

Testing the Construct Validity and Responsiveness of the Single-Item Presenteeism Question

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Objective: We tested the construct validity and responsiveness of a single-item instrument for measuring absolute presenteeism—the single-item presenteeism question (SPQ). **Methods:** Two self-report questionnaire surveys were conducted among employees of 24 small- or medium-sized companies ($N = 1021$) concerning the recognized predictors of presenteeism—absenteeism, subjective health risks, work engagement, and workplace social capital. Responsiveness was measured by determining whether changes in the presence of predictors between the surveys were accompanied by commensurate changes in SPQ presenteeism. **Results:** SPQ presenteeism exhibited significant associations with the predictors, denoting adequate construct validity. Regarding responsiveness, unfavorable changes in most predictors were associated with increased SPQ presenteeism, as expected. **Conclusions:** We confirmed the construct validity and responsiveness of the SPQ—an instrument that can be employed to promote workplace health and productivity management.

Keywords: absenteeism, construct validity, health, presenteeism, responsiveness, the single-item presenteeism question, workplace

Presenteeism, namely decreased productivity while at work, is reported to be one of major occupational problems in many countries. In Japan, presenteeism as assessed by the quality and quantity method,¹ which aims to measure the quantity and quality of work performed on a daily basis, costs companies 3055 USD per person per year, equivalent to 64% of their employee health costs.² This figure markedly exceeds the costs of absenteeism (unplanned absences caused by sickness or injury) and medical/pharmaceutical expenses, which account for 11% and 25% of health-related costs, respectively.² In Japan, efforts to tackle presenteeism have been underway for some years. Many private companies, governmental organizations, and non-profit organizations promote health and productivity management (HPM; Japanese: *kenkou keiei*) as a key part of a company's business strategy. Under the 2020 Certified HPM Outstanding Organizations Recognition Program, operated by the Ministry of Economy, Trade, and Industry, 1481 large enterprises and 4723 small- and medium-sized enterprises were recognized.³

The instruments for measuring presenteeism fall into two categories. The first comprises questionnaire surveys that measure presenteeism indirectly, using questions about employees' ability to concentrate and complete tasks. Examples of these surveys include the Stanford presenteeism scale (SPS)⁴ and the work limitations

questionnaire (WLQ).⁵ These measures are useful for verifying important factors that affect work performance (eg, by decreasing physical function, the ability to concentrate, time management, and communication). The other category consists of a questionnaire survey that measures presenteeism directly: The World Health Organization's health and work performance questionnaire (HPQ).⁶ Unlike the SPS and WLQ, the HPQ is designed to measure the return on investing in worker health by comparing the effect of such measures against their costs. As such, the HPQ provides employers a useful means to assess how effectively they are managing workers' health and productivity.⁷ The World Health Organization also offers a short-form version of the HPQ, which consists only of the questions on absolute/relative absenteeism and presenteeism.⁸ Some previous studies have considered absolute presenteeism rather than relative presenteeism. HPQ absolute presenteeism correlates with health factors such as high stress,⁹ psychological wellbeing, musculoskeletal pain,¹⁰ subjective health status, and arthritis at work¹¹; lifestyle factors such as sleep quality and sedentary time¹²; and job factors such as job description, job satisfaction,¹⁰ and commuting (eg, means of transport and travel time).¹³

HPQ absolute presenteeism has gained popularity. This form of presenteeism is measured by asking the question “On a scale from 0 to 10, where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate your overall job performance on the days you worked during the past four weeks (28 days)?” Kessler et al⁶ highlighted a strategy to improve the accuracy of responses via self-anchoring response scales with a 0 to 10 distribution, where 0 defines the worst possible performance and 10 defines the best possible performance. However, the self-anchoring scale of HPQ absolute presenteeism has two problems. First, respondents may struggle to assume the worst worker's performance and the top worker's performance based on their experience.^{14,15} Second, because respondents rate their performance compared with a hypothetical range of performances, the calculation of HPQ absolute presenteeism will depend not only on how the respondents perceive their own performance but also on the assumption of performances of both the worst worker and the top worker.

To address these disadvantages, we developed the SPQ, an instrument consisting of a single question that measures absolute presenteeism using a modified version of the self-anchoring scale of the HPQ. We then used the SPQ concurrently with the HPQ and compared the results to evaluate the construct validity and responsiveness of the SPQ.

METHODS

Design

Two self-report questionnaire surveys were conducted, one in July 2019 and the other in December 2019, among employees of small- or medium-sized companies ($N = 1021$). The companies were all based in Iwate, a prefecture in northeastern Japan. Of the employees, 35% worked in construction, 35% in services, 19% in manufacturing, 15% in retail, and 7% in finance, forestry, or other industries. The companies were recruited using snowball sampling; prefectural officials selected companies with workforces ranging between 5 and 100 workers, taking care to ensure that no one industry represented the sample majority.

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Ethical Considerations & Disclosure: This study was approved by the University of Tokyo's Research Ethics Committee (no. 19–81).

Clinical Significance: We developed a single-item instrument for measuring absolute presenteeism—the single-item presenteeism question (SPQ). This study revealed the construct validity and responsiveness of the SPQ. The SPQ is significantly associated with the recognized predictors of presenteeism and can be employed to promote workplace health and productivity management.

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The questionnaire forms included a written briefing that described the purpose of the study and explained that participants' personal data would be protected and that no one would experience any disadvantage from participating. Based on this briefing, participants were deemed to have provided their informed consent if they responded to the survey. The completed survey forms were returned to the prefectural officials in sealed envelopes to prevent participants' superiors or coworkers from seeing the responses.

Before the surveys were conducted, the prefectural officials prepared a table that linked participants' personal details with a personal ID code. During the survey, participants stated their ID in the answer form, along with their responses. The prefectural officials shared the ID codes and other anonymized information with the authors. Using the ID codes, a portion of the samples in the second survey were linked to the corresponding samples in the first. The linked data were analyzed, while the missing data were removed using pairwise deletion. This study was approved by the University of Tokyo's Research Ethics Committee (no. 19–81).

Measures

SPQ

The single question asked respondents to rate their own performance, considering the effects of any sickness or injury. Respondents provided a rating of 1% to 100%, with 100% defined as the best performance possible when there is no sickness or injury (see Appendix 1, <http://links.lww.com/JOM/A883>). The difference between respondents' ratings and 100 (ie, the degree of productivity loss) was defined as "SPQ presenteeism." Higher SPQ presenteeism indicated a greater degree of productivity loss.

HPQ Absolute Presenteeism

We used one question from the HPQ Short Form⁸ (the Japanese version¹⁶): Question B11 (see Appendix 2, <http://links.lww.com/JOM/A883>). Kessler et al⁶ demonstrated the content validity of the HPQ. They also demonstrated its criterion validity in some occupational domains using objective performance criteria. In the literature, the score for B11 multiplied by 10 is defined as HPQ absolute presenteeism. A higher HPQ absolute presenteeism score indicates a lower degree of productivity loss. In the present study, however, HPQ absolute presenteeism subtracted from 100 was defined as HPQ presenteeism (ie, the degree of productivity loss).¹² As with SPQ presenteeism, higher HPQ presenteeism score indicated a greater degree of productivity loss.

$$\text{HPQ absolute presenteeism} = 10 \times \text{B11.}$$

$$\text{HPQ presenteeism} = 100 - \text{HPQ absolute presenteeism.}$$

Absenteeism

Absenteeism, defined as productivity loss owing to absences caused by sickness or injury, is positively correlated with presenteeism.¹⁷ Absenteeism was measured by asking respondents to state how many days of work they had missed in the past 4 weeks owing to sickness or injury. Kessler et al⁶ reported that absenteeism data (obtained by facilitating memory search) showed significant associations with objective job performance data such as payroll records ($r=0.61$ to 0.87). We used a binary variable for absenteeism: respondents were assigned a value of 0 ("no [absenteeism] risk") if they reported missing no days in the past 4 weeks and a value of 1 ("[absenteeism] risk present") if they reported otherwise.

Subjective Health Risks

Ten subjective health risks were measured. One was physical: malaise; four were mental: subjective general health, job satisfaction, family life satisfaction, and high stress; and five were lifestyle-related: physical activity, dietary habit, sleep quality, drinking habit,

and smoking. In a survey by the Ministry of Health, Labour and Welfare,¹⁸ malaise risk was recognized by an affirmative response to a question asking whether respondents had experienced some sort of subjective symptoms of a disorder and disease in the past several days.

In the same survey, subjective general health risk was recognized by a negative response ("quite bad" or "bad") to a question asking about respondents' present health. Both job satisfaction risk and family life satisfaction risk were recognized by a negative response ("somewhat dissatisfied" or "dissatisfied") to a question about respondents' job/family life.¹⁹ In a survey by Furukawa et al,²⁰ high stress risk was recognized by a score of 10 or more on the Kessler 6 (K6) screening scale in the World Mental Health Survey. The K6 scale is used to screen for the presence of severe depression and psychological distress.²¹ In that paper, Kessler et al²¹ suggested that a score of 13 is the ideal cut-off. However, a cut-off of 10 was used in the present study on the assumption that moderate as well as severe distress can pose an occupational risk, and because such a cut-off is consistent with the criteria that the National Institute of Health and Nutrition outlined in its Basic Direction for Comprehensive Implementation of National Health Promotion.²²

The five lifestyle-related risks were quantified using scores for the Questionnaire on Specific Health Examinations.²³ Specifically, physical activity risk was recognized by a negative answer to the following question: "In your daily life, do you walk or do any equivalent amount of physical activity for more than one hour a day?" Dietary habit risk was recognized by an affirmative answer to both the following questions: "Do you eat supper two hours before bedtime more than three times a week?" and "Do you skip breakfast more than three times a week?" Sleep quality risk was recognized by a negative response to a question on whether the respondent felt refreshed after a night's sleep. Drinking habit risk was recognized by a response of "every day" to the question "How often do you drink" and a response of "two glasses or more" to the following question: "How much do you drink a day, in terms of glasses of refined sake? (a glass [180 mL] of refined sake [rice wine] is equivalent to a medium bottle [500 mL] of beer, 110 mL of *shochu* [alcohol content 25%], a glass [double, 60 mL] of whiskey, or two glasses [240 mL] of wine)." Smoking risk was recognized by an affirmative answer to a question on whether respondents smoked regularly. All subjective health risks were represented as binary variables, with a value of 1 representing presence of the risk and a value of 0 representing absence of the risk.

Work Engagement

Work engagement describes the extent that employees are motivated and take pride in their work. Employees with a strong work engagement are less likely to incur presenteeism losses.^{24,25} In the present study, work engagement was measured using two items from the New Brief Job Stress Questionnaire (N-BJSQ), a scale developed by Inoue et al.²⁶ The first item is "I feel motivated in my work." The second is "I take pride in my work." Both items were scored on a four-point scale (4. Agree, 3. Somewhat agree, 2. Somewhat disagree, and 1. Disagree). The mean score was used to define a binary variable: respondents were assigned a value of 1 (low) if their mean score was less than 2.5 (the midway point in the distribution), and a value of 0 (high) if it was 2.5 or higher.

Workplace Social Capital

Workplace social capital describes the extent to which employees have forged healthy workplace relationships, including relationships that foster effective communication, mutual understanding, trust, and the reassurance that support is available when needed. Zhu et al²⁷ reported that a high level of workplace social capital in individuals was negatively associated with presenteeism.

In the present study, workplace social capital was measured using three items from the N-BJSQ.²⁶ The first item was “My coworkers and I are happy to work alongside each other.” The second was “My coworkers and I understand and respect each other.” The third was “My coworkers and I communicate job information to each other effectively.” Each item was scored on a four-point scale (4. Agree, 3. Somewhat agree, 2. Somewhat disagree, and 1. Disagree). The mean score used to define a binary variable: respondents were assigned a value of 1 (low) if their mean score was less than 2.5 (the midway point of the distribution) and a value of 0 (high) if it was 2.5 or higher.

Additional Variables

In the first of the two surveys, participants were asked about their sex, age, job, employment status, work conditions, childcare commitments, and elder care commitments. For age, respondents selected one of five age ranges (from “20 or younger” to “60 or older”). For job, eight answer options were provided to represent different categories of employment. The categories, which were based on the Japan Standard Industrial Classification,²⁸ were as follows: clerical, management, technical, sales/services, production, transportation/machinery, construction/mining, and other. For employment status, participants were asked whether they were regular workers or non-regular workers (eg, casual worker, part-timer, temporary staff, contract staff). For work conditions, participants were asked whether they worked shifts (double or triple). For childcare and elder care commitments, participants were asked questions taken from the Employment Status Survey: “Do you have childcare commitments (for preschool children)?” and “Do you care for any older relatives (cohabitants or otherwise)?” Sex was represented as a binary, with 1 for women and 0 for men. For other variables, binary coding was used: 1 for an affirmative response and 0 for a negative response.

Statistical Procedures

Ospina et al²⁹ claimed that there is effectively no gold standard for instruments measuring presenteeism. We tested the construct validity and responsiveness of the SPQ in compliance with the COSMIN (CONsensus-based Standards for the selection of health Measurement INSTRUMENTS) study design checklist³⁰ for cases with no gold standard. Specifically, we tested hypotheses for construct validity by comparing SPQ presenteeism between subgroups and with the predictor items. Responsiveness was evaluated by examining whether changes in the predictors of presenteeism were accompanied by commensurate changes in SPQ presenteeism. We applied the same procedure to HPQ presenteeism. The results were used to evaluate the construct validity and responsiveness of the SPQ. The threshold for significance was $P < 0.05$. All statistical analyses were conducted using R version 3.6.1 (R Foundation for Statistical Computing, Vienna, Austria),³¹ which was used to perform multiple logistic regression analyses and multiple comparisons.

Hypotheses Testing for Construct Validity

Comparison Between Subgroups

First, we tested whether the subgroups of the additional variables affected the presenteeism results. Terry and Xi³² reported that presenteeism does not follow a normal distribution. Accordingly, we assessed inter-subgroup variation in median SPQ/HPQ presenteeism. The Wilcoxon rank-sum test was used to compare the additional variables with two subgroups, while the Kruskal–Wallis test was used for those with three or more subgroups. For the additional variables that were found to be significantly different across subgroups from the results of the Kruskal–Wallis test, we used the Bonferroni-adjusted Wilcoxon rank-sum test (unpaired observations) to confirm significant differences between each subgroup.

Comparison With Other Outcome Measurement Instruments

Kessler et al⁶ noted that the HPQ fails to accurately measure high performance of employees. Accordingly, in testing construct validity, we analyzed how absenteeism, subjective health risks, work engagement, and workplace social capital affected SPQ/HPQ presenteeism across the whole sample, and how they affected the odds for low/high performers versus middle performers in SPQ/HPQ presenteeism. First, we performed Wilcoxon rank-sum tests with SPQ presenteeism (continuous) or HPQ presenteeism (discrete) as the dependent variable, and with the predictors of presenteeism (absenteeism, subjective health risks, work engagement, and workplace social capital) as independent variables.

Second, referring to the results for SPQ and HPQ, we divided the sample into low, middle, and high performers. Kessler et al⁶ argued that respondents are low performers if their presenteeism rating falls in the top 20% of the distribution, and respondents are high performers if their presenteeism rating falls in the bottom 20%. Accordingly, respondents in the top 20% for SPQ/HPQ presenteeism were defined as low performers, and respondents in the bottom 20% for SPQ/HPQ presenteeism were defined as high performers. Middle performers were defined as those who were neither low nor high performers.

We estimated two adjusted odds ratios, namely low performers versus middle performers (reference), and high performers versus middle performers (reference), via two multiple logistic regression analyses. In the first analysis, we extracted low and middle performers, and SPQ/HPQ presenteeism were formatted as binary dependent variables, with a value of 1 for low performers and a value of 0 for middle performers. In the second analysis, we extracted high and middle performers, with SPQ/HPQ presenteeism coded as in the first analysis. These analyses were performed with the predictors of presenteeism as independent variables and adjusted for sex and age.

Responsiveness

Changes between surveys in the predictors of presenteeism were represented in three subgroups: reduced, no change, and gained. For example, if a subjective health risk was present in the first survey but absent in the second, the case would be assigned to the “reduced” subgroup. Change in SPQ/HPQ presenteeism was defined as the presenteeism score for the second survey less the presenteeism score for the first survey. Using the Tukey–Kramer procedure, changes in SPQ/HPQ presenteeism were compared with changes in the predictors of presenteeism.

RESULTS

Participants

The first survey yielded 1238 samples, and the second yielded 1145. The 1124 samples from the second survey were linked with their equivalents in the first survey, by ID number. The mean age was 46, and 32% of the respondents were women. Table 1 shows the breakdown of respondents’ personnel attributes. For the sample as a whole, the mean (\pm standard deviation [SD]) rating for SPQ presenteeism was 19.4% (\pm 17.9), and that for HPQ presenteeism was 37.4% (\pm 17.8). The mean number (%) of missing samples in the first and second survey of the SPQ was 50 (4.4%), and that of the HPQ was 40 (3.5%).

Hypotheses Testing for Construct Validity

Comparison With the Additional Variables

Table 1 shows the results for the first survey broken down by the additional variables. The median (interquartile range [IQR]) for

TABLE 1. Personnel Attributes and Inter-Subgroup Comparisons

	<i>n</i>	%	SPQ Presenteeism		HPQ Presenteeism	
			Median (IQR)	<i>P</i>	Median (IQR)	<i>P</i>
All samples			20.0 (1.0–30.0)		40.0 (20.0–50.0)	
Sex						
Male	767	69	20.0 (0.0–30.0)	0.054	40.0 (30.0–50.0)	0.034
Female	353	32	20.0 (10.0–30.0)		30.0 (20.0–50.0)	
Age, yr						
29 or younger	123	11	20.0 (10.0–30.0)	0.013	50.0 (40.0–52.5)	<0.001
30–39	218	20	20.0 (10.0–30.0)		40.0 (30.0–50.0)	
40–49	360	32	20.0 (0.0–30.0)		40.0 (20.0–50.0)	
50–59	254	23	15.0 (0.0–27.5)		30.0 (20.0–50.0)	
60 or older	165	15	20.0 (0.0–23.8)		30.0 (20.0–40.0)	
Job						
Managerial	175	16	20.0 (0.0–30.0)	0.006	40.0 (30.0–50.0)	0.003
Expert/technical	237	21	20.0 (0.0–30.0)		40.0 (20.0–50.0)	
Clerical	264	24	20.0 (5.0–30.0)		30.0 (20.0–50.0)	
Sales/services	90	8	20.0 (10.0–31.3)		40.0 (30.0–50.0)	
Production	120	11	20.0 (10.0–30.0)		40.0 (30.0–50.0)	
Transportation/machinery	53	5	10.0 (0.0–20.0)		20.0 (10.0–40.0)	
Construction	133	12	20.0 (10.0–30.0)		40.0 (20.0–50.0)	
Other	48	4	20.0 (7.5–30.0)		40.0 (22.5–50.0)	
Employment status						
Regular	934	84	20.0 (0.0–30.0)	0.541	40.0 (20.0–50.0)	0.015
Non-regular	177	16	20.0 (5.0–30.0)		30.0 (20.0–50.0)	
Shifts						
No	1043	94	20.0 (0.0–30.0)	0.030	40.0 (20.0–50.0)	0.563
Yes (double or triple)	67	6	20.0 (10.0–30.0)		40.0 (22.5–50.0)	
Night work						
No	1037	93	20.0 (0.0–30.0)	<0.001	40.0 (20.0–50.0)	0.031
Yes	81	7	20.0 (10.0–30.0)		40.0 (30.0–50.0)	
Childcare commitments						
No	915	84	20.0 (0.5–30.0)	0.869	40.0 (20.0–50.0)	0.793
Yes	176	16	20.0 (10.0–30.0)		40.0 (30.0–50.0)	
Older care commitments						
No	1023	93	20.0 (0.0–30.0)	0.567	40.0 (20.0–50.0)	0.658
Yes	76	7	20.0 (10.0–30.0)		40.0 (20.0–50.0)	

Two tests were used in the univariate analyses: the Wilcoxon rank-sum test was used for variables with two subgroups, and the Kruskal–Wallis test was used for those with three or more subgroups. HPQ, health and work performance questionnaire; IQR, interquartile range; SPQ, single-item presenteeism question.

SPQ/HPQ presenteeism is shown for each subgroup. All subgroups had at least 50 samples, which demonstrated the relationship between the SPQ and the subgroups with “adequate” quality.³⁰

SPQ presenteeism had less significant differences between the subgroups compared with HPQ presenteeism. SPQ presenteeism correlated significantly with age, job, shifts, and night work. From the results of multiple tests, SPQ presenteeism for those in their 30s was significantly greater than for those in their 50s, and that for those who work in sales/services was significantly greater than for those who work in managerial positions. Meanwhile, HPQ presenteeism correlated significantly with sex, age, job, employment status, and night work. From the results of multiple tests, HPQ presenteeism for those in their 20s was significantly greater than any other age group, that for those in their 30s was significantly greater than those in their 50s and 60s, and that for those in their 40s was significantly greater than those in their 60s. HPQ presenteeism for those who work in transportation/machinery was significantly smaller than for those who work in managerial, expert/technical, clerical, sales/services, production, and construction positions. Childcare/elder care commitments showed no correlation with either SPQ or HPQ presenteeism.

Comparison With Predictors

The results of testing construct validity (comparison of SPQ/HPQ presenteeism with predictors) are presented in Tables 2–4. The

predictors were all measured synchronously, and none of their subgroups had fewer than 100 samples, which demonstrated the relationship between the SPQ and the predictors with “very good” quality.³⁰

Table 2 shows the results of testing construct validity (relationships of the predictors with SPQ/HPQ presenteeism). Regarding the SPQ data, absenteeism was associated with a significantly higher rating for SPQ presenteeism. Most of the subjective health risks were, likewise, associated with a higher rating for SPQ presenteeism—the exceptions being physical activity and drinking habit. Respondents with low work engagement and low workplace social capital gave significantly higher ratings for SPQ presenteeism. The results for HPQ were similar, except that absenteeism, malaise, and smoking showed no significant association with HPQ presenteeism.

We calculated two adjusted odds ratios for absenteeism, subjective health risks, work engagement, and workplace social capital for low performers versus middle performers (reference), and high performers versus middle performers (reference), as measured by SPQ (Table 3). Given the distribution of SPQ presenteeism ratings, low performers were defined as those with an SPQ presenteeism rating of at least 30% ($n = 311$, 29%), and high performers were defined as those with an SPQ presenteeism rating of 0% ($n = 263$, 25%). Middle performers measured by SPQ were defined as those who were neither low nor high performers ($n = 487$, 46%). Risk of absenteeism, subjective general health, job satisfaction, and high

TABLE 2. The Result of Hypotheses Testing for Construct Validity

	<i>n</i>	<i>%</i>	SPQ Presenteeism		HPQ Presenteeism	
			Median (IQR)	<i>P</i>	Median (IQR)	<i>P</i>
Absenteeism						
0 No risk	925	89	20.0 (0.0–30.0)	<0.001	40 (20–50)	0.687
1 Risk present	117	11	20.0 (20.0–35.0)		35 (20–50)	
Malaise						
0 No risk	798	72	20.0 (0.0–30.0)	0.033	40 (20–50)	0.565
1 Risk present	304	28	20.0 (8.8–30.0)		40 (20–50)	
Subjective general health						
0 No risk	965	87	20.0 (0.0–30.0)	<0.001	40 (20–50)	<0.001
1 Risk present	147	13	20.0 (10.0–40.0)		40 (30–60)	
Job satisfaction						
0 No risk	778	70	15.0 (0.0–20.0)	<0.001	30 (20–50)	<0.001
1 Risk present	331	30	20.0 (10.0–40.0)		40 (30–50)	
Family life satisfaction						
0 No risk	924	83	20.0 (0.0–30.0)	0.003	40 (20–50)	<0.001
1 Risk present	186	17	20.0 (10.0–30.0)		40 (30–52.5)	
High stress						
0 No risk	898	83	20.0 (0.0–25.0)	<0.001	30 (20–50)	<0.001
1 Risk present	183	17	30.0 (20.0–40.0)		50 (40–60)	
Physical activity						
0 No risk	348	32	15.0 (0.0–30.0)	0.130	40 (20–50)	0.421
1 Risk present	750	68	20.0 (5.0–30.0)		40 (20–50)	
Dietary habit						
0 No risk	983	89	20.0 (0.0–30.0)	0.015	40 (20–50)	0.006
1 Risk present	117	11	20.0 (10.0–35.0)		40 (30–50)	
Sleep quality						
0 No risk	620	56	15.0 (0.0–30.0)	<0.001	30 (20–50)	0.007
1 Risk present	480	44	20.0 (10.0–30.0)		40 (20–50)	
Drinking habit						
0 No risk	973	88	20.0 (1.0–30.0)	0.256	40 (20–50)	0.288
1 Risk present	139	13	20.0 (0.0–27.5)		40 (20–50)	
Smoking						
0 No risk	743	68	20.0 (0.0–30.0)	0.004	30 (20–50)	0.053
1 Risk present	356	32	20.0 (10.0–30.0)		40 (30–50)	
Work engagement						
0 High	556	51	10.0 (0.0–20.0)	<0.001	30 (20–40)	<0.001
1 Low	532	49	20.0 (10.0–30.0)		40 (30–50)	
Workplace social capital						
0 High	758	70	20.0 (0.0–29.0)	<0.001	30 (20–50)	<0.001
1 Low	330	30	20.0 (10.0–33.8)		40 (30–50)	

In the univariate analyses, the Wilcoxon rank-sum test was used for each variable. HPQ, health and work performance questionnaire; IQR, interquartile range; SPQ, single-item presenteeism question.

TABLE 3. The Result of Multiple Logistic Regression Analysis of SPQ

	Low Performers vs Middle Performers (Reference)			High Performers vs Middle Performers (Reference)		
	OR	95% CI	<i>P</i>	OR	95% CI	<i>P</i>
Absenteeism	1.27	1.08–1.49	0.005	0.48	0.30–0.79	0.004
Malaise	1.21	0.88–1.67	0.239	0.80	0.56–1.14	0.220
Subjective general health	1.66	1.12–2.47	0.012	0.50	0.29–0.86	0.013
Job satisfaction	2.19	1.60–2.99	<0.001	0.61	0.42–0.89	0.011
Family life satisfaction	1.26	0.87–1.84	0.222	0.72	0.46–1.13	0.156
High stress	2.87	1.99–4.15	<0.001	0.57	0.33–0.99	0.045
Physical activity	1.03	0.74–1.42	0.867	0.85	0.61–1.19	0.351
Dietary habit	1.65	1.05–2.61	0.032	0.99	0.58–1.71	0.985
Sleep quality	1.18	0.88–1.59	0.262	0.61	0.44–0.84	0.002
Drinking habit	0.78	0.50–1.24	0.294	0.86	0.55–1.35	0.519
Smoking	1.57	1.14–2.18	0.007	0.79	0.56–1.13	0.198
Work engagement	2.26	1.67–3.07	<0.001	0.75	0.55–1.03	0.077
Workplace social capital	1.74	1.28–2.37	<0.001	0.94	0.66–1.33	0.723

The model includes sex and age as controls. CI, confidence interval; OR, odds ratio; SPQ, single-item presenteeism question.

TABLE 4. The Result of Multiple Logistic Regression Analysis of HPQ

	Low Performers vs Middle Performers (Reference)			High Performers vs Middle Performers (Reference)		
	OR	95% CI	P	OR	95% CI	P
Absenteeism	1.19	1.02–1.40	0.032	1.16	0.92–1.47	0.203
Malaise	1.35	0.97–1.88	0.072	1.26	0.89–1.77	0.197
Subjective general health	1.75	1.16–2.65	0.007	0.78	0.47–1.28	0.319
Job satisfaction	2.20	1.60–3.02	<0.001	0.84	0.58–1.22	0.351
Family life satisfaction	1.97	1.34–2.89	<0.001	1.10	0.70–1.72	0.681
High stress	2.79	1.91–4.07	<0.001	0.63	0.37–1.08	0.093
Physical activity	1.30	0.94–1.79	0.116	0.88	0.63–1.23	0.466
Dietary habit	1.34	0.85–2.13	0.211	0.92	0.53–1.58	0.756
Sleep quality	1.34	1.00–1.79	0.051	0.98	0.71–1.34	0.895
Drinking habit	0.87	0.56–1.36	0.552	1.17	0.74–1.84	0.493
Smoking	1.14	0.83–1.56	0.425	0.82	0.57–1.16	0.257
Work engagement	2.23	1.65–3.00	<0.001	0.62	0.45–0.85	0.003
Workplace social capital	1.65	1.22–2.25	0.001	0.79	0.55–1.12	0.184

The model includes sex and age as controls. CI, confidence interval; HPQ, health and work performance questionnaire; OR, odds ratio.

stress were associated with significantly increased odds for low performers versus middle performers (reference), and decreased odds for high performers versus middle performers (reference). The respondents with dietary habit risk, smoking risk, low work engagement, and low workplace social capital were significantly more likely to be low performers than middle performers. Sleep quality risk was associated with significantly decreased odds for high performers as compared with middle performers.

Table 4 shows the results of multiple logistic regression analysis of the HPQ. Given the distribution of HPQ presenteeism ratings, low performers were defined as those with an HPQ presenteeism rating of at least 50% ($n = 382$, 35%), and high performers were defined as those with an HPQ presenteeism rating of less than 20% ($n = 297$, 27%). Middle performers measured by HPQ were defined as those who were neither low nor high performers ($n = 410$, 38%). The results were similar to those for the SPQ data for some items; however, all predictors except work engagement were not significantly related to the odds ratios for high performers versus middle performers (reference). Additionally, dietary habit, sleep quality, and smoking risks—all of which were significant in the case of SPQ performance—were not significantly related to HPQ presenteeism.

Responsiveness

Tables 5 and 6 show changes in SPQ/HPQ presenteeism and changes in predictors of presenteeism. For most predictors, the subgroups (reduced, no change, gained) each had at least 50 samples (the exceptions being dietary habit, drinking habit, and smoking), which demonstrated responsiveness with “adequate” quality.³⁰

Tables 5 and 6 show the results of multiple comparison tests of changes in SPQ/HPQ presenteeism and changes in the predictors of presenteeism (as represented by the three subgroups reduced, no change, and gained). As for SPQ presenteeism, for all predictors except sleep quality, the gained subgroup was, as expected, significantly associated with an increase in SPQ presenteeism. For HPQ presenteeism, the results were similar to those for SPQ presenteeism with the exception that for family life satisfaction, dietary habit, and drinking habit, the gained subgroup was associated with a decrease in HPQ presenteeism.

DISCUSSION

We developed the SPQ as a single-item instrument for measuring absolute presenteeism. The SPQ showed adequate

construct validity in that it was significantly associated with absenteeism, subjective health risks except physical activity and drinking habit, work engagement, and workplace social capital. Regarding responsiveness, unfavorable change in every predictor of presenteeism, except sleep quality, was associated, unsurprisingly, with an increase in SPQ presenteeism.

The construct validity of the SPQ was superior to that of the HPQ in three respects. First, the SPQ correlated with more of the predictors than did the HPQ. The former showed particularly strong associations with absenteeism, malaise, and lifestyle-related risks (eg, smoking). Second, high performers in the SPQ were significantly less likely to have absenteeism and four subjective health risks (subjective general health, job satisfaction, high stress, and sleep quality), whereas high performance in HPQ presenteeism showed no significant association with absenteeism and all subjective health risks. Third, the SPQ was minimally affected by the additional variables (respondents’ personal attributes and job details), as evidenced from the fact that inter-subgroup variation for the SPQ was less than that for the HPQ. Thus, if researchers use the SPQ, they could compare presenteeism in different workplaces without needing to worry about variation in workplace composition or job details.

The SPQ responded, as expected, to changes in the recognized predictors of presenteeism. Increases in absenteeism, subjective health risks, work engagement, and workplace social capital were accompanied by an increase in SPQ presenteeism. Conversely, HPQ ratings, contrary to expectation, decreased with increases in some predictors, particularly dietary and drinking habit. Statistically speaking, however, neither the SPQ nor the HPQ demonstrated adequate responsiveness. This finding is consistent with a review by Noben et al,³³ which noted that none of the presenteeism instruments they considered (eg, the World Health Organization’s health and work performance questionnaire [HPQ], the Stanford presenteeism scale [SPS], the work limitations questionnaire [WLQ]) showed adequate responsiveness. In another review, Ospina et al²⁹ confirmed responsiveness of three presenteeism instruments (SPS, Endicott Work Productivity Scale, Work Productivity and Activity Impairment Questionnaire in Crohn disease), citing two reports for which the quality was rated excellent/good. However, neither of these studies were conducted with the general population; the first study was conducted with people with rheumatoid arthritis or osteoarthritis,³⁴ while the second was conducted on people with Crohn disease.³⁵ Thus, further research is needed to examine the responsiveness of the SPQ and other presenteeism instruments.

TABLE 5. The Results of Hypotheses Testing for the Responsiveness of the SPQ

Change in the Predictors	n	%	Change in SPQ Presenteeism		Change in the Predictors						
			Mean	SD	Reduced			No Change			
					Diff	95% CI	P ^a	Diff	95% CI	P ^a	
Absenteeism											
Reduced	78	8	-1.4	21.2							
No change	815	82	-0.1	17.9	1.3	-3.9-6.5	0.826				
Gained	101	10	5.1	22.5	6.6	-0.1-13.2	0.053	5.3	0.6-9.9	0.021	
Malaise											
Reduced	128	13	-1.1	13.9							
No change	739	74	0.2	18.6	1.3	-2.9-5.5	0.758				
Gained	131	13	0.8	22.6	2.0	-3.5-7.4	0.676	0.7	-3.5-4.8	0.920	
Subjective general health											
Reduced	65	6	-1.0	18.7							
No change	891	87	0.0	18.6	0.9	-4.8-6.6	0.922				
Gained	70	7	2.9	22.8	3.9	-3.7-11.6	0.453	3.0	-2.5-8.5	0.414	
Job satisfaction											
Reduced	111	11	-1.1	21.8							
No change	811	79	-0.1	17.9	1.0	-3.5-5.5	0.855				
Gained	102	10	4.5	22.7	5.6	-0.4-11.7	0.075	4.6	0-9.3	0.052	
Family life satisfaction											
Reduced	76	7	0.6	22.9							
No change	893	87	0.1	18.7	-0.5	-5.8-4.8	0.975				
Gained	55	5	1.4	16.6	0.8	-7.1-8.7	0.968	1.3	-4.9-7.5	0.874	
High stress											
Reduced	65	7	-4.3	16.4							
No change	843	86	0.6	18.2	4.9	-0.7-10.4	0.100				
Gained	73	7	1.9	21.6	6.2	-1.1-13.5	0.117	1.3	-3.9-6.6	0.821	
Physical activity											
Reduced	116	12	0.7	17.9							
No change	754	76	-0.4	18.8	-1.1	-5.5-3.3	0.824				
Gained	128	13	3.3	19.0	2.6	-3.1-8.2	0.531	3.7	-0.5-7.9	0.099	
Dietary habit											
Reduced	34	3	-3.2	17.6							
No change	943	93	0.3	19.0	3.5	-4.2-11.3	0.536				
Gained	37	4	1.9	18.2	5.2	-5.4-15.7	0.487	1.6	-5.8-9.1	0.865	
Sleep quality											
Reduced	138	14	-1.6	19.0							
No change	772	76	0.6	18.9	2.2	-1.9-6.3	0.410				
Gained	105	10	-0.5	19.7	1.1	-4.6-6.9	0.893	-1.1	-5.7-3.5	0.838	
Drinking habit											
Reduced	30	3	0.5	21.7							
No change	952	94	0.1	19.0	-0.4	-8.7-7.8	0.992				
Gained	36	4	2.4	17.1	1.9	-9.1-13	0.910	2.4	-5.2-9.9	0.744	
Smoking											
Reduced	29	3	-2.9	27.1							
No change	961	95	0.2	18.6	3.1	-5.3-11.5	0.662				
Gained	23	2	5.9	20.5	8.8	-3.6-21.2	0.221	5.7	-3.7-15.1	0.328	
Work engagement											
Reduced	102	10	-4.9	19.2							
No change	768	77	0.3	18.9	5.3	0.6-9.9	0.021				
Gained	122	12	3.0	17.9	7.9	2-13.8	0.005	2.6	-1.7-6.9	0.327	
Workplace social capital											
Reduced	70	7	-0.9	20.8							
No change	780	78	-0.1	18.0	0.8	-4.7-6.3	0.941				
Gained	144	14	2.0	22.0	2.9	-3.6-9.3	0.546	2.1	-1.9-6.1	0.438	

For SPQ presenteeism, a positive value indicates an increase in productivity loss. CI, confidence interval; Diff, difference; Pa, adjusted P-value; SD, standard deviation; SPQ, single-item presenteeism question.

The results of the present study suggest that the SPQ is a useful tool for measuring an employer’s HPM efforts in three respects. First, the SPQ is simple, consisting of just one question item. It also has universal viability since the scale requires no basis for comparison. Second, the SPQ recognizes employees with less

absenteeism, better physical and mental health, and healthy lifestyles as high-performing employees, and workplaces with numerous such employees as high-performing workplaces. That is, the SPQ demonstrates excellent construct validity for absenteeism, one form of work productivity losses, and subjective health risks.

TABLE 6. The Results of Hypotheses Testing for the Responsiveness of the HPQ

Change in the Predictors	n	%	Change in HPQ Presenteeism		Change in the Predictors						
			Mean	SD	Reduced Risk			No Change			
					Diff	95% CI	P ^a	Diff	95% CI	P ^a	
Absenteeism											
Reduced	76	8	-0.8	15.8							
No change	802	83	-1.1	17.4	-0.3	-5.2-4.5	0.987				
Gained	94	10	4.6	16.8	5.4	-0.9-11.6	0.108	5.7	1.3-10.1	0.007	
Malaise											
Reduced	127	13	-2.4	15.2							
No change	741	74	-0.5	17.8	1.9	-2.1-5.8	0.507				
Gained	127	13	1.2	17.5	3.5	-1.6-8.7	0.238	1.7	-2.2-5.6	0.575	
Subjective general health											
Reduced	70	7	-2.4	16.2							
No change	901	87	-0.4	17.5	2.1	-3-7.2	0.604				
Gained	69	7	0.4	18.4	2.9	-4.1-9.8	0.598	0.8	-4.3-5.9	0.930	
Job satisfaction											
Reduced	112	11	-2.4	15.9							
No change	821	79	-1.0	16.9	1.5	-2.6-5.6	0.681				
Gained	106	10	5.6	21.5	8.0	2.5-13.5	0.002	6.5	2.3-10.7	0.001	
Family life satisfaction											
Reduced	76	7	-2.8	22.5							
No change	905	87	-0.2	16.8	2.5	-2.4-7.4	0.443				
Gained	59	6	-0.2	20.3	2.6	-4.5-9.7	0.669	0.1	-5.5-5.6	1.000	
High stress											
Reduced	64	7	-8.0	14.3							
No change	838	86	-0.4	17.2	7.6	2.3-12.9	0.002				
Gained	75	8	3.6	20.6	11.6	4.6-18.5	0.000	4.0	-0.9-8.9	0.141	
Physical activity											
Reduced	119	12	-1.6	17.8							
No change	756	76	-0.8	16.7	0.8	-3.3-4.8	0.897				
Gained	121	12	2.2	21.1	3.8	-1.5-9.1	0.206	3.1	-0.9-7.1	0.172	
Dietary habit											
Reduced	34	3	-3.8	17.1							
No change	956	93	-0.1	17.6	3.7	-3.5-10.9	0.453				
Gained	39	4	-3.6	16.9	0.2	-9.5-9.9	0.998	-3.5	-10.2-3.3	0.452	
Sleep quality											
Reduced	136	13	-0.1	16.8							
No change	787	76	-0.8	17.8	-0.6	-4.4-3.2	0.925				
Gained	106	10	1.8	16.7	1.9	-3.4-7.3	0.671	2.6	-1.7-6.8	0.339	
Drinking habit											
Reduced	30	3	-3.0	19.7							
No change	965	93	-0.2	17.3	2.8	-4.8-10.4	0.671				
Gained	38	4	-1.3	19.5	1.7	-8.3-11.7	0.918	-1.1	-7.9-5.7	0.926	
Smoking											
Reduced	30	3	-0.3	20.8							
No change	973	95	-0.5	17.3	-0.1	-7.8-7.5	0.999				
Gained	23	2	1.3	24.6	1.6	-9.8-13.1	0.940	1.8	-6.9-10.5	0.881	
Work engagement											
Reduced	107	10	-6.5	17.2							
No change	803	78	-0.2	17.1	6.4	2.2-10.6	0.001				
Gained	126	12	2.4	18.5	8.9	3.6-14.3	0.000	2.5	-1.3-6.4	0.275	
Workplace social capital											
Reduced	75	7	0.0	19.9							
No change	812	78	-0.8	17.0	-0.8	-5.8-4.1	0.919				
Gained	148	14	0.9	18.1	0.9	-4.8-6.7	0.922	1.8	-1.9-5.4	0.491	

For HPQ presenteeism, a positive value indicates an increase in productivity loss. CI, confidence interval; Diff, difference; HPQ, health and work performance questionnaire; Pa, adjusted *P*-value; SD, standard deviation.

Employers can use SPQ-measured presenteeism to determine the share of employees with these risks and use this metric to measure workplace health promotion efforts. Third, the SPQ is minimally affected by respondents' personal attributes and job details. Inter-subgroup variation in average rating was less in the SPQ than in the

HPQ. It is reasonable to assume that this reduced variation is the result of modifying the self-anchoring scale of the HPQ.

This study revealed some caveats when using the SPQ to measure the success of HPM efforts. In the responsiveness test, SPQ presenteeism was statistically unresponsive to changes in individual

lifestyle-related risks. Similarly, Burton et al³⁶ found no significant correlation between changes in lifestyle variables (including smoking, physical activity, and drinking habit) and changes in presenteeism. It is likely, therefore, that the changes in presenteeism were attributable to changes in a variable other than the predictor of interest, or to changes in a combination of predictors. The literature supports such an assumption; recent studies have shown that integrating the promotion of employee health with the promotion of workplace performance is an effective strategy for mitigating presenteeism. Two reviews of workplace health promotion^{37,38} highlighted two integrated interventions that led to an improvement in workplace performance. Additionally, von Thiele Schwarz et al³⁹ reported that presenteeism improved following an intervention that integrated health protection/promotion with a system of continuous improvement (Japanese: *Kaizen*), without specifying the risks to mitigate. Tsutsumi et al⁴⁰ reported favorable changes in stress and presenteeism following an intervention that focused on environment or job redesign, rather than behavioral change in symptoms of ill health. Thus, when using the SPQ to measure HPM outcomes, it is necessary to ascertain changes at a workplace level in addition to changes in respondents' health risks.

Limitations

This study had two key limitations. First, the results were based on subjective responses. Data were obtained using a self-report questionnaire in which respondents subjectively rated their SPQ, HPQ, absenteeism, subjective health risks, work engagement, and workplace social capital.

Second, this study was validated with respect to construct validity and responsiveness of SPQ. Thus, other measurement properties, such as criterion validity and reliability, needed to be verified in future studies.

CONCLUSION

This study revealed some support for the construct validity and responsiveness of the SPQ. Its construct validity was equal or superior to that of the HPQ. Although the responsiveness of the SPQ was limited, it did respond to changes in predictors of presenteeism, as expected. Thus, the SPQ provides, in a single question, a simple measure of presenteeism without sacrificing construct validity or responsiveness. As such, it provides a useful means to evaluate the success of HPM measures. Future studies of SPQ should be conducted in various types of businesses and areas, and with different time intervals, to further test responsiveness.

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REFERENCES

- Brouwer WB, Koopmanschap MA, Rutten FF. Productivity losses without absence: measurement validation and empirical evidence. *Health Policy*. 1999;48:13–27.
- Nagata T, Mori K, Ohtani M, et al. Total health-related costs due to absenteeism, presenteeism, and medical and pharmaceutical expenses in Japanese employers. *J Occup Environ Med*. 2018;60:e273.
- Ministry of Economy Trade and Industry. Announcement of organizations recognized under the 2020 Certified Health & Productivity Management Outstanding Organizations Recognition Program; 2020. Available at: https://www.meti.go.jp/english/press/2020/0302_001.html. Accessed August 8, 2020.
- Koopman C, Pelletier KR, Murray JF, et al. Stanford Presenteeism scale: health status and employee productivity. *J Occup Environ Med*. 2002;44:14–20.
- Lerner D, Amick BC 3rd, Rogers WH, et al. Thework limitations questionnaire. *MedCare*. 2001;39:72–85.
- Kessler RC, Barber C, Beck A, et al. The World Health Organization health and work performance questionnaire (HPQ). *J Occup Environ Med*. 2003;45:156–174.
- Loeppke R, Taitel M, Haufle V, Parry T, Kessler RC, Jinnett K. Health and productivity as a business strategy: a multiemployer study. *J Occup Environ Med*. 2009;51:411–428.
- World Health Organization. HPQ Short Form; 2007. Available at: <https://www.hcp.med.harvard.edu/hpq/info.php>. Accessed August 8, 2020.
- Suzuki T, Miyaki K, Song Y, et al. Relationship between sickness presenteeism (WHO-HPQ) with depression and sickness absence due to mental disease in a cohort of Japanese workers. *J Affect Disord*. 2015;180:14–20.
- Pereira MJ, Johnston V, Straker LM, et al. An investigation of self-reported health-related productivity loss in office workers and associations with individual and work-related factors using an employer's perspective. *J Occup Environ Med*. 2017;59:e138–e144.
- Zhang W, Gignac MA, Beaton D, Tang K, Anis AH. Productivity loss due to presenteeism among patients with arthritis: estimates from 4 instruments. *J Rheumatol*. 2010;37:1805–1814.
- Guertler D, Vandelanotte C, Short C, Alley S, Schoeppe S, Duncan MJ. The association between physical activity, sitting time, sleep duration, and sleep quality as correlates of presenteeism. *J Occup Environ Med*. 2015;57:321–328.
- Ma L, Ye R. Does daily commuting behavior matter to employee productivity? *J Transp Geogr*. 2019;76:130–141.
- Scuffham PA, Vecchio N, Whiteford HA. Exploring the validity of HPQ-based presenteeism measures to estimate productivity losses in the health and education sectors. *Med Decis Making*. 2014;34:127–137.
- Kawakami N, Inoue A, Tsuchiya M, et al. Construct validity and test-retest reliability of the World Mental Health Japan version of the World Health Organization Health and Performance Questionnaire Short Version: a preliminary study. *Ind Health*. 2020;58:375–387.
- World Health Organization. HPQ Short Form (Japanese). Available at: https://www.hcp.med.harvard.edu/hpq/ftplib/WMHJ-HPQ-SF_2018.pdf. Accessed August 12, 2020.
- Leineweber C, Westerlund H, Hagberg J, Svedberg P, Alexanderson K. Sickness presenteeism is more than an alternative to sickness absence: results from the population-based SLOSH study. *Int Arch Occup Environ Health*. 2012;85:905–914.
- Ministry of Health Labour and Welfare. Summary report of comprehensive survey of living conditions; 2016. Available at: https://www.mhlw.go.jp/english/database/db-hss/dl/report_gaikyo_2016.pdf. Accessed August 12, 2020.
- Ministry of Health Labour and Welfare. The Brief Job Stress Questionnaire English version; 2019. Available at: https://www.mhlw.go.jp/bunya/roudou-kijun/anzenisei12/dl/stress-check_e.pdf. Accessed August 8, 2020.
- Furukawa TA, Kawakami N, Saitoh M, et al. The performance of the Japanese version of the K6 and K10 in the world mental health survey Japan. *Int J Methods Psychiatr Res*. 2008;17:152–158.
- Kessler RC, Barker PR, Colpe LJ, et al. Screening for serious mental illness in the general population. *Arch Gen Psychiatry*. 2003;60:184–189.
- National Institute of Health and Nutrition. Health Japan 21 (the second term) Annual changes in current data; 2020. Available at: <https://www.nibiohn.go.jp/eiken/kenkouinippon21/en/kenkouinippon21/data03.html#e01>. Accessed August 8, 2020.
- Shiga Federation of National Health Insurance Organization. Questionnaire on specific health examination; 2018. Available at: [http://www.shigakokuho.or.jp/cmsfiles/contents/0000000/60/englishi\(H30kara\).pdf](http://www.shigakokuho.or.jp/cmsfiles/contents/0000000/60/englishi(H30kara).pdf). Accessed August 8, 2020.
- Burton WN, Chen CY, Li X, Schultz AB. The association of employee engagement at work with health risks and presenteeism. *J Occup Environ Med*. 2017;59:988–992.
- Okazaki E, Nishi D, Susukida R, Inoue A, Shimazu A, Tsutsumi A. Association between working hours, work engagement, and work productivity in employees: a cross-sectional study of the Japanese Study of Health, Occupation, and Psychosocial Factors Relates Equity. *J Occup Health*. 2019;61:182–188.
- Inoue A, Kawakami N, Shimomitsu T, et al. Development of a short questionnaire to measure an extended set of job demands, job resources, and positive health outcomes: the new brief job stress questionnaire. *Ind Health*. 2014;52:175–189.
- Zhu Y, Gao J, Wang J, et al. Association between workplace social capital and absolute presenteeism: a multilevel study in a Chinese context. *J Occup Environ Med*. 2018;60:e543–e547.

28. Ministry of Internal Affairs and Communications. Japan Standard Occupational Classification; 2009. Available at: https://www.soumu.go.jp/english/dgpp_ss/seido/shokgyou/co09-2.htm. Accessed August 8, 2020.
29. Ospina MB, Dennett L, Waye A, Jacobs P, Thompson AH. A systematic review of measurement properties of instruments assessing presenteeism. *Am J Manag Care*. 2015;21:e171–e185.
30. Mokkink LB, Prinsen CA, Patrick DL, et al. COSMIN study design checklist for patient-reported outcome measurement instruments; 2019. Available at: https://www.cosmin.nl/wp-content/uploads/COSMIN-study-designing-checklist_final.pdf#. Accessed August 8, 2020.
31. R Foundation. Statutes of “The R Foundation for Statistical Computing.” 2002. Available at: <https://www.r-project.org/foundation/Rfoundation-statutes.pdf>. Accessed August 12, 2020.
32. Terry PE, Xi M. An examination of presenteeism measures: the association of three scoring methods with health, work life, and consumer activation. *Popul Health Manag*. 2010;13:297–307.
33. Noben CY, Evers SM, Nijhuis FJ, de Rijk AE. Quality appraisal of generic self-reported instruments measuring health-related productivity changes: a systematic review. *BMC Public Health*. 2014;14:115.
34. Beaton DE, Tang K, Gignac MA, et al. Reliability, validity, and responsiveness of five at-work productivity measures in patients with rheumatoid arthritis or osteoarthritis. *Arthritis Care Res*. 2010;62:28–37.
35. Reilly MC, Gerlier L, Brabant Y, Brown M. Validity, reliability, and responsiveness of the work productivity and activity impairment questionnaire in Crohn’s disease. *Clin Ther*. 2008;30:393–404.
36. Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW. The association between health risk change and presenteeism change. *J Occup Environ Med*. 2006;48:252–263.
37. Grimani A, Aboagye E, Kwak L. The effectiveness of workplace nutrition and physical activity interventions in improving productivity, work performance and workability: a systematic review. *BMC Public Health*. 2019;19:1676.
38. Tarro L, Llauradó E, Ulldemolins G, Hermoso P, Solà R. Effectiveness of workplace interventions for improving absenteeism, productivity, and work ability of employees: a systematic review and meta-analysis of randomized controlled trials. *Int J Environ Res Public Health*. 2020;17:1901.
39. von Thiele Schwarz U, Augustsson H, Hasson H, Stenfors-Hayes T. Promoting employee health by integrating health protection, health promotion, and continuous improvement: a longitudinal quasi-experimental intervention study. *J Occup Environ Med*. 2015;57:217–225.
40. Tsutsumi A, Nagami M, Yoshikawa T, Kogi K, Kawakami N. Participatory intervention for workplace improvements on mental health and job performance among blue-collar workers: a cluster randomized controlled trial. *J Occup Environ Med*. 2009;51:554–563.