

BMJ Open Association of work performance and interoceptive awareness of 'body trusting' in an occupational setting: a cross-sectional study

Chisato Tanaka ^{1,2}, Kenta Wakaizumi ^{3,4}, Shizuko Kosugi,^{2,5} Shintaro Tanaka,¹ Ko Matsudaira,⁶ Hiroshi Morisaki,⁵ Masaru Mimura,¹ Daisuke Fujisawa^{1,2}

To cite: Tanaka C, Wakaizumi K, Kosugi S, *et al*. Association of work performance and interoceptive awareness of 'body trusting' in an occupational setting: a cross-sectional study. *BMJ Open* 2021;**11**:e044303. doi:10.1136/bmjopen-2020-044303

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-044303>).

Received 29 August 2020
Revised 04 February 2021
Accepted 04 March 2021



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Dr Shizuko Kosugi;
shizuko.kosugi@gmail.com

ABSTRACT

Objectives Work performance has been known to be influenced by both psychological stress (mind) and physical conditions (body). The aim of this study was to investigate the association between work performance and 'body trusting', which is a dimension of interoceptive awareness representing mind–body interactions.

Methods A cross-sectional study was conducted among a sample of workers in an industrial manufacturing company in Japan. Participants were assessed with a self-reported questionnaire including evaluations of work performance, body trusting, psychological distress, pain persistence, workplace and home stressors, and workaholism. Participants' sociodemographic, health and lifestyle characteristics were collected from their annual health check data. The association between work performance and body trusting was examined using multivariable regression analyses in the overall sample and in a subsample of people with pain.

Results A total of 349 workers participated in the study. A significant association between work performance and body trusting was observed, with higher body trusting representing higher work performance. The association was significant after controlling for psychological distress, workplace and home stress, workaholism and participants' characteristics ($p < 0.001$). Compared with people without pain ($n = 126$, 36.1%), people with pain ($n = 223$, 63.9%) showed less body trusting, which was associated with decreased work performance after controlling for pain-related variables ($p < 0.001$).

Conclusions Workers with higher body trusting showed higher work performance, even after controlling for various influencing factors. Body trusting may be an important target to promote work performance and to prevent loss of performance induced by health problems.

INTRODUCTION

The promotion of work performance and occupational health is an urgent task in modern industrial society. Especially in developed countries with an ageing population and low birth rate, the negative impacts of decreasing productivity on national gross domestic product are spreading.¹ The ratio

Strengths and limitations of this study

- This is the first study that demonstrated the effect of individuals' level of 'body trusting' on work performance.
- This effect was significant after controlling for pain, workplace stressors and mental health factors.
- Our findings imply that interventions to improve body trusting, such as mindfulness, may increase work performance.
- This is a single-centre, cross-sectional study with limited generalisability and a lack of information on cause–effect relationships.

of the population aged 65 and over to the total population in Japan was 28.1% as of 2019²; this ratio is expected to increase further, with a declining total population as well as a declining working age population. Therefore, qualitative strengthening of the labour force is an emerging issue.³ The Japanese Ministry of Economy, Trade and Industry advocates 'Health and productivity management', which encourages companies to commit strategically to employees' health promotion such as by increasing the rate of medical examinations, working towards early detection of mental illness and intervening in lifestyle habits such as smoking and drinking. These investments in employees' health are intended to enhance the employees' work performance and the corporation's value.⁴

Work performance is influenced by both psychological stress and physical health problems.⁵ Stress-related mental illnesses, such as depression and anxiety disorders, are important risk factors that impair work performance.⁶ Second to mental problems, physical disabilities that incur pain such as chronic low back pain have a strong impact on work productivity loss.⁷ Since pain intensity, frequency and duration are critical



factors in determining the impact on physical disability,⁸ these pain characteristics are related to lowered performance in people with pain.

In addition, there is an interaction effect between psychological stress and physical disability. Mind and body relate to each other and together can impact health in synergy. For example, people with pain frequently show psychological distress, and people with heightened psychological distress are more vulnerable to pain and show a lower level of physical activity.⁹ However, little is known about the interaction effect between psychology and physical conditions on work performance.

A key construct of the mind–body interaction is known as interoceptive awareness, which is the conscious perception of sensations from inside the body that creates a sense of the physiological condition of the body, such as heartbeat, respiration, satiety and the autonomic nervous system related to emotions.¹⁰ Interoceptive awareness is composed of multiple dimensions, among which ‘not worrying’ and ‘body trusting’ have been reported to strongly associate with stress and depression.¹¹ Since the ‘not worrying’ dimension is considered not sufficiently robust,¹² in the current study, we focused on ‘body trusting’ as an index of interoceptive awareness.

Body trusting is an ‘attitude of body awareness’ in the process of examining the major components of interoceptive awareness. People with higher body trusting show more positive responses to bodily cues.¹³ Body listening skills to sense the experiences of one’s body actively are helpful to feel safety and trustworthiness in the body.¹⁴ Body trusting is associated with physical function in people with mental illness or pain,^{11 15} as is psychological well-being, which has been shown to clearly enhance work performance.¹⁶ We could not find any studies that specifically refer to the association between body trusting and work performance. Therefore, in the current study, we aimed to investigate that association and hypothesised that people with high levels of body trusting show better work performance even after controlling for factors that may influence that performance. Since pain is a common symptom that impairs psychological and physical well-being as well as work performance, this study also examines the association of body trusting and work performance while controlling for the influence of properties of pain.

METHODS

Study design

This cross-sectional survey was conducted in a technology development division of an industrial steel manufacturing company. The branch office in which we worked is located in the suburbs of Tokyo, Japan. The main tasks of the workers are documentation and data management concerning the development of new products and sales. Most employees are so-called white-collar workers who work mainly at their desks and are at potential risk for

pain and mental health problems caused by visual display terminal work and prolonged sitting posture.^{17 18}

This study was conducted in the form of a fill-in paper questionnaire. A set of questionnaires was distributed to all targets by the company’s healthcare administration team on 19 July 2018. The participants filled the questionnaires out individually and returned the completed questionnaires to our research unit by post. Anonymised data were collected by 10 August 2018. A total of 349 workers participated in the study. A multivariate regression analysis was used in three models in the total sample as well as four models in the pain subsample.

Participants

We included people (1) with full-time employment; (2) who consented to provide his/her annual health check data; (3) who were able to understand and complete the questionnaires in Japanese. All participants were informed about the aim of the study through the company’s intranet and a document attached to the questionnaires. They were informed that responding to the questionnaire was voluntary and that submitting the questionnaire means that they consented to participate in the study.

Patient and public involvement

Patients were not involved in the design, reporting or dissemination plans of our research.

Measurements

Work performance

The participants’ overall work performance was measured by the Japanese version of the WHO Health and Work Performance Questionnaire (HPQ) Short Form. Participants self-rated their work performance on the days they worked during the past 4 weeks using an 11-point Likert scale ranging from 0 (the lowest imaginable performance) to 10 (the highest imaginable performance). The HPQ has been validated in the Japanese population with a Cronbach’s α of 0.73.

Body trusting

The participants’ level of body trusting was measured with a subscale of the Multidimensional Assessment of Interoceptive Awareness (MAIA), a self-report questionnaire assessing interoceptive perception.¹⁴ The MAIA consists of eight dimensions: noticing, not ignoring, not worrying, attention regulation, emotional awareness, self-regulation, listening and trusting. The body trusting subscale contains three items: ‘I am at home in my body’, ‘I feel that my body is a safe place’ and ‘I trust my body sensations’. Each item was rated on a 5-point scale ranging from 0 (never) to 4 (always). The average score of the three items was used to estimate the level of body trusting. Higher scores indicate greater confidence and reliability in one’s body experience. The reliability and validity of the body trusting subscale have been confirmed in several populations, including outpatients with current pain (Cronbach’s α =0.77) and people recovered from pain

(Cronbach's $\alpha=0.82$).¹¹ The reliability and the validity of the Japanese version of MAIA have been also validated, as have the reliability and validity of the body trusting subscale (Cronbach's $\alpha=0.83$).¹⁹

Psychological distress

The participants' psychological distress was assessed by the Kessler Psychological Distress Scale (K6). The respondents rated their psychological distress during the past 30 days on six items (eg, nervousness, worthlessness) on a 5-point scale of frequency from 0 (none of the time) to 4 (all of the time). A higher total score represents more severe psychological distress. In a previous survey, participants who scored 13 points or more were categorised as having serious psychological distress.²⁰ We chose to use 13 as a cut-off value for this study as well.

Work-home demands

We evaluated occupational stress based on a job demands-resources model.²¹ We investigated both workplace and home stresses as well as degree of satisfaction from the viewpoint of work-home interference. The work demands are composed of work overload and work emotional demands. We evaluated the participants' work overload using four items developed by Furda,²² which refer to a demanding workload (eg, job quantity) and high pressure (eg, time pressure). We evaluated the participants' work emotional demands using six questions developed by van Veldhoven that refer to the frequency of emotionally challenging events in one's job circumstance (eg, 'Is your work emotionally stressful?', 'Does your work involve people who continuously complain or emotionally appeal to you in another way?').²³ The work overload and emotional work demands were rated on a 5-point scale from 1 (never) to 5 (always). Higher total scores indicate a higher degree of work demands. Likewise, we evaluated the participants' home demands on a six-item questionnaire with a 5-point scale referring to home overload and home emotional demands (eg, 'Do you find that you are busy at home?', 'How often do emotional issues arise at home?').²⁴ Higher total scores indicate higher home demands.

Work-home resources

To evaluate the participants' resources at work and at home, we used the 'social supports' and 'controllability' subscales of the Brief Job Stress Questionnaire (BJSQ).²⁵ The BJSQ is an instrument developed by the Japanese Ministry of Health, Labour and Welfare and its research group, and it has been widely used in Japan as a regular yearly screening for high psychosocial stress in the workplace, which is a mandatory stress check system for enterprises with 50 or more employees.

Degrees of support from one's supervisors, coworkers and family were assessed using three items on a 4-point Likert scale ranging from 1 (strongly agree) to 4 (strongly disagree); for example, 'How often do you feel free to talk to your boss?', 'How often do your colleagues listen

to your personal problems?'. Likewise, personal controllability at work was assessed by three items on a 4-point Likert scale. Family control was measured by four items such as 'I determine what happens at home'. Items were scored on a 5-point Likert scale that ranged from 1 (never) to 5 (always). The higher total scores of social supports and controllability represent worse resources at work and home.

Workaholism

Workaholism, an addictive attitude towards work, has also been known as a relevant factor for work performance.²⁶ We used the Dutch Work Addiction Scale (DUWAS)²⁷ to evaluate the participants' tendency towards workaholism. DUWAS includes two trends of cognitive bias to work: working excessively (eg, I stay busy and keep many irons in the fire) and working compulsively (eg, I feel guilty when I take time off work). Each subscale consists of five items, which were rated on a 4-point Likert scale from 1 (totally disagree) to 4 (totally agree). A higher score indicates a higher tendency of workaholism.

Pain-related measures

We asked the participants whether they had experienced pain within 4 weeks preceding the survey. The participants with pain symptoms in the last 4 weeks were asked to report their pain intensity measured by the numeric rating scale,²⁸ where '0' corresponds to no pain and '10' indicates the worst imaginable pain. We asked the participant whether their pain duration was less than 3 months, corresponding to the definition of 'chronic pain' by the International Association of Study for Pain.²⁹ We asked the participants about their frequency of pain at three levels: almost every day, 2 or more days per week, 1 day or less a week.

Demographic and lifestyle-related measures

The participants' sociodemographic and health-related characteristics were collected from the latest data of their annual health check. The following data were collected: age, sex, body mass index (BMI, kg/m²), smoking status (current smoker or non-smoker), daily alcohol intake (ethanol equivalent: 0, 1–23, 24–45 or ≥ 46 g), educational background (high school graduate or junior college graduate, bachelor's degree, master's degree or doctorate), physical exercise habits (whether a participant exercises more than 30 min, twice per week), sleep duration (<5, 6, 7, 8 or ≥ 9 hours), blood pressure and serum concentrations of low-density lipoprotein (LDL) cholesterol. In accordance with an extensive cohort study in Japan,³⁰ high alcohol intake was defined as consuming more than 46 g of ethanol equivalent per day. We defined low education as below a bachelor's degree, short sleep as shorter than 5 hours of sleep duration, hypertension as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg following the definition by the Japanese Society of Hypertension and high LDL cholesterol

as serum concentrations of LDL cholesterol ≥ 140 mg/dL following the definition by Japan Atherosclerosis Society.

Statistical analyses

Full sample analyses

We examined an association between body trusting and work performance using a multivariable regression analysis with adjustments for age and sex (model 1A). In model 2A, we added sociodemographic characteristics, lifestyle and health measures to the variables of model 1A; this included low education, BMI, current smoker, high alcohol intake, exercise habits, short sleep, hypertension, high LDL cholesterol and presence of pain within 4 weeks. In model 3A, we added serious psychological distress (K6 ≥ 13 points), work/home demands and resources, workaholic tendency and work/home dissatisfaction to the variables of model 2A.

Table 1 Demographic characteristics and measures of all participants (n=349)

Age (years), mean (SD) (range)	40.9 (11.3)	(18–68)
Male, n (%)	292 (83.7)	
Low education (below bachelor's degree), n (%)	54 (15.5)	
Body mass index (kg/m ²), mean (SD)	23.1 (3.4)	
Current smoker, n (%)	33 (9.5)	
High alcohol intake (ethanol 46 g / day), n (%)	18 (5.2)	
Exercise habit (≥ 30 min twice a week), n (%)	124 (35.5)	
Short sleep (≤ 5 hours/day), n (%)	82 (23.5)	
Pain in last 4 weeks, n (%)	223 (63.9)	
Hypertension, n (%)	37 (10.6)	
High LDL cholesterol, n (%)	114 (32.6)	
Serious psychological distress (K6 ≥ 13 points), n (%)	33 (9.0)	
Body trusting, mean (SD) (range)	2.8 (1.1)	(1–5)
Work performance, mean (SD) (range)	6.5 (1.6)	(0–10)
Work demands, mean (SD) (range)	24.9 (7.5)	(10–50)
Work resources, mean (SD) (range)	19.4 (4.7)	(9–33)
Home demands, mean (SD) (range)	12.4 (4.3)	(6–30)
Home resources, mean (SD) (range)	19.2 (3.9)	(7–32)
Workaholism		
Excessive, mean (SD) (range)	11.29 (3.5)	(5–20)
Compulsive, mean (SD) (range)	9.61 (3.1)	(5–20)
Work dissatisfaction, n (%)	103 (29.5)	
Home dissatisfaction, n (%)	73 (20.9)	

LDL, low-density lipoprotein; K6, Kessler Psychological Distress Scale.

Table 2 Association of body trusting with work performance of all participants (n=349)

	β	95% CI (LL, UL)	std- β	Adjusted R ²
Model 1	0.49***	(0.35, 0.64)	0.33	0.151
Model 2	0.52***	(0.37, 0.67)	0.35	0.154
Model 3	0.33***	(0.18, 0.49)	0.23	0.222

Model 1: adjusted for age and sex.

Model 2: adjusted for variables in model 1 and low education, body mass index, current smoker, high alcohol intake, exercise habit, short sleep, hypertension, high low-density lipoprotein (LDL) cholesterol and pain in last 4 weeks.

Model 3: adjusted for variables in model 2 and serious psychological distress, work demands, work resources, home demands, home resources, workaholic tendency, work dissatisfaction and home dissatisfaction.

*** $p < 0.001$.

β , regression coefficients; LL, lower limit; std- β , standardised regression coefficient; UL, upper limit.

Subsample analyses

First, we compared the characteristics of people with pain within 4 weeks (pain group) to those of people without pain (no-pain group). χ^2 tests were used for categorical variables and Student's t-tests were used for continuous variables. We calculated Cohen's *d* as an effect size between the two groups.

Then, in the sample of participants with pain, we conducted multiple linear regression analyses to examine the association of body trusting with work performance. Four multivariable regression models were used with the following variables: age and sex (model 1B); pain intensity, pain duration (≥ 3 months), pain frequency (more than 2 days/week) and the variables included in model 1 (model 2B); low education, BMI, current smoker, high alcohol intake, exercise habits, short sleep, hypertension, high LDL cholesterol and the variables included in model 2B (model 3B); serious psychological distress, work/home demands and resources, workaholic tendency, work/home dissatisfactions and the variables included in model 3B (model 4B).

All statistical analyses were performed by Statistical Package for Social Sciences (SPSS) V.25.0 software package (IBM). Statistical significance was identified by two-tailed *p* values < 0.05 .

RESULTS

All 545 employees in the office were invited to participate in the study. Of those, 354 people responded to the questionnaire (65% response rate). Five people with incomplete data were excluded, and 349 participants were included in the analyses.

The participants' mean age was 40.9, ranging from 18 to 68 years. The participants were predominantly male (84%). One-third of the participants reported that they had an exercise habit, and one-fourth reported short sleep. Serious psychological distress was identified in 33 participants (9%), and 223 participants (64%) reported

Table 3 Demographic characteristics and measures of participants with and without pain

	No-pain group	Pain group	Cohen's <i>d</i>
Participants, n (%)	126 (36.1)	223 (63.9)	
Work performance, mean (SD)	6.4 (1.8)	6.5 (1.6)†	0.10
Body trusting, mean (SD)	3.1 (1.1)	2.7 (1.1)†	0.38***
Age (years), mean (SD)	39.9 (11.7)	41.5 (11.0)†	0.14
Male, n (%)	109 (0.9)	183 (0.8)‡	
Low education (below bachelor's degree), n (%)	19 (15.1)	35 (15.7)‡	
Body mass index (kg/m ²), mean (SD)	22.5 (3.0)	23.3 (3.6)†	0.23*
Current smoker, n (%)	14 (11.1)	19 (8.5)‡	
High alcohol intake (ethanol ≥46 g/day), n (%)	12 (9.5)	6 (2.7)‡	
Exercise habit (≥30 min twice a week), n (%)	47 (37.3)	77 (34.5)‡	
Short sleep (≤5 hours/day), n (%)	21 (16.6)	61 (27.4)‡	*
Hypertension, n (%)	27 (21.4)	10 (4.5)‡	
High LDL cholesterol, n (%)	40 (31.7)	74 (33.2)‡	
Serious psychological distress (K6 ≥13 points), n (%)	10 (7.9)	23 (10.3)‡	
Work demands, mean (SD)	24.0 (7.5)	25.4 (7.4)†	0.19
Work resources, mean (SD)	19.1 (5.0)	19.5 (4.6)†	0.01
Home demands, mean (SD)	11.4 (3.7)	13.0 (4.5)†	0.36 ***
Home resources, mean (SD)	19.0 (3.7)	19.4 (4.0)†	0.11
Workaholism			
Excessive, mean (SD)	10.8 (3.6)	11.6 (3.5)†	0.21
Compulsive, mean (SD)	9.1 (2.8)	9.9 (3.2)†	0.26**
Work dissatisfaction, n (%)	33 (26.2)	70 (31.4)‡	
Home dissatisfaction, n (%)	24 (19.0)	49 (22.0)‡	
Pain intensity (NRS), mean (SD)	–	2.6 (0.1)	
Pain duration ≥3 months, n (%)	–	155 (69.5)	
Pain frequency			
Almost every day, n (%)	–	90 (40.7)	
2 or more days a week, n (%)	–	69 (31.2)	
1 day or less a week, n (%)	–	62 (28.1)	

Test for significant difference: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

†t-test.

‡ χ^2 test.

K6, Kessler Psychological Distress Scale; LDL, low-density lipoprotein; NRS, numeric rating scale.

pain in the last 4 weeks. The mean work performance score was 6.47, and the mean body trusting score was 2.82 points (table 1).

In the full sample analyses, body trusting was positively associated with work performance, meaning that people with higher levels of body trusting were more likely to have better work performance. This association remained significant even after adjusting for age and sex (model 1A; $p < 0.001$); sociodemographic characteristics, lifestyle and health measures (model 2A; $p < 0.001$); and psychological distress, various stress-related factors and workaholism (model 3A; $p < 0.001$) (table 2).

There were 223 people with pain (63.9%), with a mean pain intensity of 2.6. Among them, 155 (69.5%) people's responses corresponded to chronic pain. The work

performance of people with pain did not differ from those without pain. However, people with pain showed significantly lower levels of body trusting ($p = 0.001$), higher BMI ($p = 0.03$), a higher frequency of short sleep ($p = 0.02$), worse home demands ($p = 0.001$) and greater compulsive workaholism ($p = 0.02$) (table 3).

Body trusting was significantly associated with work performance in this pain group as well. The association remained significant after adjustments for age and sex (model 1B; $p < 0.001$); pain intensity, pain duration and pain frequency (model 2B; $p < 0.001$); sociodemographic characteristics, lifestyle and health measures (model 3B; $p < 0.001$); and psychosocial factors (model 4B; $p < 0.001$) (table 4).

Table 4 Association between body trusting and work performance in participants with pain (n=223)

	β	95% CI (LL, UL)	std- β	Adjusted R ²
Model 1	0.44***	(0.27, 0.62)	0.31	0.13
Model 2	0.44***	(0.27, 0.62)	0.32	0.12
Model 3	0.45***	(0.27, 0.64)	0.32	0.11
Model 4	0.46***	(0.11, 0.51)	0.22	0.16

Model 1: adjusted only for age and sex.

Model 2: adjusted for pain intensity, pain duration, pain frequency and all the variables in model 1.

Model 3: adjusted for low education, body mass index, current smoker, high alcohol intake, exercise habit, short sleep, hypertension, high low-density lipoprotein (LDL) cholesterol and all the variables in model 2.

Model 4: adjusted for serious psychological distress, work demands, work resources, home demands, home resources, workaholic tendency, work dissatisfaction, home dissatisfaction and all the variables in model 3.

***p<0.001.

β , regression coefficients; LL, lower limit; std- β , standardised regression coefficient; UL, upper limit.

DISCUSSION

Implications of the study

This study demonstrated that workers with more body trusting showed higher levels of work performance. This association was significant after controlling for variables that have been known to affect work performance including sociodemographic and lifestyle factors, physical and psychological measures and various stress-related issues. The positive association between the level of body trusting and work performance was consistent in a subsample of people with pain. These findings suggest that body trusting is an independent mediator for increasing work performance.

There are a few possible mechanisms to explain why body trusting has a positive association with work performance. First, people with high body trusting are more likely to have positive body images (such as feeling safe and trustworthy) about themselves.³¹ This positive body image serves as a foundation for their psychological well-being (ie, self-esteem, optimism and proactive coping), which contributes to better cognitive performance. Many studies have demonstrated that better psychological well-being promotes work performance through flexible, creative, integrated, information-open-minded and effective thinking, resulting in improved accuracy and speed of information processing and flexible optimisation of cognitive function.³²

Second, body trusting may contribute to better work performance through a buffering effect of negative emotions. People with negative body image are more prone to show heightened anxiety and depression than those without negative body image.³³ For example, sedentary behaviour, which is known to decrease work performance, can be attributed to both mental and physical problems.

These negative emotions divert attentional resources to the self and away from the task at hand, which impairs work performance.^{10 34} At the same time, a high level of interoceptive awareness has been known to alleviate negative emotions.¹¹ People with higher levels of body trusting have been shown to exhibit lower levels of trait anxiety.¹⁴ A sense of psychological safety helps people overcome their anxiety and make good use of new inputs, promotes work engagement and facilitates creativity.³⁵ People with higher levels of body trusting, who feel greater levels of psychological safety in their body with a healthy body image, are expected to be more resilient and able to cope with stress and adversity, resulting in sustained performance.³⁶

Third, body trusting can promote work performance in the context of interpersonal relationships. Psychological safety and well-being promote friendly behaviour and facilitate improved communication in a community.³⁷ The friendly atmosphere and flexible cognitive functions associated with positive emotions at an individual level facilitate more efficient problem-solving strategies and promote social adaptation with improved compassion and coping abilities, resulting in improved conflict resolution at a team level as well.³⁸

In addition to the psychological effect on the work performance mentioned above, physical difficulty at work (eg, pain) has a negative impact on work performance.³⁹ People with lower levels of body trusting are more vulnerable to bodily dissociation, which is a sense of separation from sensory and emotional experience.⁴⁰ Body trusting may provide a synergistic effect between psychological health and physical performance because bidirectional promotive effects have been observed between them. Experience of a good physical performance is received as a reward, by which people will strengthen confidence in their own body and physical activities.⁴¹ Body trusting is assumed to mediate this virtuous circle of mind–body interaction, contributing to better performance. Future studies are needed to clarify the underlying mechanisms of body trusting in mind–body interactions.

Possible clinical implications of our findings include using body trusting as a focus of intervention to promote work performance. Recently, mindfulness-based training has been garnering attention as a strategy to promote mental health and work performance.⁴² Mindfulness training improves interoceptive awareness, including body trusting,¹⁵ through a comprehensive programme of cultivating non-judgemental acceptance, a sense of self-grounded experience in the present moment and a sense of embodiment of physical sensations.⁴³ By focusing on body trusting, a more efficient programme to promote work performance may be developed.

Limitations of the study

There are a few limitations to this study. First, the study was conducted in a single institution with predominantly male workers, thus the generalisability of the findings is limited. Second, most of the measurements used in this study, including work performance, were based on the

participants' self-reports. Although there is evidence that subjective work performance is significantly correlated with objective work performance,⁴⁴ more robust methods of measurement exist and should be used in future research. Third, because of the cross-sectional study design, the causal relationship of body trusting and work performance is not clear. Moreover, since employees on leave at the time of the survey were not included in this study, further longitudinal studies will be required to examine the relationship between burn-out and body trusting. Lastly, the current study focused on work performance only at an individual level. Future studies should also examine the impact on work performance at the organisational level, including management. Increasing body trusting may contribute to both increased performance and well-being, meaning that it benefits both employees as individuals and the company as a whole.

CONCLUSIONS

This study demonstrated that a higher level of body trusting was significantly associated with increased work performance. This finding was robust after controlling for multiple covariates (including psychological distress and stress-related factors) that may influence work performance, and the finding was consistent in a subsample of people with pain. Considering the high prevalence of mental issues and pain in working populations, the concept of body trusting may play a key role in maintaining work performance and occupational health.

Further studies using more objective measures, especially on work performance and interoceptive awareness (body trusting) in a longitudinal design, and the development of a programme to cultivate a sense of body trusting are warranted.

Author affiliations

¹Neuropsychiatry, Graduate School of Medicine, Keio University School of Medicine, Shinjuku-ku, Japan

²Interdisciplinary Pain Center, Keio University Hospital, Shinjuku-ku, Japan

³Shirley Ryan AbilityLab, Chicago, Illinois, USA

⁴Department of Physical Medicine and Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

⁵Department of Anesthesiology, Graduate School of Medicine, Keio University School of Medicine, Shinjuku-ku, Japan

⁶Department of Medical Research and Management for Musculoskeletal Pain, 22nd Century Medical and Research Center, Faculty of Medicine, The University of Tokyo-Hospital, Tokyo, Japan

Acknowledgements The authors thank the staff members and the field coordinators in the survey. They also appreciate Dr Akito Shimazu, professor in the Keio University Faculty of Policy Management, for providing instruments to assess psychosocial factors at home. The authors express their sincere appreciation to Dr Masayuki Hasegawa and other staff from the Research and Engineering Centre of Nippon Steel for their generous support in conducting this survey. The authors thank Editage (www.editage.jp) for English language editing.

Contributors CT contributed to the study conception, acquisition of data, analysis, interpretation of data and drafting of the manuscript. KW designed the study, analysed the data and edited the first draft. CT, ST and SK participated in data collection. KM, HM and MM revised the manuscript critically for important intellectual content. DF contributed to designing the study, supervised the data

analysis and gave critical input on the draft. All authors reviewed and approved the final manuscript.

Funding This research was partially supported by Grants-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (grant number JP18K07476), the Health Labour Sciences Research Grant (grant number 19FG1001), and The Mental Health Okamoto Memorial Foundation Research Activity Grant.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval All procedures were approved by the Keio University School of Medicine Ethics Committee (approval number 20170069) and the company's safety and health committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Analysed data in this study are available under the permission of the Institutional Review Board in Keio University School of Medicine corresponding to each request (<https://www.ctr.med.keio.ac.jp/rinri/>).

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Chisato Tanaka <http://orcid.org/0000-0003-1737-5573>

Kenta Wakaizumi <http://orcid.org/0000-0003-4884-6251>

REFERENCES

- Rasmussen B, Sweeny K, Sheehan P. *Health and the economy the impact of wellness on workforce productivity in global markets*. U.S. Chamber of Commerce, 2016.
- Cabinet office. Annual report on the ageing Society: 2019, 2019. Available: <https://www8.cao.go.jp/kourei/english/annualreport/2019/pdf/2019.pdf> [Accessed 24 Apr 2020].
- Ministry of Health, Labour and Welfare. Population trends of Japan, 2010. Available: https://www.mhlw.go.jp/english/wp/wp-hw4/dl/general_welfare_and_labour/P5.pdf [Accessed 24 Apr 2020].
- Ministry of Economy Trade and Industry. Enhancing health and productivity management., 2020. Available: https://www.meti.go.jp/policy/mono_info_service/healthcare/downloadfiles/180717health-and-productivity-management.pdf [Accessed 24 Apr 2020].
- de Graaf R, Tuithof M, van Dorsselaer S, et al. Comparing the effects on work performance of mental and physical disorders. *Soc Psychiatry Psychiatr Epidemiol* 2012;47:1873–83.
- Stansfeld SA, Fuhrer R, Head J. Impact of common mental disorders on sickness absence in an occupational cohort study. *Occup Environ Med* 2011;68:408–13.
- Patel AS, Farquharson R, Carroll D, et al. The impact and burden of chronic pain in the workplace: a qualitative systematic review. *Pain Pract* 2012;12:578–89.
- Grönblad M, Järvinen E, Airaksinen O, et al. Relationship of subjective disability with pain intensity, pain duration, pain location, and work-related factors in nonoperated patients with chronic low back pain. *Clin J Pain* 1996;12:194–200.
- Goodwin RD. Association between physical activity and mental disorders among adults in the United States. *Prev Med* 2003;36:698–703.
- Cameron OG, Kanfer R, Ackerman PL. Interoception. *Pain* 1996;74:1741–5.
- Mehling WE, Daubenmier J, Price CJ, et al. Self-reported interoceptive awareness in primary care patients with past or current low back pain. *J Pain Res* 2013;6:403–18.
- Mehling WE, Acree M, Stewart A, et al. The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). *PLoS One* 2018;13:e0208034–12.
- Mehling WE, Gopisetty V, Daubenmier J, et al. Body awareness: construct and self-report measures. *PLoS One* 2009;4:e5614.



- 14 Mehling WE, Price C, Daubenmier JJ, *et al.* The multidimensional assessment of interoceptive awareness (Maia). *PLoS One* 2012;7:e48230.
- 15 Fissler M, Winnebeck E, Schroeter T, *et al.* An investigation of the effects of brief mindfulness training on self-reported interoceptive awareness, the ability to Decenter, and their role in the reduction of depressive symptoms. *Mindfulness* 2016;7:1170–81.
- 16 Hanley AW, Mehling WE, Garland EL. Holding the body in mind: interoceptive awareness, dispositional mindfulness and psychological well-being. *J Psychosom Res* 2017;99:13–20.
- 17 Ministry of Health, Labour and Welfare. The occupational health guidelines on information device work at office, 2019. Available: https://www.mhlw.go.jp/english/policy/employ-labour/labour-standards/dl/The_Occupational_Health_Guidelines_on_Information_Device_Work_at_Office.pdf [Accessed 24 Apr 2020].
- 18 Nakamura M, Toyama Y, Nishiwaki Y, *et al.* Prevalence and characteristics of chronic musculoskeletal pain in Japan: a second survey of people with or without chronic pain. *J Orthop Sci* 2014;19:339–50.
- 19 Shoji M, Mehling WE, Hautzinger M, *et al.* Investigating multidimensional interoceptive awareness in a Japanese population: validation of the Japanese MAIA-J. *Front Psychol* 2018;9:1–12.
- 20 Kessler RC, Barber C, Beck A, *et al.* The world Health organization health and work performance questionnaire (HPQ). *J Occup Environ Med* 2003;45:156–74.
- 21 Schaufeli WB, Bakker AB. Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. *J Organ Behav* 2004;25:293–315.
- 22 Furda J. Werk, persoon en welzijn : een toets van het JD-C model [work, personality, and well-being : A test of the JD-C model]. *Dr Diss Utr Univ* 1995 <https://ci.nii.ac.jp/naid/10026964544/>
- 23 van Veldhoven M, Broersen S. Measurement quality and validity of the “need for recovery scale”. *Occup Environ Med* 2003;60:3i–9.
- 24 Peeters MCW, Montgomery AJ, Bakker AB, *et al.* Balancing work and home: how job and home demands are related to burnout. *Int J Stress Manag* 2005;12:43–61.
- 25 Shimomitsu T. *The final development of the brief job stress questionnaire mainly used for assessment of the individuals.* Tokyo Medical College, 2000. <http://ci.nii.ac.jp/naid/10015685640/ja/>
- 26 Schaufeli WB, Taris TW, van Rhenen W. Workaholism, burnout, and work engagement: three of a kind or three different kinds of employee well-being? *Appl Psychol* 2008;57:173–203.10.1111/j.1464-0597.2007.00285.x
- 27 Shimazu A, Schaufeli WB. Is workaholism good or bad for employee well-being? the distinctiveness of workaholism and work engagement among Japanese employees. *Ind Health* 2009;47:495–502.
- 28 Turk DC, Dworkin RH, Allen RR, *et al.* Core outcome domains for chronic pain clinical trials: IMMPACT recommendations. *Pain* 2003;106:337–45.
- 29 Nicholas M, Vlaeyen JWS, Rief W, *et al.* The IASP classification of chronic pain for ICD-11: chronic primary pain. *Pain* 2019;160:28–37.
- 30 Kawakita D, Oze I, Hosono S, *et al.* Prognostic value of drinking status and aldehyde dehydrogenase 2 polymorphism in patients with head and neck squamous cell carcinoma. *J Epidemiol* 2016;26:292–9.
- 31 Tylka TL, Wood-Barcalow NL. What is and what is not positive body image? Conceptual foundations and construct definition. *Body Image* 2015;14:118–29.
- 32 Fredrickson BL. The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions. *Am Psychol* 2001;56:218–26.
- 33 Turel T, Jameson M, Gitimu P, *et al.* Disordered eating: Influence of body image, sociocultural attitudes, appearance anxiety and depression - a focus on college males and a gender comparison. *Cogent Psychology* 2018;5:1483062.
- 34 Kanfer R, Ackerman PL. Motivation and cognitive abilities: an integrative/aptitude-treatment interaction approach to skill acquisition. *J Appl Psychol* 1989;74:657–90.
- 35 Kark R, Carmeli A. Alive and creating: the mediating role of vitality and aliveness in the relationship between psychological safety and creative work involvement. *J Organ Behav* 2009;30:785–804.
- 36 Tung KS, Ning WW, Kris L. Effect of resilience on self-perceived stress and experiences on stress symptoms a surveillance report. *Univers J Public Heal* 2014;2:64–72.
- 37 Edmondson A. Psychological safety and learning behavior in work teams. *Adm Sci Q* 1999;44:350–83.
- 38 Baer M, Frese M. Innovation is not enough: climates for initiative and psychological safety, process innovations, and firm performance. *J Organ Behav* 2003;24:45–68.
- 39 Jinnett K, Schwatka N, Tenney L, *et al.* Chronic conditions, workplace safety, and job demands contribute to absenteeism and job performance. *Health Aff* 2017;36:237–44.
- 40 Price CJ, Thompson EA. Measuring dimensions of body connection: body awareness and bodily dissociation. *J Altern Complement Med* 2007;13:945–53.
- 41 Kosteli M-C, Cumming J, Williams SE. Self-regulatory imagery and physical activity in middle-aged and older adults: a social-cognitive perspective. *J Aging Phys Act* 2018;26:14–24.
- 42 Bartlett L, Martin A, Neil AL, *et al.* A systematic review and meta-analysis of workplace mindfulness training randomized controlled trials. *J Occup Health Psychol* 2019;24:108–26.
- 43 Carruthers G. Types of body representation and the sense of embodiment. *Conscious Cogn* 2008;17:1302–16.
- 44 AlHeresh R, LaValley MP, Coster W, *et al.* Construct validity and scoring methods of the world Health organization: health and work performance questionnaire among workers with arthritis and Rheumatological conditions. *J Occup Environ Med* 2017;59:e112–8.