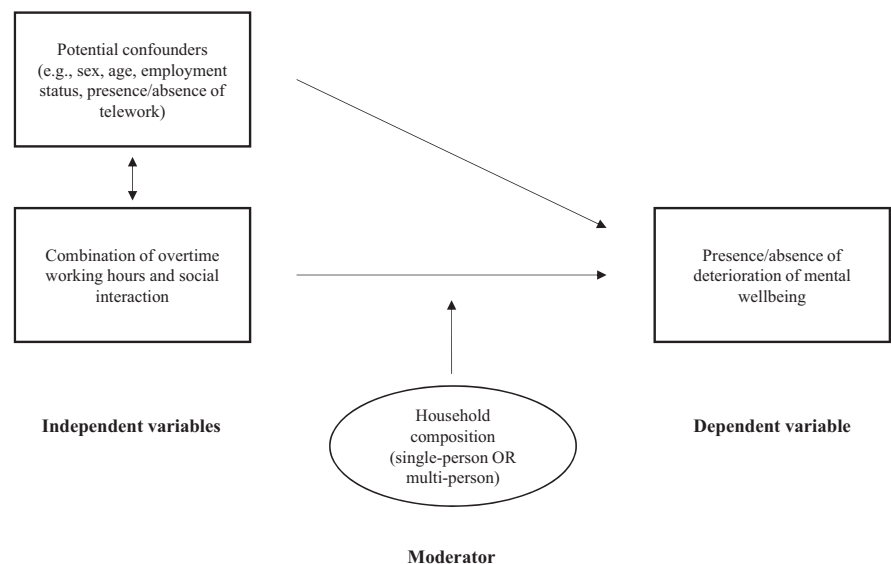
randomly selected. All participants volunteered to participate in the survey after reading a description of the purpose and procedure of the survey. Consent to participate was implied by the completion and submission of the survey.

To examine the association between overtime working hours, social interaction, and deterioration of psychological well-being during the pandemic among full-time employees, we set the exclusion criteria for eligibility as follows: (i) those who were unemployed ( $n = 1530$ ), (ii) those who were self-employed ( $n = 478$ ), (iii) those who were doing a part-time job ( $n = 1168$ ), (iv) those who had changed the job following the first wave (i.e., March 2020) ( $n = 390$ ), and (v) those who had been infected prior to participating in the survey ( $n = 46$ ). To evaluate the changes of the amount of overtime working hours before and after the outbreak of the COVID-19 pandemic, we removed the participants who had switched jobs after March 2020, the time point when the first wave of cases started. Similarly, to investigate the changes of mental well-being among COVID-19-free participants, we excluded those who had been infected before the survey. Of 8000 participants, 4388 (1515 females and 2873 males; mean age [standard deviation], 43.1 [10.75] years) were eligible according to these criteria.

### 2.2 | Measure

#### 2.2.1 | Deterioration of mental well-being

To assess the deterioration of mental well-being between January 2020 (ie, time point before the COVID-19 outbreak in Japan) and November 2020 (ie, time point right after the beginning of the third wave of the novel coronavirus), for each item of the WHO-Five Well-being Index (WHO-5) (ie, “I have felt cheerful and in good spirits,” “I have felt calm



**FIGURE 2** Conceptual model for the present study

and relaxed,” “I have felt active and vigorous,” “I woke up feeling fresh and rested,” and “My daily life has been filled with things that interest me.”),<sup>9,10</sup> we asked the participants to answer whether they experienced any changes in their psychological state (“Have your current psychological well-being changed from that at the time point before starting the COVID-19 outbreak [ie, around January 2020]?”). The WHO-5 is among the most widely used questionnaires assessing subjective mental well-being. For each statement, participants responded to the question among the following three options: “increasing” = 1, “unchanged” = 0, “decreasing” = -1. Since Cronbach’s alpha coefficient was 0.88, we calculated the total score for the five items for each participant. As relatively few reported an improvement in their psychological well-being (ie, total score:  $1 \leq$ ), we coded the participants into the following two categories: “the presence of deterioration of mental well-being” (ie, total score:  $-5 - 1$ ) and “the absence of deterioration of mental well-being” (ie, total score:  $0 - 5$ ).

### 2.2.2 | Overtime working hours

To investigate the change of overtime working hours through the pandemic, we asked the participants whether the current overtime work was increased or decreased compared to the period prior to the COVID-19 pandemic (ie, around January 2020). The participants were offered three options: “increase,” “not change,” and “decrease.”

### 2.2.3 | Social interaction

To assess the changes in social interaction with a close person(s) whom participants could consult about their problems or stress during the COVID-19 pandemic, first, participants were asked whether they had such a person (or persons) other than family members. Subsequently, if they answered yes, they were asked whether they contacted such a person (or persons) more than once per month in January 2020 and November 2020. Based on the answers to these questions, each participant was coded into the following three categories: “no close contact from January 2020 to November 2020,” “decreased frequency of interaction from January 2020 to November 2020,” and “no change in the frequency of interaction from January 2020 to November 2020.” The frequency distribution of each category was unbalanced (ie, “decreased the frequency of interaction from January 2020 to November 2020”: 7.2%, “no close contact from January 2020 to November 2020”: 22.5%, “no change in the frequency of interaction from January 2020 to November 2020”: 70.3%), and cross-tabulation analysis indicated that the trend in the results regarding “no close contact from January 2020 to

November 2020” and “decreased frequency of interaction from January 2020 to November 2020” was similar. Thus, in this study, we coded each participant into either of the following two categories: “no close contact, or decreased the frequency of interaction from January 2020 to November 2020” and “no change in the frequency of interaction from January 2020 to November 2020.”

### 2.2.4 | Combination of overtime working hours and social interaction

To further examine how the work-life mutual relation in terms of overtime working hours and social interaction, respectively, associated with the deterioration of mental well-being, we constructed a variable combination patterns of overtime working hours and social interaction. Regarding an interaction term by categorical variables, creating the values (ie, subtracting the mean value from the original value for each variable) makes the interpretation of the original variables difficult and, therefore, is not recommended in general. Therefore, in this study, we created the combination variable between these two categorical variables with six categories (i.e., (i) decreased overtime/decreased interaction, (ii) decreased overtime/unchanged interaction, (iii) unchanged overtime/decreased interaction, (iv) unchanged overtime/unchanged interaction, (v) increased overtime/decreased interaction, and (vi) increased overtime/unchanged interaction) for statistical analysis. To identify groups that may be at particular risk for deterioration of psychological well-being, the “unchanged overtime/unchanged interaction” combination category was set as the reference category and constructed with other combinations because that is the combination where least influence on mental well-being is expected to be observed.

### 2.2.5 | Household composition

To measure the household composition of participants, we asked them the number of cohabitants. According to the answer, we coded the participants into two categories: “single-person household” and “multi-person household.”

### 2.2.6 | Potential confounders

Following the previous literatures,<sup>3,11</sup> we measured current mental well-being (“poor” or “not poor”), employment status (regular employee or non-regular employee), occupation (clerical work, sales, service, professional work, and others [eg, transport-related occupation]), presence/absence of the increase in frequency of working from home, presence/

absence of the increase in amount of housework, household income (“ $\leq 5$  million yen”, “5 million < and  $\leq 8$  million yen” yen, and “8 million < yen”), sleep hours ( $6 \text{ h} \leq$  or  $< 6 \text{ h}$ ), presence/absence of the increase in frequency of alcohol drinking, presence/absence of close people with COVID-19, presence/absence of constant information collecting related to COVID-19, and demographic variables (ie, sex [male or female], age [25–34 years, 35–44 years, 45–54 years, and 55–64 years]) as potential confounders. In terms of current mental well-being, we asked the participants the mental status of the past 2 weeks, using the Japanese version of the WHO-5,<sup>9,12</sup> which has high psychometric properties. Each option is self-rated on a 6-point Likert scale (“at no time” = 0 to “all the time” = 5). Total scores range from 0 to 25, with scores  $< 13$  suggesting “poor” psychological well-being. We coded the participants into either of the following two categories: “poor” and “not poor.”

### 2.3 | Statistical analysis

We conducted cross-tabulation and chi-square tests to examine the association between each variable and the presence/absence of deterioration of psychological well-being, reporting effect size to supplement *P*-value.

To examine the association between the combination of overtime working hours and social interaction to the deterioration of psychological well-being, we carried out multivariate logistic regression analysis with the presence/absence of deterioration of psychological well-being as the dependent variable. Models were adjusted for demographic variables and other potential confounders (ie, employment status, occupation, presence/absence of the increase in working from home, amount of housework, household income, household composition, current mental well-being, sleep hours, frequency of drinking, presence/absence of close people with COVID-19, and presence/absence of constant information gathering regarding COVID-19).

As a subgroup analysis, we performed multivariate logistic regression analysis by household composition to examine the association of overtime working hours, social interaction, and deterioration of mental well-being.

$P < .05$  was considered statistically significant. All analyses were performed using SPSS version 25 (IBM, Chicago, IL, USA).

## 3 | RESULTS

Table 1 shows participants' characteristics. In total, a large volume of participants ( $n = 1583$ , 36.1%) was in the group of “unchanged overtime/unchanged interaction” in terms of the combination of overtime working hours and social

interaction. Roughly one-fourth of participants ( $n = 1110$ , 25.3%) reported living as a single-person household. One-third of them ( $n = 1458$ , 33.2%) were doing clerical work, about quarter ( $n = 1066$ , 24.3%) were doing professional work, 15.7% ( $n = 690$ ) were doing sales work, 6.4% ( $n = 279$ ) were working in sales, and around one-fifth were performing other types of work ( $n = 895$ , 20.4%).

Table 2 shows the characteristics of participants by the presence/absence of deterioration of psychological well-being. Almost half the participants ( $n = 1931$ , 44%) answered that their psychological well-being deteriorated compared to before starting the COVID-19 outbreak. Moreover, of the combination of overtime working hours and social interaction, the frequency distribution of each category differed significantly by the presence/absence of deterioration of mental well-being.

Table 3 summarizes the results of multivariate logistic regression analysis using the presence/absence of deterioration of mental well-being as the dependent variable. Regarding overtime working hours and social interaction, participants coded as “increased overtime/decreased interaction” reported greater deterioration of psychological well-being (odds ratio [OR]: 2.14, 95% confidence interval [CI]: 1.59–2.89) compared to those in the category of “unchanged overtime/unchanged interaction” as a reference, while those who coded as “decreased overtime/decreased interaction” also reported more deterioration in psychological well-being (OR: 1.93, 95% CI: 1.48–2.53). Focusing on single-person households in the subgroup analysis, those who were in the category of “increased overtime/decreased interaction” (OR: 2.66, 95% CI: 1.50–4.69) and “decreased overtime/decreased interaction” (OR: 2.08, 95% CI: 1.24–3.47) reported significantly more severe deterioration of mental well-being.

## 4 | DISCUSSION

This study examined the association between overtime working hours, social interaction, and deterioration of psychological well-being during the COVID-19 pandemic, focusing on full-time employees in Japan. Approximately 45% of participants reported that they experienced deterioration of mental well-being between January 2020 and November 2020. The multivariate analysis revealed that the combination of the increase in the amount of overtime working hours and decrease in social interaction was significantly associated with deterioration of mental well-being. Moreover, this association was relatively stronger among single-person households. Participants coded as “decreased overtime/decreased interaction” also tended to report the deterioration of psychological well-being considerably.

Almost half of the study participants had reported deterioration of mental well-being since the COVID-19 outbreak

TABLE 1 Characteristics of participants

	Total (n = 4383)	Single-person household (n = 1110)		Multi-person household (n = 3278)	
	n	n	(%)	n	(%)
Combination of overtime working hours and social interaction					
Decreased overtime/decreased interaction	308	91	(29.5)	217	(70.5)
Decreased overtime/unchanged interaction	817	199	(24.4)	618	(75.6)
Unchanged overtime/decreased interaction	742	221	(29.8)	521	(70.2)
Unchanged overtime/unchanged interaction	1583	367	(23.2)	1216	(76.8)
Increased overtime/decreased interaction	254	75	(29.5)	179	(70.5)
Increased overtime/unchanged interaction	684	157	(23.0)	527	(77.0)
Employment status					
Regular employee	3902	978	(25.1)	2924	(74.9)
Non-regular employee	486	132	(27.2)	354	(72.8)
Occupation					
Clerical work	1458	383	(26.3)	1075	(73.7)
Sales	690	148	(21.4)	542	(78.6)
Service	279	74	(26.5)	205	(73.5)
Professional work	1066	293	(27.5)	773	(72.5)
Others (eg, transport-related occupation)	895	212	(23.7)	683	(76.3)
Increase in frequency of working from home					
Presence	2245	581	(25.9)	1664	(74.1)
Absence	2143	529	(24.7)	1614	(75.3)
Increase in amount of housework					
Presence	1243	251	(20.2)	992	(79.8)
Absence	3145	859	(27.3)	2286	(72.7)
House income					
≤5 million yen	1480	700	(47.3)	780	(52.7)
5 million< and ≤8 million yen	1372	277	(20.2)	1095	(79.8)
8 million< yen	1536	133	(8.7)	1403	(91.3)
Household composition					
Single-person household	1110	–	–	–	–
Multi-person household	3278	–	–	–	–
Current mental well-being					
Not poor	2432	565	(23.2)	1867	(76.8)
Poor	1956	545	(27.9)	1411	(72.1)
Sleep hours					
6 h ≤	2811	720	(25.6)	2091	(74.4)
<6 h	1577	390	(24.7)	1187	(75.3)

(Continues)

TABLE 1 (Continued)

	Total (n = 4383)	Single-person household (n = 1110)		Multi-person household (n = 3278)	
	n	n	(%)	n	(%)
Close people with confirmed coronavirus					
Presence	267	56	(21.0)	211	(79.0)
Absence	4121	1054	(25.6)	3067	(74.4)
Constant information gathering related to COVID-19					
Presence	910	208	(22.9)	702	(77.1)
Absence	3478	902	(25.9)	2576	(74.1)
Increase in frequency of alcohol drinking					
Presence	338	89	(26.3)	249	(73.7)
Absence	4050	1021	(25.2)	3029	(74.8)
Sex					
Male	2873	636	(22.1)	2237	(77.9)
Female	1515	474	(31.3)	1041	(68.7)
Age group					
25–34 years	1298	415	(32.0)	883	(68.0)
35–44 years	1145	282	(24.6)	863	(75.4)
45–54 years	1058	247	(23.3)	811	(76.7)
55–64 years	887	166	(18.7)	721	(81.3)

started in Japan. According to previous studies, the deterioration of mental well-being associated with lockdown or the restrictions related to COVID-19 were reported globally.<sup>13–15</sup> In contrast, with regard to the COVID-19-related policy, Japanese citizens had undergone a unique circumstance. The Japanese government declared a state of emergency on April 7, 2020, which authorized prefectural governors to “request” residents to refrain from going out of their homes for non-essential reasons and restrict the use of stores and facilities. Therefore, enforceable measures are extremely limited in the declarations and are much less restrictive than the lockdowns introduced in some regions such as Europe. However, during this limited lockdown, the deterioration of mental well-being can be seen among half of the participants, and this study can suggest that even request-based restriction may be associated with the deterioration of mental well-being among workers. In contrast, Sasaki and colleagues found that the psychological well-being remained almost the same among non-healthcare workers while healthcare workers tended to experience deterioration during the COVID-19 outbreak.<sup>11</sup> In their report, the participants were asked about their mental condition right after the first wave (May 2020), earlier than we asked our participants in the present research. Due to this timing gap, it is possible to consider that the work style and lifestyle of employees had changed through the second wave, and this may have made the mental well-being worse.

Recent meta-analyses have suggested that the association between long working hours and depressive symptoms was

stronger in Asian countries, including Japan.<sup>1</sup> Another study has indicated the associations between personal problems such as relationships with others and psychological distress among employees.<sup>6</sup> Based on these indications, this study focused on how the combination of work-related and life-related factors, the amount of overtime working hours, and the presence of social interaction, respectively, were associated with employees' mental well-being, and it found out the negative consequence associated with the combination of increasing overtime working hours and decreasing social interaction. Particularly during the COVID-19 crisis, also as known for the period of isolation, this negative combination between overtime working hours and social interaction, therefore, must be paid attention to.

Interestingly, those who coded as “decreased overtime/decreased interaction” and “decreased overtime/unchanged interaction” also tended to reveal the deterioration of psychological well-being. Considering the data from 2020 by the Ministry of Health, Labour and Welfare in Japan, overtime pay included around 7% of the total monthly income. Moreover, the amount of overtime pay in a month was reduced by approximately 10%; there was a reduction of >30% in the service business specifically, compared to the previous year among full-time workers.<sup>16</sup>

From this perspective, the COVID-19 pandemic made economic activity near-standstill because of stay-home requirements from the government, and some employees had undergone the reduction of overtime work, which might be related to the financial difficulty, accompanied by the feeling

**TABLE 2** Characteristics of participants by the presence/absence of deterioration of psychological well-being

	Subgroup analysis by household composition																	
	Total (n = 4388)						Single-person household (n = 1110)						Multi-person household (n = 3278)					
	n	(%)	Deteriorate (n = 1931)	Chi-square test	Effect size		n	(%)	not deteriorate (n = 626)	Deteriorate (n = 484)	Chi-square test	Effect size	n	(%)	not deteriorate (n = 1831)	Deteriorate (n = 1447)	Chi-square test	Effect size
Combination of overtime working hours and social interaction	<i>P</i> < .001 0.14						<i>P</i> < .001 0.164						<i>P</i> < .001 0.138					
Decreased overtime/ decreased interaction	135	(43.8)	173 (56.2)			39	(42.9)	52 (57.1)				96	(44.2)	121 (55.8)				
Decreased overtime/ unchanged interaction	462	(56.5)	355 (43.5)			116	(58.3)	83 (41.7)				346	(56.0)	272 (44.0)				
Unchanged overtime/ decreased interaction	399	(53.8)	343 (46.2)			122	(55.2)	99 (44.8)				277	(53.2)	244 (46.8)				
Unchanged overtime/ unchanged interaction	1000	(63.2)	583 (36.8)			234	(63.8)	133 (36.2)				766	(63.0)	450 (37.0)				
Increased overtime/ decreased interaction	95	(37.4)	159 (62.6)			26	(34.7)	49 (65.3)				69	(38.5)	110 (61.5)				
Increased overtime/ unchanged interaction	366	(53.5)	318 (46.5)			89	(56.7)	68 (43.3)				277	(52.6)	250 (47.4)				

(Continues)



**TABLE 2** (Continued)

	Subgroup analysis by household composition																	
	Total (n = 4388)						Single-person household (n = 1110)						Multi-person household (n = 3278)					
	not deteriorate (n = 2457)	Deteriorate (n = 1931)	Chi-square test	Effect size	not deteriorate (n = 626)	Deteriorate (n = 484)	Chi-square test	Effect size	not deteriorate (n = 1831)	Deteriorate (n = 1447)	Chi-square test	Effect size						
n (%)	n (%)			n (%)	n (%)			n (%)	n (%)									
Employment status			<i>P</i> = .553	0.01			<i>P</i> = .506	0.02			<i>P</i> = .270	0.019						
Regular employee	2191 (56.2)	1711 (43.8)			548 (56.0)	430 (44.0)			1643 (56.2)	1281 (43.8)								
Non-regular employee	266 (54.7)	220 (45.3)			78 (59.1)	54 (40.9)			188 (53.1)	166 (46.9)								
Occupation			<i>P</i> = .145	0.04			<i>P</i> = .201	0.073			<i>P</i> = .020	0.06						
Clerical work	785 (53.8)	673 (46.2)			205 (53.5)	178 (46.5)			580 (54.0)	495 (46.0)								
Sales	398 (57.7)	292 (42.3)			87 (58.8)	61 (41.2)			311 (57.4)	231 (42.6)								
Service	148 (53.0)	131 (47.0)			50 (67.6)	24 (32.4)			98 (47.8)	107 (52.2)								
Professional work	603 (56.6)	463 (43.4)			115 (54.2)	97 (45.8)			408 (59.7)	275 (40.3)								
Others (eg, transport-related occupation)	523 (58.4)	372 (41.6)			169 (57.7)	124 (42.3)			434 (56.1)	339 (43.9)								
Increase in frequency of working from home			<i>P</i> = .467	0.01			<i>P</i> = .686	0.012			<i>P</i> = .548	0.01						
Presence	1269 (56.5)	976 (43.5)			331 (57.0)	250 (43.0)			938 (56.4)	726 (43.6)								
Absence	1188 (55.4)	955 (44.6)			295 (55.8)	234 (44.2)			893 (55.3)	721 (44.7)								
Increase in amount of housework			<i>P</i> < .001	0.08			<i>P</i> = .024	0.068			<i>P</i> < .001	0.08						
Presence	620 (49.9)	623 (50.1)			126 (50.2)	125 (49.8)			494 (49.8)	498 (50.2)								
Absence	1837 (58.4)	1308 (41.6)			500 (58.2)	359 (41.8)			1337 (58.5)	949 (41.5)								
House income			<i>P</i> = .002	0.05			<i>P</i> = .012	0.089			<i>P</i> = .016	0.05						
≤5 million yen	789 (53.3)	691 (46.7)			377 (53.9)	323 (46.1)			412 (52.8)	368 (47.2)								

(Continues)

TABLE 2 (Continued)

	Subgroup analysis by household composition											
	Total (n = 4388)				Single-person household (n = 1110)				Multi-person household (n = 3278)			
	not deteriorate (n = 2457)	Deteriorate (n = 1931)	Chi-square test	Effect size	not deteriorate (n = 626)	Deteriorate (n = 484)	Chi-square test	Effect size	not deteriorate (n = 1831)	Deteriorate (n = 1447)	Chi-square test	Effect size
	n (%)	n (%)			n (%)	n (%)			n (%)	n (%)		
5 million < and ≤ 8 million yen	755 (55.0)	617 (45.0)			159 (57.4)	118 (42.6)			596 (54.4)	499 (45.6)		
8 million < yen	913 (59.4)	623 (40.6)	<i>P</i> = .754	0.01	90 (67.7)	43 (32.3)	-	-	823 (58.7)	580 (41.3)	-	-
Household composition												
Single-person household	626 (56.4)	484 (43.6)			-	-			-	-		
Multi-person household	1831 (55.9)	1447 (44.1)			-	-			-	-		
Current mental well-being			<i>P</i> < .001	0.34			<i>P</i> < .001	0.339			<i>P</i> < .001	0.338
Not poor	1727 (71.0)	705 (29.0)			412 (72.9)	153 (27.1)			1315 (70.4)	552 (29.6)		
Poor	730 (37.3)	1226 (62.7)			214 (39.3)	331 (60.7)			516 (36.6)	895 (63.4)		
Sleep hours			<i>P</i> < .001	0.07			<i>P</i> = .058	0.057			<i>P</i> < .001	0.07
6 h ≤	1644 (58.5)	1167 (41.5)			421 (58.5)	299 (41.5)			1223 (58.5)	868 (41.5)		
< 6 h	813 (51.6)	764 (48.4)			205 (52.6)	185 (47.4)			608 (51.2)	579 (48.8)		
Close people with confirmed coronavirus			<i>P</i> = .09	0.04			<i>P</i> = .475	0.021			<i>P</i> = .010	0.045
Presence	129 (48.3)	138 (51.7)			29 (51.8)	27 (48.2)			100 (47.4)	111 (52.6)		
Absence	2328 (56.5)	1793 (43.5)			597 (56.6)	457 (43.4)			1731 (56.4)	1336 (43.6)		
Constant information gathering related to COVID-19			<i>P</i> = .046	0.03			<i>P</i> = .257	0.034			<i>P</i> = .101	0.029
Presence	483 (53.1)	427 (46.9)			110 (52.9)	98 (47.1)			373 (53.1)	329 (46.9)		
Absence	1974 (56.8)	1504 (43.2)			516 (57.2)	386 (42.8)			1458 (56.6)	1118 (43.4)		

(Continues)

**TABLE 2** (Continued)

	Subgroup analysis by household composition											
	Total (n = 4388)				Single-person household (n = 1110)				Multi-person household (n = 3278)			
	not deteriorate (n = 2457)	Deteriorate (n = 1931)	Chi-square test	Effect size	not deteriorate (n = 626)	Deteriorate (n = 484)	Chi-square test	Effect size	not deteriorate (n = 1831)	Deteriorate (n = 1447)	Chi-square test	Effect size
n (%)	n (%)			n (%)	n (%)			n (%)	n (%)			
Increase in frequency of alcohol drinking			$P < .001$	0.07			$P = .168$	0.041			$P < .001$	0.077
Presence	150 (44.4)	188 (55.6)			44 (49.4)	45 (50.6)			106 (42.6)	143 (57.4)		
Absence	2307 (57.0)	1743 (43.0)			582 (57.0)	439 (43.0)			1725 (56.9)	1304 (43.1)		
Sex			$P = .01$	0.05			$P = .034$	0.064			$P = .007$	0.047
Male	1661 (57.8)	1212 (42.2)			376 (59.1)	260 (40.9)			1285 (57.4)	952 (42.6)		
Female	796 (52.5)	719 (47.5)			250 (52.7)	224 (47.3)			546 (52.4)	495 (47.6)		
Age group			$P = .006$	0.05			$P = .620$	0.04			$P = .002$	0.068
25–34 years	755 (58.2)	543 (41.8)			230 (55.4)	185 (44.6)			525 (59.5)	358 (40.5)		
35–44 years	633 (55.3)	512 (44.7)			154 (54.6)	128 (45.4)			479 (55.5)	384 (44.5)		
45–54 years	614 (58.0)	444 (42.0)			148 (59.9)	99 (40.1)			466 (57.5)	345 (42.5)		
55–64 years	455 (51.3)	432 (48.7)			94 (56.6)	72 (43.4)			361 (50.1)	360 (49.9)		

**TABLE 3** Univariate and Multivariate logistic regression analysis with the presence/absence of deterioration of mental well-being as the dependent variable

	Total (n = 4388)		Subgroup analysis by household composition					
			Single-person household (n = 1110)		Multi-person household (n = 3278)			
	Univariate <sup>†</sup>		Multivariate		Multivariate		Multivariate	
	Odds ratio	(95% CI <sup>‡</sup> )	Odds ratio	(95% CI)	Odds ratio	(95% CI)	Odds ratio	(95% CI)
Combination of overtime working hours and social interaction								
Decreased overtime/ decreased interaction	2.30	(1.80–2.95)	1.93	(1.48–2.53)	2.08	(1.24–3.47)	1.93	(1.40–2.66)
Decreased overtime/ unchanged interaction	1.34	(1.12–1.59)	1.35	(1.12–1.63)	1.46	(0.98–2.16)	1.34	(1.08–1.67)
Unchanged overtime/ decreased interaction	1.48	(1.24–1.77)	1.17	(0.96–1.41)	1.20	(0.83–1.74)	1.15	(0.92–1.44)
Unchanged overtime/ unchanged interaction	(Ref <sup>§</sup> )		(Ref)		(Ref)		(Ref)	
Increased overtime/ decreased interaction	3.02	(2.29–3.97)	2.14	(1.59–2.89)	2.66	(1.50–4.69)	2.00	(1.41–2.85)
Increased overtime/ unchanged interaction	1.54	(1.28–1.85)	1.37	(1.12–1.67)	1.44	(0.95–2.19)	1.36	(1.08–1.71)
Employment status								
Regular employee	(Ref)		(Ref)		(Ref)		(Ref)	
Non-regular employee	0.94	(0.77–1.14)	0.87	(0.70–1.08)	0.68	(0.45–1.04)	0.93	(0.72–1.20)
Occupation								
Clerical work	(Ref)		(Ref)		(Ref)		(Ref)	
Sales	0.92	(0.76–1.11)	0.92	(0.75–1.13)	0.87	(0.56–1.35)	0.94	(0.74–1.18)
Service	1.08	(0.83–1.40)	1.02	(0.77–1.36)	0.51	(0.29–0.92)	1.30	(0.94–1.82)
Professional work	0.95	(0.80–1.11)	0.94	(0.79–1.12)	0.96	(0.68–1.35)	0.94	(0.77–1.15)
Others (eg, transport-related occupation)	0.88	(0.74– .1.05)	0.87	(0.72–1.06)	1.03	(0.70–1.52)	0.84	(0.67–1.05)
Increase in frequency of working from home								
Presence	0.98	(0.87–1.10)	0.93	(0.81–1.07)	0.90	(0.67–1.20)	0.94	(0.79–1.11)
Absence	(Ref)		(Ref)		(Ref)		(Ref)	
Increase in amount of housework								
Presence	1.41	(1.24–1.62)	1.37	(1.18–1.60)	1.47	(1.06–2.02)	1.36	(1.15–1.61)
Absence	(Ref)		(Ref)		(Ref)		(Ref)	
House income								
≤5 million yen	1.27	(1.10–1.48)	1.19	(0.998– 1.43)	1.78	(1.12–2.85)	1.07	(0.87–1.31)
5 million< and ≤8 million yen	1.22	(1.05–1.42)	1.20	(1.02–1.41)	1.54	(0.95–2.51)	1.18	(0.99–1.41)
8 million< yen	(Ref)		(Ref)		(Ref)		(Ref)	
Household composition								
Single-person household	0.98	(0.85–1.12)	0.85	(0.72–1.00)	–	–	–	–
Multi-person household	(Ref)		(Ref)		–	–	–	–
Current mental well-being								
Not poor	(Ref)		(Ref)		(Ref)		(Ref)	

(Continues)

TABLE 3 (Continued)

	Total ( <i>n</i> = 4388)		Subgroup analysis by household composition					
			Single-person household ( <i>n</i> = 1110)			Multi-person household ( <i>n</i> = 3278)		
	Univariate <sup>†</sup>		Multivariate		Multivariate		Multivariate	
	Odds ratio	(95% CI <sup>‡</sup> )	Odds ratio	(95% CI)	Odds ratio	(95% CI)	Odds ratio	(95% CI)
Poor	4.18	(3.68–4.75)	4.09	(3.58–4.68)	4.18	(3.19–5.48)	4.10	(3.50–4.79)
Sleep hours								
6 h ≤	(Ref)		(Ref)		(Ref)		(Ref)	
<6 h	1.31	(1.16–1.49)	1.04	(0.91–1.20)	1.04	(0.78–1.37)	1.04	(0.89–1.22)
Close people with confirmed coronavirus								
Presence	1.41	(1.10–1.81)	1.45	(1.11–1.90)	1.19	(0.65–2.15)	1.53	(1.13–2.07)
Absence	(Ref)		(Ref)		(Ref)		(Ref)	
Constant information gathering related to COVID-19								
Presence	1.14	(0.98–1.32)	1.25	(1.06–1.46)	1.48	(1.05–2.08)	1.20	(0.997–1.44)
Absence	(Ref)		(Ref)		(Ref)		(Ref)	
Increase in frequency of alcohol drinking								
Presence	1.66	(1.33–2.08)	1.47	(1.16–1.88)	1.15	(0.71–1.86)	1.60	(1.21–2.13)
Absence	(Ref)		(Ref)		(Ref)		(Ref)	
Sex								
Male	(Ref)		(Ref)		(Ref)		(Ref)	
Female	1.27	(1.12–1.44)	1.32	(1.14–1.53)	1.38	(1.04–1.84)	1.30	(1.09–1.54)
Age group								
25–34 years	(Ref)		(Ref)		(Ref)		(Ref)	
35–44 years	1.15	(0.98–1.35)	1.02	(0.86–1.22)	0.92	(0.66–1.30)	1.10	(0.89–1.35)
45–54 years	1.04	(0.88–1.22)	0.93	(0.78–1.12)	0.79	(0.54–1.13)	1.02	(0.82–1.26)
55–64 years	1.37	(1.16–1.63)	1.43	(1.18–1.74)	1.03	(0.67–1.58)	1.62	(1.29–2.03)

<sup>†</sup>The univariate logistic regression analysis was adjusted by sex and age groups.

<sup>‡</sup>Confidence Interval

<sup>§</sup>Reference

of isolation because of social distancing. Thus, based on this viewpoint, it may be possible that whereas decreasing overtime seems to be associated with a reduction of job stress, financial distress due to reduction of overtime work has a negative impact on mental well-being among employees during the pandemic. This type of combination would also have an impact on employees' mental well-being.

In this study, the household composition itself was not associated with the deterioration of mental well-being, whereas it was also revealed that living in a single-person household was associated with worsening of a harmful impact of “increased overtime/decreased interaction” combination on the psychological well-being. In terms of the relation between household composition and mental well-being, several studies had been already conducted, yet there are inconsistent. A previous study found no or little association between the number

of cohabitants itself and stress levels during the COVID-19 pandemic.<sup>17</sup> In contrast, other studies reported that single-person households had experienced low mental well-being compared to multi-person households.<sup>18–20</sup> This study revealed that living alone itself may not be associated with the deterioration of mental well-being directly, which was consistent with a previous report,<sup>17</sup> whereas the presence of cohabitants would moderate the effect of the combination of the increase of overtime working hours and lack of social interaction under the COVID-19 situation. From this consequence, it is suggested that employees living in a single-person household would have more chances of experiencing difficulties because of the absence of cohabitants. In fact, the British government implemented the “social bubble” strategy to reduce the negative effect on the mental well-being of single-person households under the lockdown,<sup>21</sup> and our findings may imply the

effectiveness of this strategy on the promotion/maintenance of psychological well-being among those in single-person households in public health crises, including a pandemic.

As far as we know, this is the first study that intended to shed some light on the relation between overtime working hours, social interaction, and long-term deterioration of mental well-being during the COVID-19 pandemic. However, the study also has potential limitations to note. First, to contact the participants during the pandemic, it was necessary to use a web-based survey. In addition, applicants for participation in the survey were accepted in the order of receipt until the number of participants reached the quotas. Due to this procedure, there is a possibility that the subjects who are potentially interested in this study may gather faster to apply. Furthermore, to remove the participants who did not devote an appropriate amount of attention when answering the question, the research company excluded the respondents who answered the same option throughout the questionnaire and those who completed answering it too soon, yet there has not been sufficient evidence to support the reliability and validity of these methods. For these reasons, there might be selection biases that could limit our findings. Moreover, because of the Internet-based questionnaire, all participants answered the questions in the form of a self-report. Second, the cross-sectional nature of this study made it difficult to determine the causality between overtime working hours, social interaction, and deterioration of mental well-being. In addition, although the questionnaire item was developed to assess the changes in mental well-being, the amount of overtime working hours, the opportunity of social interaction, and other variables, it is almost impossible to exclude recall biases from the survey. Third, in the adopted questionnaire, we could not obtain the information about, for example, the accessibility of preventive measures (eg, face mask and medical supply) against the COVID-19, the presence of financial vulnerability, or fear of job loss. Fourth, the questionnaire was written in Japanese and distributed to citizens in the metropolis of Tokyo and the three surrounding prefectures. Furthermore, the participants answered the questionnaire after the second wave of COVID-19, as shown in Figure 1. The state of mental well-being in the general public might differ by the time point during the period.<sup>22</sup> Therefore, it is uncertain whether our findings are applicable to the population living in other countries or regions or different time periods. Further investigation is required to generalize the present findings to different populations. Finally, the eligibility of this study made it difficult to analyze the difference in deterioration of mental well-being between genders given the fact that the gender composition of the study sample was unbalanced (ie, single-household men: 14.5%, multi-household men: 51.0%, single-household women: 10.8%, multi-household women: 23.7%). However, female workers, especially those who are in multi-person households, may have unique vulnerability to deterioration of mental well-being due to an increase in the burden of

household chores in the “stay home” recommendation during the COVID-19 pandemic. Thus, in future studies, it is worth focusing on female-specific vulnerability to deterioration of mental well-being during the pandemic.

## 5 | CONCLUSION

Focusing on full-time employees in Japan, it has been suggested that a negative combination—that is, increasing overtime work and decreasing social interaction—may have an impact on the deterioration of mental well-being during the COVID-19 pandemic. In addition, this association seems to be more apparent among single-person households who are easily falling into isolation. During the pandemic, when people tend to lose in-person contact due to the preventive measures, it is necessary to pay close attention to not only work-associated load such as the amount of overtime working hours, but also the presence of social interaction, to address the employees’ mental well-being issues, especially among single-person households as a vulnerable group.

## 6 | DATA SHARING

The data cannot be shared publicly as they contain information that could compromise the privacy of research participants, based on the “Ethical Guidelines for Medical and Health Research Involving Human Subjects” set forth by the Japanese government. Under these guidelines, in principle, institutional review boards in Japan do not allow researchers to publicly share data obtained from human subjects with a third party. Accordingly, in the application requesting ethical approval for this study to the institutional review board of the Jikei University School of Medicine, Tokyo, Japan, we declared that this study would be conducted under the condition that only researchers approved by the review board at the time of the ethical application can access the dataset. Upon reasonable request from a third party, the corresponding author, MS (E-mail: suka@jikei.ac.jp), will consult with the review board (E-mail: rinri@jikei.ac.jp) regarding permission for data sharing.

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## DISCLOSURE

*Ethics approval:* The study protocol was approved by the institutional review board of the Jikei University School of Medicine (No. 32-304 (10386)). This study has been conducted in accordance with the Ethical Guidelines for Medical

and Health Research Involving Human Subjects by the Japanese government. *Informed consent*: All participants voluntarily agreed to participate in the study after reading a description of the purpose and procedure of the web-based questionnaire survey. Consent to participate was implied by the completion and submission of the survey. *Competing interests*: None declared.

## AUTHOR CONTRIBUTION

TY, MS, and HY designed the study and collected the data. MT and TY analyzed the data and prepared the first draft of the manuscript. MS and HY interpreted the data and critically reviewed the manuscript. All authors read and approved the final version of the manuscript.

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