BMJ Open

An epidemiological study of cognitive stress appraisal and related factors among workers: cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019404
Article Type:	Research
Date Submitted by the Author:	05-Sep-2017
Complete List of Authors:	Tohmiya, Natsuka; Setagaya District Administration Offices,, Public Health Promotion Division; Yokohama Shiritsu Daigaku, Guraduate School of Medicine Tadaka, Etsuko; Yokohama City University, Community Health Nursing Arimoto, Azusa; Yokohama Shiritsu Daigaku, Department of Community Health Nursing
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Nursing, Mental health, Public health
Keywords:	cognitive stress appraisal, environmental factor, individual factor, workers

An epidemiological study of cognitive stress appraisal and related factors among workers: cross-sectional study

Corresponding aouthor
Natsuka Tohmiya
MSN, RN, PHN
Public Health Promotion Division, Setagaya District Administration Offices,
4-22-33 Setagaya Setagaya-city, Tokyo 154-8504 Japan
E-mail: natsuka.dct.ft@gmail.com
TEL: +81-3-5432-2896
FAX: +81-3-5432-3074

Co-author

Etsuko Tadaka, Azusa Arimoto

Graduate School of Medicine, Yokohama City University, Yokohama, Kanagawa, Japan

Word count: 3,613 words

ABSTRACT

Objective Stress as a trigger for depression has enormous socioeconomic implications for all spheres of employment, because it affects absenteeism, turnover, productivity, morale, and suicide. Positive or negative cognitive stress appraisal can, however, affect workers' ability to cope with stress as a self-care strategy. This study examined cognitive stress appraisal among workers and identify related individual and environmental factors.

Design Cross-sectional study using self-administered postal questionnaires.

Participants 2,311 people working at 48 companies in metropolitan areas in Japan. In total, 341 questionnaires were returned (response rate: 14.8%), 337 of which were suitable for analysis (effective response rate: 98.8%).

Primary measures Cognitive stress appraisal was assessed using the Japanese version of the Perceived Stress Scale (PSS). Potential variables related to stress appraisal included demographic, individual, and environmental factors. Multiple regression analysis was used to identify factors related to cognitive stress appraisal.

Results The mean age ± SD was 42.8 ± 11.7 years, and two-thirds were male. The mean PSS score ± SD was 25.8 ± 6.2. Multiple regression analysis after controlling for variables of age, sex, and depression indicated that those with poorer economic status ($\beta = 0.161$, $p < 0.001$), lower eHealth literacy ($\beta = -0.116$, $p = 0.009$), higher traditional organizational climate ($\beta = 0.124$, $p = 0.005$), and lower feelings of social support ($\beta = -0.220$, $p < 0.001$) experienced significantly higher negative levels of perceived stress.

Conclusion The results show the individual and environmental factors related to cognitive stress appraisal among workers. The inter-professional approach of public health nurses and health practitioners, including a spectrum of enhanced self-coping skills using the eHealth literacy of individual workers, improvement of traditional organizational climate at their worksite, and social support in their community, might be an effective strategy to contribute to improved mental health among workers.

Strengths and limitations of this study

・First study to examine the individual and environmental factors related to cognitive stress appraisal of healthy and general workers.
・Simultaneously examine both eHealth literacy, multidimensional perceived social support and traditional organizational climate.
・This study is cross-sectional design, it could not identify causal relationships between cognitive stress appraisal and related factors.
・This study's target population is limited to metropolitan areas in Japan.

keywords: cognitive stress appraisal, environmental factor, individual factor, workers

INTRODUCTION

Depression is one of the most common psychiatric disorders, affecting about 350 million people worldwide [1]. In Japan, depression is estimated to have affected up to 1.116 million people in 2015 [2]. Certain occupational factors account for up to 8% of cases of depression) [3]. The World Health Organization's comprehensive mental health action plan 2013–2020 was adopted by the 66th World Health Assembly [4] and argues that determinants of mental health and psychiatric disorders include not only individual attributes but also social, cultural, economic, political, and environmental factors [5]. Mental illnesses are associated with a substantial deterioration in individual quality of life and economic loss in the community and the workplace [5, 6]. Therefore, primary prevention of depressive disorders is an important issue nationally and internationally, and not just for individuals.

Stress as a trigger for depression has enormous socioeconomic implications for all spheres of employment, because it affects absenteeism, turnover, productivity, morale, and suicide [7,8,9]. In Japan, the number of employees applying for industrial accident compensation insurance for mental disorders because of stress has increased in recent years [10]. In 2015, the number of applications was 1,515, up from 1,272 in 2011 [11]. The proportion of workers experiencing anxiety, distress, and work stress has progressively increased since 1982 and is now around 60% [12]. Against this background, the Japanese government launched a new occupational health policy in 2015 called "The Stress Check Program" to screen for workers experiencing high psychosocial stress [13]. The law mandates use of the Stress Check Program and its guidelines at least once per year in all workplaces with 50 or more employees in Japan. The program and its guidelines recommends individual checks on perceived stress and sets out four principles of care in the workplace: (1) self-care; (2) line-care; (3) health practitioners' care in the workplace; and (4) health practitioners' care in the community.

Cognitive stress appraisal is the evaluation of how individuals perceive the stressors that cause stress and is a self-care strategy. In primary appraisal, an individual's evaluations are divided into "threat," and "challenge", threat describes anticipated harm/loss, and challenge describes a threat that can be met or overcome [14,15]. Whether something is given a cognitive appraisal of "threat" or "challenge" can affect mental health [15,16]. The stress response and stress coping caused by cognitive appraisal differ among individuals, even in response to the same stressors [17]. For example, people making a positive cognitive appraisal may see stress as a challenging health issue to be resolved, and set themselves challenging goals [14,15]. Those making a negative cognitive appraisal can view the same issues as a health threat, and may believe that resolving tasks and situations is beyond their abilities. Positive or negative cognitive stress appraisal can therefore be an important concept in mental health to improve stress-coping skills and control stress among workers. In an individual, a positive cognitive appraisal contributes to prevention of depression, thus improving quality of

life. At the societal level, this is important in controlling the escalation of medical costs and increasing corporate and community-wide productivity.

The Perceived Stress Scale (PSS) measures the degree to which situations are cognitively appraised as stressful [18]. Many previous studies have measured cognitive stress appraisal using the PSS and related factors in students [19-23], medical workers [24,25], and patients with chronic disease [26-29]. The scale has not, however, been used with healthy adult workers in a wide spectrum of employments. Previous studies clarified various individual factors related to the PSS, but varied for different participants. Some studies examined the physical and psychological health condition of students and conditions in particular groups such as adults with a disease or pregnant women [27,30,31]. Others examined the lifestyles of students, pregnant women, and medical workers [25,32,33]; job stress among medical workers [24,34,35]; stressors and coping in adults, such as survivors of suicide and pregnant women [30,36]; and health literacy in African-American adults [37]. However, there is limited information about the relationship between cognitive stress appraisal and individual and environmental factors such as work environment and social support available to adult workers [38].

The purpose of this study was to examine cognitive stress appraisal and identify individual and environmental factors among workers. The study can contribute to minimizing the effect of one factor that might be associated with an increased risk of depression and contribute to the promotion of individual self-care and improvement of worksite environments to promote mental health among workers. Furthermore, it can be useful for primary prevention of mental health disorders among workers by public health nurses and health practitioners at worksites.

METHODS

Participants and sampling

The study participants were workers at companies in metropolitan areas of Japan. The criteria for participation included being between 18 and 64 years old. An age of 64 years is the upper limit for consideration of retirement and re-employment under the Law Concerning Stabilization of Employment of Older Persons; 18 years is the earliest age for employment immediately after graduating high school in Japan.

The study design was a cross-sectional study using self-administered postal questionnaires. Data were collected across two metropolitan areas of Japan (Tokyo and Kanagawa prefectures) from companies registered in the Japan Company Handbook 2016. Questionnaires were sent to employees randomly selected, stratified by the number of employees of each

conpany. In total, 361 of 2,026 companies were selected (17.8%).

Ethics

The questionnaire was unsigned to maintain the anonymity of all personal participant information. The Institutional Review Board of the Medical Departmentof the Yokohama City University approved this study on August 9, 2016 (Certification No.A1608008).

Measuring instruments

Dependent variable: Cognitive stress appraisal

The dependent variable was cognitive stress appraisal, which was determined using the Japanese version of the PSS [39,40]. The PSS consists of 14 items and includes questions such as “In the last month, how often have you been upset because of something that happened unexpectedly?” and “In the last month, how often have you felt that you were unable to control the important things in your life?” The responses were coded for scoring as “Never” = 0, “Almost Never” = 1, “Sometimes” = 2, “Fairly Often” = 3, and “Very Often” = 4. Possible total scores ranged from 0 to 56 with higher scores indicating higher levels of negative cognitive stress appraisal. All 14 items are highly intercorrelated in the Japanese version (Cronbach’s alpha = 0.74).

Demographic characteristics

Demographic characteristics collected about the participants in this study included age, sex, marital status, household membership, educational status, employment status, economic status, and depression.

Depression was measured using the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D) [41,42], which consists of 20 items. Each item is measured on a four-point Likert-type scale ranging from 0 to 3. The total score ranges from 0 to 60 with higher scores indicating greater levels of depression; scores above 16 on the CES-D indicate a depressive state. CES-D was developed for use in epidemiological studies of depressive symptomatology in the general population [41,42]. A group with a high average score may be interpreted to be “at risk” of depression or in need of treatment [42].

Independent variable

Individual factors of the participants in this study included any disease currently under treatment (e.g., cancer, diabetes), body mass index (BMI), self-rated health, physical complaints, physical demands, lifestyle, perceived health competence, and electronic health literacy (eHealth literacy).

Self-rated health was measured on a four-point Likert-type scale from 1 (very poor) to 4 (very good). Physical complaints were measured using the Brief Job Stress Questionnaire (BJSQ) [43]. The BJSQ is used in the Japan Stress Check Test by the Ministry of Health, Labour and Welfare [12] and can be easily used in the workplace. It consists of 57 items across 19 subscales, from which we drew 11 items (e.g., "I have felt dizzy" and "I have experienced joint pains"). Each item was measured on a four-point Likert-type scale. The total scores ranged from 11 to 44 with higher scores indicating more frequent physical complaints.

Physical demands were measured using the Job Content Questionnaire (JCQ) [44], which consists of 45 items divided into six subscales. We used three items on physical exertion and two on isometric load. Each item was measured on a five-point Likert-type scale. The total scores for physical exertion ranged from three to 15, and for isometric load from two to 10, with higher scores indicating stronger physical demands and isometric load. The JCQ was developed based on the job demands–control model and has been nationally standardized by occupation in several countries [44-46].

Lifestyle was measured using seven items based on Breslow's good health habits [47]. The scale covered smoking, drinking alcohol, eating breakfast every day, physical activity, eating snacks after dinner, skipping breakfast, and sleeping and resting. The responses were coded for scoring as "yes" or "no."

Perceived health competence was measured using the Perceived Health Competence Scale, Japanese version (PHCS) [48], which consists of eight items. Each was measured on a five-point Likert-type scale. The total scores ranged from 8 to 40, with higher scores indicating higher perceived health competence. Perceived health competence is related to stress [49]. The PHCS was designed to assess efficacy and competence beliefs about personal health at this intermediate level of domain-specificity [50].

eHealth literacy was measured using the Japanese version of the eHealth Literacy Scale (eHEALS) [51], which consists of eight items. eHealth literacy is defined as the ability to seek, find, understand, and appraise health information from electronic sources, and apply the

knowledge gained from doing so in addressing or solving a health problem [52,53]. Responses to the scale were assessed using a five-point Likert-type scale. The total scores ranged from 8 to 40 with higher scores showing greater health literacy. In Japan, Internet penetration in the age group under study is over 90% [54]. eHEALS has been developed to address the need to assess eHealth literacy for a wide range of populations and contexts. It is designed to provide a general estimate of consumer eHealth-related skills to inform clinical decision-making and health promotion planning with individuals or specific populations [53].

Environmental factors: Organizational climate

Organizational climate was measured using the 12-item Organizational Climate Scale [55], which is divided into two six-item subscales: the tradition scale and the organizational environment scale. The responses were coded for scoring as “yes” = 2 and “no” = 1. The total possible scores ranged from six to 12 for each scale. Higher scores on the tradition scale show a more mandatory, injunctive, and feudalistic organizational climate and higher scores on the organizational environment scale show a more flexible organizational system. A previous study showed that organizational climate could affect occupational stress [56]. This scale measures organizational properties based on the model of Healthy Work Organizations at NIOSH [55].

Social support

Social support was measured using the short version of the Multidimensional Scale of Perceived Social Support (MPSS) in Japanese [57,58], which consists of seven items. Each item was examined on a seven-point Likert-type scale with lower scores indicating lower feelings of social support. The MPSS specifically addresses the subjective assessment of social support adequacy and was designed to assess perceptions of social support adequacy from three specific sources: family, friends, and significant others [58].

Data collection

In total, 48 of 361 companies agreed to participate to this study. Prior to sending the questionnaire to each company, we identified the sample size from the administrators. A total of 2,311 questionnaires were sent to the 48 companies via mail. The potential participants, all the employees in each of these companies, were asked to complete the questionnaire anonymously and on a voluntary basis, between October 1 and December 9, 2016. The anonymity of the workers was maintained throughout the process by using unsigned forms,

which they posted back themselves. Returning the document was considered to indicate informed consent.

Statistical analysis

The mean, SD, frequency, and percentage were calculated for demographic characteristics, positive or negative cognitive stress appraisal (PSS), and individual and environmental factors. Univariate analysis using Spearman's correlation was used to examine correlations between the dependent and independent variables. A multiple regression analysis was then used to identify factors related to cognitive stress appraisal among workers, using all potentially significant predictors identified by the univariate analyses ($P < 0.05$) as independent variables via the forced entry (variable reduction) method. The multiple regression model contained selected independent variables and all statistical analyses. Sex, age, and depression were contained as controlled variables. A previous study reported high correlation between the PSS and the CES-D, but both scales still independently predicted symptomatology [18]. The aim of this research was primary prevention of poor mental health, specifically depression. We therefore assumed that depression was covariate and treated it as a control variable. All analyses were performed using IBM SPSS Statistics for Windows version 22.0. The level of significance was set at $P < 0.05$.

RESULTS

Of the 2,311 questionnaires mailed to the companies, 341 were returned (response rate: 14.8%). Four of the 341 questionnaires were from participants aged over 65 years or who did not provide their age. We excluded these questionnaires and were left with 337 questionnaires for analysis (effective response rate: 98.8%).

Participants' background information (demographic characteristics, individual factors, environmental factors) is shown in Table 1.

Table 1. Background of the participants

Items	Number or Mean±SD	% (Range)
Demographic characteristics		
Age	42.8±11.7	(18-64)
Sex		
Male	228	67.7
Female	109	32.3
Matital status		
Unmarried	110	32.6
Married	203	60.2
Divorced/Widowed	24	7.1
Household membership		
Live alone	76	22.8
Spouse	48	14.4
Spouse and childeren	129	38.6
Parentes	50	15.0
Others	31	9.3
Educational status		
Junior high school/High school	78	23.1
Vocational college/Junior college	53	15.7
College or University/Graduate school	206	61.1
Employment status		
Fulltime worker	301	89.9
Part-time worker	27	8.1
Others	7	2.1
Economic status		
Sufficient	106	31.5
Slightly sufficient	175	51.9
Slightly insufficient	51	15.1
Insufficient	5	1.5
Depression（CES-D）		
Score	12.8±7.6	(0-45)
Depression(CES-D≧16; cut-off point）	99	29.5
Dependent variable		
Cognitive stress appraisal (PSS)	25.8±6.2	(6-48)

SD, standard deviation

Table 1. Background of the participants (cont.)

Items	Number or Mean±SD	%(Range)
Individual factors		
Disease currently under treatment		
No	252	75.0
Yes	84	25.0
High blood pressure	25	7.4
Gout	11	3.3
Hyperlipidemia	8	2.4
Respiratory disease	8	2.4
Diabetes	7	2.1
Digestive disease	7	2.1
Mental disease	7	2.1
Others	26	7.7
Body-mass index (BMI)		
Mean	22.0±3.1	(14.5-34.6)
Thin（BMI＜18.5）	32	9.8
Standard(18.5≦BMI＜25)	243	74.8
Obesity（25≦BMI）	50	15.4
Self-rated health		
Very poor	7	2.2
Rather poor	47	14.6
Rather good	216	66.9
Very good	53	16.4
Physical complaint (BJSQ)	19.3±5.1	(11-36)
Physical demands (JCQ)		
Physical exertion	4.9±1.8	(3-11)
Isometric load	3.2±1.3	(2-8)
Life style		
No smoking	255	75.7
Non or sometimes drinking alcohol	256	76.0
Breakfast everyday	241	71.5
More than once a week physical acticvity	75	22.3
No eating after dinner over 3days per week	246	73.0
No skipping breakfast over 3days per week	248	73.6
Get enough sleep and rest	190	56.5
Perceived health competence (PHCS)	23.4±6.5	(8-40)
eHealth literacy (eHEALS)	22.0±7.5	(3-40)
Environmental factors		
Organizational climate		
Tradition	8.0±1.6	(6-12)
Organizational environment	8.6±1.8	(6-12)
Social support	5.4±1.2	(2-7)

SD, standard deviation

The mean age ± SD was 42.8 ± 11.7 years, and approximately two-thirds were male and

married. Two-fifths lived with their children, and one-quarter lived alone. Two-thirds had graduated from college or higher. Most participants had regular employment. Four-fifths felt good about their economic status. The mean CES-D score ± SD was 12.8 ± 7.6, and 99 participants (29.5%) were rated as having depression based on the cut-off point. The mean PSS score ± SD was 25.8 ± 6.2. One-quarter of the participants were being treated for a disease. The mean BMI ± SD was 22.0 ± 3.1, and three-quarters were within the healthy range (over 18.5, less than 25). Four-fifths reported that their self-rated health was good or fairly good. The mean physical complaint score ± SD was 19.3 ± 5.1. The mean scores for physical exertion and isometric load ± SD were 4.9 ± 1.8, and 3.2 ± 1.3. Most of the healthy lifestyle options were chosen by at least 50% of the participants, and some by approximately three-quarters of them. The mean score for PHCS and eHEALS ± SD were 23.4 ± 6.5, and 22.0 ± 7.5. The mean ± SD for the tradition scale score was 8.0 ± 1.6, the organizational environment scale 8.6 ± 1.8, and the social support scale score 5.4 ± 1.2.

There were correlations among demographic characteristics, individual and environmental factors, and cognitive stress appraisal. Spearman's correlation coefficients measured the linear relationship between each factor and PSS among workers (Table 2).

Table 2. Cognitive stress appraisal and related factors

	β	*p*
Demographic characteristics		
Economic status (1=sufficient, 2=slightly sufficient, 3=slightly insufficient, 4=insufficient)	0.171	0.000
Individual factors		
eHealth literacy (total score)	-0.113	0.012
Environmental factors		
Organizational climate: Tradition (total score)	0.131	0.004
Social support (total score)	-0.205	0.000
Adjusted R^2		0.412

Multiple regression analysis.

Controlled variables: Age, Sex (0=female, 1=male), Depression (0=no, 1=yes).

The demographic characteristics showing significant correlations with cognitive stress appraisal were age ($r = -0.300$, $p < 0.001$), marital status ($r = -0.207$, $p < 0.001$), household membership ($r = -0.231$ $p < 0.001$), economic status ($r = 0.355$, $p < 0.001$) and depression ($r = 0.528$, $p < 0.001$). Individual factors showing significant correlations with cognitive stress appraisal were self-rated health ($r = -0.275$, $p < 0.001$), physical complaints ($r = 0.372$, $p < 0.001$), total scores for physical exertion ($r = 0.109$, $p = 0.048$) and isometric load ($r = 0.183$,

$p = 0.001$), physical activity (r = −0.162, $p = 0.003$), sleeping and resting (r = −0.278, $p < 0.001$), perceived health competence (r = 0.412, $p < 0.001$), and eHealth literacy (r = −0.295, $p < 0.001$). Environmental factors showing significant correlations with cognitive stress appraisal were total scores for the tradition (r = 0.197, $p < 0.001$) and organizational environment scales (r = −0.182, $p = 0.001$) and social support (r = —0.398, $p < 0.001$).

The factors associated with cognitive stress appraisal—marital status, household membership, economic status, physical activity, sleeping, isometric load, eHealth literacy, tradition and organizational environment scales, and social support—were used as independent variables, and age, sex, and depression as control variables in a multiple regression analysis. The results are shown in Table 3. This analysis indicated that those with poorer economic status (β = 0.161, $p = 0.001$), lower eHealth literacy (β = −0.116, $p = 0.009$), higher traditional organizational climate (β = 0.124, $p = 0.005$), and lower feelings of social support (β = −0.220, $p < 0.001$) experienced a higher level of perceived negative stress. The adjusted R^2 in this analysis was 0.411.

DISCUSSION

The participants in this study were representative of healthy adult workers in a wide spectrum of employments in Japan. Firstly, in terms of demographic characteristics, such as age, sex and the proportion of participants in this study was similar to the national statistics for full-time workers in Japan [59]. Secondly, in terms of the participants' levels of the PSS, the PSS scores in this study were quite similar to those obtained when the PSS was originally developed [18] and from the scores of adults in other countries [60,61]. Therefore this study can be generalized to other workers not only in Japan but also other developed countries.

Our study is the first to our knowledge to examine the features of cognitive stress appraisal in workers and identify the associated individual and environmental factors. This study has added to the existing research evidence that individual factors, including eHealth literacy, and environmental factors, such as the organizational climate, are both related to cognitive stress appraisal among workers. This study therefore has important practical implications in promoting stress management and primary prevention of stress-related disease and suicide among workers.

The economic status is related to cognitive stress appraisal. It is possible that poor economic status itself is the origin of the stress, and workers with poor economic status therefore cannot cope with their own stress. Cognitive stress appraisal and subjective economic status are related and self-efficacy played an important role as a mediator between cognitive evaluation of stress and life satisfaction [62]. Workers may be unable to appraise challenges and struggle in stressful situations because they feel that their own ability level is low and resources are few.

Lower eHealth literacy was related to negative stress appraisal in this study. Health literacy

is a cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health [63]. Higher health literacy may enable an individual to actively seek support and solutions to problems [64]. Good eHealth literacy means people can access health information resources and use the information via the Internet. The Internet is increasingly becoming an effective information tool for improving self-care behavior [65-67]. There is a considerable amount of health information on the Internet, which is helpful for positive cognitive stress appraisal. Improving eHealth literacy should empower workers to obtain, understand, and act on information that they need for optimal mental health.

More traditional organizational climates were related to negative cognitive stress appraisal. A traditional organizational climate is more directive and feudalistic [55]. Higher tradition scores corresponded to higher levels of depressive state, lower job satisfaction, and lower levels of mental health [55]. A “traditional” structure or climate implies high levels of mandatory working, a lack of respect for individual opinion and pressure from superiors. Workers in a traditional organizational climate have less discretion and a more stressful environment. They may be unable to ask for help from their supervisor, or make improvements to the work environment.

Lower levels of social support were also related to negative stress appraisal. This is consistent with previous studies reporting that the amount of social support was associated with levels of depression [68], and that social support buffered adverse effects on mental health [69]. Social support also protects from the pathogenic effects of stressful events by altering the appraisal of those events or the process by which perceived stress causes illness [18]. Those who feel that they have little social support may be unable to buffer stressful events, on the other hand, those who feel that they have enough social support may be able to buffer stressful events.

In conclusion, it is suggested that the inter-professional approach of public health nurses and health practitioners, including provision of a spectrum of enhanced self-coping skills using the eHealth literacy of individual workers, development of a more modern organizational climate at their worksite, and social support in their community might be an effective strategy to contribute to minimizing the effect of one factor, ‘cognitive stress appraisal’ that might be associated with an increased risk of depression and contribute to the promotion of mental health in workers.

Limitations

This study had several limitations. First, it used a cross-sectional design, which means that it could not identify causal relationships between cognitive stress appraisal and related factors.

Second, the adjusted R^2 was 0.409 in this study, which was higher than the value of 0.05–0.27 reported previously [74]. Although this provides an adequate explanation of the factors related to cognitive stress appraisal, other factors are also likely to contribute. Future research requires longitudinal studies across other areas, widening the scope.

Conclusions

This study aimed to examine the cognitive stress appraisal, and to identify factors related to the cognitive stress appraisal in workers. The results indicated that cognitive stress appraisal is associated with economic status, depression, eHealth literacy, traditional organizational climate, and social support. Thus, it was recommended that public health nurses and health practitioners should enhance economic status, eHealth literacy, traditional organizational climate, and social support, and improvement depression to encourage workers for better cognitive stress appraisal. Furthermore, occupational and community interventions are required to create and inform people of the opportunities for cognitive stress appraisal in worksite and communities.

Acknowledgements

The authors would like to thank all the employees who agreed to participate in this study.

Contributors

NT, ET and AA contributed to develop the concept and design of this study.
ET was responsible for acquiring the Institutional Review Board (IRB) approval of this study.
NT was responsible for data collection and analysis.
NT and AA were responsible for drafting and revising the manuscript.
ET is responsible for study supervision and reporting of study results.
All authors have read and approved the final manuscript.

Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Funding

This study was supported by University Center of Community (COC) program funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan (http://www.mext.go.jp/en/). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Patient consent

Obtained.

Ethics approval

The Institutional Review Board of the Medical Department of the Yokohama City University approved this study on August 9, 2016 (Certification No.A1608008).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

There are no additional data available.

REFERENCES

1. World Health Organization [Internet]. Genéve: Depression; 2016 [cited 26 December 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs369/en/.

2. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Patient Survey; 2015 [cited 12 December 2016]. Available from: http://www.mhlw.go.jp/toukei/saikin/hw/kanja/14/dl/kanja.pdf (in Japanese)

3. World Health Organization [Internet]. Genéve: Depression; 2014 [cited 26 December 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs389/en/

4. World Health Organization [Internet]. Genéve: Comprehensive mental health action plan 2013–2020; 2013 [cited 27 December 2016]. Available from: http://www.who.int/mental_health/action_plan_2013/en/

5. World Health Organization [Internet]. Genéve: Mental Health Action Plan 2013-2020; 2013 [cited 26 December 2016]. Available from: http://apps.who.int/iris/bitstream/10665/89966/1/9789241506021_eng.pdf?ua=1

6. World Economic Forum and the Harvard School of Public Health [Internet]. Genéve: The global economic burden of non-communicable diseases; 2011 [cited 27 December 2016. Available from: http://apps.who.int/medicinedocs/documents/s18806en/s18806en.pdf

7. Van den Berg TIJ, Alavinia SM, Bredt FJ, et al. The influence of psychosocial factors at work and life style on health and work ability among professional workers. *International Archives of Occupational and Environmental Health*. 2008;81(8):1029-1036. doi:10.1007/s00420-007-0296-7.

8. Lee YM. Loss of Productivity due to Depression among Korean Employees. *Journal Occupational Health*. 2010;52(6):389-394.
9. Kim SE, Kim HN, Cho J, et al. Direct and Indirect Effects of Five Factor Personality and Gender on Depressive Symptoms Mediated by Perceived Stress. *PLOS ONE*. 2016;11(4): e0154140.
doi: 10.1371/journal.pone.0154140.
10. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2011 [cited 22 December 2016]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/rousaihoken04/dl/120215-01.pdf.Japanese
11. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2016 [cited 22 December 2016]. Available from: http://www.mhlw.go.jp/file/04-Houdouhappyou-11402000-Roudoukijunkyokuroudouhoshoubu-Hoshouka/h27_seishin.pdf. Japanese
12. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Basic Survey on Industrial Safety and Health; 2013 [cited 23 January 2017]. Available from: http://www.mhlw.go.jp/file/05-Shingikai-11201000-Roudoukijunkyoku-Soumuka/0000061406.pdf. Japanese.
13. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Stress check system; 2015 [cited 12 December 2016]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/anzeneisei12/. Japanese.
14. Lazarus R. Psychological Stress and the Coping Process. New York, McGraw-Hill; 1966.
15. Lazarus R & Folkman S. Stress, Appraisal, and Coping, New York, Springer; 1984.
16. Carpenter R. A Review of Instruments on Cognitive Appraisal of Stress. *Archives of Psychiatric Nursing*. 2016;30(2):271-279.
doi: http://dx.doi.org/10.1016/j.apnu.2015.07.002.
17. Fevre ML, Matheny J, Kolt GS. Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology*.2003;18(7):726-744. doi: 10.1108/02683940310502412
18. Cohen S, Kamarck T, Mermelstein R. A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*. 1983;24(4):385-396.
19. Schelle KJ, Olthof BMJ, Reintjes W, et al.A survey of substance use for cognitive enhancement by university students in the Netherlands.*Frontiers in Systems Neuroscience*.2015;9:10. doi:10.3389/fnsys.2015.00010.
20. Roberti JW, Harrington LN, Storch EA. Further Psychometric Support for the 10-Item Version of the Perceived Stress Scale. *Journal of College Counseling*. 2006;9:135-147. doi: 10.1002/j.2161-1882.2006.tb00100.x.
21. Hamaideh SH, Al-ashram SA, Al-modallal H. Premenstrual syndrome and premenstrual dysphoric disorder among Jordanian women. *Journal of Psychiatric and Mental Health Nursing*. 2014;21(1):60-68. doi: 10.1111/jpm.12047.

22. Wawrzyniak AJ & Whiteman MCP. Perceived stress, loneliness, and interaction with fellow students does not affect innate mucosal immunity in first year university students. *Psychological Japanese Research*.2011;53(2):121-132. doi: 10.1111/j.1468-5884.2011.00466.x.

23. Gupta R, Singh N, Kumar R. Longitudinal predictive validity of emotional intelligence on first year medical students perceived stress. *BMC Medical Education*. 2017;17:139. doi:10.1186/s12909-017-0979-z.

24. Li S, Li L, Zhu X, et al. Comparison of characteristics of anxiety sensitivity across career stages and its relationship with nursing stress among female nurses in Hunan, China.*BMJ Open*.2016;6(5):e010829. doi: 10.1136/bmjopen-2015-010829.

25. Győrffy Z & Girasek E. Mental Health of Physicians Nationwide Representative Study from Hungary. *Ideggyogyaszati szemle-Clinical Neuroscience*. 2015;68(7-8):258-269.

26. Su X, Lau JT, Mak WW, et al. Development of the Perceived Stress Scale for People Living with HIV/AIDS in China. *AIDS Patient Care and STDs*. 2008;22(12):989-998. doi: 10.1089/apc.2008.0095.

27. Kimura T, Yokoyama A, Kohno N, et al. Perceived Stress, Severity of Asthma, and Quality of Life in Young Adults with Asthma. *Allergology International*. 2009;58(1):71-79. doi: 10.2332/allergolint.O-07-531.

28. Hara Y, Hisatomi M, Ito H, et al. Effects of gender, age, family support, and treatment on perceived stress and coping of patients with type 2 diabetes mellitus. *BioPsychoSocial Medicine*.2014;8:16. doi: 10.1186/1751-0759-8-16.

29. Lee EH, Chung Y, Suh H, et al. Korean versions of the Perceived Stress Scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. *Scand J Caring Sci*. 2015;29(1):183-192. doi: 10.1111/scs.12131.

30. Mitchell AM, Crane PA, & Kim Y. Perceived Stress in Survivors of Suicide: Psychometric Properties of the Perceived Stress Scale. *Research in Nursing & Health*. 2008;31(6):576-85. doi: 10.1002/nur.20284.

31. Andreou E, Alexopoulos EC, Lionis C, et al. Perceived Stress Scale: reliability and validity study in Greece. *Int J Environ Res Public Health*. 2011;8(8):3287-3298. doi: 10.3390/ijerph8083287

32. Barrington WE, Ceballos RM, Bishop SK, et al. Perceived Stress, Behavior, and Body Mass Index among Adults Participating in a Worksite Obesity Prevention Program, Seattle, 2005-2007. *Prev Chronic Dis*. 2012;9:E152. doi: 10.5888/pcd9.120001

33. Leung DY, Lam TH, Chan SS. Three versions of Perceived Stress Scale: validation in sample of Chinese cardiac patients who smoke. *BMC Public Health*. 2010;25;10:513. doi: 10.1186/1471-2458-10-513.

34. Willert MV, Wieclaw J, Thulstrup AM. Rehabilitation of individuals on long-term sick

leave due to sustained stress-related symptoms: A comparative follow-up study. *Scand J Public Health.* 2014;42(8):719-27.
doi: 10.1177/1403494814551859.

35. Wiernik E, Nabi H, Pannier B, et al. (2014): Perceived stress, sex, and occupational status interact to increase the risk of future high blood pressure: the IPC cohort study. *J Hypertens*. 2014;32(10):1979-1986.
doi: 10.1097/HJH.0000000000000288.

36. Horiuchi S, Tsuda A, Kim E, et al. Relationships between stage of change for stress management behavior and perceived stress and coping. *Japanese psychological Research.* 2010;52(4):291-297.
doi: 10.1111/j.1468-5884.2010.00444.x.

37. Stewart DW, Vidrine JI, Shete S, et al. Health literacy, smoking, and health indicators in African American adults. *J Health Commun.* 2015;20 Suppl 2:24-33. doi: 10.1080/10810730.2015.1066465.

38. Faresjö Å, Theodorsson E, Chatziarzenis M, et al. Higher Perceived Stress but Lower Cortisol Levels Found among Young Greek Adults Living in a Stressful Social Environment in Comparison with Swedish Young Adults. *PLoS One*. 2013;8(9):e73828.
doi: 10.1371/journal.pone.0073828

39. Mimura C & Griffiths G. A Japanese version of the perceived stress scale: translation and preliminary test. *International Journal of Nursing Studies*. 2004; 41(4): 379-385.

40. Mimura C & Griffiths G. A Japanese version of the Perceived Stress Scale: cross-cultural translation and equivalence assessment. *BMC Psychiatry.* 2008;8:85. doi: 10.1186/1471-244X-8-85.

41. Shima S, Kano T, Kitamura T, et al. Atarashii yokuutsusei jiko hyouka syakudo ni tsuite (A new self-report depression scale). Clinical Psychiatry, 1985:27; 717–723. Japanese

42. Radloff LS. The CES-D Scale. A self-report depression scale for research in the general population. *Applied Psychological Measurement*.1985;1(3):385-401.
doi: https://doi.org/10.1177/014662167700100306

43. Shimomitsu T, & Odagiri Y. The brief job stress questionnaire. *Japanese Journal of Occupational Mental Health*.2004;12(1):25-36. Japanese

44. Kawakami N & Fujigaki Y. Reliability and Validity of the Japanese Version of Job Content Questionnaire: Replication and Extension in Computer Company Employees. *Industrial Health*.1996;34(4):295-306.

45. Karasek R, Brisson C, Kawakami N, et al. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol.* 1998;3(4):322-55.

46. Kawakami N, Kobayashi F, Araki S, et al. Assessment of job stress dimensions based on the Job Demands-Control model of employees of telecommunication and electric power

companies in Japan: reliability and validity of the Japanese version of Job Content Questionnaire. *Int J Behav Med*. 1995;2(4):358-75.

47. Suzuki-Saito T, Yasumura S, Okamura T, et al. Medical care costs and the characteristics of higher medical costs among BMI groups in the early-stage elderly Analysis of data obtained from a large-scale study of 29,490 elderly. *Japanese Journal of Public Health*.2012:59(7);466-473. Japanese.
doi: http://doi.org/10.11236/jph.59.7_466

48. Togari T, Yamazaki Y, Koide S, et al. Reliability and validity of the Modified Perceived Health Competence Scale (PHCS) Japanese version. *Japanese Journal of Public Health*.2006: 53(1); 51-57. Japanese.
doi:http://doi.org/10.11236/jph.53.1_51

49. Leon-Perez JM, Antino M, Leon-Rubio JM. The Role of Psychological Capital and Intragroup Conflict on Employees' Burnout and Quality of Service: A Multilevel Approach. *Front Psychol*. 2016; 7: 1755. doi: 10.3389/fpsyg.2016.01755

50. Smith MS, Wallston KA, Smith CA. The development and validation of the Perceived Health Competence Scale. *Health Educ Res*. 1995 Mar;10(1):51-64.

51. Mitsutake S, Shibata A, Ishii K, et al. Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Japanese Journal of Public Health*.2011;58(5):361-371. Japanese. doi: http://doi.org/10.11236/jph.58.5_361

52. Norman CD & Skinner HA. eHealth Literacy: Essential Slills for Consumer Health in a Networked World. *J Med Internet Res*. 2006; 8(2): e9. doi: 10.2196/jmir.8.2.e9

53. Norman CD & Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res*. 2006 Oct-Dec; 8(4): e27. doi: 10.2196/jmir.8.4.e27

54. Ministry of Internal Affairs and Communications [Internet] Tokyo: White Paper on Information and Communications in Japan; 2016 [cited 28 January 2017. Available from: http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2016/chapter-5.pdf#page=1

55. Fukui S, Haratani T, Toshima Y, et al. Measuring Workplace Climate: Reliability and Validity of the 12-item Organizational Climate Scale (OCS-12). *Japan Society for Occupational Health*. 2004;46(6):213-222.
Japanese. doi:http://doi.org/10.1539/sangyoeisei.46.213

56. Hemingway MA & Smith CS. Organizational climate and occupational stressors as predictors of withdrawal behaviors and injuries in nurses. *Journal of Occupational and Organizational Psychology*. 1999;72(3):285-299.
doi:10.1348/096317999166680

57. Iwasa H. Gondo Y, Masui Y, et al. Reliability and validity of “Social Support Scale”, Japanese language edition: Investigation targeting middle and old age. *Indicators of social welfare*.2007 54(6), 26-33. Japanese.

58. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidemensional Scale of Perceived

Social Support. *Jounal of Personality Assessment*. 1988;52(1):30-41. doi: 10.1207/s15327752jpa5201_2

59. Japan Institute for Labour Policy and Training [Internet] Tokyo: Labour statistics data retrieval system (Basic Survey on Wage Structure); 2015 [cited 19 December 2016]. http://stat.jil.go.jp/jil63/plsql/JTK0400?P_TYOUSA=R1&P_HYOUJI=C0010&P_KITYOU=0

60. Katsarou A, PAnagiotakos D, Zafeiropoulou A, et al. Validation of a Greek Version of PSS-14: A global measure of perceived stress. *Cent Eur J Public Health*. 2012;20(2):104-109.

61. Remor E. Psychometric properties of a European Spanish version of the Perceived Stress Scale (PSS). *Span J Psyvhol*. 2006: 9(1); 86-93.

62. Lee J, Kim EY, Wachholtz A. The effect of perceived stress on life satisfaction: The mediating effect of self-efficacy. *Chongsonyonhak Yongu*. 2016;23(10):29-47.

63. Nutbeam D. Health promotion glossary. *Health Promotion International*. 1998;13(4):349-364.

64. Ishikawa H, Nomura K, Sato M, et al. Developing a measure of communicative and critical health literacy: a pilot study of Japanese office workers. Health Promotion International. *Health Promot Int*. 2008;23(3):269-274. doi: 10.1093/heapro/dan017.

65. Ministry of Economy, Trade and Industry [Internet]. Tokyo: Employment Status Survey; 2012 [cited 24 December 2016] Available from: http://www.stat.go.jp/english/data/shugyou/pdf/sum2012.pdf. Japanese

66. Ritterband LM & Palermo T. Introduction to the Special Issue: eHealth in Pediatric Psychology. *Journal of Pediatric Psychology*. 2009;34(5):453-456. doi: 10.1093/jpepsy/jsp008

67. Mitsutake S, Shibata A, Ishii K, et al. Associations of eHealth Literacy With Health Behavior Among Adult Internet Users. *J Med Internet Res*. 2016;18(7):e192. doi: 10.2196/jmir.5413.

68. Koizumi Y, Awata S, Kuriyama S, et al. Association between social support and depression status in the elderly: results of a 1-year community-based prospective cohort study in Japan. *Psychiatry Clin Neurosci*. 2005;59(5):563-569.

69. Frasure-Smith N, Lesperance F, Gravel G, et al. Social Support, depression, and mortality during the first year after myocardial infarction. *Circulation*. 2000;101(16):1919-1924.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-7
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	-
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-11
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

An epidemiological study of cognitive stress appraisal and related factors among workers: cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019404.R1
Article Type:	Research
Date Submitted by the Author:	28-Dec-2017
Complete List of Authors:	Tohmiya, Natsuka; Setagaya District Administration Offices,, Public Health Promotion Division; Yokohama Shiritsu Daigaku, Guraduate School of Medicine Tadaka, Etsuko; Yokohama City University, Community Health Nursing Arimoto, Azusa; Yokohama Shiritsu Daigaku, Department of Community Health Nursing
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Epidemiology, Mental health, Nursing, Public health, Occupational and environmental medicine
Keywords:	cognitive stress appraisal, environmental factor, individual factor, workers

An epidemiological study of cognitive stress appraisal and related factors among workers: cross-sectional study

Corresponding aouthor
Natsuka Tohmiya
MSN, RN, PHN
Public Health Promotion Division, Setagaya District Administration Offices,
4-22-33 Setagaya Setagaya-city, Tokyo 154-8504 Japan
E-mail: natsuka.dct.ft@gmail.com
TEL: +81-3-5432-2896
FAX: +81-3-5432-3074

Co-author

Etsuko Tadaka, Azusa Arimoto

Graduate School of Medicine, Yokohama City University, Yokohama, Kanagawa, Japan

Word count: 4,283 words

ABSTRACT

Objective Stress as a trigger for depression has enormous socioeconomic implications for all spheres of employment, because it affects absenteeism, turnover, productivity, morale, and suicide. Positive or negative cognitive stress appraisal can, however, affect workers' ability to cope with stress as a self-care strategy. This study examined cognitive stress appraisal among workers and identify related individual and environmental factors.

Design Cross-sectional study using self-administered postal questionnaires.

Participants 2,311 people working at 48 companies in metropolitan areas in Japan. In total, 341 questionnaires were returned (response rate: 14.8%), 337 of which were suitable for analysis (effective response rate: 98.8%).

Primary measures Cognitive stress appraisal was assessed using the Japanese version of the Perceived Stress Scale (PSS). Potential variables related to stress appraisal included demographic, individual, and environmental factors. Multiple regression analysis was used to identify factors related to cognitive stress appraisal.

Results The mean age ± SD was 42.8 ± 11.7 years, and two-thirds were male. The mean PSS score ± SD was 25.8 ± 6.2. Multiple regression analysis after controlling for variables of age, sex, and depression indicated that those with poorer economic status ($\beta = 0.161$, $p < 0.001$), lower eHealth literacy ($\beta = -0.116$, $p = 0.009$), higher traditional organizational climate ($\beta = 0.124$, $p = 0.005$), and lower feelings of social support ($\beta = -0.220$, $p < 0.001$) experienced significantly higher negative levels of perceived stress.

Conclusion The results show the individual and environmental factors related to cognitive stress appraisal among workers. The inter-professional approach of public health nurses and health practitioners, including a spectrum of enhanced self-coping skills using the eHealth literacy of individual workers, improvement of traditional organizational climate at their worksite, and social support in their community, might be an effective strategy to contribute to improved mental health among workers.

Strengths and limitations of this study

・First study to examine the individual and environmental factors related to cognitive stress appraisal of healthy and general workers.
・Simultaneously examine both eHealth literacy, multidimensional perceived social support and traditional organizational climate.
・This study is cross-sectional design, it could not identify causal relationships between cognitive stress appraisal and related factors.
・This study's target population is limited to metropolitan areas in Japan.

keywords: cognitive stress appraisal, environmental factor, individual factor, workers

INTRODUCTION

Depression is one of the most common psychiatric disorders, affecting about 350 million people worldwide [1]. In Japan, depression is estimated to have affected up to 1.116 million people in 2015 [2]. Certain occupational factors account for up to 8% of cases of depression) [3]. The World Health Organization's comprehensive mental health action plan 2013–2020 was adopted by the 66th World Health Assembly [4] and argues that determinants of mental health and psychiatric disorders include not only individual attributes but also social, cultural, economic, political, and environmental factors [5]. Mental illnesses are associated with a substantial deterioration in individual quality of life and economic loss in the community and the workplace [5, 6]. Therefore, primary prevention of depressive disorders is an important issue nationally and internationally, and not just for individuals.

Stress as a trigger for depression has enormous socioeconomic implications for all spheres of employment, because it affects absenteeism, turnover, productivity, morale, and suicide [7,8,9]. In Japan, the number of employees applying for industrial accident compensation insurance for mental disorders because of stress has increased in recent years [10]. In 2015, the number of applications was 1,515, up from 1,272 in 2011 [11]. The proportion of workers experiencing anxiety, distress, and work stress has progressively increased since 1982 and is now around 60% [12]. Against this background, the Japanese government launched a new occupational health policy in 2015 called "The Stress Check Program" to screen for workers experiencing high psychosocial stress [13]. The law mandates use of the Stress Check Program and its guidelines at least once per year in all workplaces with 50 or more employees in Japan. The program and its guidelines recommends individual checks on perceived stress and sets out four principles of care in the workplace: (1) self-care; (2) line-care; (3) health practitioners' care in the workplace; and (4) health practitioners' care in the community.

Cognitive stress appraisal is the evaluation of how individuals perceive the stressors that cause stress and is a self-care strategy. In primary appraisal, an individual's evaluations are divided into "threat," and "challenge", threat describes anticipated harm/loss, and challenge describes a threat that can be met or overcome [14,15]. Whether something is given a cognitive appraisal of "threat" or "challenge" can affect mental health [15,16]. The stress response and stress coping caused by cognitive appraisal differ among individuals, even in response to the same stressors [17]. For example, people making a positive cognitive appraisal may see stress as a challenging health issue to be resolved, and set themselves challenging goals [14,15]. Those making a negative cognitive appraisal can view the same issues as a health threat, and may believe that resolving tasks and situations is beyond their abilities. Positive or negative cognitive stress appraisal can therefore be an important concept in mental health to improve stress-coping skills and control stress among workers. In an individual, a positive cognitive appraisal contributes to prevention of depression, thus improving quality of

life. At the societal level, this is important in controlling the escalation of medical costs and increasing corporate and community-wide productivity.

The Perceived Stress Scale (PSS) measures the degree to which situations are cognitively appraised as stressful [18]. Cohen said that PSS is a measure of the degree to which situations in one's life are appraised as stressful. In addition, items of PSS were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives and these issues have been repeatedly found to be central components of the experience of stress. (Perceptions of stress and negative affect are necessary for stressful life events to influence disease risk.) [18] Also, Cohen said PSS can be used to determine whether "appraised" stress is an etiological (or risk) factor in behavioral disorders or disease. [18,19] Thus, we interpreted PSS can continuously measure negative cognitive stress appraisal. Many previous studies have measured cognitive stress appraisal using the PSS and related factors in students [20-24], medical workers [25,26], and patients with chronic disease [27-30]. The scale has not, however, been used with healthy adult workers in a wide spectrum of employments. Previous studies clarified various individual factors related to the PSS, but varied for different participants. Some studies examined the physical and psychological health condition of students and conditions in particular groups such as adults with a disease or pregnant women [28,31,32]. Others examined the lifestyles of students, pregnant women, and medical workers [26,33,34]; job stress among medical workers [25,35,36]; stressors and coping in adults, such as survivors of suicide and pregnant women [31,37]; and health literacy in African-American adults [38]. However, there is limited information about the relationship between cognitive stress appraisal and individual and environmental factors such as work environment and social support available to adult workers [39].

The purpose of this study was to examine cognitive stress appraisal and identify individual and environmental factors among workers. The study can contribute to minimizing the effect of one factor that might be associated with an increased risk of depression and contribute to the promotion of individual self-care and improvement of worksite environments to promote mental health among workers. Furthermore, it can be useful for primary prevention of mental health disorders among workers by public health nurses and health practitioners at worksites.

METHODS

Participants and sampling

The study participants were workers at companies in metropolitan areas of Japan. The criteria

for participation included being between 18 and 64 years old. An age of 64 years is the upper limit for consideration of retirement and re-employment under the Law Concerning Stabilization of Employment of Older Persons; 18 years is the earliest age for employment immediately after graduating high school in Japan. We selected companies stratified number of employees based on Industrial Safety and Health Act. Moreover, we clarified that there is no biased type of industry.

The study design was a cross-sectional study using self-administered postal questionnaires. Data were collected across two metropolitan areas of Japan (Tokyo and Kanagawa prefectures) from companies registered in the Japan Company Handbook 2016. Questionnaires were sent to employees randomly selected, stratified by the number of employees of each company. In total, 361 of 2,026 companies were selected (17.8%).

Measuring instruments

Dependent variable: Cognitive stress appraisal

The dependent variable was cognitive stress appraisal, which was determined using the Japanese version of the PSS [40,41]. The PSS consists of 14 items and includes questions such as “In the last month, how often have you been upset because of something that happened unexpectedly?” and “In the last month, how often have you felt that you were unable to control the important things in your life?” The responses were coded for scoring as “Never” = 0, “Almost Never” = 1, “Sometimes” = 2, “Fairly Often” = 3, and “Very Often” = 4. Possible total scores ranged from 0 to 56 with higher scores indicating higher levels of negative cognitive stress appraisal. All 14 items are highly intercorrelated in the Japanese version (Cronbach’s alpha = 0.74).

Demographic characteristics

Demographic characteristics collected about the participants in this study included age, sex (“Male”=1, “Female”=2), marital status (”Unmarried” and “Divorced/Widowed” =1, “Married”=2), household membership (“Live alone”=1, “Spouse”=2, “Spouse and Children”=3, “Parents”=4, “Others”=5"), educational status (“Junior high school/High school”=1, “Vocational college/Junior college”=2, “College or University/Graduate school”=3), employment status (“Fulltime worker”=1, “Part-time worker”=2, “Others”=3), economic status (“Sufficient”=1 ”Slightly sufficient”=2, “slightly insufficient” =3, ”Insufficient”=4) and depression. We asked standard questions generally used in previous study for workers and deliberated about items of national survey for workers.

Depression was measured using the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D) [42,43], which consists of 20 items. Each item is measured

on a four-point Likert-type scale ranging from 0 to 3. The total score ranges from 0 to 60 with higher scores indicating greater levels of depression; scores above 16 on the CES-D indicate a depressive state. CES-D was developed for use in epidemiological studies of depressive symptomatology in the general population [42,43]. A group with a higher score may be interpreted to be depressive state or in need of treatment [43]. Cognitive stress appraisal is affected by participants' mental condition at that time. Depression is basic mental condition of participants. The psychometric properties of CES-D were confirmed reliability and validity. CES-D had high internal consistency, acceptable test-retest stability, and excellent concurrent validity by clinical and self-report criteria and substantial evidence of construct validity. When CES-D designed, internal consistency was high in the general population (0.77-0.87) and even higher in the patient sample (0.85-0.92). And the test-retest correlations were in the moderate range (between 0.45 and 0.70). In addition, the correlations of the CES-D with the Hamilton Clinician's Rating scale and with the Raskin Rating scale were moderate (0.44-0.54) at admission.[42,43]

Independent variable

Conceptual framework of this study was to examine cognitive stress appraisal and identify individual and environmental factors. According to Lazarus's theory, individual and environment mutually affect in cognitive stress appraisal process. So, we thought both individual and environmental factors were important. When we selected independent variables, we referred previous studies.

Individual factors of the participants in this study included any disease currently under treatment (e.g., cancer, diabetes), body mass index (BMI), self-rated health, physical complaints, physical demands, lifestyle, perceived health competence, and electronic health literacy (eHealth literacy).

BMI is calculated from self-reported weight and height.

Self-rated health was measured on a four-point Likert-type scale from 1 (very poor) to 4 (very good). Physical complaints were measured using the Brief Job Stress Questionnaire (BJSQ) [44]. The BJSQ is used in the Japan Stress Check Test by the Ministry of Health, Labour and Welfare [12] and can be easily used in the workplace. It consists of 57 items across 19 subscales, from which we drew 11 items (e.g., "I have felt dizzy" and "I have experienced joint pains"). Each item was measured on a four-point Likert-type scale. The total scores ranged from 11 to 44 with higher scores indicating more frequent physical complaints.

Physical demands were measured using the Job Content Questionnaire (JCQ) [45], which consists of 45 items divided into six subscales. We used three items on physical exertion and two on isometric load. Each item was measured on a five-point Likert-type scale. The total scores for physical exertion ranged from three to 15, and for isometric load from two to 10, with higher scores indicating stronger physical demands and isometric load. The JCQ was developed based on the job demands–control model and has been nationally standardized by occupation in several countries [45-47].

Lifestyle was measured using seven items based on Breslow's good health habits [48]. The scale covered smoking, drinking alcohol, eating breakfast every day, physical activity, eating snacks after dinner, skipping breakfast, and sleeping and resting. The responses were coded for scoring as "yes" or "no."

Perceived health competence was measured using the Perceived Health Competence Scale, Japanese version (PHCS) [49], which consists of eight items. Each was measured on a five-point Likert-type scale. The total scores ranged from 8 to 40, with higher scores indicating higher perceived health competence. Perceived health competence is related to stress [50]. The PHCS was designed to assess efficacy and competence beliefs about personal health at this intermediate level of domain-specificity [51].

eHealth literacy was measured using the Japanese version of the eHealth Literacy Scale (eHEALS) [52], which consists of eight items. eHealth literacy is defined as the ability to seek, find, understand, and appraise health information from electronic sources, and apply the knowledge gained from doing so in addressing or solving a health problem [53,54]. Responses to the scale were assessed using a five-point Likert-type scale. The total scores ranged from 8 to 40 with higher scores showing greater health literacy. In Japan, Internet penetration in the age group under study is over 90% [55]. eHEALS has been developed to address the need to assess eHealth literacy for a wide range of populations and contexts. It is designed to provide a general estimate of consumer eHealth-related skills to inform clinical decision-making and health promotion planning with individuals or specific populations [54].

Environmental factors: Organizational climate

Organizational climate was measured using the 12-item Organizational Climate Scale [56], which is divided into two six-item subscales: the tradition scale and the organizational environment scale. The responses were coded for scoring as "yes" = 2 and "no" = 1. The total possible scores ranged from six to 12 for each scale. Higher scores on the tradition scale show

a more mandatory, injunctive, and feudalistic organizational climate and higher scores on the organizational environment scale show a more flexible organizational system. A previous study showed that organizational climate could affect occupational stress [57]. This scale measures organizational properties based on the model of Healthy Work Organizations at NIOSH [56].

Social support

Social support was measured using the short version of the Multidimensional Scale of Perceived Social Support (MPSS) in Japanese [58,59], which consists of seven items. Each item was examined on a seven-point Likert-type scale with lower scores indicating lower feelings of social support. The MPSS specifically addresses the subjective assessment of social support adequacy and was designed to assess perceptions of social support adequacy from three specific sources: family, friends, and significant others [59].

Data collection

In total, 48 of 361 companies agreed to participate to this study. Prior to sending the questionnaire to each company, we identified the sample size from the administrators. A total of 2,311 questionnaires were sent to the 48 companies via mail. Of the 2,311 questionnaires mailed to the companies, 341 were returned (response rate: 14.8%).The potential participants, all the employees in each of these companies, were asked to complete the questionnaire anonymously and on a voluntary basis, between October 1 and December 9, 2016. The anonymity of the workers was maintained throughout the process by using unsigned forms, which they posted back themselves. Returning the document was considered to indicate informed consent.

Statistical analysis

The mean, SD, frequency, and percentage were calculated for demographic characteristics, positive or negative cognitive stress appraisal (PSS), and individual and environmental factors. Univariate analysis using Spearman's correlation was used to examine correlations between the dependent and independent variables. A multiple regression analysis was then used to identify factors related to cognitive stress appraisal among workers, using all potentially significant predictors identified by the univariate analyses ($P < 0.05$) considering multicollinearity as independent variables via the forced entry (variable reduction) method.

The multiple regression model contained selected independent variables and all statistical analyses. We performed with step 1 have the control variables, step 2 having the demographics, and step 3 having the remaining predictors. Sex, age, and depression were contained as controlled variables. A previous study reported high correlation between the PSS and the CES-D, but both scales still independently predicted symptomatology [18]. The aim of this research was primary prevention of poor mental health, specifically depression. We therefore assumed that depression was covariate and treated it as a control variable. All analyses were performed using IBM SPSS Statistics for Windows version 22.0. Sample size was calculated using sample-size calculating software G*Power version 3.0.10. [60] With power of 80 %, 0.05 statistical level of significance, effect size of 0.15[61] and number of predictors of 13, sample size for multiple regression model was calculated to be 131. We converted a missing data into a median value of this study sample. The level of significance was set at $P < 0.05$.

RESULTS

Returned questionnaires were 341. Four of the 341 questionnaires were from participants aged over 65 years or who did not provide their age. We excluded these questionnaires and were left with 337 questionnaires for analysis (effective response rate: 98.8%).

Participants' background information (demographic characteristics, individual factors, environmental factors) is shown in Table 1.

The mean age ± SD was 42.8 ± 11.7 years, and approximately two-thirds were male and married. Two-fifths lived with their children, and one-quarter lived alone. Two-thirds had graduated from college or higher. Most participants had regular employment. Four-fifths felt good about their economic status. The mean CES-D score ± SD was 12.8 ± 7.6, and 99 participants (29.5%) were rated as having depression based on the cut-off point. The mean PSS score ± SD was 25.8 ± 6.2. One-quarter of the participants were being treated for a disease. The mean BMI ± SD was 22.0 ± 3.1, and three-quarters were within the healthy range (over 18.5, less than 25). Four-fifths reported that their self-rated health was good or fairly good. The mean physical complaint score ± SD was 19.3 ± 5.1. The mean scores for physical exertion and isometric load ± SD were 4.9 ± 1.8, and 3.2 ± 1.3. Most of the healthy lifestyle options were chosen by at least 50% of the participants, and some by approximately three-quarters of them. The mean score for PHCS and eHEALS ± SD were 23.4 ± 6.5, and 22.0 ± 7.5. The mean ± SD for the tradition scale score was 8.0 ± 1.6, the organizational environment scale 8.6 ± 1.8, and the social support scale score 5.4 ± 1.2.

Table 1. Background of the participants

Items	Number or Mean±SD	% (Range)
Demographic characteristics		
Age	42.8±11.7	(18-64)
Sex		
Male	228	67.7
Female	109	32.3
Matital status		
Unmarried	110	32.6
Married	203	60.2
Divorced/Widowed	24	7.1
Household membership		
Live alone	76	22.8
Spouse	48	14.4
Spouse and childeren	129	38.6
Parentes	50	15.0
Others	31	9.3
Educational status		
Junior high school/High school	78	23.1
Vocational college/Junior college	53	15.7
College or University/Graduate school	206	61.1
Employment status		
Fulltime worker	301	89.9
Part-time worker	27	8.1
Others	7	2.1
Economic status		
Sufficient	106	31.5
Slightly sufficient	175	51.9
Slightly insufficient	51	15.1
Insufficient	5	1.5
Depression（CES-D）		
Score	12.8±7.6	(0-45)
Depression(CES-D≧16; cut-off point)	99	29.5
Dependent variable		
Cognitive stress appraisal (PSS)	25.8±6.2	(6-48)

SD, standard deviation

311

312

313

Table 1. Background of the participants (cont.)

Items	Number or Mean±SD	%(Range)
Individual factors		
Disease currently under treatment		
No	252	75.0
Yes	84	25.0
High blood pressure	25	7.4
Gout	11	3.3
Hyperlipidemia	8	2.4
Respiratory disease	8	2.4
Diabetes	7	2.1
Digestive disease	7	2.1
Mental disease	7	2.1
Others	26	7.7
Body-mass index (BMI)		
Mean	22.0±3.1	(14.5-34.6)
Thin（BMI＜18.5）	32	9.8
Standard(18.5≦BMI＜25)	243	74.8
Obesity（25≦BMI）	50	15.4
Self-rated health		
Very poor	7	2.2
Rather poor	47	14.6
Rather good	216	66.9
Very good	53	16.4
Brief Job Stress (BJSQ)		
Physical complaint	19.3±5.1	(11-36)
Physical demands (Job Content: JCQ)		
Physical exertion	4.9±1.8	(3-11)
Isometric load	3.2±1.3	(2-8)
Life style		
No smoking	255	75.7
Non or sometimes drinking alcohol	256	76.0
Breakfast everyday	241	71.5
More than once a week physical acticvity	75	22.3
No eating after dinner over 3days per week	246	73.0
No skipping breakfast over 3days per week	248	73.6
Get enough sleep and rest	190	56.5
Perceived health competence (PHCS)	23.4±6.5	(8-40)
eHealth literacy (eHEALS)	22.0±7.5	(3-40)
Environmental factors		
Organizational climate		
Tradition	8.0±1.6	(6-12)
Organizational environment	8.6±1.8	(6-12)
Social support	5.4±1.2	(2-7)

SD, standard deviation

314

315

There were correlations among demographic characteristics, individual and environmental factors, and cognitive stress appraisal. Spearman's correlation coefficients measured the linear relationship between each factor and PSS among workers.

The demographic characteristics showing significant correlations with cognitive stress appraisal were age ($r = -0.300$, $p < 0.001$), marital status ($r = -0.207$, $p < 0.001$), household membership ($r = -0.231$ $p < 0.001$), economic status ($r = 0.355$, $p < 0.001$) and depression ($r = 0.528$, $p < 0.001$). Individual factors showing significant correlations with cognitive stress appraisal were self-rated health ($r = -0.275$, $p < 0.001$), physical complaints ($r = 0.372$, $p < 0.001$), total scores for physical exertion ($r = 0.109$, $p = 0.048$) and isometric load ($r = 0.183$, $p = 0.001$), physical activity ($r = -0.162$, $p = 0.003$), sleeping and resting ($r = -0.278$, $p < 0.001$), perceived health competence ($r = 0.412$, $p < 0.001$), and eHealth literacy ($r = -0.295$, $p < 0.001$). Environmental factors showing significant correlations with cognitive stress appraisal were total scores for the tradition ($r = 0.197$, $p < 0.001$) and organizational environment scales ($r = -0.182$, $p = 0.001$) and social support ($r = —0.398$, $p < 0.001$).

The factors associated with cognitive stress appraisal—marital status, household membership, economic status, physical activity, sleeping, isometric load, eHealth literacy, tradition and organizational environment scales, and social support—were used as independent variables, and age, sex, and depression as control variables in a multiple regression analysis. The results are shown in Table 2. This analysis indicated that those with poorer economic status ($\beta = 0.161$, $p = 0.001$), lower eHealth literacy ($\beta = -0.116$, $p = 0.009$), higher traditional organizational climate ($\beta = 0.124$, $p = 0.005$), and lower feelings of social support ($\beta = -0.220$, $p < 0.001$) experienced a higher level of perceived negative stress. The adjusted R^2 in this analysis was 0.412.

Table 2. Cognitive stress appraisal and related factors

	β	*p*
Demographic characteristics		
Economic status (1=sufficient, 2=slightly sufficient, 3=slightly insufficient, 4=insufficient)	0.171	0.000
Individual factors		
eHealth literacy (total score)	-0.113	0.012
Environmental factors		
Organizational climate: Tradition (total score)	0.131	0.004
Social support (total score)	-0.205	0.000
Adjusted R^2		0.412

Multiple regression analysis.

Controlled variables: Age, Sex (0=female, 1=male), Depression (0=no, 1=yes).

DISCUSSION

The participants in this study were representative of healthy adult workers in a wide spectrum of employments in Japan. Firstly, in terms of demographic characteristics, such as age, sex and the proportion of participants in this study was similar to the national statistics for full-time workers in Japan [62]. Secondly, in terms of the participants' levels of the PSS, the PSS scores in this study were quite similar to those obtained when the PSS was originally developed [18] and from the scores of adults in other countries [63,64]. Therefore this study can be generalized to other workers not only in Japan but also other developed countries.

Our study is the first to our knowledge to examine the features of cognitive stress appraisal in workers and identify the associated individual and environmental factors. This study has added to the existing research evidence that individual factors, including eHealth literacy, and environmental factors, such as the organizational climate, are both related to cognitive stress appraisal among workers. This study therefore has important practical implications in promoting stress management and primary prevention of stress-related disease and suicide among workers.

The economic status is related to cognitive stress appraisal. It is possible that poor economic status itself is the origin of the stress, and workers with poor economic status therefore cannot cope with their own stress. Cognitive stress appraisal and subjective economic status are related and self-efficacy played an important role as a mediator between cognitive evaluation of stress and life satisfaction [65]. Workers may be unable to appraise challenges and struggle in stressful situations because they feel that their own ability level is low and resources are few.

Lower eHealth literacy was related to negative stress appraisal in this study. Health literacy is a cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health [66]. Higher health literacy may enable an individual to actively seek support and solutions to problems [67]. Good eHealth literacy means people can access health information resources and use the information via the Internet. The Internet is increasingly becoming an effective information tool for improving self-care behavior [68-70]. There is a considerable amount of health information on the Internet, which is helpful for positive cognitive stress appraisal. Improving eHealth literacy should empower workers to obtain, understand, and act on information that they need for optimal mental health.

More traditional organizational climates were related to negative cognitive stress appraisal. A traditional organizational climate is more directive and feudalistic [56]. Higher tradition scores corresponded to higher levels of depressive state, lower job satisfaction, and lower levels of mental health [56]. A "traditional" structure or climate implies high levels of mandatory working, a lack of respect for individual opinion and pressure from superiors. Workers in a traditional organizational climate have less discretion and a more stressful

environment. They may be unable to ask for help from their supervisor, or make improvements to the work environment. The relation between organizational climate and worker's performance can be explained using the Social Exchange Theory. This theory is based upon the assumption that social exchanges involve several actions that create obligations, and that relationships evolve over time into trusting, loyal, and mutual commitments [71]. Organizational climate can be changed when employers establish an organizational climate that is perceived as positive by their employees with their good relationships, and this can result in better organizational performance and higher levels of motivation in workers.

Lower levels of social support were also related to negative stress appraisal. This is consistent with previous studies reporting that the amount of social support was associated with levels of depression [72], and that social support buffered adverse effects on mental health [73]. Social support also protects from the pathogenic effects of stressful events by altering the appraisal of those events or the process by which perceived stress causes illness [18]. Those who feel that they have little social support may be unable to buffer stressful events, on the other hand, those who feel that they have enough social support may be able to buffer stressful events.

In conclusion, it is suggested that the inter-professional approach of public health nurses and health practitioners, including provision of a spectrum of enhanced self-coping skills using the eHealth literacy of individual workers, development of a more modern organizational climate at their worksite, and social support in their community might be an effective strategy to contribute to minimizing the effect of one factor, 'cognitive stress appraisal' that might be associated with an increased risk of depression and contribute to the promotion of mental health in workers.

Limitations

This study had several limitations. First, it used a cross-sectional design, which means that it could not identify causal relationships between cognitive stress appraisal and related factors. Second, it was low response rate, which may be a lot of instrument. So we should consider the number of questions, and collection method of questionnaires. Third, the adjusted R^2 was 0.412 in this study, which was higher than the value of 0.05–0.27 reported previously [65]. Although this provides an adequate explanation of the factors related to cognitive stress appraisal, other factors are also likely to contribute. Future research requires longitudinal studies across other areas, widening the scope.

Conclusions

This study aimed to examine the cognitive stress appraisal, and to identify factors related to the cognitive stress appraisal in workers. The results indicated that cognitive stress appraisal is associated with economic status, depression, eHealth literacy, traditional organizational climate, and social support. Thus, it was recommended that public health nurses and health practitioners should enhance economic status, eHealth literacy, traditional organizational climate, and social support, and improvement depression to encourage workers for better cognitive stress appraisal. Furthermore, occupational and community interventions are required to create and inform people of the opportunities for cognitive stress appraisal in worksite and communities.

Acknowledgements

The authors would like to thank all the employees who agreed to participate in this study.

Footnotes

Contributors

NT, ET and AA contributed to develop the concept and design of this study.
ET was responsible for acquiring the Institutional Review Board (IRB) approval of this study.
NT was responsible for data collection and analysis.
NT and AA were responsible for drafting and revising the manuscript.
ET is responsible for study supervision and reporting of study results.
All authors have read and approved the final manuscript.

Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Funding

This study was supported by University Center of Community (COC) program funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan (http://www.mext.go.jp/en/). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Ethics

The questionnaire was unsigned to maintain the anonymity of all personal participant

information. The Institutional Review Board of the Medical Department of the Yokohama City University approved this study on August 9, 2016 (Certification No.A1608008 ; PI: Dr.Etsuko Tadaka).

Data sharing statement

No additional unpublished data from the study are available at the moment.

REFERENCES

1. World Health Organization [Internet]. Genéve: Depression; 2016 [cited 26 December 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs369/en/.

2. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Patient Survey; 2015 [cited 12 December 2016]. Available from: http://www.mhlw.go.jp/toukei/saikin/hw/kanja/14/dl/kanja.pdf (in Japanese)

3. World Health Organization [Internet]. Genéve: Depression; 2014 [cited 26 December 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs389/en/

4. World Health Organization [Internet]. Genéve: Comprehensive mental health action plan 2013–2020; 2013 [cited 27 December 2016]. Available from: http://www.who.int/mental_health/action_plan_2013/en/

5. World Health Organization [Internet]. Genéve: Mental Health Action Plan 2013-2020; 2013 [cited 26 December 2016]. Available from: http://apps.who.int/iris/bitstream/10665/89966/1/9789241506021_eng.pdf?ua=1

6. World Economic Forum and the Harvard School of Public Health [Internet]. Genéve: The global economic burden of non-communicable diseases; 2011 [cited 27 December 2016. Available from: http://apps.who.int/medicinedocs/documents/s18806en/s18806en.pdf

7. Van den Berg TIJ, Alavinia SM, Bredt FJ, et al. The influence of psychosocial factors at work and life style on health and work ability among professional workers. *International Archives of Occupational and Environmental Health*. 2008;81(8):1029-1036. doi:10.1007/s00420-007-0296-7.

8. Lee YM. Loss of Productivity due to Depression among Korean Employees. *Journal Occupational Health*. 2010;52(6):389-394.

9. Kim SE, Kim HN, Cho J, et al. Direct and Indirect Effects of Five Factor Personality and Gender on Depressive Symptoms Mediated by Perceived Stress. *PLOS ONE*. 2016;11(4): e0154140. doi: 10.1371/journal.pone.0154140.

10. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2011 [cited 22 December 2016]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/rousaihoken04/dl/120215-01.pdf.Japanese

11. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2016 [cited 22 December 2016]. Available from: http://www.mhlw.go.jp/file/04-Houdouhappyou-11402000-Roudoukijunkyokuroudouhoshoubu-Hoshouka/h27_seishin.pdf. Japanese

12. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Basic Survey on Industrial Safety and Health; 2013 [cited 23 January 2017]. Available from: http://www.mhlw.go.jp/file/05-Shingikai-11201000-Roudoukijunkyoku-Soumuka/0000061406.pdf. Japanese.

13. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Stress check system; 2015 [cited 12 December 2016]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/anzeneisei12/. Japanese.

14. Lazarus R. Psychological Stress and the Coping Process. New York, McGraw-Hill; 1966.

15. Lazarus R & Folkman S. Stress, Appraisal, and Coping, New York, Springer; 1984.

16. Carpenter R. A Review of Instruments on Cognitive Appraisal of Stress. *Archives of Psychiatric Nursing*. 2016;30(2):271-279. doi: http://dx.doi.org/10.1016/j.apnu.2015.07.002.

17. Fevre ML, Matheny J, Kolt GS. Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology*.2003;18(7):726-744. doi: 10.1108/02683940310502412

18. Cohen S, Kamarck T, Mermelstein R. A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*. 1983;24(4):385-396.

19.

20.Schelle KJ, Olthof BMJ, Reintjes W, et al.A survey of substance use for cognitive enhancement by university students in the Netherlands.*Frontiers in Systems Neuroscience*.2015;9:10. doi:10.3389/fnsys.2015.00010.

21. Roberti JW, Harrington LN, Storch EA. Further Psychometric Support for the 10-Item Version of the Perceived Stress Scale. *Journal of College Counseling*. 2006;9:135-147. doi: 10.1002/j.2161-1882.2006.tb00100.x.

22. Hamaideh SH, Al-ashram SA, Al-modallal H. Premenstrual syndrome and premenstrual dysphoric disorder among Jordanian women. *Journal of Psychiatric and Mental Health Nursing*. 2014;21(1):60-68. doi: 10.1111/jpm.12047.

23. Wawrzyniak AJ & Whiteman MCP. Perceived stress, loneliness, and interaction with fellow students does not affect innate mucosal immunity in first year university students. *Psychological Japanese Research*.2011;53(2):121-132. doi: 10.1111/j.1468-5884.2011.00466.x.

24. Gupta R, Singh N, Kumar R. Longitudinal predictive validity of emotional intelligence on first

year medical students perceived stress. *BMC Medical Education*. 2017;17:139. doi:10.1186/s12909-017-0979-z.

25. Li S, Li L, Zhu X, et al. Comparison of characteristics of anxiety sensitivity across career stages and its relationship with nursing stress among female nurses in Hunan, China.*BMJ Open*.2016;6(5):e010829. doi: 10.1136/bmjopen-2015-010829.

26. Győrffy Z & Girasek E. Mental Health of Physicians Nationwide Representative Study from Hungary. *Ideggyogyaszati szemle-Clinical Neuroscience*. 2015;68(7-8):258-269.

27. Su X, Lau JT, Mak WW, et al. Development of the Perceived Stress Scale for People Living with HIV/AIDS in China. *AIDS Patient Care and STDs*. 2008;22(12):989-998. doi: 10.1089/apc.2008.0095.

28. Kimura T, Yokoyama A, Kohno N, et al. Perceived Stress, Severity of Asthma, and Quality of Life in Young Adults with Asthma. *Allergology International*. 2009;58(1):71-79. doi: 10.2332/allergolint.O-07-531.

29. Hara Y, Hisatomi M, Ito H, et al. Effects of gender, age, family support, and treatment on perceived stress and coping of patients with type 2 diabetes mellitus. *BioPsychoSocial Medicine*.2014;8:16.
doi: 10.1186/1751-0759-8-16.

30. Lee EH, Chung Y, Suh H, et al. Korean versions of the Perceived Stress Scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. *Scand J Caring Sci*. 2015;29(1):183-192. doi: 10.1111/scs.12131.

31. Mitchell AM, Crane PA, & Kim Y. Perceived Stress in Survivors of Suicide: Psychometric Properties of the Perceived Stress Scale. *Research in Nursing & Health*. 2008;31(6):576-85. doi: 10.1002/nur.20284.

32. Andreou E, Alexopoulos EC, Lionis C, et al. Perceived Stress Scale: reliability and validity study in Greece. *Int J Environ Res Public Health*. 2011;8(8):3287-3298. doi: 10.3390/ijerph8083287

33. Barrington WE, Ceballos RM, Bishop SK, et al. Perceived Stress, Behavior, and Body Mass Index among Adults Participating in a Worksite Obesity Prevention Program, Seattle, 2005-2007. *Prev Chronic Dis*. 2012;9:E152. doi: 10.5888/pcd9.120001

34. Leung DY, Lam TH, Chan SS. Three versions of Perceived Stress Scale: validation in sample of Chinese cardiac patients who smoke. *BMC Public Health*. 2010;25;10:513. doi: 10.1186/1471-2458-10-513.

35. Willert MV, Wieclaw J, Thulstrup AM. Rehabilitation of individuals on long-term sick leave due to sustained stress-related symptoms: A comparative follow-up study. *Scand J Public Health*. 2014;42(8):719-27.
doi: 10.1177/1403494814551859.

36. Wiernik E, Nabi H, Pannier B, et al. (2014): Perceived stress, sex, and occupational status interact to increase the risk of future high blood pressure: the IPC cohort study. *J Hypertens*.

2014;32(10):1979-1986.
doi: 10.1097/HJH.0000000000000288.
37. Horiuchi S, Tsuda A, Kim E, et al. Relationships between stage of change for stress management behavior and perceived stress and coping. *Japanese psychological Research.* 2010;52(4):291-297.
doi: 10.1111/j.1468-5884.2010.00444.x.
38. Stewart DW, Vidrine JI, Shete S, et al. Health literacy, smoking, and health indicators in African American adults. *J Health Commun.* 2015;20 Suppl 2:24-33. doi: 10.1080/10810730.2015.1066465.
39. Faresjö Å, Theodorsson E, Chatziarzenis M, et al. Higher Perceived Stress but Lower Cortisol Levels Found among Young Greek Adults Living in a Stressful Social Environment in Comparison with Swedish Young Adults. *PLoS One*. 2013;8(9):e73828.
doi: 10.1371/journal.pone.0073828
40. Mimura C & Griffiths G. A Japanese version of the perceived stress scale: translation and preliminary test. *International Journal of Nursing Studies*. 2004; 41(4): 379-385.
41. Mimura C & Griffiths G. A Japanese version of the Perceived Stress Scale: cross-cultural translation and equivalence assessment. *BMC Psychiatry.* 2008;8:85. doi: 10.1186/1471-244X-8-85.
42. Shima S, Kano T, Kitamura T, et al. Atarashii yokuutsusei jiko hyouka syakudo ni tsuite (A new self-report depression scale). Clinical Psychiatry, 1985:27; 717–723. Japanese
43. Radloff LS. The CES-D Scale. A self-report depression scale for research in the general population. *Applied Psychological Measurement*.1985;1(3):385-401.
doi: https://doi.org/10.1177/014662167700100306
44. Shimomitsu T, & Odagiri Y. The brief job stress questionnaire. *Japanese Journal of Occupational Mental Health*.2004;12(1):25-36. Japanese
45. Kawakami N & Fujigaki Y. Reliability and Validity of the Japanese Version of Job Content Questionnaire: Replication and Extension in Computer Company Employees. *Industrial Health.*1996;34(4):295-306.
46. Karasek R, Brisson C, Kawakami N, et al. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol.* 1998;3(4):322-55.
47. Kawakami N, Kobayashi F, Araki S, et al. Assessment of job stress dimensions based on the Job Demands-Control model of employees of telecommunication and electric power companies in Japan: reliability and validity of the Japanese version of Job Content Questionnaire. *Int J Behav Med*. 1995;2(4):358-75.
48. Suzuki-Saito T, Yasumura S, Okamura T, et al. Medical care costs and the characteristics of higher medical costs among BMI groups in the early-stage elderly Analysis of data obtained from a large-scale study of 29,490 elderly. *Japanese Journal of Public*

Health.2012:59(7);466-473. Japanese.
doi: http://doi.org/10.11236/jph.59.7_466
49. Togari T, Yamazaki Y, Koide S, et al. Reliability and validity of the Modified Perceived Health Competence Scale (PHCS) Japanese version. *Japanese Journal of Public Health*.2006: 53(1); 51-57. Japanese.
doi:http://doi.org/10.11236/jph.53.1_51
50. Leon-Perez JM, Antino M, Leon-Rubio JM. The Role of Psychological Capital and Intragroup Conflict on Employees' Burnout and Quality of Service: A Multilevel Approach. *Front Psychol.* 2016; 7: 1755. doi: 10.3389/fpsyg.2016.01755
51. Smith MS, Wallston KA, Smith CA. The development and validation of the Perceived Health Competence Scale. *Health Educ Res*. 1995 Mar;10(1):51-64.
52. Mitsutake S, Shibata A, Ishii K, et al. Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Japanese Journal of Public Health*.2011;58(5):361-371. Japanese. doi: http://doi.org/10.11236/jph.58.5_361
53. Norman CD & Skinner HA. eHealth Literacy: Essential Slills for Consumer Health in a Networked World. *J Med Internet Res*. 2006; 8(2): e9. doi: 10.2196/jmir.8.2.e9
54. Norman CD & Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res*. 2006 Oct-Dec; 8(4): e27. doi: 10.2196/jmir.8.4.e27
55. Ministry of Internal Affairs and Communications [Internet] Tokyo: White Paper on Information and Communications in Japan; 2016 [cited 28 January 2017. Available from: http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2016/chapter-5.pdf#page=1
56. Fukui S, Haratani T, Toshima Y, et al. Measuring Workplace Climate: Reliability and Validity of the 12-item Organizational Climate Scale (OCS-12). *Japan Society for Occupational Health.* 2004;46(6):213-222.
Japanese. doi:http://doi.org/10.1539/sangyoeisei.46.213
57. Hemingway MA & Smith CS. Organizational climate and occupational stressors as predictors of withdrawal behaviors and injuries in nurses. *Journal of Occupational and Organizational Psychology*. 1999;72(3):285-299.
doi:10.1348/096317999166680
58. Iwasa H. Gondo Y, Masui Y, et al. Reliability and validity of "Social Support Scale", Japanese language edition: Investigation targeting middle and old age. *Indicators of social welfare*.2007 54(6), 26-33. Japanese.
59. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidemensional Scale of Perceived Social Support. *Jounal of Personality Assessment*. 1988;52(1):30-41. doi: 10.1207/s15327752jpa5201_2
60. Cohen J. A Power Primer. *Psychological Bulletin.* 1992; 112(1): 155-159.
61. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res*

Methods. 2007;3:175-91.
62. Japan Institute for Labour Policy and Training [Internet] Tokyo: Labour statistics data retrieval system (Basic Survey on Wage Structure); 2015 [cited 19 December 2016]. http://stat.jil.go.jp/jil63/plsql/JTK0400?P_TYOUSA=R1&P_HYOUJI=C0010&P_KITYOU=0
63. Katsarou A, PAnagiotakos D, Zafeiropoulou A, et al. Validation of a Greek Version of PSS-14: A global measure of perceived stress. *Cent Eur J Public Health*. 2012;20(2):104-109.
64. Remor E. Psychometric properties of a European Spanish version of the Perceived Stress Scale (PSS). *Span J Psyvhol*. 2006: 9(1); 86-93.
65. Lee J, Kim EY, Wachholtz A. The effect of perceived stress on life satisfaction: The mediating effect of self-efficacy. *Chongsonyonhak Yongu*. 2016;23(10):29-47.
66. Nutbeam D. Health promotion glossary. *Health Promotion International*. 1998;13(4):349-364.
67. Ishikawa H, Nomura K, Sato M, et al. Developing a measure of communicative and critical health literacy: a pilot study of Japanese office workers. Health Promotion International. *Health Promot Int*. 2008;23(3):269-274. doi: 10.1093/heapro/dan017.
68. Ministry of Economy, Trade and Industry [Internet]. Tokyo: Employment Status Survey; 2012 [cited 24 December 2016] Available from: http://www.stat.go.jp/english/data/shugyou/pdf/sum2012.pdf. Japanese
69. Ritterband LM & Palermo T. Introduction to the Special Issue: eHealth in Pediatric Psychology. *Journal of Pediatric Psychology*. 2009;34(5):453-456. doi: 10.1093/jpepsy/jsp008
70. Mitsutake S, Shibata A, Ishii K, et al. Associations of eHealth Literacy With Health Behavior Among Adult Internet Users. *J Med Internet Res*. 2016;18(7):e192. doi: 10.2196/jmir.5413.
71. Cropanzano R & Mitchell MS. Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*. 2005:31(6): 874-900
72. Koizumi Y, Awata S, Kuriyama S, et al. Association between social support and depression status in the elderly: results of a 1-year community-based prospective cohort study in Japan. *Psychiatry Clin Neurosci*. 2005;59(5):563-569.
73. Frasure-Smith N, Lesperance F, Gravel G, et al. Social Support, depression, and mortality during the first year after myocardial infarction. *Circulation*. 2000;101(16):1919-1924.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-8
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4,9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7-8
		(*e*) Describe any sensitivity analyses	8-9
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4-5
		(b) Give reasons for non-participation at each stage	4-5
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-11
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	13-14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A cross-sectional study of cognitive stress appraisal and related factors among workers in metropolitan areas of Japan.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019404.R2
Article Type:	Research
Date Submitted by the Author:	09-Mar-2018
Complete List of Authors:	Tohmiya, Natsuka; Setagaya District Administration Offices,, Public Health Promotion Division; Yokohama Shiritsu Daigaku, Guraduate School of Medicine Tadaka, Etsuko; Yokohama City University, Community Health Nursing Arimoto, Azusa; Yokohama Shiritsu Daigaku, Department of Community Health Nursing
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Epidemiology, Mental health, Nursing, Public health, Occupational and environmental medicine
Keywords:	cognitive stress appraisal, environmental factor, individual factor, workers

A cross-sectional study of cognitive stress appraisal and related factors among workers in metropolitan areas of Japan

Corresponding author
Natsuka Tohmiya
MSN, RN, PHN
Public Health Promotion Division, Setagaya District Administration Offices,
4-22-33 Setagaya Setagaya-city, Tokyo 154-8504 Japan
Email: natsuka.dct.ft@gmail.com
TEL: +81-3-5432-2896
FAX: +81-3-5432-3074

Co-authors

Etsuko Tadaka, Azusa Arimoto

Graduate School of Medicine, Yokohama City University, Yokohama, Kanagawa, Japan

Word count: 4,013words

ABSTRACT

Objective: Stress has major socioeconomic implications for all spheres of employment. It is a trigger for depression, and affects absenteeism, turnover, productivity, morale, and suicide. Positive or negative cognitive stress appraisal can be a self-care strategy that affects workers' ability to cope with stress. This study examined cognitive stress appraisal among workers and identified related individual and environmental factors.

Design: Cross-sectional study using self-administered postal questionnaires.

Setting: Companies located in two metropolitan areas of Japan (Tokyo and Kanagawa prefectures)

Participants: 2,311 employees of 48 companies in metropolitan areas in Japan. In total, 341 questionnaires were returned (response rate: 14.8%), 337 of which were suitable for analysis (effective response rate: 98.8%).

Primary measures: Cognitive stress appraisal was assessed using the Japanese version of the Perceived Stress Scale (PSS). Potential variables related to stress appraisal included demographic, individual, and environmental factors. Multiple regression analysis was used to identify factors related to cognitive stress appraisal.

Results: Participants' mean ± standard deviation [SD] age was 42.8 ± 11.7 years, and two-thirds were male. The mean ± SD PSS score was 25.8 ± 6.2. The multiple regression analysis controlled for age, sex, and depression showed that those with poorer economic status ($\beta = 0.161$, $p < 0.001$), lower eHealth literacy ($\beta = -0.116$, $p = 0.009$), higher traditional organizational climate ($\beta = 0.124$, $p = 0.005$), and lower perceived social support ($\beta = -0.220$, $p < 0.001$) experienced significantly higher levels of negatively perceived stress.

Conclusions: The results show individual and environmental factors related to cognitive stress appraisal among workers. An effective strategy to improve mental health among workers may involve an inter-professional approach by public health nurses and health practitioners that includes enhanced self-coping skills using individual workers' eHealth literacy, improvement of organizational climates in workplaces, and community-based social support.

Strengths and limitations of this study

・This study is the first to examine individual and environmental factors related to cognitive stress appraisal among healthy workers.
・We simultaneously examined eHealth literacy, multidimensional perceived social support, and traditional organizational climates.
・This study used a cross-sectional design, and could not identify causal relationships between cognitive stress appraisal and related factors.
・The target population of this study was limited to metropolitan areas in Japan.

keywords: cognitive stress appraisal, environmental factor, individual factor, workers

INTRODUCTION

Depression is a common psychiatric disorder, affecting about 350 million people worldwide and is a major contributor to the overall global burden of disease.[1] In Japan, depression is estimated to have affected up to 1.116 million people in 2015.[2] Depression is different from usual mood fluctuations and short-lived emotional responses to challenges in everyday life. Especially when long-lasting and with moderate or severe intensity, depression may become a serious health condition. In particular, depression caused by occupational stress result in increasing rates of long-term illness and absence from work among workers.[3] The World Health Organization's Comprehensive Mental Health Action Plan 2013–2020 adopted by the 66th World Health Assembly[4] argues that determinants of mental health and psychiatric disorders include individual attributes and social, cultural, economic, political, and environmental factors for protecting workers' health.[5] Mental illnesses are associated with a substantial deterioration in individual quality of life, and economic loss in the community and workplace.[5,6] Therefore, primary prevention of depressive disorders is important nationally and internationally, as well as for individuals.

Stress has major socioeconomic implications for all spheres of employment. It is a trigger for depression and affects absenteeism, turnover, productivity, morale, and suicide.[7,8,9] In Japan, the number of employees that applied for industrial accident compensation insurance for mental disorders because of stress has increased in recent years.[10] There was 1,515 applications in 2015, which was up from 1,272 in 2011.[11] The proportion of workers experiencing anxiety, distress, and work stress has progressively increased since 1982, and is now estimated at 60%.[12] In this context, the Japanese government launched "The Stress Check Program" in 2015, a new occupational health policy to screen for workers experiencing high psychosocial stress.[13] The law mandates use of the Stress Check Program and its guidelines at least once each year in all workplaces in Japan with 50 or more employees. The program and guidelines recommend individual checks for perceived stress, and sets out four principles of care in the workplace: 1) self-care; 2) line-care; 3) health practitioners' care in the workplace; and 4) health practitioners' care in the community.

Cognitive stress appraisal is a self-care strategy based on individuals' evaluation of how they perceive stressors. In primary appraisal, an individual's evaluations are divided into "threat" and "challenge"; threat describes anticipated harm/loss, and challenge describes a threat that can be met or overcome.[14,15] The cognitive appraisal of something as a "threat" or "challenge" can affect mental health.[15,16] The stress response and stress coping following cognitive appraisal differ among individuals, even in response to the same stressors.[17] For example, people making a positive cognitive appraisal may perceive stress as a challenging health issue to be resolved, and set themselves challenging goals.[14,15] Those making a negative cognitive appraisal may view the same issue as a health threat, and

believe that resolving the issue is beyond their abilities. Positive or negative cognitive stress appraisal can therefore be an important mental health concept to improve stress-coping skills and control stress among workers. For individuals, positive cognitive appraisal contributes to prevention of depression, thereby improving quality of life. At the societal level, this is important in controlling the escalation of medical costs and increasing corporate and community-wide productivity.

The Perceived Stress Scale (PSS) measures the degree to which situations are cognitively appraised as stressful.[18] Cohen explained the PSS as a measure of the degree to which situations in one's life are appraised as stressful. PSS items were designed to capture how unpredictable, uncontrollable, and overloaded respondents perceive their lives. These issues have been repeatedly found to be central components of the experience of stress. In addition, stressful life events influence disease risk through an individual's perceptions of stress and negative affect.[18] Cohen also noted that the PSS can be used to determine whether "appraised" stress is an etiological (or risk) factor in behavioral disorders or disease.[18,19] Therefore, we considered that the PSS can continuously measure negative cognitive stress appraisal. Previous studies have measured cognitive stress appraisal using the PSS and investigated related factors with students,[20-24] medical professionals,[25,26] and patients with chronic diseases.[27-30] However, the scale has not previously been used with healthy adult workers in a range of employment types. Previous studies clarified various individual factors related to the PSS, but these varied for different participants. Some studies examined the physical and psychological health conditions among students or conditions in particular populations (e.g., adults with a disease or pregnant women).[28,31,32] Other studies examined lifestyle factors among students, pregnant women, and medical professionals;[26,33,34] job stress among medical professionals;[25,35,36] stressors and coping in adult survivors of suicide and pregnant women;[31,37] and health literacy in African-American adults.[38] However, there is limited information about the relationship between cognitive stress appraisal and individual and environmental factors (e.g., work environment and available social support) among adult workers.[39]

This study aimed to examine cognitive stress appraisal among workers and identify associated individual and environmental factors. The findings may contribute to minimizing the effect of factors associated with an increased risk for depression, and contribute to promoting individual self-care and improving workplace environments to promote mental health among workers. Furthermore, the findings may be useful for public health nurses and health practitioners at worksites engaged in primary prevention of mental health disorders among workers.

METHODS

Participants and sampling

Study participants were employees of companies located in metropolitan areas of Japan. The inclusion criterion was employees aged 18–64 years. The age of 64 years is the upper limit for consideration of retirement and re-employment under the Japanese Law Concerning Stabilization of Employment of Older Persons, and 18 years is the youngest age for employment immediately after graduating high school in Japan.

This study used a cross-sectional design with self-administered postal questionnaires. Data were collected from employees of companies registered in the Japan Company Handbook 2016 across two metropolitan areas of Japan (Tokyo and Kanagawa prefectures).We stratified companies by size and type of industry, and selected companies randomly within that stratification; 361 of a total 2,026 companies were selected (17.8%). The questionnaire did not collect details about company name, number of employees and type of industry to safeguard participant anonymity.

Data collection

Forty-eight of 361 companies agreed to participate in this study. Before sending the questionnaires to each company, we identified the relevant sample size from company administrators. In total, 2,311 questionnaires were mailed to the 48 companies. Of these, 341 questionnaires were returned (response rate: 14.8%). Potential participants (all employees of the participating companies) were invited to complete the questionnaire anonymously on a voluntary basis, between October 1 and December 9, 2016. Participant anonymity was maintained throughout data collection as the questionnaires did not collecting any identifying information. In addition, participants returned completed questionnaires by mail to the researchers themselves. Returning a completed questionnaire was considered to indicate provision of informed consent.

Instruments

Dependent variable: cognitive stress appraisal

The dependent variable was cognitive stress appraisal, which was determined using the Japanese version of the PSS [40,41]. The PSS comprises 14 items and includes questions such as, “In the last month, how often have you been upset because of something that happened unexpectedly?” and “In the last month, how often have you felt that you were unable to control the important things in your life?” Responses were coded for scoring as Never = 0, Almost Never = 1, Sometimes = 2, Fairly Often = 3, and Very Often = 4. Possible total scores

ranged from 0–56, with higher scores indicating higher levels of negative cognitive stress appraisal. All 14 items in the Japanese version of the scale are highly intercorrelated (Cronbach's alpha = 0.74).

Demographic characteristics

Participants' demographic characteristics included age, sex (Male = 1, Female = 2), marital status (Unmarried and Divorced/Widowed = 1, Married = 2), household membership (Live alone = 1, Spouse = 2, Spouse and Children = 3, Parents = 4, Others = 5), educational status (Junior high school/High school = 1, Vocational college/Junior college = 2, College or University/Graduate school = 3), employment status (Fulltime= 1, Part-time = 2, Others = 3), economic status (Sufficient = 1, Slightly Sufficient = 2, Slightly Insufficient = 3, Insufficient = 4), and depression. Items were based on standard questions generally used in previous studies involving workers and items used in a recent national survey for workers.

Depression was measured using the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D),[42,43] which comprises 20 items. Each item is measured on a four-point Likert-type scale from 0–3. Total scores range from 0–60, with higher scores indicating greater levels of depression. CES-D scores above 16 indicate a depressive state. The CES-D was developed for use in epidemiological studies of depressive symptomatology in the general population.[42,43] A specific group with a higher mean score may be interpreted to be at risk for a depressive state or in need of intervention.[43] Cognitive stress appraisal is affected by participants' mental condition at that particular time, which includes depression. The psychometric properties of the CES-D have been investigated, and the scale showed high internal consistency, acceptable test-retest stability, excellent concurrent validity for clinical and self-report criteria, and substantial evidence of construct validity. When the CES-D was designed, the internal consistency was high in the general population (0.77–0.87) and higher in the patient sample (0.85–0.92), and test-retest correlations were in the moderate range (0.45–0.70). In addition, the CES-D showed moderate correlations with the Hamilton Clinician's Rating scale and the Raskin Rating scale (0.44–0.54) at admission.[42,43]

Independent variables

The conceptual framework of this study was to examine cognitive stress appraisal and identify related individual and environmental factors. According to Lazarus's theory, individual and environmental factors mutually affect the cognitive stress appraisal process. Therefore, we considered both individual and environmental factors to be important. Independent variables were selected based on previous studies[20-37].

Individual factors included any disease currently under treatment (e.g., cancer, diabetes),

body mass index (BMI), self-rated health, physical complaints, physical demands, lifestyle, perceived health competence, and electronic health (eHealth) literacy. BMI was calculated from self-reported weight and height. Self-rated health was measured on a four-point Likert-type scale from 1 (very poor) to 4 (very good).

Physical complaints were measured using the Brief Job Stress Questionnaire (BJSQ).[44] The BJSQ is used in the Japan Stress Check Test by the Ministry of Health, Labour and Welfare,[12] and can be easily used in the workplace. It comprises 57 items on 19 subscales, from which we drew 11 items (e.g., "I have felt dizzy" and "I have experienced joint pains"). Each item was measured on a four-point Likert-type scale. Total scores ranged from 11–44, with higher scores indicating more frequent physical complaints. Physical demands were measured using the Job Content Questionnaire (JCQ),[45] which comprises 45 items on six subscales. We used three items for physical exertion and two for isometric load. Items were measured on a five-point Likert-type scale. Total scores for physical exertion ranged from 3–15, and for isometric load from 2–10, with higher scores indicating stronger physical demands/isometric load. The JCQ was developed based on the job demands–control model, and has been nationally standardized by occupation in several countries.[45-47]

Lifestyle was measured using seven items based on Breslow's good health habits.[48] These items covered smoking, drinking alcohol, eating breakfast every day, physical activity, eating snacks after dinner, skipping breakfast, and sleeping and resting. Responses were coded for scoring as "yes" or "no." Perceived health competence was measured using the Japanese version of the Perceived Health Competence Scale (PHCS).[49] The PHCS comprises eight items measured on a five-point Likert-type scale. Total scores ranged from 8–40, with higher scores indicating higher perceived health competence. Perceived health competence is related to stress,[50] and the PHCS was designed to assess efficacy and competence beliefs about personal health at an intermediate level of domain-specificity.[51]

Finally, eHealth literacy was measured using the Japanese version of the eight-item eHealth Literacy Scale (eHEALS).[52] eHealth literacy is defined as the ability to seek, find, understand, and appraise health information from electronic sources, and apply that knowledge in addressing or solving a health problem.[53,54] Responses were assessed using a five-point Likert-type scale. Total scores ranged from 8–40, with higher scores indicating greater eHealth literacy. In Japan, Internet penetration in the studied age group is over 90%.[55]. eHEALS was developed to address the need to assess eHealth literacy for a range of populations and contexts. It is designed to provide a general estimate of consumer eHealth-related skills to inform clinical decision-making and health promotion planning for individuals or specific populations.[54]

Environmental factors: Organizational climate

Organizational climate was measured using the 12-item Organizational Climate Scale,[56] which is divided into two six-item subscales: a tradition scale and an organizational environment scale. Responses were coded for scoring as Yes = 2 and No = 1. The total possible scores ranged from 6–12 for each subscale. Higher scores on the tradition scale indicate a more mandatory, injunctive, and feudalistic organizational climate. Higher scores on the organizational environment scale indicate a more flexible organizational system. A previous study showed that organizational climate may affect occupational stress.[57] This scale measures organizational properties based on the model of Healthy Work Organizations at the National Institute for Occupational Safety and Health (NIOSH) of U.S. Department of Labor.[56]

Social support

Social support was measured using the short version of the Multidimensional Scale of Perceived Social Support (MPSS) in Japanese,[58,59] which comprises seven items. Responses were on a seven-point Likert-type scale, with lower scores indicating lower perceived social support. The MPSS specifically addresses the subjective assessment of social support adequacy, and was designed to assess perceptions of social support adequacy from three sources: family, friends, and significant others.[59]

Statistical analysis

Means, SDs, frequencies, and percentages were calculated for demographic characteristics, positive or negative cognitive stress appraisal (PSS scores), and individual and environmental factors. Univariate analysis using Spearman's correlation was used to examine correlations between the dependent and independent variables. A multiple regression analysis was then used to identify factors related to cognitive stress appraisal among workers, using all potentially significant predictors identified by the univariate analyses ($p < 0.05$). Multicollinearity of independent variables was considered via the forced entry (variable reduction) method. The multiple regression model included selected independent variables and all statistical analyses. In the model, step 1 included the control variables, step 2 the demographic characteristics, and step 3 the remaining predictors. Sex, age, and depression were entered as control variables. A previous study reported high correlation between the PSS and the CES-D, but both scales still independently predicted symptomatology.[18] Because the aim of this study was primary prevention of poor mental health, specifically depression, we assumed that depression was a covariate and treated it as a control variable. Of the 337 effective response, data was missing for; BMI (n=2, 0.59%), self-rated health (n=14, 4.15%), household membership (n=3, 0.89%), employment status (n=2, 0.59%), and CES-D (n=10,

3.20%), therefore, these cases were excluded from the multiple regression models. The sample size was calculated using G*Power version 3.0.10.[60] With power of 80%, a 0.05 level of statistical significance, an effect size of 0.15[61] and the number of predictors as 13, the required sample size for the multiple regression model was calculated as 131. The level of significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics for Windows version 22.0.

Patient and Public Involvement

Patients and or public were not involved in developing the hypothesis, the aim, nor were they involved in developing plans for study design or implementation of the study.

RESULTS

In total, 341 questionnaires were returned. Four questionnaires were from participants aged over 65 years or who did not provide their age. We excluded these questionnaires, which left 337 questionnaires for analysis (effective response rate: 98.8%). Participants' background information (demographic characteristics, individual factors, environmental factors) is shown in Table 1. Results are reported below as means ± SD.

Participants mean age was 42.8 ± 11.7 years. Approximately 67.7% were male and 60.2% were married. 38.6% lived with their spouse and children, and 22.8% lived alone. 61.1% had graduated with a college education or higher, and most participants had regular employment. 83.4% felt good about their economic status. The mean CES-D score was 12.8 ± 7.6, with 99 participants (29.5%) rated as having depression based on the cut-off point. The mean PSS score was 25.8 ± 6.2, with one-quarter of participants being treated for a disease. The mean BMI was 22.0 ± 3.1; 74.8% of participants were in the healthy range (over 18.5, less than 25). 83.3% reported their self-rated health as good or fairly good. The mean physical complaint score was 19.3 ± 5.1, and mean scores for physical exertion and isometric load were 4.9 ± 1.8 and 3.2 ± 1.3, respectively. At least 50% of participants chose most of the healthy lifestyle options, and approximately 75% chose some health options. The mean PHCS and eHEALS scores were 23.4 ± 6.5 and 22.0 ± 7.5, respectively. The mean tradition subscale score was 8.0 ± 1.6 and that of the organizational environment scale was 8.6 ± 1.8. The mean social support scale score was 5.4 ± 1.2.

Table 1. Background of the participants

Items	Number or Mean±SD	% (Range)
Demographic characteristics		
Age	42.8±11.7	(18-64)
Sex		

Male	228	67.7
Female	109	32.3
Matital status		
Unmarried	110	32.6
Married	203	60.2
Divorced/Widowed	24	7.1
Household membership		
Live alone	76	22.8
Spouse	48	14.4
Spouse and childeren	129	38.6
Parentes	50	15.0
Others	31	9.3
Educational status		
Junior high school/High school	78	23.1
Vocational college/Junior college	53	15.7
College or University/Graduate school	206	61.1
Employment status		
Fulltime worker	301	89.9
Part-time worker	27	8.1
Others	7	2.1
Economic status		
Sufficient	106	31.5
Slightly sufficient	175	51.9
Slightly insufficient	51	15.1
Insufficient	5	1.5
Depression（CES-D）		
Score	12.8±7.6	(0-45)
Depression(CES-D≧16; cut-off point)	99	29.5
Dependent variable		
Cognitive stress appraisal (PSS)	25.8±6.2	(6-48)

SD, standard deviation

312

Table 1. Background of the participants (cont.)

Items	Number or Mean±SD	%(Range)
Individual factors		
Disease currently under treatment		
No	252	75.0
Yes	84	25.0
High blood pressure	25	7.4
Gout	11	3.3
Hyperlipidemia	8	2.4
Respiratory disease	8	2.4
Diabetes	7	2.1
Digestive disease	7	2.1
Mental disease	7	2.1
Others	26	7.7
Body-mass index (BMI)		
Mean	22.0±3.1	(14.5-34.6)

Thin（BMI＜18.5）	32	9.8
Standard(18.5≦BMI＜25）	243	74.8
Obesity（25≦BMI）	50	15.4
Self-rated health		
Very poor	7	2.2
Rather poor	47	14.6
Rather good	216	66.9
Very good	53	16.4
Brief Job Stress (BJSQ)		
Physical complaint	19.3±5.1	(11-36)
Physical demands (Job Content: JCQ)		
Physical exertion	4.9±1.8	(3-11)
Isometric load	3.2±1.3	(2-8)
Life style		
No smoking	255	75.7
Non or sometimes drinking alcohol	256	76.0
Breakfast everyday	241	71.5
More than once a week physical acticvity	75	22.3
No eating after dinner over 3days per week	246	73.0
No skipping breakfast over 3days per week	248	73.6
Get enough sleep and rest	190	56.5
Perceived health competence (PHCS)	23.4±6.5	(8-40)
eHealth literacy (eHEALS)	22.0±7.5	(3-40)
Environmental factors		
Organizational climate		
Tradition	8.0±1.6	(6-12)
Organizational environment	8.6±1.8	(6-12)
Social support	5.4±1.2	(2-7)

SD, standard deviation

There were correlations among demographic characteristics, individual and environmental factors, and cognitive stress appraisal. Spearman's correlation coefficients were used to measure the linear relationship between each factor and PSS among workers. The demographic characteristics showing significant correlations with cognitive stress appraisal were: age ($r = -0.300$, $p < 0.001$), marital status ($r = -0.207$, $p < 0.001$), household membership ($r = -0.231$ $p < 0.001$), economic status ($r = 0.355$, $p < 0.001$), and depression ($r = 0.528$, $p < 0.001$). Individual factors showing significant correlations with cognitive stress appraisal were: self-rated health ($r = -0.275$, $p < 0.001$), physical complaints ($r = 0.372$, $p < 0.001$), total scores for physical exertion ($r = 0.109$, $p = 0.048$) and isometric load ($r = 0.183$, $p = 0.001$), physical activity ($r = -0.162$, $p = 0.003$), sleeping and resting ($r = -0.278$, $p < 0.001$), perceived health competence ($r = 0.412$, $p < 0.001$), and eHealth literacy ($r = -0.295$, $p < 0.001$). Environmental factors showing significant correlations with cognitive stress appraisal were: total scores for the tradition ($r = 0.197$, $p < 0.001$) and organizational environment scales ($r = -0.182$, $p = 0.001$), and social support ($r = -0.398$, $p < 0.001$).

In the multiple regression analysis, Factors associated with cognitive stress appraisal,

(marital status, household membership, economic status, physical activity, sleeping, isometric load, eHealth literacy, tradition and organizational environment scales, and social support) were used as independent variables, and age, sex, and depression as control variables (Table 2). This analysis indicated that those with poorer economic status (β = 0.161, p = 0.001), lower eHealth literacy (β = −0.116, p = 0.009), higher traditional organizational climate (β = 0.124, p = 0.005), and lower perceived social support (β = −0.220, p < 0.001) experienced a higher level of perceived negative stress. The adjusted R^2 in this analysis was 0.412.

Table 2. Cognitive stress appraisal and related factors

	β	*p*
Demographic characteristics		
Economic status (1=sufficient, 2=slightly sufficient, 3=slightly insufficient, 4=insufficient)	0.171	0.000
Individual factors		
eHealth literacy (total score)	-0.113	0.012
Environmental factors		
Organizational climate: Tradition (total score)	0.131	0.004
Social support (total score)	-0.205	0.000
Adjusted R^2		0.412

Multiple regression analysis.

Controlled variables: Age, Sex (0=female, 1=male), Depression (0=no, 1=yes).

DISCUSSION

Participants in this study were representative of healthy adult workers in a range of employment types in Japan. First, in terms of demographic characteristics (e.g., age, sex) and proportion of participants, this study was similar to the reported national statistics for full-time workers in Japan.[62] Second, the PSS scores in this study were similar to those obtained when the PSS was originally developed[18] and those of adults in other countries.[63,64] Therefore this study can be generalized to other workers in Japan and to other developed countries.

Our study is the first to examine the features of cognitive stress appraisal in workers and identify associated individual and environmental factors. This study adds to existing research evidence that both individual factors (including eHealth literacy) and environmental factors (such as organizational climate) are related to cognitive stress appraisal among workers. Therefore, this study has important practical implications in promoting stress management and primary prevention of stress-related disease and suicide among workers.

Economic status was related to cognitive stress appraisal. It is possible that poor economic status in itself is the origin of stress, and workers with poor economic status have difficulty coping with their own stress. Cognitive stress appraisal and subjective economic status are related, and self-efficacy plays an important role as a mediator between cognitive evaluation of stress and life satisfaction.[65] Workers may be unable to appraise challenges and struggle in stressful situations because they feel that their own ability level is low and they have limited resources.

We found that lower eHealth literacy was related to negative stress appraisal. Health literacy is a cognitive and social skill that determines individuals' motivation and ability to gain access to, understand, and use information in ways that promote and maintain good health.[66] Higher health literacy may enable an individual to actively seek support and solutions to problems.[67] Good eHealth literacy means people can access health information resources via the Internet. The Internet is increasingly becoming an effective information tool for improving self-care behavior.[68-70] In addition, the Internet holds a considerable amount of health information, which is helpful for positive cognitive stress appraisal. Improving eHealth literacy may empower workers to obtain, understand, and act on information they need for optimal mental health.

We also found that more traditional organizational climates were related to negative cognitive stress appraisal. A traditional organizational climate is more directive and feudalistic.[56] Higher tradition scores correspond to higher levels of depressive state, lower job satisfaction, and lower levels of mental health.[56] A traditional structure or climate implies high levels of mandatory working, a lack of respect for individual opinion, and pressure from superiors. Workers in traditional organizational climates have less discretion and a more stressful environment. They may be unable to ask for help from their supervisor, or make improvements to the work environment. The relationship between organizational climate and workers' performance may be explained using the social exchange theory. This theory is based on the assumption that social exchanges involve several actions that create obligations, and that relationships evolve over time into trusting, loyal, and mutual commitments.[71] Organizational climate can be changed when employers establish a climate that is perceived as positive by their employees with good relationships, and this can result in better organizational performance and higher levels of motivation in workers.

In addition, lower levels of social support were related to negative stress appraisal. This is consistent with previous studies that reported the amount of social support was associated with levels of depression,[72] and that social support buffered adverse effects on mental health.[73] Social support also protects individuals from the pathogenic effects of stressful events by altering the appraisal of those events or the process by which perceived stress causes illness.[18] Those who feel that they have little social support may be unable to buffer stressful events, whereas those who feel that they have sufficient social support may be able to

buffer stressful events.

Our findings suggested that an inter-professional approach involving public health nurses and health practitioners that includes provision of enhanced self-coping skills using individual workers' eHealth literacy, along with development of more modern organizational climates in workplaces and social support in communities may be effective in minimizing the effect negative cognitive stress appraisal that may be associated with an increased risk of depression. This would contribute to the overall promotion of mental health among workers.

Limitations

This study had several limitations. First, we used a cross-sectional design, meaning that we could not identify causal relationships between cognitive stress appraisal and related factors. Second, the response rate was low, which might be explained by the number of instruments included in the questionnaire. Future studies should consider the number of included questions and collection method for questionnaires. Third, the adjusted R^2 was 0.412, which was higher than the values of 0.05–0.27 previously reported.[65] Although this provides an adequate explanation of factors related to cognitive stress appraisal, other factors are also likely to have contributed. In future, longitudinal studies should be conducted across other areas to widen the scope of investigation.

Conclusions

This study examined cognitive stress appraisal and identified factors related to cognitive stress appraisal among workers. The results indicated that cognitive stress appraisal is associated with economic status, depression, eHealth literacy, traditional organizational climates, and social support. Therefore, it is recommended that public health nurses and health practitioners enhance eHealth literacy, and improve organizational climates and social support, to help improve depression and support workers to develop better cognitive stress appraisal. Furthermore, occupational and community interventions are required to create and inform people of opportunities for cognitive stress appraisal in the workplace and the community.

Acknowledgements

The authors would like to thank all the employees who agreed to participate in this study. We thank Audrey Holmes, MA, from Edanz Group (www.edanzediting.com/ac) for editing a draft of this manuscript.

Footnotes

Contributors

NT, ET and AA contributed to develop the concept and design of this study. ET was responsible for acquiring the Institutional Review Board (IRB) approval of this study. NT was responsible for data collection and analysis. NT and AA were responsible for drafting and revising the manuscript. ET is responsible for study supervision and reporting of study results. All authors have read and approved the final manuscript.

Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Funding

This study was supported by University Center of Community (COC) program funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan (http://www.mext.go.jp/en/)(PI:Etsuko Tadaka). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Ethics

The questionnaire was unsigned to maintain the anonymity of all personal participant information. The Institutional Review Board of the Medical Department of the Yokohama City University approved this study on August 9, 2016 (Certification No.A1608008 ; PI: Dr.Etsuko Tadaka).

Data sharing statement

No additional unpublished data from the study are available at the moment.

REFERENCES

1. World Health Organization [Internet]. Genéve: Depression; 2016 [cited 22 February 2018]. Available from: http://www.who.int/mediacentre/factsheets/fs369/en/

2. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Patient Survey; 2015 [cited 22 February 2018]. Available from: http://www.mhlw.go.jp/toukei/saikin/hw/kanja/14/dl/kanja.pdf (in Japanese)

3. World Health Organization [Internet]. Genéve: Protecting workers' health; 2017 [cited 22 February 2018]. Available from: http://www.who.int/mediacentre/factsheets/fs389/en/

4. World Health Organization [Internet]. Genéve: Comprehensive mental health action plan 2013–2020; 2013 [cited 22 February 2018]. Available from: http://www.who.int/mental_health/action_plan_2013/en/

5. World Health Organization [Internet]. Genéve: Mental Health Action Plan 2013-2020; 2013 [cited 22 February 2018]. Available from: http://apps.who.int/iris/bitstream/10665/89966/1/9789241506021_eng.pdf?ua=1

6. World Economic Forum and the Harvard School of Public Health [Internet]. Genéve: The global economic burden of non-communicable diseases; 2011 [cited 22 February 2018]. Available from: http://apps.who.int/medicinedocs/documents/s18806en/s18806en.pdf

7. Van den Berg TIJ, Alavinia SM, Bredt FJ, et al. The influence of psychosocial factors at work and life style on health and work ability among professional workers. *International Archives of Occupational and Environmental Health*. 2008;81(8):1029-1036. doi:10.1007/s00420-007-0296-7.

8. Lee YM. Loss of Productivity due to Depression among Korean Employees. *Journal Occupational Health*. 2010;52(6):389-394.

9. Kim SE, Kim HN, Cho J, et al. Direct and Indirect Effects of Five Factor Personality and Gender on Depressive Symptoms Mediated by Perceived Stress. *PLOS ONE*. 2016;11(4): e0154140. doi: 10.1371/journal.pone.0154140.

10. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2011 [cited 22 February 2018]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/rousaihoken04/dl/120215-01.pdf (in Japanese)

11. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Industrial accident compensation insurance for mental disorders; 2016 [cited 22 February 2018]. Available from: http://www.mhlw.go.jp/file/04-Houdouhappyou-11402000-Roudoukijunkyokuroudouhoshoubu-Hoshouka/h27_seishin.pdf (in Japanese)

12. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Basic Survey on Industrial Safety and Health; 2013 [cited 22 February 2018]. Available from: http://www.mhlw.go.jp/file/05-Shingikai-11201000-Roudoukijunkyoku-Soumuka/0000061406.pdf (in Japanese)

13. Ministry of Health, Labor and Welfare [Internet]. Tokyo: Stress check system; 2015 [cited 22 February 2018]. Available from: http://www.mhlw.go.jp/bunya/roudoukijun/anzeneisei12/ (in Japanese)

14. Lazarus R. Psychological Stress and the Coping Process. New York, McGraw-Hill; 1966.

15. Lazarus R & Folkman S. Stress, Appraisal, and Coping, New York, Springer; 1984.

16. Carpenter R. A Review of Instruments on Cognitive Appraisal of Stress. *Archives of Psychiatric Nursing*. 2016;30(2):271-279.

doi: http://dx.doi.org/10.1016/j.apnu.2015.07.002.

17. Fevre ML, Matheny J, Kolt GS. Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology*.2003;18(7):726-744. doi: 10.1108/02683940310502412

18. Cohen S, Kamarck T, Mermelstein R. A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*. 1983;24(4):385-396.

19. Cohen S, Williamson G. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, eds. *The social psychology of health.* Newbury Park, Calif.: Sage, 1988:31–67.

20.Schelle KJ, Olthof BMJ, Reintjes W, et al.A survey of substance use for cognitive enhancement by university students in the Netherlands.*Frontiers in Systems Neuroscience*.2015;9:10. doi:10.3389/fnsys.2015.00010.

21. Roberti JW, Harrington LN, Storch EA. Further Psychometric Support for the 10-Item Version of the Perceived Stress Scale. *Journal of College Counseling*. 2006;9:135-147. doi: 10.1002/j.2161-1882.2006.tb00100.x.

22. Hamaideh SH, Al-ashram SA, Al-modallal H. Premenstrual syndrome and premenstrual dysphoric disorder among Jordanian women. *Journal of Psychiatric and Mental Health Nursing*. 2014;21(1):60-68. doi: 10.1111/jpm.12047.

23. Wawrzyniak AJ & Whiteman MCP. Perceived stress, loneliness, and interaction with fellow students does not affect innate mucosal immunity in first year university students. *Psychological Japanese Research*.2011;53(2):121-132.
doi: 10.1111/j.1468-5884.2011.00466.x.

24. Gupta R, Singh N, Kumar R. Longitudinal predictive validity of emotional intelligence on first year medical students perceived stress. *BMC Medical Education*. 2017;17:139. doi:10.1186/s12909-017-0979-z.

25. Li S, Li L, Zhu X, et al. Comparison of characteristics of anxiety sensitivity across career stages and its relationship with nursing stress among female nurses in Hunan, China.*BMJ Open*.2016;6(5):e010829. doi: 10.1136/bmjopen-2015-010829.

26. Győrffy Z & Girasek E. Mental Health of Physicians Nationwide Representative Study from Hungary. *Ideggyogyaszati szemle-Clinical Neuroscience*. 2015;68(7-8):258-269.

27. Su X, Lau JT, Mak WW, et al. Development of the Perceived Stress Scale for People Living with HIV/AIDS in China. *AIDS Patient Care and STDs*. 2008;22(12):989-998. doi: 10.1089/apc.2008.0095.

28. Kimura T, Yokoyama A, Kohno N, et al. Perceived Stress, Severity of Asthma, and Quality of Life in Young Adults with Asthma. *Allergology International*. 2009;58(1):71-79. doi: 10.2332/allergolint.O-07-531.

29. Hara Y, Hisatomi M, Ito H, et al. Effects of gender, age, family support, and treatment on perceived stress and coping of patients with type 2 diabetes mellitus. *BioPsychoSocial Medicine.*2014;8:16.

doi: 10.1186/1751-0759-8-16.

30. Lee EH, Chung Y, Suh H, et al. Korean versions of the Perceived Stress Scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. *Scand J Caring Sci.* 2015;29(1):183-192. doi: 10.1111/scs.12131.

31. Mitchell AM, Crane PA, & Kim Y. Perceived Stress in Survivors of Suicide: Psychometric Properties of the Perceived Stress Scale. *Research in Nursing & Health*. 2008;31(6):576-85. doi: 10.1002/nur.20284.

32. Andreou E, Alexopoulos EC, Lionis C, et al. Perceived Stress Scale: reliability and validity study in Greece. *Int J Environ Res Public Health.* 2011;8(8):3287-3298. doi: 10.3390/ijerph8083287

33. Barrington WE, Ceballos RM, Bishop SK, et al. Perceived Stress, Behavior, and Body Mass Index among Adults Participating in a Worksite Obesity Prevention Program, Seattle, 2005-2007. *Prev Chronic Dis*. 2012;9:E152. doi: 10.5888/pcd9.120001

34. Leung DY, Lam TH, Chan SS. Three versions of Perceived Stress Scale: validation in sample of Chinese cardiac patients who smoke. *BMC Public Health*. 2010;25;10:513. doi: 10.1186/1471-2458-10-513.

35. Willert MV, Wieclaw J, Thulstrup AM. Rehabilitation of individuals on long-term sick leave due to sustained stress-related symptoms: A comparative follow-up study. *Scand J Public Health.* 2014;42(8):719-27.
doi: 10.1177/1403494814551859.

36. Wiernik E, Nabi H, Pannier B, et al. (2014): Perceived stress, sex, and occupational status interact to increase the risk of future high blood pressure: the IPC cohort study. *J Hypertens*. 2014;32(10):1979-1986.
doi: 10.1097/HJH.0000000000000288.

37. Horiuchi S, Tsuda A, Kim E, et al. Relationships between stage of change for stress management behavior and perceived stress and coping. *Japanese psychological Research.* 2010;52(4):291-297.
doi: 10.1111/j.1468-5884.2010.00444.x.

38. Stewart DW, Vidrine JI, Shete S, et al. Health literacy, smoking, and health indicators in African American adults. *J Health Commun.* 2015;20 Suppl 2:24-33. doi: 10.1080/10810730.2015.1066465.

39. Faresjö Å, Theodorsson E, Chatziarzenis M, et al. Higher Perceived Stress but Lower Cortisol Levels Found among Young Greek Adults Living in a Stressful Social Environment in Comparison with Swedish Young Adults. *PLoS One*. 2013;8(9):e73828.
doi: 10.1371/journal.pone.0073828

40. Mimura C & Griffiths G. A Japanese version of the perceived stress scale: translation and preliminary test. *International Journal of Nursing Studies*. 2004; 41(4): 379-385.

41. Mimura C & Griffiths G. A Japanese version of the Perceived Stress Scale: cross-cultural

translation and equivalence assessment. *BMC Psychiatry.* 2008;8:85. doi: 10.1186/1471-244X-8-85.

42. Shima S, Kano T, Kitamura T, et al. Atarashii yokuutsusei jiko hyouka syakudo ni tsuite (A new self-report depression scale). Clinical Psychiatry, 1985:27; 717–723. Japanese

43. Radloff LS. The CES-D Scale. A self-report depression scale for research in the general population. *Applied Psychological Measurement*.1985;1(3):385-401. doi: https://doi.org/10.1177/014662167700100306

44. Shimomitsu T, & Odagiri Y. The brief job stress questionnaire. *Japanese Journal of Occupational Mental Health*.2004;12(1):25-36. Japanese

45. Kawakami N & Fujigaki Y. Reliability and Validity of the Japanese Version of Job Content Questionnaire: Replication and Extension in Computer Company Employees. *Industrial Health*.1996;34(4):295-306.

46. Karasek R, Brisson C, Kawakami N, et al. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol.* 1998;3(4):322-55.

47. Kawakami N, Kobayashi F, Araki S, et al. Assessment of job stress dimensions based on the Job Demands-Control model of employees of telecommunication and electric power companies in Japan: reliability and validity of the Japanese version of Job Content Questionnaire. *Int J Behav Med*. 1995;2(4):358-75.

48. Suzuki-Saito T, Yasumura S, Okamura T, et al. Medical care costs and the characteristics of higher medical costs among BMI groups in the early-stage elderly Analysis of data obtained from a large-scale study of 29,490 elderly. *Japanese Journal of Public Health*.2012:59(7);466-473. Japanese. doi: http://doi.org/10.11236/jph.59.7_466

49. Togari T, Yamazaki Y, Koide S, et al. Reliability and validity of the Modified Perceived Health Competence Scale (PHCS) Japanese version. *Japanese Journal of Public Health*.2006: 53(1); 51-57. Japanese. doi:http://doi.org/10.11236/jph.53.1_51

50. Leon-Perez JM, Antino M, Leon-Rubio JM. The Role of Psychological Capital and Intragroup Conflict on Employees' Burnout and Quality of Service: A Multilevel Approach. *Front Psychol.* 2016; 7: 1755. doi: 10.3389/fpsyg.2016.01755

51. Smith MS, Wallston KA, Smith CA. The development and validation of the Perceived Health Competence Scale. *Health Educ Res*. 1995 Mar;10(1):51-64.

52. Mitsutake S, Shibata A, Ishii K, et al. Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Japanese Journal of Public Health*.2011;58(5):361-371. Japanese. doi: http://doi.org/10.11236/jph.58.5_361

53. Norman CD & Skinner HA. eHealth Literacy: Essential Slills for Consumer Health in a Networked World. *J Med Internet Res*. 2006; 8(2): e9. doi: 10.2196/jmir.8.2.e9

54. Norman CD & Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res*. 2006 Oct-Dec; 8(4): e27. doi: 10.2196/jmir.8.4.e27

55. Ministry of Internal Affairs and Communications [Internet] Tokyo: White Paper on Information and Communications in Japan; 2016 [cited 22 February 2018]. Available from: http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2016/chapter-5.pdf#page=1

56. Fukui S, Haratani T, Toshima Y, et al. Measuring Workplace Climate: Reliability and Validity of the 12-item Organizational Climate Scale (OCS-12). *Japan Society for Occupational Health*. 2004;46(6):213-222. Japanese. doi:http://doi.org/10.1539/sangyoeisei.46.213

57. Hemingway MA & Smith CS. Organizational climate and occupational stressors as predictors of withdrawal behaviors and injuries in nurses. *Journal of Occupational and Organizational Psychology*. 1999;72(3):285-299. doi:10.1348/096317999166680

58. Iwasa H. Gondo Y, Masui Y, et al. Reliability and validity of "Social Support Scale", Japanese language edition: Investigation targeting middle and old age. *Indicators of social welfare*.2007 54(6), 26-33. Japanese.

59. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidemensional Scale of Perceived Social Support. *Jounal of Personality Assessment*. 1988;52(1):30-41. doi: 10.1207/s15327752jpa5201_2

60. Cohen J. A Power Primer. *Psychological Bulletin*. 1992; 112(1): 155-159.

61. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;3:175-91.

62. Japan Institute for Labour Policy and Training [Internet] Tokyo: Labour statistics data; 2016 [cited 23 February 2018] Available from: http://www.jil.go.jp/kokunai/statistics/timeseries/html/g0209.html (in Japanese)

63. Katsarou A, PAnagiotakos D, Zafeiropoulou A, et al. Validation of a Greek Version of PSS-14: A global measure of perceived stress. *Cent Eur J Public Health*. 2012;20(2):104-109.

64. Remor E. Psychometric properties of a European Spanish version of the Perceived Stress Scale (PSS). *Span J Psyvhol*. 2006: 9(1); 86-93.

65. Lee J, Kim EY, Wachholtz A. The effect of perceived stress on life satisfaction: The mediating effect of self-efficacy. *Chongsonyonhak Yongu*. 2016;23(10):29-47.

66. Nutbeam D. Health promotion glossary. *Health Promotion International*. 1998;13(4):349-364.

67. Ishikawa H, Nomura K, Sato M, et al. Developing a measure of communicative and critical health literacy: a pilot study of Japanese office workers. Health Promotion International. *Health Promot Int*. 2008;23(3):269-274. doi: 10.1093/heapro/dan017.

68. Ministry of Economy, Trade and Industry [Internet]. Tokyo: Employment Status Survey; 2012 [cited 22 February 2018] Available from: http://www.stat.go.jp/english/data/shugyou/pdf/sum2012.pdf (in Japanese)

69. Ritterband LM & Palermo T. Introduction to the Special Issue: eHealth in Pediatric Psychology. *Journal of Pediatric Psychology*. 2009;34(5):453-456. doi: 10.1093/jpepsy/jsp008

70. Mitsutake S, Shibata A, Ishii K, et al. Associations of eHealth Literacy With Health Behavior Among Adult Internet Users. *J Med Internet Res*. 2016;18(7):e192. doi: 10.2196/jmir.5413.

71. Cropanzano R & Mitchell MS. Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*. 2005:31(6): 874-900

72. Koizumi Y, Awata S, Kuriyama S, et al. Association between social support and depression status in the elderly: results of a 1-year community-based prospective cohort study in Japan. *Psychiatry Clin Neurosci*. 2005;59(5):563-569.

73. Frasure-Smith N, Lesperance F, Gravel G, et al. Social Support, depression, and mortality during the first year after myocardial infarction. *Circulation*. 2000;101(16):1919-1924.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-9
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8-9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5,8-9
		(*e*) Describe any sensitivity analyses	8-9
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-11
		(b) Indicate number of participants with missing data for each variable of interest	8-9
Outcome data	15*	Report numbers of outcome events or summary measures	9-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.