




ORIGINAL ARTICLE

Associations between job and workplace factors, health and physical factors, personal factors, and presenteeism among general employees in Japan: A longitudinal study

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Abstract

Objective: Presenteeism is gaining attention as an occupational health issue in Japan. However, few studies have longitudinally examined the associations between work- and health-related factors and presenteeism using validated instruments in Japan. Drawing on a theoretical framework, we aimed to examine longitudinal associations between job and workplace factors, health and physical factors, personal factors, and presenteeism among Japanese general employees. We also aimed to use the findings to identify educational factors to reduce presenteeism in the Japanese occupational field.

Methods: We conducted two surveys (T1: conducted 2019; T2: conducted 2020) in a Japanese food-related company using a self-administered questionnaire. Presenteeism was assessed using a work functioning impairment scale (WFun). We used multiple linear regression analysis to examine the associations between each factor at T1 and presenteeism at T2.

Results: A total of 2914 employees completed the T1 survey (response rate: 55.7%) and 1467 completed the T2 survey. Thus, we analyzed data for 1467 employees. Of these, 1038 (70.8%) were men and 886 (60.4%) were aged over 40 years at T1. The mean presenteeism score at T2 was 15.06 (standard deviation: 6.22). Multiple linear regression analysis showed that job demands, self-rated health status, dietary choices, and health literacy were associated with presenteeism after 1 year.

Conclusions: The findings suggest that job demands, self-rated health status, dietary habits, and health literacy were associated with higher degree of presenteeism in future. Further intervention studies focusing on these factors are needed to develop and examine effective interventions to reduce presenteeism in Japan.

KEYWORDS

health literacy, Japanese general employees, occupational health, presenteeism

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1 | INTRODUCTION

Presenteeism is gaining attention as an occupational health issue in both the occupational health and management fields. Presenteeism refers to work productivity loss that is attributable to physical and psychosocial conditions and illness.¹ In many countries, including Japan, the economic cost of lost productivity from presenteeism is higher than the cost of absenteeism (not attending work because of illness).^{2,3} Thus, many Japanese companies and insurers have initiated attempts to reduce the risk of presenteeism.^{4,5}

In the academic field, a theoretical framework of the factors associated with presenteeism has been proposed.⁶ This framework broadly categorizes the factors associated with presenteeism into three groups: job and workplace factors, health and physical factors, and personal factors. Job and workplace factors include aspects of the work environment such as job role demands and workplace policies. Previous findings suggest that presenteeism is associated with overtime,⁷ employment status,⁸ work format,⁹ type of work,¹⁰ ease of taking vacations,¹¹ and job stress (workplace support, job demands, and job control).^{9,12} Health and physical factors include existing (long-term) health conditions and physical factors such as lifestyle-related disease. Previous studies show that presenteeism is associated with lifestyle-related diseases such as obesity¹³ and self-rated health.^{14,15} Personal factors include personal attitudes to individual behavior, socioeconomic status, lifestyle, and health literacy. Previous studies have demonstrated that presenteeism is associated with lifestyle factors (e.g., dietary habits, exercise habits, and sleep quality)^{16–18} and health literacy.^{19,20} Health literacy is defined as “the ability to exercise critical judgment of health information and resources, as well as the ability to interact and express personal and societal needs for promoting health” and “the critical ability for informed decision-making”.²¹ Previous studies consistently indicate that individuals with limited health literacy tend to have poorer health status.^{22,23} In the 2015 publication “Health Care 2035,” the Japanese Ministry of Health, Labour and Welfare highlighted the need for support to improve health literacy.²⁴ Thus, health literacy plays an important role in both employee health and presenteeism.

Although previous studies in western countries have examined the associations between work- and health-related factors and presenteeism, few studies in Japan have used validated instruments to longitudinally examine the associations between these factors and presenteeism. The Japanese work environment is unique. For example, Japan has universal healthcare insurance coverage under a public insurance scheme, and the Industrial Safety and Health Act ensures that all employees are eligible for

annual health checkups. It may reduce barriers to healthcare access and facilitate the use of preventive healthcare services. Given these differences in terms of healthcare insurance system, medical examination system, and work culture, factors associated with the risk of presenteeism may differ between Japan and western countries. Thus, a comprehensive and longitudinal study is needed to examine which factors are associated with future presenteeism among Japanese employees.

Drawing on the above-mentioned theoretical framework, the study aim was to examine longitudinal associations between job and workplace factors, health and physical factors, personal factors, and presenteeism among Japanese general employees. Using the findings of this longitudinal investigation, we aimed to identify educational factors to reduce presenteeism in the Japanese occupational field. We hope that these findings inform future intervention studies focused on reducing the risk of presenteeism among Japanese general employees.

2 | METHODS

2.1 | Study design

This was a longitudinal observational study to examine the associations between job and workplace factors, health and physical factors, personal factors, and presenteeism among general employees in Japan.

2.2 | Research methods and study participants

We conducted two surveys (T1 and T2) in a Japanese food-related company using a self-administered questionnaire. We asked employees to respond to an online questionnaire posted on the company intranet during March 18–29, 2019 (T1), and March 10–31, 2020 (T2). The company healthcare center (which is managed by the human resources department) sent an explanation of the study to employees (using the online system) requesting their participation. Employees provided their informed consent via the online system; only those who provided consent were able to proceed to the next screen to answer questions.

2.3 | Measures

2.3.1 | Outcome (presenteeism)

The two main definitions used for presenteeism were attending work despite feeling unwell²⁵ and reduced

productivity at work because of health problems.²⁶ We measured presenteeism using a work functioning impairment scale (the WFun), which is based on the latter definition.²⁷ This scale comprises the following items: (i) I have changed my work routine; (ii) I have postponed a troublesome task; (iii) I have changed a work schedule; (iv) I have asked other staff to undertake part/all of my task; (v) my work content or amount has changed; (vi) my work hours have been changed; (vii) I could not take on some work because of poor health. Five response categories were set: (1) not at all; (2) one or more days per month; (3) about 1 day per week; (4) two or more days per week; (5) almost every day. The possible score range was 7–35; higher scores indicate worse functional impairment. The internal consistency of the scale was adequate (Cronbach's $\alpha = .98$).

2.3.2 | Covariates

To investigate job and workplace factors, we assessed overtime, employment status, work format, type of work, and percentage of paid vacations used. We also evaluated perceived job stress (workplace support, job demands, and job control) using the Brief Job Stress Questionnaire.²⁸ We measured the level of workplace support using six items: (i) How freely can you talk with superiors? (ii) How freely can you talk with coworkers? (iii) How reliable are superiors when you are worried? (iv) How reliable are coworkers when you are worried? (v) How well would superiors listen to you if you asked for advice on personal matters? (vi) How well would coworkers listen to you if you asked for advice on personal matters? Each item was rated on a 4-point scale ranging from 1 (very much) to 4 (not at all). We categorized participants whose response was 3 or 4 for five or more of the six items as having an unsupportive workplace. We used seven items to measure the level of job demand; responses to each item were rated on a 4-point scale that ranged from 1 (very much) to 4 (not at all). We categorized participants whose response was 1 or 2 for six of the seven items as having high job demand. Finally, we used three items to measure the level of job control; responses to each item were rated on a 4-point scale ranging from 1 (very much) to 4 (not at all). We categorized participants whose response was 3 or 4 for two of the three items as having low job control.

To investigate health and physical factors, we assessed whether or not participants knew how to consult medical staff, self-rated health status, and body mass index (BMI). For self-rated health status, participants were asked, "How healthy do you think you are now?" Responses were rated on a 5-point Likert scale ranging from 1 (not healthy at

all) to 5 (very healthy). Participants who answered "1 (not healthy at all)" or "2 (not very healthy)" were classified as "low," "3 (cannot say either way)" were classified as "medium," and "4 (moderately healthy)" or "5 (very healthy)" were classified as "high." Because of the need to protect personal information, we were unable to assess BMI using a questionnaire. To determine whether employees were obese, we used only information provided by the employer about whether employees' BMI was ≥ 25 or < 25 .

To investigate personal factors, we assessed participants' lifestyle in terms of dietary choices, exercise habits, drinking habits, smoking status, and sleep quality using the 2018 Comprehensive Survey of Living Conditions (Health Questionnaire).²⁹ We used question 14–1 of the health questionnaire to assess dietary choices. Participants were asked, "Do you eat breakfast, lunch, and dinner regularly?" Participants who answered "yes" were classified as "consumes three meals per day." Similarly, we used question 14-5 to assess exercise habits. Participants were asked, "Do you exercise (including sports) moderately or are you very physically active?" Participants who answered "yes" were classified as "exercises regularly." To measure drinking habits, we used question 12 to assess the amount and frequency of drinking. Using the Ministry of Health, Labour and Welfare Healthy Japan 21 standards, we assessed whether daily alcohol intake was < 20 g using participants' responses to question 12. If intake was < 20 g per day, the participant was defined as "drinks an appropriate amount," and if intake was more than 20 g per day, the participant was defined as "dose not drink an appropriate amount." To assess smoking status, we used question 13. To assess sleep quality, we used question 14-6. Participants were asked, "Do you get enough sleep?" Participants who answered "yes" were classified as "good." We also measured participants' health literacy using a scale developed and validated in Japan to assess communicative and critical health literacy.²³ The scale includes three items on communicative health literacy and two on critical health literacy. Participants were asked whether they could do the following: (i) obtain health-related information from various sources; (ii) extract the required information; (iii) understand and communicate the information obtained; (iv) assess the reliability of the information; (v) make decisions based on the information, specifically in the context of health-related issues. We rated each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scores of the five items were summed and divided by five to yield a scale score (theoretical range: 1–5). The internal consistency of the scale was adequate (Cronbach's $\alpha = .86$). In this study, participants who scored higher than the mean score at T1 were classified as "high." Additionally, we assessed sex, age, education, marital status, parenting and caregiving responsibilities,

cohabitation status, and household income to identify participants' socioeconomic status.

2.4 | Statistical analyses

To examine the univariate associations between each factor at T1 and presenteeism at T2, we conducted one-way analysis of variance (ANOVA). We then conducted multiple linear regression analysis to examine the associations between job and workplace factors, health and physical factors, personal factors, and future risk of presenteeism. The main outcome variable was presenteeism score (T2). We included the following as objective variables: overtime (T1), employment status (T1), work format (T1), type of work (T1), workplace support (T1), job demands (T1), job control (T1), knowledge of how to consult medical staff (T1), self-rated health status (T1), dietary choices (T1), exercise habits (T1), sleep quality (T1), and health literacy (T1), which were significantly associated with presenteeism (T2) in the one-way ANOVA. As adjustment variables, we included all variables related to socioeconomic status (T1) that were significantly associated with presenteeism in previous studies and that showed a significant association in the one-way ANOVA. In addition, we included presenteeism (T1) as an adjustment variable.

2.5 | Ethical considerations

The study was approved by the ethical review committee of the Graduate School of Medicine, The University of Tokyo (examination number 11926).

3 | RESULTS

In the first survey (T1), conducted March 18–29, 2019, 2914 of 5236 employees completed a self-administered questionnaire (response rate: 55.7%). In the second survey (T2), conducted March 10–31, 2020, 3022 of 5391 employees completed a self-administered questionnaire (response rate: 56.0%). Of the 2914 employees who completed the questionnaire at T1, 1467 completed the questionnaire at T2. A comparison between the 1447 employees who only completed at T1 and the 1467 employees who completed at both T1 and T2 showed approximately the same distribution (Appendix 1). In our study, the number of the follow-up population was 5236 and data for 1467 employees were analyzed in this longitudinal study (the effective response rate: 28.0%).

Tables 1 and 2 show the participant characteristics (T1) and descriptive results for the study variables. A

TABLE 1 Characteristics of study participants (T1) ($N = 1467$)

Variables at T1	Total	
	<i>n</i>	%
Sex ($n = 1467$)		
Men	1038	70.8
Women	429	29.2
Age (years) ($n = 1467$)		
<30	201	13.7
30–39	380	25.9
40–49	481	32.8
50–59	338	23.0
≥60	67	4.6
Education ($n = 1467$)		
Junior or senior high school	430	29.3
Higher professional school/ vocational school/junior college	233	15.9
College or graduate school	804	54.8
Marital status ($n = 1467$)		
Single	491	33.5
Married	895	61.0
Divorced or widowed	81	5.5
Parenting and caregiving ($n = 1467$)		
Parenting responsibilities	555	37.8
Caregiving responsibilities	63	4.3
Parenting and caregiving responsibilities	27	1.8
No parenting or caregiving responsibilities	822	56.0
Cohabitation status ($n = 1467$)		
Lives with others	973	66.3
Lives alone	494	33.7
Household income (millions of yen) ($n = 1467$)		
<4.0	335	22.8
4.0–8.0	795	54.2
>8.0	337	23.0

Abbreviation: T1, the first survey was conducted in 2019.

total of 264 (18.0%) participants worked overtime for more than 3 h a day and 1336 (91.1%) were permanent employees. Of all participants, 519 (35.4%) consumed three meals per day, 1038 (70.8%) were men, 886 (60.4%) were aged over 40 years, and 491 (33.5%) were single. The mean presenteeism scores at T1 and T2 were 15.55 (standard deviation: 6.23) and 15.06 (standard deviation: 6.22). The mean health literacy score at T1 was 3.39 (standard deviation: 0.62). In this study, overtime (T1), employment status (T1), work format (T1), type of work (T1), workplace support (T1), job demands (T1),

TABLE 2 Job, health, and personal factors (T1) and reported presenteeism (T2) ($N = 1467$)

Variables at T1	Total		Presenteeism at T2		P^a
	n	%	Mean	SD	
Job and workplace factors					
Overtime ($n = 1466$)					
<1.0 h per day	386	26.3	13.77	5.86	<.001
1.0–1.9 h per day	542	37.0	15.40	6.16	
2.0–2.9 h per day	274	18.7	15.74	6.14	
≥3.0 h per day	264	18.0	15.54	6.67	
Employment status ($n = 1467$)					
Permanent employee	1336	91.1	15.23	6.28	<.001
Contracted employee/non-permanent employee	131	8.9	13.25	5.21	
Work format ($n = 1467$)					
Fixed shift work	1075	73.3	14.73	6.10	.008
Shift work	257	17.5	15.96	6.20	
Fixed shift and shift work	124	8.5	15.81	6.68	
Other	11	0.7	17.36	6.90	
Type of work ($n = 1467$)					
Desk duty	910	62.0	15.39	6.34	.014
Sales/sales-related position	149	10.2	14.12	5.69	
Production line work	144	9.8	15.50	6.20	
Research	57	3.9	14.28	5.67	
Executive officer	170	11.6	13.85	5.88	
Other	37	2.5	15.51	6.83	
Percentage of paid vacations used ($n = 1466$)					
≤20	293	20.0	14.43	6.19	.125
21–39	117	8.0	14.30	5.64	
40–59	267	18.2	15.07	6.20	
60–79	308	21.0	15.46	6.48	
≥80	481	32.8	15.37	6.18	
Job stress: workplace support ($n = 1467$)					
Supportive workplace	1057	72.1	14.51	5.98	<.001
Unsupportive workplace	410	27.9	16.46	6.59	
Job stress: job demands ($n = 1467$)					
High	526	35.9	16.54	6.22	<.001
Low	941	64.1	14.23	6.06	
Job stress: job control ($n = 1467$)					
High	956	65.2	14.26	5.92	<.001
Low	511	34.8	16.55	6.49	
Health and physical factors					
Knowledge of how to consult medical staff ($n = 1467$)					
Knows how to consult	840	57.3	14.65	6.14	.004
Does not know how to consult	627	42.7	15.60	6.29	
Self-rated health status ($n = 1467$)					

(Continues)

TABLE 2 (Continued)

Variables at T1	Total		Presenteeism at T2		P ^a
	n	%	Mean	SD	
Low (not healthy at all or Not very healthy)	356	24.3	16.71	6.69	<.001
Medium (cannot say either way)	381	26.0	16.00	6.51	
High (moderately healthy or very healthy)	730	49.8	13.75	5.51	
Obesity (n = 1358)					
Obese (BMI ≥25)	438	32.3	15.42	6.70	.272
Non-obese (BMI <25)	920	67.7	15.02	5.99	
Personal factors					
Lifestyle: dietary choices (n = 1467)					
Consumes three meals per day	519	35.4	13.67	5.66	<.001
Does not consume three meals per day	948	64.6	15.81	6.38	
Lifestyle: exercise habits (n = 1467)					
Exercises regularly	438	29.9	14.54	5.90	.037
Does not exercise regularly	1029	70.1	15.28	6.34	
Lifestyle: drinking habits (n = 1467)					
Drinks an appropriate amount	1157	78.9	15.07	6.25	.889
Does not drink an appropriate amount	310	21.1	15.01	6.09	
Lifestyle: smoking status (n = 1467)					
Smokes every day or smokes occasionally	410	27.9	15.04	5.96	.954
Non-smoker or ex-smoker	1057	72.1	15.06	6.31	
Lifestyle: sleep quality (n = 1467)					
Good	435	29.7	13.91	5.69	<.001
Not good	1032	70.3	15.54	6.37	
Health literacy (n = 1467)					
High (employees who scored higher than the mean score at T1)	837	57.1	14.05	5.83	<.001
Low (employees who scored lower than the mean score at T1)	630	42.9	16.39	6.47	

Abbreviations: BMI, body mass index; SD, standard deviation; T1, the first survey was conducted in 2019; T2, the second survey was conducted in 2020.

^aOne-way analysis of variance.

job control (T1), knowledge of how to consult medical staff (T1), self-rated health status (T1), dietary choices (T1), exercise habits (T1), sleep quality (T1), health literacy (T1), age (T1), marital status (T1), and household income (T1) were significantly associated with presenteeism (T2).

Table 3 shows the results of the multiple regression analysis. The results showed that job demands (T1) ($\beta = -.044$, $P = .039$), self-rated health status (T1) ($\beta = -.046$, $P = .035$), dietary choices (T1) ($\beta = -.074$, $P = .001$), and health literacy (T1) ($\beta = -.043$, $P = .030$) were significantly associated with presenteeism at T2.

4 | DISCUSSION

In this study, we examined the longitudinal associations between job and workplace factors, health and physical factors, personal factors, and presenteeism among Japanese general employees.

The mean presenteeism scores at T1 and T2 were 15.55 and 15.06. These scores are comparable to previous study findings. For example, baseline presenteeism scores of Japanese employees who participated in a randomized controlled trial were 16.5 (control group) and 14.7 (intervention group).³⁰ A prospective cohort study conducted in

TABLE 3 Associations between job and workplace factors (T1), health and physical factors (T1), personal factors (T1), and presenteeism (T2) ($n = 1467$)

Variables at T1	<i>B</i>	Standard error	β	<i>P</i>	95% confidence interval lower bound	95% confidence interval upper bound
Job and workplace factors						
Overtime (continuous variable)	-.047	0.127	-.008	.713	-0.297	0.203
Employment status (1: Contracted employee/non-permanent employee, 0: Permanent employee)	-.909	0.489	-.042	.063	-1.867	0.050
Work format (2: Fixed shift work, 1: Shift work, 0: Fixed shift and shift work)	.182	0.199	.020	.362	-0.209	0.572
Type of work (1: Desk duty, 2: Sales/sales-related position, 3: Production line work, 4: Research, 5: Executive officer)	-.036	0.089	-.009	.689	-0.210	0.139
Job stress: workplace support (1: Supportive workplace, 0: Unsupportive workplace)	-.461	0.295	-.033	.117	-1.039	0.116
Job stress: job demands (1: Low, 0: High)	-.572	0.276	-.044	.039	-1.114	-0.030
Job stress: job control (1: High, 0: Low)	-.225	0.285	-.017	.428	-0.784	0.333
Health and physical factors						
Knowledge of how to consult medical staff (1: Knows how to consult, 0: Does not know how to consult)	-.145	0.266	-.012	.585	-0.666	0.376
Self-rated health status (1: Low to 5: High)	-.299	0.142	-.046	.035	-0.577	-0.021
Personal factors						
Dietary choices (1: Consumes three meals per day, 0: Does not consume three meals per day)	-.962	0.293	-.074	.001	-1.537	-0.387
Exercise habits (1: Exercises regularly, 0: Does not exercise regularly)	.231	0.291	.017	.428	-0.340	0.802
Sleep quality (1: Good, 0: Not good)	.283	0.309	.021	.360	-0.323	0.889
Health literacy (continuous variable)	-.431	0.220	-.043	.030	-0.862	0.000
R^2	.427					
Adjusted R^2	.418					

Note: Outcome: presenteeism at T2 (score range: 7–35; higher scores indicate higher risk of presenteeism). Multiple linear regression analysis was adjusted for sex, age, education, marital status, parenting and caregiving, cohabitation status, household income, and presenteeism at T1.

Abbreviations: *B*, coefficient of partial regression; β , standard partial regression coefficient; T1, the first survey was conducted in 2019; T2, the second survey was conducted in 2020.

a manufacturing company in Japan found a presenteeism score of 15.3.³¹ Thus, the mean presenteeism score in the present study is comparable with those of previous studies.

Our longitudinal findings indicated that employees with lower job demands tended to show a low risk of presenteeism after 1 year. These findings are generally consistent with previous studies.^{9,12} For example, a meta-analytic study suggested that higher job demands in the form of challenging tasks increase work engagement and motivation. As a result, employees tend to work longer and more intensively. Therefore, higher job demands may increase presenteeism.¹² Since 2015, all companies in Japan with 50 or more employees are required to conduct annual “stress checks.” These stress checks assess employee work-related stress, which helps companies

to monitor the level of workplace support, job demands, and job control. To reduce the risk of presenteeism among general employees, it would be useful to longitudinally assess stress check results and use them to identify signs of future presenteeism. Additionally, findings from randomized controlled trials suggest that stress-management interventions could be effective in reducing perceived stress and presenteeism levels.³² Thus, to prevent presenteeism, it would be useful to conduct an intervention program focused on job demands. Additional studies are needed to examine the effectiveness of interventional educations in reducing the risk of presenteeism in Japanese workplaces.

In the present study, employees with higher self-rated health status were more likely to have a lower risk of presenteeism after 1 year. This is generally consistent with

previous findings suggesting that poor self-rated health status is associated with presenteeism.^{14,15} Many previous studies suggest that self-rated health status is associated with various health outcomes. For example, individuals with higher self-rated health status tend to have higher survival rates, regardless of presence of disease.³³ Because presenteeism is closely associated with self-rated health status, it may also be related to various health indicators. Although such alternative indicators do not always accurately evaluate presenteeism compared with scales developed to assess presenteeism, they may be useful when it is difficult to administer validated presenteeism instruments in the workplace. In addition to examining the association between presenteeism and self-rated health status, it would be useful to investigate associations between presenteeism and other health indicators.

The present longitudinal study also indicated that employees who consumed three meals per day tended to have a lower risk of presenteeism after 1 year. Previous studies suggest that presenteeism is associated with dietary habits such as dietary choices and dietary regularity.^{16,34} The Global Alliance for Improved Nutrition has suggested that the provision of nutrient-rich diets could have an immediate and measurable effect on work performance deficiencies.³⁵ Thus, countermeasures focused on dietary habits may be effective in reducing the risk of presenteeism among Japanese general employees. Recently, several Japanese companies have attempted to reduce presenteeism by improving employees' dietary habits.⁵ Further studies are needed to examine whether interventions to improve dietary habits are effective in reducing future presenteeism risk.

This longitudinal study also suggested that employees with higher health literacy tended to have lower risk of presenteeism after 1 year. This is generally consistent with previous findings of an association between health literacy and presenteeism.^{19,20} Previous research also suggests that individuals with higher health literacy use relaxation techniques and social support.^{36,37} Because employees with higher health literacy may be more likely to engage in adequate rest activities and obtain support, they may have a lower risk of presenteeism. In recent years, the Japanese Ministry of Health, Labour and Welfare has emphasized the importance of developing health literacy, which is now one of the indicators used to assess whether a company has engaged in health management.³⁸ This has led to an increase in the number of companies and insurers committed to improving employees' health literacy. Health literacy can be improved by providing information, effective communication, and structured education.³⁹ A recent pilot study indicated that providing individuals with necessary information and skills may improve health literacy.⁴⁰ However, it is

unclear what kind of information, communication, and education could improve health literacy among general employees. Longitudinal research is needed to examine the association between presenteeism and health literacy and to consider the effects of education on health literacy to reduce the risk of presenteeism.

Our study has several limitations. First, it is possible that there was a selection bias due to factors that were not assessed in the self-administered questionnaire. In addition, the effective response rate to the self-administered questionnaire was low (approximately 30%) and study was conducted at only one food-related company in Japan. Thus, care is needed when generalizing the results. Second, we were unable to obtain geographical information, such as work location, from participants. Although work environment may differ according to work location, we were unable to consider the potential influence of these factors on the results. Third, we assessed only two factors (self-rated health status and BMI) related to health status. Thus, we could not fully examine the association between employee health status and presenteeism. It is necessary to confirm whether health status variables previously identified as having significant associations with presenteeism, such as mental health disorder, musculoskeletal system disorder, and occupational diseases, are associated with presenteeism. Fourth, the self-administered questionnaire at T2 was distributed in March 2020. This was 1 month before the first declaration of a state of emergency related to the spread of coronavirus 19. At this time, elementary and junior high schools had begun to close and many companies had started to recommend remote working. The difference between the social conditions at T1 (March 2019) and those at T2 (March 2020) may have affected the questionnaire responses.

In conclusion, this study indicated that job demands, self-rated health status, dietary habits, and health literacy were associated with higher degree of presenteeism in future. Despite the above-mentioned limitations with our study, these factors may be important in developing interventions to prevent and reduce presenteeism in the Japanese occupational field. Additional intervention studies are needed to examine which countermeasures to presenteeism are effective and implementable in Japanese workplaces.

AUTHOR CONTRIBUTIONS

Eiko Goto conceived the study, collected and analyzed the data, and wrote the manuscript. Hirono Ishikawa made substantial contributions to improve the conception and design of the study, led the writing, and obtained funding. All authors critically commented on the manuscript and approved the final version of the manuscript.

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DISCLOSURE

Approval of the research protocol: The study was approved by the ethical review committee of the Graduate School of Medicine, The University of Tokyo (examination number 11926). **Informed consent:** All participants provided their informed consent via the online system. **Registry and the registration no. of the study/trial:** N/A. **Animal studies:** N/A. **Conflict of interest:** N/A.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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APPENDIX 1

Comparison between respondents to T1 and T2 questionnaires and respondents to only T1 questionnaire (N = 2914)

Variables at T1	Respondents to T1 and T2 questionnaires (n = 1467)		Respondents to only T1 questionnaire (n = 1447)		P
	n	%	n	%	
Characteristics of study participants					
Sex (n = 2914)					
Men	1038	70.8	1021	70.6	.907 ^a
Women	429	29.2	426	29.4	
Age (years) (n = 2914)					
<30	201	13.7	266	18.4	.563 ^a
30–39	380	25.9	364	25.2	
40–49	481	32.8	440	30.4	
50–59	338	23.0	295	20.4	
≥60	67	4.6	82	5.7	
Education (n = 2914)					
Junior or senior high school	430	29.3	409	28.3	.722 ^a
Higher professional school/vocational school/junior college	233	15.9	257	17.8	
College or graduate school	804	54.8	781	54.0	
Marital status (n = 2914)					
Single	491	33.5	540	37.3	.804 ^a
Married	895	61.0	845	58.4	
Divorced or widowed	81	5.5	62	4.3	
Parenting and caregiving (n = 2914)					
Parenting responsibilities	555	37.8	487	33.7	.204 ^a
Caregiving responsibilities	63	4.3	68	4.7	
Parenting and caregiving responsibilities	27	1.8	34	2.3	
No parenting or caregiving responsibilities	822	56.0	858	59.3	
Cohabitation status (n = 2914)					
Lives with others	973	66.3	929	64.2	.080 ^a
Lives alone	494	33.7	518	35.8	
Household income (millions of yen) (n = 2914)					
<4.0	335	22.8	393	27.2	.070 ^a
4.0–8.0	795	54.2	756	52.2	
>8.0	337	23.0	298	20.6	
Job and workplace factors					
Overtime (n = 2913)					
<1.0 h per day	386	26.3	444	30.7	.741 ^a
1.0–1.9 h per day	542	37.0	508	35.1	
2.0–2.9 h per day	274	18.7	214	14.8	
≥3.0 h per day	264	18.0	281	19.4	
Employment status (n = 2914)					
Permanent employee	1336	91.1	1312	90.7	.444 ^a

APPENDIX 1 (Continued)

Variables at T1	Respondents to T1 and T2 questionnaires (<i>n</i> = 1467)		Respondents to only T1 questionnaire (<i>n</i> = 1447)		<i>P</i>
	<i>n</i>	%	<i>n</i>	%	
Contracted employee/non-permanent employee	131	8.9	135	9.3	
Work format (<i>n</i> = 2914)					
Fixed shift work	1075	73.3	1050	72.6	.324 ^a
Shift work	257	17.5	245	16.9	
Fixed shift and shift work	124	8.5	137	9.5	
Other	11	0.7	15	1.0	
Type of work (<i>n</i> = 2914)					
Desk duty	910	62.0	903	62.4	.241 ^a
Sales/sales-related position	149	10.2	157	10.9	
Production line work	144	9.8	152	10.5	
Research	57	3.9	64	4.4	
Executive officer	170	11.6	130	9.0	
Other	37	2.5	41	2.8	
Percentage of paid vacations used (<i>n</i> = 2914)					
≤20	293	20.0	356	24.6	.430 ^a
21–39	117	8.0	172	11.9	
40–59	267	18.2	295	20.4	
60–79	308	21.0	205	14.2	
≥80	481	32.8	419	29.0	
Job stress: workplace support (<i>n</i> = 2914)					
Supportive workplace	1057	72.1	1009	69.7	.561 ^a
Unsupportive workplace	410	27.9	438	30.3	
Job stress: job demands (<i>n</i> = 2914)					
High	526	35.9	458	31.7	.590 ^a
Low	941	64.1	989	68.3	
Job stress: job control (<i>n</i> = 2914)					
High	956	65.2	967	66.8	.243 ^a
Low	511	34.8	480	33.2	
Health and physical factors					
Knowledge of how to consult medical staff (<i>n</i> = 2914)					
Knows how to consult	840	57.3	844	58.3	.927 ^a
Does not know how to consult	627	42.7	603	41.7	
Self-rated health status (<i>n</i> = 2914)					
Low (not healthy at all or not very healthy)	356	24.3	284	19.6	.490 ^a
Medium (cannot say either way)	381	26.0	387	26.7	
High (moderately healthy or very healthy)	730	49.8	776	53.6	
Obesity (<i>n</i> = 2234)					
Obese (BMI ≥25)	438	32.3	452	32.1	.383 ^a
Non-obese (BMI <25)	920	67.7	958	67.9	

APPENDIX 1 (Continued)

Variables at T1	Respondents to T1 and T2 questionnaires (<i>n</i> = 1467)		Respondents to only T1 questionnaire (<i>n</i> = 1447)		<i>P</i>
	<i>n</i>	%	<i>n</i>	%	
Personal factors					
Lifestyle: dietary choices (<i>n</i> = 2914)					
Consumes three meals per day	519	35.4	565	39.0	.558 ^a
Does not consume three meals per day	948	64.6	882	61.0	
Lifestyle: exercise habits (<i>n</i> = 2914)					
Exercises regularly	438	29.9	452	31.2	.587 ^a
Does not exercise regularly	1029	70.1	995	68.8	
Lifestyle: drinking habits (<i>n</i> = 2914)					
Drinks an appropriate amount	1157	78.9	1167	80.6	.485 ^a
Does not drink an appropriate amount	310	21.1	280	19.4	
Lifestyle: smoking status (<i>n</i> = 2914)					
Smokes every day or smokes occasionally	410	27.9	401	27.7	.219 ^a
Non-smoker or ex-smoker	1057	72.1	1046	72.3	
Lifestyle: sleep quality (<i>n</i> = 2914)					
Good	435	29.7	341	23.6	.332 ^a
Not good	1032	70.3	1106	76.4	
Health literacy (<i>n</i> = 2914)					
High (employees who scored higher than the mean score at T1)	837	57.1	807	55.8	.849 ^a
Low (employees who scored lower than the mean score at T1)	630	42.9	640	44.2	
Presenteeism (<i>n</i> = 2914)					
Mean ± standard deviation	15.55 ± 6.23		15.73 ± 6.11		.616 ^b

^aChi-square test.^bIndependent samples *t*-test.