ABSTRACT

Objectives Limited research has focused on the association between work stress and health behaviours in Asian countries. We aimed to explore the effect of work stress on two health behaviours among employees aged 45 years or above in two countries with ageing populations, Korea and Japan.

Design A cross-sectional study.

Setting This secondary data analysis was conducted on baseline data from the Korean Longitudinal Study of Aging (KLoSA, 2006) and the Japanese Study of Aging and Retirement (JSTAR, 2007 and 2009).

Participants Included in the analytical sample were 4982 responders without missing data aged 45 years or older who reported work positions and hours (KLoSA n=3478, JSTAR n=1504).

Main outcome measures Work stress was represented by the short version of the effort-reward imbalance (ERI) model. We used logistic regression and multinomial logistic regression to investigate the association between work stress and smoking (binary current smoking) and between work stress and drinking (categorical volume of alcohol). Socioeconomic and work-related characteristics were taken into consideration, and we examined the potential interaction between ERI and gender.

Results Work stress as measured by ERI ratio was significantly associated with both smoking and drinking in the KLoSA analysis; after the model was fully adjusted, ORs were 1.45 (95% CI 1.17 to 1.80) and 1.44 (95% CI 1.09 to 1.90), respectively. In analysis of the data from JSTAR, the ERI ratio was associated with smoking (OR 1.37, 95% CI 1.01 to 1.89) but not with drinking. No statistically significant interaction was found between ERI and gender in any model (p=0.82 in KLoSA data and p=0.19 in JSTAR data).

Conclusions Statistically significant associations were found between work stress and both smoking and drinking behaviours in Korea and between work stress and smoking in Japan. Government integration of effort-reward balance programmes and health promotion programmes could effectively promote population health in these two Asian countries.

INTRODUCTION

In the last few decades, many public health studies have highlighted the necessity of studying unhealthy behaviours such as smoking, drinking, poor diet and sedentary lifestyles. Scholars have observed that smoking, binge drinking, lack of exercise and poor diet contribute significantly to high levels of morbidity and mortality in both developed and developing countries. Work stress as a potential risk factor associated with unhealthy behaviours has not been studied extensively. Moderate work stress can motivate people to become more productive; however, excessive or unmanageable work stress may increase the risk of unhealthy behaviours. A theoretical framework for the association between occupational stress and health behaviours can be found in Lazarus and Folkman, who found that individuals respond to threatening events via primary and secondary appraisals. While individuals engage in ‘primary appraisal’ to evaluate potential threats, they use ‘secondary appraisal’ to identify opportunities to prevent or reduce the detrimental consequences of stress. We sought to examine whether health behaviours play an important role in this secondary appraisal process.
Two models for work stress evaluation

Work stress has been shown to result from dissatisfaction with work or from lack of reward for work effort. Two models widely used in many epidemiological studies to evaluate the level of work stress are Karasek’s job demand-control (JDC) model and Siegrist’s effort-reward imbalance (ERI) model. The JDC model measures the magnitude of work-related stress from job demand and job control dimensions. The model postulates that the most stressed people are those with high job demands combined with low work control. In contrast, the core of the ERI model is the principle of the work contract and social reciprocity. This model predicts that the combination of high effort and low reward significantly increases negative emotions and may lead to a high level of work stress.

Reasons for studying the association between work stress and health behaviours in Korea and Japan

Most studies that examined the association between job stress and health behaviours have focused on European and North American countries, and only a few have focused on East Asian countries. For example, a study from Finland adopted the ERI model to examine the relationship between work stress and smoking and found that highly stressed people were more likely to smoke. A study from the USA, using the job strain model, produced a similar result and concluded that high-stress jobs were positively associated with smoking intensity. In terms of drinking, Siegrist and Rödel, in their meta-analysis of 18 articles, investigated from the perspective of a Western lifestyle the association between work-related stress and alcohol consumption. They indicated that most of the articles used the JDC model to evaluate work stress, while few articles used the ERI model. Although a study from Norway failed to determine the association between work-related stress and drinking, some European studies found that work-related stress contributed to chronic heavy drinking and alcohol addiction.

Nevertheless, middle-aged and older workers in Asia have been shown to be particularly vulnerable to work-related stress. Further, Korea, Japan and other East Asian countries have longer working hours than Western countries. In 2007, the average working hours in Korea exceeded 2300, which is the highest among Organisation for Economic Co-operation and Development member countries. Japan has a similar situation, and Okamoto mentioned that approximately 30% of male and 10% of female Japanese workers had long working hours in 2015. Although the governmental minister in Japan has introduced a criterion to limit overtime work, no consequences have been established for overworking situations. Based on these facts and the lack of relevant policies and welfare systems guaranteeing the rights of employees in Asia, it is predicted that work-related stress might have a more serious impact on employees in East Asian countries than in Western countries.

It has been postulated that East Asian people of various countries may have similar patterns of coping with stress. We know that two developed countries with similar economic development patterns, Japan and Korea, have witnessed an increased rate of work-related deaths in the last three decades. Since the early 1990s, sudden deaths due to heavy workloads have become common in both countries. Thus, investigating the factors associated with health behaviours and work stress in Korea and Japan may provide valuable information for designing appropriate public health strategies. Further, this work may offer helpful experience for other countries that also face increasing problems related to work stress.

In Korea and Japan, evidence from the analysis of the relationships between work-related stress and health behaviours is limited. Kawakami and Haratani pointed out that compared with some European countries, Japanese people felt less satisfied with their jobs, thereby making them vulnerable to work-related stress. In a Korean cohort study, job security was negatively associated with smoking status among people aged 20–59. Similarly, in a cross-sectional study conducted in Japan, a considerable number of nurses with high job strains depended on heavy smoking.

Despite these similarities when exploring the association between work stress and healthy behaviour in Korea and Japan, no literature has compared the two countries directly. Several Japanese and Korean studies found that a gender difference might exist in the association between work stress and various health outcomes. Lack of intrinsic work rewards and uncertainty about the future contributed to unhealthy behaviours more seriously in males than in females. Moreover, previous studies also found that age, gender, education level, marital status, occupational grade, socioeconomic status and working time might be covariates that need to be controlled for when studying the relationship between work-related stress and health behaviours in Korea and Japan.

Research gaps in work stress and health behaviours

In summary, past Japanese and Korean work stress research focused on the relationship between work-related stress and individual health behaviours in some specific occupations, but not in general population samples. Thus, this paper focuses on the association between work stress and two unhealthy behaviours, current smoking status and heavy alcohol consumption, in Korea and Japan by using two well-known ageing data sets, the Korean Longitudinal Study of Aging (KLoSA) and the Japanese Study of Aging and Retirement (JSTAR). To focus on a potentially vulnerable population, the target population of this research is middle-aged and older workers, aged 45 years and above, in Korea and Japan. The short form of ERI used in the KLoSA and JSTAR data sets, previously used and partially validated by Siegrist et al, will be used to measure the ERI model.

The study has three objectives: (1) to examine the association between ERI and health behaviours in KLoSA...
and JSTAR, (2) to investigate the potential interactions between ERI and gender, and (3) to compare results from Korea and Japan and to identify any potential differences in findings.

METHODS

Study design

The KLoSA and JSTAR databases are public data with open access. The KLoSA study was based on the random selection of men and women aged 45–98 in South Korea, excluding Jeju Island. The baseline data were obtained in 2006, and computer-assisted personal interviewing was employed to ask questions related to work stress and health behaviours. Because of the large number of missing outcome variables in the follow-up waves, we decided to focus our study on cross-sectional analysis using 2006 data (wave 1).

The JSTAR survey was conducted by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University and the University of Tokyo. This survey focused on men and women aged 50–78 in 2007. According to the JSTAR first results report, the data quality was evaluated by comparing the JSTAR database with the 2005 Japanese census data. JSTAR has a high response rate in terms of the Japanese standard; however, JSTAR data sets have various limitations, such as changing the questionnaire between waves. Because of this, some variables are missing in different waves. Siegrist et al pointed out that JSTAR data were not of sufficient quality for the longitudinal analysis of work stress, as many people dropped out in later waves. Hence, our project uses the baseline JSTAR data to perform cross-sectional analyses.

The baseline data from five cities (Adachi, Kanazawa, Shirakawa, Sendai and Takikawa) were collected in 2007, with an additional two cities (Tosu and Naha) obtained in 2009.

Because KLoSA is a much larger study and past literature suggests that it is of better quality than JSTAR, the present study will focus mainly on Korean results. The Japanese results will then be compared with the Korean results.

Study sample

Figures 1 and 2 present the analytical sample selection in this study. Responders in wave 1 of KLoSA (n=3478) and JSTAR (n=1504) who reported a working position and working hours and were not missing data were included in the analytical sample. A total of 482 participants were excluded from the analysis due to missing data, which accounted for 12.2% of the total workers in the Korean baseline sample. According to the same inclusion and exclusion criteria, approximately 53.5% (n=1504) of responders could be used from a Japanese sample. In summary, nearly 87.8% of the eligible Korean sample was analysed, while only approximately half of the eligible Japanese sample was included in the analysis. To test whether the potential bias caused by the missing values would influence the results, this study applied the multiple imputation method for both data sets. The samples after imputation accounted for 91.24% of KLoSA (n=3613) and 81.59% of JSTAR (n=2292).

Patient and public involvement

No patients were involved in this study that used deidentified data.

Measurement

ERI evaluation

ERI, the measure of work stress in this project, was measured with three questions in KLoSA and six questions in JSTAR. The ERI questionnaire used in those reports consisted of 17 items; six of the items measure ‘efforts’
and the remainder measure ‘rewards’.\textsuperscript{19} Because of limitations in the existing data from Korea, only one item was available for evaluating the effort dimension, while two items were available for assessing the reward dimension (‘ERI [1+2]’). In data from Japan, two and four questions were used to measure ‘efforts’ and ‘rewards’ (‘ERI [2+4]’), respectively. In 2012, Siegrist et al demonstrated that the short and long versions of the ERI model had similar properties.\textsuperscript{13} Hence, the results from the analysis using the ERI (1+2) model will be directly comparable between KLoSA and JSTAR samples. Further, we used the ERI (2+4) model in a Japanese sample to carry out the sensitivity analysis.\textsuperscript{40}

Responses to each item in the model used a 4-point Likert scale. A higher level of stress is indicated by higher scores on the effort scale and by lower scores on the reward scale.\textsuperscript{40} The ERI ratio is calculated by adding the score of the effort and then dividing the value by the total score of reward, adjusted for the different number of items (correction factor), which is 0.5 in the three-item ERI model and six-item ERI model. Then, the categorical ERI is obtained by dividing the continuous ERI into tertiles.\textsuperscript{13} Individual questions available in both data sets are shown in table 1, with questions requiring reverse scoring marked with an asterisk.

**Health behaviours**

The main health behaviours focused on in this report are current smoking and drinking status. Measured as a binary outcome in the data from Korea, smoking was assessed by the question ‘Do you smoke cigarettes now?’ Participants who answered ‘yes’ were classified as current smokers, and those whose response was ‘No’ were considered non-smokers. The questionnaire in Japan asked, ‘Do you regularly use tobacco, or did you use it in the past?’ Participants were given three options: (1) Yes, I smoke now; (2) I smoked in the past, but I have quit; and (3) No, I have never smoked regularly. To ensure comparability between the two countries and considering that this paper mainly examines the current smoking variable, participants in Japan who chose option (1) were regarded as current smokers, and those who selected (2) or (3) were classified as current non-smokers.

Drinking was measured as a categorical outcome in the analysis. First, weekly alcohol consumption was calculated by multiplying the weekly drinking frequency of different drinks by their alcohol content. Next, according to the criteria of different drinking levels among men and women, we classified individuals in Korea and Japan into three groups: non-drinkers, moderate drinkers and heavy drinkers.\textsuperscript{31} Males who drank between 0 and 210 g of alcohol per week (g/week) were considered moderate drinkers, and those who consumed more than 210 g/week were regarded as heavy drinkers. Similarly, females who drank approximately 0–140 g/week and more than 140 g/week were considered moderate drinkers and heavy drinkers, respectively.\textsuperscript{41}

**Covariates**

All available covariates were categorised as demographic, social and socioeconomic, and work-related characteristics. Demographic variables included age and sex. Age was divided into 5-year age groups. Social variables included education and marital status. In each country, education was classified into four categories. Marital status was classified into five categories (married, separated, divorced, widowed and never married) in Korea but was available in only two categories (married/not married) in Japan. The work-related variables refer to working position and weekly working hours. In both countries, the working position was classified as non-supervisor, supervisor and self-employed. Participants were asked ‘How many hours do you work per week on average?’ to estimate weekly working hours.

**Analytical strategy**

This study employed the number (%) and mean (SD) for all variables of interest to describe the characteristics of the analytical sample. The associations between exposure (categorical ERI ratio) and outcomes (smoking and drinking) were examined in both countries separately. Given that smoking is a binary variable, logistic regression

---

**Table 1** Questions related to ERI measurement

|                | KLoSA                                                                 | JSTAR                                                                 |
|----------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| **Effort**     | My job requires lots of physical effort.*                            | My current job involves physical labour.*                              |
|                | N/A                                                                  | I have a lot of work and always feel time pressure.*                  |
| **Reward**     | I feel my job is secure.*                                             | Do you think it is likely that you could lose your current job for a reason other than retirement? |
|                | I am satisfied with current wage.*                                    | Considering the effort I put in and the results I produce, I am satisfied with my current pay.* |
|                | N/A                                                                  | I receive appropriate evaluation on my work from coworkers.*          |
|                | N/A                                                                  | When I have problems doing my work, colleagues give me advice and help me.* |

*Reverse coding.

ERI, effort-reward imbalance; JSTAR, Japanese Study of Aging and Retirement; KLoSA, Korean Longitudinal Study of Aging.
was used to explore the relationship between ERI and the prevalence of smoking, and ORs were estimated. Multinomial logistic regression was used to evaluate the association between ERI and drinking. In both analyses, the associations between ERI and two outcomes were analysed in the same order of adjustment. For all the analyses, four adjusted models were fitted: (model 1) adjusted for age; (model 2) model 1+gender; (model 3) model 2+education, marital status; and (model 4) model 3+working position, working hours. Moreover, on the basis of model 4, we used the samples after imputation for the additional analysis and presented the results in model 5.

To compare the KLoSA and JSTAR data sets, our analytical process of JSTAR data used the same sequence of adjustments of the covariates as used for KLoSA data. As more ERI-related questions were available in JSTAR, we used a shorter version (ERI 1+2, same as in Korea) to make available comparisons and a longer version of the ERI model (2+4) to perform the sensitivity analysis. Additionally, we used ERI as a continuous variable in the sensitivity analysis since the arbitrariness of setting thresholds might exist in the categorical ERI variable.

Considering that differences might be observed in the healthy behaviours of men and women, likelihood-ratio tests were performed to examine the interactions between ERI and gender. The goodness-of-fit indices of the regression models, including and excluding the corresponding interaction terms, were compared (online supplemental tables 1 and 2).

All the analyses mentioned above were conducted in STATA MP V.16.

RESULTS
Characteristics of samples in Korea and Japan
Table 2 describes both analytical samples. The mean age of respondents in the Korean sample was 55.6 years (SD=8.3 years), while that of the Japanese sample was 59.2 years (SD=6.1 years). More than half of the participants had at least a high school education in both Korea (53.3%) and Japan (70.1%). A large proportion of subjects (Korea 88.6%, Japan 84.3%) were married. In both samples, the proportion of respondents in supervisory working positions was larger for men (Korea 15.6%, Japan 8.8%) than women (Korea 3.0%, Japan 2.9%).

The prevalence of smoking was 32.2% in Korea and 30.7% in Japan. In both countries, the prevalence of smoking was higher among men (Korea 44.5%, Japan 39.9%) than among women (Korea 3.6%, Japan 13.7%). The prevalence of male heavy drinkers was 21.1% in Korea and 43.0% in Japan; the prevalence of female heavy drinkers was 3.2% in Korea and 12.9% in Japan.

Evaluation of potential gender effect modification
In terms of the association between ERI and smoking, no statistically significant interactions by gender were found after adjusting for age, education, marital status, work position and weekly working hours (p>0.05). The p values

| Table 2 | Characteristics of the cross-sectional sample in Korea and Japan |
|---------|---------------------------------------------------------------|
| **Variables** | **Korea** | **Japan** |
| Sample | 3478 (n = 1000) | 1504 (n = 1000) |
| Age | | |
| Years, mean (SD) | 55.6 (8.3) | 59.2 (6.1) |
| 45–49 years | 1055 (30.3) | N/A |
| 50–54 years | 787 (22.6) | 392 (26.1) |
| 55–59 years | 596 (17.1) | 513 (34.1) |
| 60–64 years | 444 (12.8) | 296 (19.7) |
| >65 years | 358 (10.3) | 191 (12.7) |
| Gender | | |
| Male | 2431 (69.9) | 977 (65.0) |
| Female | 1047 (30.1) | 527 (35.0) |
| Education | | |
| Elementary | 988 (28.4) | 330 (21.9) |
| Middle | 635 (18.3) |  |
| Vocational school | N/A | 120 (8.0) |
| High | 1281 (36.8) | 715 (47.5) |
| College/university | 574 (16.5) | 339 (22.5) |
| Marital status | | |
| Married | 3080 (88.6) | 1255 (83.4) |
| Separated | 36 (1.0) | N/A |
| Divorced | 90 (2.6) | N/A |
| Widowed | 238 (6.8) | N/A |
| Never married | 34 (1.00) | N/A |
| Not married | N/A | 249 (16.6) |
| Working position | | |
| Non-supervisor | 1366 (39.3) | 994 (66.1) |
| Supervisor | 409 (11.8) | 101 (6.7) |
| Self-employed | 1703 (49.0) | 409 (27.2) |
| Working hour | | |
| Hours/week (SD) | 48.5 (18.3) | 41.7 (16.4) |
| Location | | |
| Seoul | 536 (15.4) | N/A |
| Other places | 2942 (84.6) | N/A |
| ERI (1+2) | 3478 | 1504 |
| Lowest tertile | 1611 (46.3) | 543 (36.1) |
| Middle tertile | 1001 (28.8) | 579 (38.5) |
| Upper tertile (ERI) | 866 (24.9) | 382 (25.4) |
| ERI (2+4) | N/A | 1504 |
| Lowest tertile | N/A | 559 (37.2) |
| Middle tertile | N/A | 447 (29.7) |
| Upper tertile (ERI) | N/A | 498 (33.1) |
| Smoking | | |
| Continued | | |
In addition, place of residence was taken into consideration. In the data from Korea, participants were classified as living in the capital Seoul or elsewhere. The effect estimates of ERI did not change when the residence variable was added into the regression models. The result of the likelihood-ratio test showed that residence did not play a role in the association between ERI and smoking or between ERI and drinking when comparing the model with and without residence variable, as the p values were 0.30 in Korea and 0.87 in Japan, respectively.

In model 5, after missing values were imputed, the association between work stress and health behaviours presented similar results to the model that dropped missing values. In Korea, ERI was significantly associated with current smoking and heavy drinking behaviours, with ORs of 1.51 (95% CI 1.22 to 1.86) and 1.29 (95% CI 1.05 to 1.59), respectively.

**ERI and health behaviours in Japan**

In the data from Japan, using the ERI (1+2) model, the higher ERI group had a higher proportion of smoking individuals. Compared with the lowest tertile ERI group, the proportion of heavy drinkers in the upper tertile ERI group (31.1%) was slightly lower than that in the lowest tertile ERI group (35.3%).

**Smoking**

Table 4 shows the relationship between ERI and current smoking and alcohol drinking behaviours in Japan. To compare the results from Japan and Korea, the results also used the ERI (1+2) evaluation. The OR of smoking was 1.50 (95% CI 1.13 to 2.00) when adjusted for age (model 1) and was 1.56 (95% CI 1.16 to 2.10) when additionally adjusted for sex (model 2). The magnitude and strength of the association decreased when additionally adjusted for education and marital status. ERI in JSTAR remained associated with smoking in a similar way as in KLoSA. Moreover, the imputed Japanese sample presents a stronger association between job stress and smoking after adjusting for all the covariates in model 5.

**Drinking**

According to table 4, the relationship between the ERI categorised into tertiles and drinking in Japan was different from the trend seen in Korea. When comparing people in different ERI groups, people with higher work stress were less likely to drink. Moreover, when adjusted for additional covariates, work stress was not statistically associated with heavy drinking behaviour, and the effect estimates of ERI on drinking did not change much (model 3 and model 4), even when the imputed data sample was used (model 5).

**Sensitivity analysis**

The results of the sensitivity analysis are shown in tables 5 and 6. In table 5, using the ERI (2+4) model, the prevalence of smoking was the highest in the middle tertile. No statistically significant differences between the top and bottom ERI tertiles were found when the ERI (2+4) was

---

**Table 2 Continued**

| Variables | Korea n (%) | Japan n (%) |
|-----------|-------------|-------------|
| No        | 2359 (67.8) | 1042 (69.3) |
| Yes       | 1119 (32.2) | 462 (30.7)  |
| Drinking  |             |             |
| g/week (SD)| 201.7 (289.2) | 169.7 (242.5) |
| Never     | 1490 (42.8)  | 553 (36.8)  |
| Moderate  | 1441 (41.4)  | 460 (30.6)  |
| Heavy     | 547 (15.7)   | 491 (32.7)  |

ERI, effort-reward imbalance.
| Korea | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|-------|---------|---------|---------|---------|---------|
| **ERI tertiles** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** |
| Smoking | | | | | | | | | | |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| T2 (middle) | 1.07 (0.90 to 1.27) | 0.42 | 1.38 (1.14 to 1.67) | 0.001 | 1.23 (1.01 to 1.50) | 0.04 | 1.21 (0.99 to 1.48) | 0.06 | 1.25 (1.02 to 1.52) | 0.03 |
| T3 (upper ERI) | 1.45 (1.22 to 1.73) | <0.001 | 1.81 (1.49 to 2.20) | <0.001 | 1.48 (1.20 to 1.83) | <0.001 | 1.45 (1.17 to 1.80) | 0.001 | 1.51 (1.22 to 1.86) | <0.001 |
| P for linear trend | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | | |
| Drinking | | | | | | | | | | |
| Non-drinker | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| Moderate drinker | | | | | | | | | | |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| T2 (middle) | 0.83 (0.70 to 0.99) | 0.04 | 0.99 (0.82 to 1.19) | 0.88 | 0.99 (0.81 to 1.19) | 0.88 | 1.00 (0.83 to 1.22) | 0.98 | 1.26 (0.87 to 1.83) | 0.23 |
| T3 (upper ERI) | 0.96 (0.80 to 1.16) | 0.69 | 1.11 (0.91 to 1.36) | 0.29 | 1.11 (0.90 to 1.37) | 0.32 | 1.15 (0.93 to 1.42) | 0.21 | 1.20 (0.80 to 1.81) | 0.38 |
| P for linear trend | 0.45 | 0.34 | 0.36 | 0.24 | 0.34 | | | | | |
| Heavy drinker | | | | | | | | | | |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | |
| T2 (middle) | 0.81 (0.63 to 1.03) | 0.08 | 1.01 (0.78 to 1.31) | 0.92 | 0.96 (0.73 to 1.25) | 0.75 | 0.94 (0.72 to 1.23) | 0.66 | 0.97 (0.80 to 1.18) | 0.79 |
| T3 (upper ERI) | 1.32 (1.04 to 1.67) | 0.02 | 1.60 (1.24 to 2.07) | <0.001 | 1.45 (1.10 to 1.91) | 0.008 | 1.44 (1.09 to 1.90) | 0.01 | 1.29 (1.05 to 1.59) | 0.02 |
| P for linear trend | 0.07 | 0.001 | 0.01 | 0.02 | 0.03 | | | | | |

n 3478 3478 3478 3478 3613

Model 1: adjusted for age.
Model 2: model 1+gender.
Model 3: model 2+education, marital status.
Model 4: model 3+working position, working hours.
Model 5: fully adjusted model (after MI).
ERI, effort-reward imbalance; MI, multiple imputation.
|                  | Japan Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|------------------|---------------|---------|---------|---------|---------|
|                  | OR (95% CI)   | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value |
| Smoking (1+2)    |               |         |         |         |         |         |         |         |         |         |
| T1 (reference)   | 1.00          | 1.00    | 1.00    | 1.00    | 1.00    |
| T2 (middle)      | 1.31 (1.01 to 1.70) | 0.05    | 1.42 (1.08 to 1.87) | 0.01    | 1.33 (1.01 to 1.75) | 0.04    | 1.32 (1.00 to 1.75) | 0.05    | 1.27 (1.00 to 1.61) | 0.05    |
| T3 (upper ERI)   | 1.50 (1.13 to 2.00) | 0.005   | 1.56 (1.16 to 2.10) | 0.004   | 1.36 (1.00 to 1.85) | 0.05    | 1.37 (1.01 to 1.89) | 0.05    | 1.41 (1.09 to 1.82) | 0.01    |
| P for linear trend | 0.004         | 0.003   | 0.04    | 0.04    | 0.01    |
| Drinking (1+2)   |               |         |         |         |         |
| Non-drinker      | 1.00          | 1.00    | 1.00    | 1.00    | 1.00    |
| Moderate drinker |               |         |         |         |         |
| T1 (reference)   | 1.00          | 1.00    | 1.00    | 1.00    | 1.00    |
| T2 (middle)      | 0.74 (0.55 to 0.99) | 0.04    | 0.74 (0.55 to 1.00) | 0.05    | 0.77 (0.56 to 1.04) | 0.09    | 0.76 (0.56 to 1.04) | 0.08    | 0.87 (0.68 to 1.12) | 0.29    |
| T3 (upper ERI)   | 0.90 (0.65 to 1.24) | 0.50    | 0.85 (0.61 to 1.18) | 0.33    | 0.92 (0.65 to 1.30) | 0.63    | 0.91 (0.64 to 1.29) | 0.59    | 1.02 (0.78 to 1.34) | 0.89    |
| P for linear trend | 0.40          | 0.26    | 0.53    | 0.50    | 0.93    |
| Heavy drinker    |               |         |         |         |         |
| T1 (reference)   | 1.00          | 1.00    | 1.00    | 1.00    | 1.00    |
| T2 (middle)      | 0.71 (0.54 to 0.94) | 0.02    | 0.71 (0.52 to 0.97) | 0.03    | 0.71 (0.52 to 0.97) | 0.03    | 0.71 (0.52 to 0.97) | 0.03    | 0.79 (0.61 to 1.03) | 0.08    |
| T3 (upper ERI)   | 0.78 (0.57 to 1.07) | 0.12    | 0.72 (0.51 to 1.02) | 0.07    | 0.71 (0.49 to 1.01) | 0.06    | 0.71 (0.50 to 1.02) | 0.07    | 0.76 (0.57 to 1.02) | 0.07    |
| P for linear trend | 0.08          | 0.05    | 0.04    | 0.05    | 0.06    |
| n                 | 1504          | 1504    | 1504    | 1504    | 2292    |

Model 1: adjusted for age.
Model 2: model 1+gender.
Model 3: model 2+education, marital status.
Model 4: model 3+working position, working hours.
Model 5: fully adjusted model (after MI).
ERI, effort-reward imbalance; MI, multiple imputation.
Table 5  ORs (95% CI) of the association between ERI (2+4) and current smoking and alcohol drinking in Japan

| Japan   | Model 1 | P value | Model 2 | P value | Model 3 | P value | Model 4 | P value | Model 5 | P value |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Smoking (2+4) |         |         |         |         |         |         |         |         |         |         |
| ERI (tertiles) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| T2 (middle) | 1.49 (1.13 to 1.96) | 1.71 (1.28 to 2.28) | <0.001 | 1.62 (1.21 to 2.17) | 0.001 | 1.59 (1.18 to 2.14) | 0.002 | 1.33 (1.05 to 1.68) | 0.02 |
| T3 (upper ERI) | 1.30 (0.99 to 1.70) | 1.31 (0.99 to 1.73) | 0.06 | 1.21 (0.91 to 1.61) | 0.19 | 1.17 (0.87 to 1.58) | 0.29 | 1.40 (1.08 to 1.82) | 0.01 |
| P for linear trend | 0.05 | 0.05 | 0.19 | 0.29 | 0.01 |
| Drinking (2+4) |         |         |         |         |         |         |         |         |         |         |
| Moderate drinker |         |         |         |         |         |         |         |         |         |         |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| T2 (middle) | 0.79 (0.58 to 1.07) | 0.83 (0.60 to 1.14) | 0.26 | 0.84 (0.60 to 1.16) | 0.28 | 0.85 (0.61 to 1.17) | 0.32 | 1.02 (0.80 to 1.31) | 0.86 |
| T3 (upper ERI) | 0.89 (0.66 to 1.20) | 0.84 (0.62 to 1.15) | 0.28 | 0.87 (0.64 to 1.20) | 0.41 | 0.89 (0.64 to 1.23) | 0.47 | 0.99 (0.75 to 1.31) | 0.94 |
| P for linear trend | 0.44 | 0.27 | 0.40 | 0.47 | 0.96 |
| Heavy drinker |         |         |         |         |         |         |         |         |         |         |
| T1 (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| T2 (middle) | 0.75 (0.56 to 1.02) | 0.82 (0.59 to 1.14) | 0.24 | 0.80 (0.57 to 1.11) | 0.18 | 0.80 (0.57 to 1.12) | 0.19 | 0.85 (0.66 to 1.10) | 0.23 |
| T3 (upper ERI) | 0.78 (0.58 to 1.05) | 0.72 (0.52 to 0.99) | 0.05 | 0.71 (0.51 to 0.97) | 0.04 | 0.71 (0.51 to 0.97) | 0.04 | 0.72 (0.53 to 0.97) | 0.03 |
| P for linear trend | 0.09 | 0.04 | 0.04 | 0.04 | 0.03 |
| n | 1504 | 1504 | 1504 | 1504 | 2292 |

Model 1: adjusted for age.
Model 2: model 1+gender.
Model 3: model 2+education, marital status.
Model 4: model 3+working position, working hours.
Model 5: fully adjusted model (after MI).
ERI, effort-reward imbalance; MI, multiple imputation.
used (model 4). However, the association between ERI (2+4) and smoking was found in the data imputed model 5, which was consistent with the results of the ERI (1+2) model. The OR of smoking was significantly increased in the middle ERI ratio group (models 1–4).

In terms of drinking, the results of ERI (1+2) and ERI (2+4) evaluation presented a similar trend among moderate drinkers. Additionally, the ERI ratios of the upper tertile (T3) in both ERI measurements had the widest range from 1.14 to 4 and from 0.93 to 3.20, respectively. The characteristics of drinking prevalence in the ERI (2+4) version were similar to those in the ERI (1+2) version. Meanwhile, when comparing the imputed (model 5) and unimputed (model 4) models, the associations between ERI and heavy drinking behaviours were consistent. Because the female data from Japan might not be reliable, this study also tested the gender-specific association between ERI and health behaviours (online supplemental tables 1 and 2).

In table 6, when considering ERI as a continuous variable, similar results were found. There was a statistically significant association between stress and smoking in both countries. No association was found between job stress and drinking in Japan.

**DISCUSSION**

**Main findings and comparison with previous studies**

Our results indicate that a higher ERI level was positively associated with a higher prevalence of smoking and heavy drinking among Korean workers and positively associated with a higher prevalence of smoking among Japanese workers. ERI was, however, negatively associated with the prevalence of drinking in Japan. The Japanese results for alcohol consumption contradict some previous studies. This finding might be due to report bias and selection bias. Nonetheless, the effect estimates and direction of the ERI were consistent with results from previous research in non-Asian regions. Moreover, the results from Japan also provide some evidence for the validity of the short version of the ERI. In both analyses of JSTAR, the results using ERI (1+2) and ERI (2+4) are mostly but not entirely similar.

This study also used the likelihood-ratio test to explore the potential interaction between ERI and gender factors. No gender interaction was found in Korea or Japan. However, the associations between ERI and health behaviours were significant only among men. Although this finding may be because few women in both data sets were smokers or heavy drinkers, the result is consistent with a previous US study showing that gender was not an effect modifier in the relationship between work-related stress and health behaviours. A finding contrary to most previous observational and experimental studies conducted in Western countries. Our study found that work-related stress might be a protective factor against heavy drinking among Japanese workers and that this type of stress was not statistically significantly associated with outcomes among Japanese females. People with the

| Table 6 | ORs (95% CI) of the association between ERI (continuous) and current smoking and alcohol drinking |
|---------|----------------------------------------------------------------------------------------------------------------|
| **Korea** | **** Model 1 | Model 2 | Model 3 | Model 4 |
| **ERI (continuous)** | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value |
| **Smoking** | 1.23 (1.12 to 1.35) | <0.001 | 1.40 (1.26 to 1.56) | <0.001 | 1.26 (1.12 to 1.41) | <0.001 | 1.24 (1.11 to 1.39) | <0.001 |
| **Drinking** | **Moderate drinker** | 0.94 (0.77 to 1.16) | 0.57 | 1.05 (0.85 to 1.30) | 0.64 | 0.99 (0.79 to 1.24) | 0.92 | 1.00 (0.80 to 1.25) | 0.98 |
| | **Heavy drinker** | 1.00 (0.91 to 1.11) | 0.92 | 1.11 (0.99 to 1.24) | 0.07 | 1.07 (0.96 to 1.21) | 0.22 | 1.10 (0.98 to 1.23) | 0.12 |
| **Japan (1+2)** | **Smoking** | 1.32 (1.12 to 1.54) | 0.001 | 1.32 (1.12 to 1.56) | 0.001 | 1.21 (1.03 to 1.45) | 0.03 | 1.23 (1.03 to 1.46) | 0.02 |
| **Drinking** | **Moderate drinker** | 1.05 (0.88 to 1.25) | 0.58 | 1.01 (0.84 to 1.21) | 0.91 | 1.06 (0.88 to 1.28) | 0.55 | 1.05 (0.87 to 1.27) | 0.60 |
| | **Heavy drinker** | 0.92 (0.76 to 1.11) | 0.38 | 0.87 (0.72 to 1.07) | 0.19 | 0.86 (0.70 to 1.06) | 0.17 | 0.87 (0.71 to 1.08) | 0.21 |

Model 1: adjusted for age. Model 2: model 1+gender. Model 3: model 2+education, marital status. Model 4: model 3+working position, working hours. ERI, effort-reward imbalance.
highest ERI levels had low odds (OR <1) of becoming heavy drinkers in Japan. Moreover, no significant association existed between work stress and drinking by comparing moderate drinkers to non-drinkers in Japan.

Thus, in Japan and Korea the association between work-related stress and drinking was dissimilar. The following explanations may account for the different results in Japan. First, an occupational drinking subculture could contribute to job stress. The purposes of socialisation and career development could also make individuals more or less prone to heavy drinking. In several Asian countries, such as Japan, drinking alcohol is considered an essential way of engaging in social interactions.

Differences in drinking patterns in Japan and Korea account for the disparity in the results. Most drinkers in Japan are moderate drinkers, while those in Korea are more likely to binge drink. Hence, in Japan, the influence of drinking culture tends to be greater than the impact of work-related stress. Nevertheless, subculture and cultural norms are difficult elements to control in the analysis. With a sample size of 26,946 people, one US study detected a statistically significant association between stress and drinking even though work-related stress had a much larger effect on male versus female drinking behaviours.

Strengths and limitations of this study
This study used the ERI model to evaluate work stress levels and used two national-based data sets to examine the association between work stress and health behaviours in Korea and Japan. Compared with the JDC model, the ERI model concentrated on the personal component rather than the job dimension. In previous research, only a few studies have applied the ERI model to explore the association between work stress and health behaviours. Of those few studies, only a small percentage focused on Asian countries. Acquired from two reliable organisations (the Korea Employment Information Service (KEIS), Research Institute of Economy, Trade and Industry (RIETI)), the baseline data of this study were collected nationally. These data provided a representative sample in Korea and a male sample group in Japan. Although the representation of Japanese females was not ideal, it has been previously stated that JSTAR provides more useful information than other existing female-based studies because the latter were based on only a limited geographical area or a specific occupation or age group.

This study fills research gaps regarding the association between Asian workers’ stress and health behaviours. Moreover, the study sample in this project comprised middle-aged and older adults, 45 years of age and above, who may be more sensitive to the experience of work-related stress than younger people. Multinomial logistic regression was applied in this project to explore the association between work stress and health behaviours, thereby providing a better way to control various potential confounders simultaneously.

However, the results of this study have several limitations. One limitation is the small sample size of JSTAR after the selection process with the inclusion and exclusion criteria; and, due to data limitation, sampling weights were not calculated in our study. From a methodological standpoint, the nature of the self-reported questions may influence the results through reporting/recall bias. Recall bias indicates that variation in personal response tendencies existed but was difficult to control. Apart from possibly causing outcome misclassification, it is highly likely that the effect estimates of work-related stress on smoking and drinking are underestimated.

A third limitation is that the effect of residual confounding from other risk factors, for example, drinking subcultures, was not taken into account because of data limitations of the two data sets. Residual confounding might influence the association between stress and health behaviours, leading to underestimation or overestimation of the ORs of the association. Moreover, due to the cross-sectional nature of the study design, the question of causality between work stress and health behaviours is not addressed at this time.

Suggestions for further research
In future research, it will be pertinent to identify other data sets in Korea and Japan to evaluate associations and determine whether the results are consistent within national boundaries, and to investigate whether any study has better data on drinking patterns to test the ERI-drinking association.

Furthermore, longitudinal studies based on a larger sample size are recommended to control for more possible confounders, to explore causality and to clarify the relationship between work-related stress and health behaviours.

CONCLUSION
Overall, after accounting for available covariates, our study found that higher work stress expressed by the ERI (1+2) version was positively associated with a higher prevalence of smoking and heavy drinking among senior workers 45 years of age and above in Korea, positively associated with a higher prevalence of smoking in Japan, but negatively associated with the prevalence of heavy drinking in Japan. The results indicated that the effects of work stress were not significantly modified by gender. The ERI-smoking association was similar in Korea and Japan. The ERI-drinking association, however, was different in these two countries. This discrepancy may be due to the action of work stress as a risk factor in Korea but as a protective factor in Japan. Based on these findings, we recommend that governments enhance the balance between extrinsic efforts and work rewards in Asian countries. Doing so may improve health behaviours, particularly smoking behaviour, of workers and accelerate social and economic development.
Contributors TC and HP designed this study. JG and HP drafted the statistical analysis plan. TC wrote the first draft of the manuscript, prepared the analysis and interpreted the data. JG and BZ helped with the data management and HP helped with the analysis. JG is responsible for the overall content as guarantor. All authors were involved in writing the manuscript, gave critical comments on multiple versions and approved its final version.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

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

Patient consent for publication Not applicable.

Ethics approval The Korean Longitudinal Study of Aging (KLoSA) received approval from the National Statistical Office (approval number: 33602) and the Institutional Review Board (IRB) of the Korea National Institute for Ethics Policy. The JSTAR survey was conducted by the Research Institute of Economy, Trade and Industry (RIETI), the Hitotsubashi University and the University of Tokyo, Japan. Data from KLoSA and JSTAR are publicly available with all data anonymised. This study also received approval for the secondary use of the KLoSA and JSTAR data. All methods in this study were carried out in accordance with the relevant guidelines and regulations. Since the KLoSA and JSTAR databases have been released to the public for scientific use and no experimental treatment was conducted on either human or animal subjects in this study, ethical approval was not required for the study. KLoSA and JSTAR were approved by relevant ethical committees in their respective countries, and all participants signed informed consent for participation in the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaimer all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

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

ORCID iD

Jing Guo http://orcid.org/0000-0001-8085-0117

REFERENCES

1. Ganster DC, Rosen CC. Work stress and employee health: a multidisciplinary review. J Manag 2013;39:1085–122.
2. Kouvonen A, Kivimäki M, Virtanen M, et al. Work stress, smoking status, and smoking intensity: an observational study of 46,190 employees. J Epidemiol Community Health 2005;59:63–9.
3. Puddепатт A-J, Jones A, Gage SH, et al. Associations of alcohol use, mental health and socioeconomic status in England: findings from a representative population survey. Drug Alcohol Depend 2021;219:108463.
4. Dansel SJ, Lienenke JP, Loprinzi PD. Physical activity and diet on quality of life and mortality: the importance of meeting one specific or both behaviors. Int J Cardiol 2016;202:328–30.
5. Kang KH, Lee KS, Kim SI, et al. The relationship between alcohol use and job stress among firemen. Korean J Occup Environ Med 2001;13:401–12.
6. Siegrist J, Rödel A. Work stress and health risk behavior. Scand J Work Environ Health 2006;32:473–81.
7. de Jonge J, Bosma H, Peter R, et al. Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study. Soc Sci Med 2000;50:1317–27.
8. Lazarus RS, Folkman S. Stress, appraisal, and coping. Springer publishing company, 1984.
9. Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. Adm Sci Q 1979;24:285.
10. Jumkern G, Janurer J, Janker TM, et al. The impact of social comparisons of job demands and job control on well-being. Appl Psychol Health Well Being 2021;13:419–36.
11. Sung-I C, Ki-Do E, Choi B. Social class, job insecurity and job strain in Korea. SJWEH Suppl 2008:60–5.
12. Kouvonen A, Kivimäki M, Virtanen M, et al. Effort-reward imbalance at work and the occurrence of lifestyle risk factors: cross-sectional survey in a sample of 36,127 public sector employees. BMC Public Health 2006;6:24.
13. Siegrist J, Lunau T, Wahlendorf M, et al. Depressive symptoms and psychosocial stress at work among older employees in three continents. Global Health 2012;8:27.
14. Hwang WJ, Hong OS, Kang DR. Psychometric testing of the Effort-Reward Imbalance-Short form among blue-collar workers employed in small industrial settings in Korea. Workplace Health Saf 2018;66:597–605.
15. Siegrist J. Adverse health effects of high-effort/low-reward conditions. J Occup Health Psychol 1996;1:27–41.
16. Payne N, Jones F, Harris PR. Employees’ perceptions of the impact of work on health behaviours. J Health Psychol 2013;18:887–99.
17. Green KL, Johnson JV. The effects of psychosocial work organization on patterns of cigarette smoking among male chemical plant employees. Am J Public Health 1990;80:1368–71.
18. Head J, Stansfeld SA, Siegrist J. The psychosocial work environment and alcohol dependence: a prospective study. Occup Environ Med 2004;61:219–24.
19. Siegrist J, Starke D, Chandola T, et al. The measurement of effort-reward imbalance at work: European comparisons. Soc Sci Med 2004;58:1483–99.
20. Kjerheim K, Haldorsen T, Andersen A, et al. Work-Related stress, coping resources, and heavy drinking in the restaurant business. Work Stress 1997;11:8–16.
21. Colell E, Sánchez-Niubó A, Benavides FG, et al. Work-related stress factors associated with problem drinking: a study of the Spanish working population. Am J Ind Med 2014;57:837–46.
22. Amano H, Fukuda T, Kawaichi I. Is high reward imbalance associated with healthy behaviors? A longitudinal study. J Occup Environ Med 2020;62:e87–93.
23. Cheng Y, Park J, Kim Y, et al. The recognition of occupational diseases attributed to heavy workloads: experiences in Japan, Korea, and Taiwan. J Occup Environ Med 2012;54:259–65.
24. Keum S, Hong WJ, Kang DR. Psychometric testing of the Work Stress scale cross-sectional study of female workers. BMC Psychol 2021;9(1):99.
25. Park E, Cho J, Hong Y, et al. Work stress, employee health and the co-occurrence of lifestyle risk factors: cross-sectional survey of a sample of 36,127 public sector employees. BMC Public Health 2006;6:24.
26. Kouvonen A, Kivimäki M, Virtanen M, et al. Effort-reward imbalance at work and the occurrence of lifestyle risk factors: cross-sectional survey in a sample of 36,127 public sector employees. BMC Public Health 2006;6:24.
27. Hwang WJ, Hong OS, Kang DR. Psychometric testing of the Effort-Reward Imbalance-Short form among blue-collar workers employed in small industrial settings in Korea. Workplace Health Saf 2018;66:597–605.
28. Siegrist J. Adverse health effects of high-effort/low-reward conditions. J Occup Health Psychol 1996;1:27–41.
29. Payne N, Jones F, Harris PR. Employees’ perceptions of the impact of work on health behaviours. J Health Psychol 2013;18:887–99.
30. Green KL, Johnson JV. The effects of psychosocial work organization on patterns of cigarette smoking among male chemical plant employees. Am J Public Health 1990;80:1368–71.
31. Head J, Stansfeld SA, Siegrist J. The psychosocial work environment and alcohol dependence: a prospective study. Occup Environ Med 2004;61:219–24.
32. Siegrist J, Starke D, Chandola T, et al. The measurement of effort-reward imbalance at work: European comparisons. Soc Sci Med 2004;58:1483–99.
33. Kjerheim K, Haldorsen T, Andersen A, et al. Work-Related stress, coping resources, and heavy drinking in the restaurant business. Work Stress 1997;11:8–16.
34. Colell E, Sánchez-Niubó A, Benavides FG, et al. Work-related stress factors associated with problem drinking: a study of the Spanish working population. Am J Ind Med 2014;57:837–46.
35. Amano H, Fukuda T, Kawaichi I. Is high reward imbalance associated with healthy behaviors? A longitudinal study. J Occup Environ Med 2020;62:e87–93.
36. Cheng Y, Park J, Kim Y, et al. The recognition of occupational diseases attributed to heavy workloads: experiences in Japan, Korea, and Taiwan. J Occup Environ Med 2012;54:259–65.
37. Keum S, Hong WJ, Kang DR. Psychometric testing of the Work Stress scale cross-sectional study of female workers. BMC Psychol 2021;9(1):99.
1 Introduction, 2009. Available: http://hdl.handle.net/10086/17551 [Accessed 22 Jan 2022].

37 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;3:322–55.

38 Fransson EI, Nyberg ST, Heikilä K, et al. Comparison of alternative versions of the job demand-control scales in 17 European cohort studies: the IPD-Work Consortium. BMC Public Health 2012;12:62.

39 Min J-young, Lee K-young, Park J-boem, et al. Social engagement, health, and changes in occupational status: analysis of the Korean longitudinal study of ageing (KLoSA). PLoS One 2012;7:e46500.

40 Siegrist J, Wege N, Pühlihofer F, et al. A short generic measure of work stress in the era of globalization: effort-reward imbalance. Int Arch Occup Environ Health 2000;82:1005–13.

41 Chalasani N, Younossi Z, Lavine JE, et al. The diagnosis and management of non-alcoholic fatty liver disease: practice guideline by the American Gastroenterological Association, American association for the study of liver diseases, and American College of gastroenterology. Gastroenterology 2012;142:1592–609.

42 Hiro H, Kawakami N, Tanaka K, et al. Association between job stressors and heavy drinking: age differences in male Japanese workers. Int Health 2007;45:415–25.

43 Ikeda A, Ito H, Toyoshima H, et al. Marital status and mortality among Japanese men and women: the Japan collaborative cohort study. BMC Public Health 2007;7:73.

44 Morikawa Y, Nakagawa H, Miura K, et al. Shift work and the risk of diabetes mellitus among Japanese male factory workers. Scand J Work Environ Health 2005;31:179–83.

45 Kitano HH, Chi i, Rhee S, et al. Norms and alcohol consumption: Japanese in Japan, Hawaii and California. J Stud Alcohol 1992;53:33–9.

46 Kouvonon A, Kiivimäki M, Elovainoio M, et al. Low organisational justice and heavy drinking: a prospective cohort study. Occup Environ Med 2008;65:44–50.

47 Ota A, Masue T, Yasuda N, et al. Association between psychosocial job characteristics and insomnia: an investigation using two relevant job stress models—the demand-control-support (DCS) model and the effort-reward imbalance (ERI) model. Scand J Work Environ Health 2005;31:353–8.

48 Dawson DA, Grant BF, Ruan WJ. The association between stress and drinking: modifying effects of gender and vulnerability. Alcohol Alcohol 2005;40:453–60.

49 Becker SJ, Marceau K, Hernandez L, et al. Is it selection or socialization? disentangling peer influences on heavy drinking and marijuana use among adolescents whose parents received brief interventions. Subst Abuse 2013;13:117822181985264.

50 Lu W, Xu J, Taylor AW, et al. Analysis of the alcohol drinking behavior and influencing factors among emerging adults and young adults: a cross-sectional study in Wuhan, China. BMC Public Health 2019;19:458.

51 Wendt S, Mohr C, Wang M, et al. Proximal predictors of alcohol use among Japanese college students. Subst Use Misuse 2018;53:763–72.

52 Makimoto K. Drinking patterns and drinking problems among Asian-Americans and Pacific Islanders. Alcohol Health Res World 1998;22:270.

53 Lee K. Gender-Specific relationships between alcohol drinking patterns and metabolic syndrome: the Korea National health and nutrition examination survey 2008. Public Health Nutr 2012;15:1917–24.

54 Eum K-D, Li J, Lee H-E, et al. Psychometric properties of the Korean version of the effort-reward imbalance questionnaire: a study in a petrochemical company. Int Arch Occup Environ Health 2007;80:653–61.

55 Wang Y, Ramos A, Wu H, et al. Relationship between occupational stress and burnout among Chinese teachers: a cross-sectional survey in Liaoning, China. Int Arch Occup Environ Health 2015;88:589–97.

56 McCreaa DR, Sadava SW. Stress, drinking, and the adverse consequences of drinking in two samples of young adults. Psychol Addict Behav 1998;12:247–61.

57 Boo S, Oh H. Women’s smoking: relationships among emotional labor, occupational stress, and health promotion. Workplace Health Saf 2019;67:361–70.

58 Nakata A, Takahashi M, Ikeda T, et al. Active and passive smoking and depression among Japanese workers. Prev Med 2008:46:451–6.

59 Rauschenbach C, Krumm S, Thielgen M, et al. Age and work-related stress: a review and meta-analysis. Journal of Manage Psych 2013;28:781–804.

60 Prayle AP, Hurley MN, Smyth AR. Compliance with mandatory reporting of clinical trial results on ClinicalTrials.gov: cross sectional study. BMJ 2012;344:d7373.

61 Albertsen K, Hannerz H, Borg V, et al. Work environment and smoking cessation over a five-year period. Scand J Public Health 2004;32:164–71.

62 Cho H-J, Khang Y-H, Jun H-J, et al. Marital status and smoking in Korea: the influence of gender and age. Soc Sci Med 2008:66:609–19.

63 Borland R, Partos TR, Cummings KM. Systematic biases in cross-sectional community studies may underestimate the effectiveness of stop-smoking medications. Nicotine Tob Res 2012;14:1483–7.

64 Pan A, Schernhammer ES, Sun Q, et al. Rotating night shift work and risk of type 2 diabetes: two prospective cohort studies in women. PLoS Med 2011;8:e1001141.

65 Macleod J, Smith GD, Heslop P, et al. Are the effects of psychosocial exposures attributable to confounding? Evidence from a prospective observational study on psychological stress and mortality. J Epidemiol Community Health 2001;55:878–84.