Relationships between temperaments, occupational stress, and insomnia among Japanese workers

Yasuhiko Deguchi*, Shinichi Iwasaki*, Hideyuki Ishimoto‡, Koichiro Ogawa‡, Yuichi Fukuda‡, Tomoko Nitta‡, Tomoe Mitake‡, Yukako Nogi‡, Koki Inoue‡

Department of Neuropsychiatry, Osaka City University, Graduate School of Medicine, Osaka, Japan

Abstract

Insomnia among workers reduces the quality of life, contributes toward the economic burden of healthcare costs and losses in work performance. The relationship between occupational stress and insomnia has been reported in previous studies, but there has been little attention to temperament in occupational safety and health research. The aim of this study was to clarify the relationships between temperament, occupational stress, and insomnia. The subjects were 133 Japanese daytime local government employees. Temperament was assessed using the Temperament Evaluation of Memphis, Pisa, Paris, and San Diego-Auto questionnaire (TEMPS-A). Occupational stress was assessed using the Generic Job Stress Questionnaire (GJSQ). Insomnia was assessed using the Athens Insomnia Scale (AIS). Stepwise multiple logistic regression analyses were conducted. In a stepwise multivariate logistic regression analysis, it was found that the higher subdivided stress group by “role conflict” (OR = 5.29, 95% CI, 1.61–17.32) and anxious temperament score (OR = 1.33; 95% CI, 1.19–1.49) was associated with the presence of insomnia using an adjusted model, whereas other factors were excluded from the model. The study limitations were the sample size and the fact that only Japanese local government employees were surveyed. This study demonstrated the relationships between workers’ anxious temperament, role conflict, and insomnia. Recognizing one’s own anxious temperament would lead to self-insight, and the recognition of anxious temperament and reduction of role conflict by their supervisors or coworkers would reduce the prevalence of insomnia among workers in the workplace.

Introduction

Insomnia impairs daytime functioning [1], reduces the quality of life [2], and contributes toward the economic burden of healthcare costs [3, 4] and losses in work performance (e.g., absenteeism and presenteeism) [5]. Non-depressed people with insomnia reportedly have a twofold risk of developing depression, compared to people with no sleep difficulties [6]. Insomnia is an independent indicator of suicide ideation even taking into account the core symptoms of depression.
such as depressed mood and anhedonia [7]. Employees’ insomnia can have significant effects on an organization’s performance, due to impairments in concentration, communication skills, decision-making, and flexible thinking [8]; therefore, a prevention strategy for insomnia is an urgent issue in the workplace. Some studies have demonstrated the relationship between insomnia and various types of occupational stress, such as job demand, job control, social support, job insecurity, organizational justice, intragroup conflict, job strain, effort–reward imbalance, employment level, and shift work [8–20].

Temperament has been defined as genetic personality factors that stay stable over time and establish an individual’s mood, reactivity, and energy at baseline. [21]. Temperament defines personality; and personality is argued to be developed through daily life experiences [22]. Akiskal formulated the modern concept of five affective temperaments and suggested that affective temperaments were the subclinical manifestations or phenotypes of mood disorders, representing one end of the continuum of affective illness, and subsequently developed the Temperament Evaluation of Memphis, Pisa, Paris, and San Diego-Auto (TEMPS-A) questionnaire for temperament research and clinical purposes [23–25]. A previous study found that unlike personality, temperaments assessed by the TEMPS-A did not change considerably over six years. [26]. Many studies have reported a relationship between temperaments and mental problems (e.g., suicide) [27, 28], mental status in non-clinical populations [29], depressive symptoms [30–32], mood disorders [33–37], anxiety disorders [38], alcohol abuse or dependence [39, 40], and substance abuse [41, 42]. In the workplace, a depressive temperament has been reported to be a kind of work-oriented personality [43], hyperthymic temperament has been reported to be a type of hyper-adapted personality [44]. A relationship between temperament and a subjective sleep pattern has been reported, and depressive, cyclothymic temperaments have been shown to be related to more dysfunctional sleep patterns; sleep-onset latency, the number of awakenings during the total sleep period, sleep quality, and hyperthymic temperament have shown an inverse and favorable sleep pattern [45].

We demonstrated the significant effects of temperaments on occupational stress in our previous study. For example, a hyperthymic temperament plays a protective role against one’s own job control, role ambiguity, role future ambiguity, an irritable temperament plays a vulnerable role against one’s own social support from supervisors, role conflict, variance in workload, intragroup conflict, and anxious temperament plays a vulnerable role against one’s own social support from coworkers, job future ambiguity [46]. Examining the effects of temperament on occupational stress was considered important to understand the relationship between insomnia and occupational stress among employees. However, temperaments have received little attention in occupational safety and health research. Moreover, previous studies on the relationship between occupational stress and insomnia did not evaluate the individual effects of temperaments, and therefore, this study seeks to extend and develop the findings of the previous study.

We hypothesized that individual temperament can play an important role in the relationship between occupational stress and insomnia. The aim of this study was to clarify the relationships between temperaments, occupational stress, and insomnia among local government employees.

**Materials and methods**

**Subjects**

We distributed self-administer, anonymous questionnaires to 172 Japanese day-shift workers in local government between August and September 2014. One hundred and thirty-three workers completed the questionnaire (response rate: 77.3%). All participants gave their verbal
informed consent to participate as volunteers, and understood that there was no penalty for choosing not to participate.

Ethics statement
The study design was approved by the Human Subjects Review Committee at Osaka City University (authorization number: 2969). All data were stored only in our database, and the employer did not have access to the data or know who had participated in the study.

Demographic and work-related variables
Demographic variables included age and gender. Work-related variables included service years, position classification (non-managerial, managerial), occupation (clerical, professional), and type of employment (regular, temporary).

Measures

Measures of temperament. Temperaments were assessed using the full version of the TEMPS-A, developed by Akiskal et al. [23, 25]. The reliability and validity of the Japanese version have been established [35]. The TEMPS-A assesses emotional, cognitive, psychomotor, interpersonal, and vegetative (such as sleep and sexual desire) dimensions that arguably play a vulnerable or adaptive role in an evolutionary context, and in the predisposition to major mood disorders [23]. The TEMPS-A is a true–false questionnaire that measures affective temperaments defining the bipolar spectrum. The instrument’s 110 items are divided into five types of temperaments, namely, depressive, cyclothymic, hyperthymic, irritable, and anxious. Higher scores suggest a greater magnitude of the temperaments.

A depressive temperament emerges as proneness to routine, self-blame, a shy nonassertive nature, sensitivity to criticism, self-denial, dependence, and preference to work for someone [23]. A cyclothymic temperament is characterized as being rather tempestuous, labile with rapid mood shifts, having variable sleep, energy, self-esteem, and socialization, being a dilettante and, perhaps by the same token, keen in perception and intense in emotions, and also a romantic [23]. A hyperthymic temperament has been associated with many positive traits: being upbeat, fun-loving, outgoing, jocular, optimistic, and confident; full of ideas and eloquent; active, a short-sleeper, but tireless; and having a preference for leadership; however, the temperament is also associated with single-mindedness, risk-taking, and a low likelihood of admitting one’s meddlesome nature [23]. An irritable temperament emerged with two characteristics—skeptical and critical—that might be considered intellectual virtues; otherwise, this temperament has the darkest nature of all: grouchy, complaining, dissatisfied, anger- and violence-prone, and sexually jealous [23]. An anxious temperament has been associated with many traits: worry, vigilance, tension, oversensitivity, unrestful sleep, and gastrointestinal symptoms [25, 47].

Two of the most commonly used assessments of temperament are the TEMPS-A and the Temperament and Character Inventory (TCI). The TCI was developed by Cloninger and colleagues [48]. The concurrent validity of the TEMPS-A with the TCI has been documented [25]. We used the TEMPS-A in this study because, with 110 items, it has the advantage of brevity over the TCI.

Measures of occupational stress. Occupational stress was assessed using the Generic Job Stress Questionnaire (GJSQ) developed by the National Institute for Occupational Safety and Health (NIOSH) [49]. The Japanese version of the GJSQ has demonstrated sufficient reliability and validity [50, 51]. We chose the GJSQ because it can assess multilateral aspects of occupational stress, including stress reactions, at the group and individual levels. The developers of
the GJSQ permit use of its independent subscales to assess occupational stress [49]. We focused on the following five subscales (49 items) to assess occupational stress: quantitative workload, job control, role conflict, role ambiguity, and intragroup conflict, and we also chose two subscales measuring social support (by supervisors and coworkers, comprising eight items) that functions as a buffer factor, according to the results of previous studies [8–20]. The present study is based on the NIOSH job stress model [49]. For the job control and social support items, item descriptions are positively oriented, so that higher scores indicate lower stress. In contrast, all other items are negatively oriented, so that higher scores indicate greater stress.

A quantitative workload refers to the amount of work that a person has to deal with on a daily basis. Job control refers to the extent to which the individual feels that his or her tasks, workplace setting, and decisions at work are controllable. Role conflict measures how often workers experience role conflict with each other. Role ambiguity measures how clearly the worker understands what is expected of him or her for adequate task performance or assumption of a role. Intragroup conflict measures the harmony, conflict, or dialogue discrepancy in the group. Social support from supervisors and coworkers measures the existence of avenues for acquiring social support during work time.

Measures of insomnia. Insomnia was assessed using the Athens Insomnia Scale (AIS), which is a common global scale of insomnia and a validated instrument based on the International Classification of Disease, 10th Revision (ICD-10) criteria [52, 53]. The Japanese version of the AIS has demonstrated sufficient reliability and validity [54]. The scale is a self-administered inventory consisting of eight items. The first five items assess difficulty in sleep initiation, awakening during the night, early morning awakening, total sleep duration, and the overall quality of sleep. The following remaining three items pertain to the consequences of insomnia on the next day: sense of well-being during the day, functioning during the day, and sleepiness during the day. Each item of the AIS was rated from 0 (no problem at all) to 3 (seriously problematic). The total score ranged from 0 to 24, and obtaining six or more points was defined as having insomnia. Participants were requested to choose rating items only if they had experienced sleep difficulty at least 3 times a week in the previous month. Based on previous studies, we defined the morbidity cut-off point on the AIS as 6 [54]. Individuals with AIS scores of more than 6 were categorized as the “Insomnia group” and displayed pathological insomnia, and those with AIS scores of less than 5 were categorized as the “Non-Insomnia group” and did not display any sleep problems.

Statistical analyses

Univariate logistic regression analyses were performed to estimate the odds ratios (ORs) of demographic variables, work-related variables, five temperaments, and the seven GJSQ subscales with regard to the Insomnia group. The GJSQ subscales were subdivided into low, middle, or high categories according to the tertile scores. Subsequently, the ORs for belonging to the Insomnia group were estimated in the stepwise forward multivariate logistic analyses, and independent variables with p-value less than 0.20 were selected for the stepwise forward multivariate model. Differences were considered significant at p < 0.05. All statistical analyses were performed using SPSS version 21.0 software (SPSS Inc., Chicago, IL).

Results

Subjects’ characteristics

Table 1 shows the subjects’ characteristics, TEMPS-A temperament scores, GJSQ scores, and AIS scores. The total AIS scores were 4.5 ± 3.6. The “Insomnia group” consisted of 48 participants (36.1%; 16 male: 35.4% and 32 female: 36.4%) and displayed a mean AIS score of
8.5 ± 2.4. The “Non-Insomnia group” comprised 85 (63.9%) workers and exhibited a mean AIS score of 2.3 ± 1.6.

Correlations between temperaments and occupational stress

Table 2 shows Spearman’s correlation between the TEMPS-A temperament scores and occupational stress according to the GJSQ. The results were interpreted based on Guilford’s rule of thumb [55]. The depressive temperament score weakly correlated with job control. The cyclothymic temperament score moderately correlated with role conflict, role ambiguity, intragroup conflict, and weakly correlated with social support from coworkers. The hyperthymic temperament score moderately correlated with job control and role ambiguity. The irritable temperament score highly correlated with role conflict and intragroup conflict, moderately correlated with role ambiguity and social support from supervisors and from coworkers, and weakly correlated with the quantitative workload. The anxious temperament score moderately correlated with role conflict, social support from coworkers, and weakly correlated with social support from supervisors.
Logistic regression analysis examining the association between temperaments, occupational stress, and insomnia

Table 3 shows the results of univariate logistic regression analysis using demographic variables (age and gender), work-related variables (service years, position classification, occupation, and type of employment), five temperaments, and each of the seven subdivided GJSQ subscales as independent variables, with the insomnia group as a dependent variable; ORs were calculated. It was found that the higher subdivided stress group by "role conflict" (OR = 8.60, 95% CI, 3.03–24.41), the lower subdivided stress group by "social support from coworkers" (OR = 3.00, 95% CI, 1.17–7.69), depressive (OR = 1.17, 95% CI, 1.05–1.31), cyclothymic (OR = 1.27, 95% CI, 1.14–1.42), irritable (OR = 1.26, 95% CI, 1.11–1.42), and anxious (OR = 1.36, 95% CI, 1.22–1.51) temperament score was associated with the presence of insomnia. Additionally, the middle subdivided stress group by "social support from supervisors" (OR = 2.71, 95% CI, 1.14–6.42) and by "social support from coworkers" (OR = 4.55, 95% CI, 1.76–11.75) was associated with the presence of insomnia.

Additionally, Table 3 shows the result of stepwise multivariate logistic regression analysis using demographic variables (age and gender), work-related variables (service years, position classification, occupation, and type of employment), 5 temperaments, and the 7 subdivided GJSQ subscales as independent variables, with the insomnia group as a dependent variable; ORs were calculated. When entering these independent variables in a stepwise multivariate logistic regression analysis, it was found that the higher subdivided stress group by "role conflict" (OR = 5.29, 95% CI, 1.61–17.32), and anxious temperament score (OR = 1.33, 95% CI, 1.19–1.49) was associated with the presence of insomnia using an adjusted model, whereas other factors were excluded from the model.

Table 2. Spearman’s correlation between the TEMPS-A temperament scores and occupational stress

|     | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|
| 1. qua | -0.021 | 0.266 | ** | 0.131 | 0.074 | -0.11 | -0.161 | 0.125 | 0.075 | -0.006 | 0.217 | * | 0.109 |
| 2. jc | 0.041 | -0.29 | ** | 0.057 | -0.045 | 0.003 | -0.188 | * | -0.094 | 0.234 | ** | -0.024 | -0.119 |
| 3. rc | 0.306 | *** | 0.461 | *** | -0.021 | 0.461 | *** | -0.455 | *** | 0.124 | 0.266 | ** | 0.012 | 0.433 | *** | 0.27 | ** |
| 4. ra | -0.216 | * | 0.12 | -0.181 | * | 0.12 | 0.256 | ** | -0.029 | 0.026 | ** | 0.026 | 0.137 |
| 5. int | -0.408 | *** | -0.451 | *** | -0.003 | 0.238 | ** | 0.114 | 0.326 | *** | 0.126 |
| 6. sup | -0.562 | *** | -0.169 | -0.168 | 0.006 | -0.252 | ** | -0.203 | * |
| 7. cow | -0.143 | -0.209 | * | 0.061 | -0.287 | ** | -0.284 | ** |
| 8. dep | 0.412 | *** | -0.183 | 0.293 | ** | 0.494 | *** |
| 9. cyc | 0.095 | 0.559 | *** | 0.483 | *** |
| 10. hyp | 0.173 | * | 0.089 |
| 11. irr | 0.468 | *** |

* p < 0.05, ** p < 0.01, *** p < 0.001

TEMPS-A: Temperament Evaluation of Memphis, Pisa, Paris, and San Diego-Auto questionnaire
qua; quantitative workload, jc; job control, rc; role conflict, ra; role ambiguity, int; intragroup conflict, sup; support from supervisors, cow; support from coworkers, dep; depressive temperament, cyc; cyclothymic temperament, hyp; hyperthymic temperament, irr; irritable temperament, anx; anxious temperament

https://doi.org/10.1371/journal.pone.0175346.t002
Table 3. Analysis of risk factors for insomnia by crude and stepwise multiple logistic regression analysis.

| Temperaments and occupational stress | Crude model | Adjusted model† |
|--------------------------------------|-------------|-----------------|
|                                      | OR (95% CI) | p               | OR (95% CI) | p               |
| Quantitative Workload                |             |                 |             |                 |
| (Low)                                | 1.00        |                 | 1.00        |                 |
| Middle                               | 1.01        | 0.40–2.59       | 0.98        |                 |
| High                                 | 1.99        | 0.83–4.77       | 0.12        |                 |
| Job Control                          |             |                 |             |                 |
| (High)                               | 1.00        |                 |             |                 |
| Middle                               | 1.41        | 0.55–3.67       | 0.48        |                 |
| Low                                  | 1.26        | 0.49–3.18       | 0.63        |                 |
| Role Conflict                        |             |                 |             |                 |
| (Low)                                | 1.00        |                 | 1.00        |                 |
| Middle                               | 2.63        | 0.90–7.69       | 0.08        | 2.12            | 0.63–7.14       | 0.224          |
| High                                 | 8.60        | 3.03–24.41      | <0.001      | 5.29            | 1.61–17.32      | 0.006          |
| Role Ambiguity                       |             |                 |             |                 |
| (Low)                                | 1.00        |                 |             |                 |
| Middle                               | 0.81        | 0.32–2.06       | 0.66        |                 |
| High                                 | 2.23        | 0.93–5.34       | 0.07        |                 |
| Intragroup Conflict                  |             |                 |             |                 |
| (Low)                                | 1.00        |                 |             |                 |
| Middle                               | 1.51        | 0.64–3.55       | 0.35        |                 |
| High                                 | 1.77        | 0.72–4.33       | 0.21        |                 |
| Social Support from Supervisor       |             |                 |             |                 |
| (High)                               | 1.00        |                 |             |                 |
| Middle                               | 2.71        | 1.14–6.42       | 0.02        | *               |
| Low                                  | 0.72        | 0.29–1.79       | 0.48        |                 |
| Social Support from Coworker         |             |                 |             |                 |
| (High)                               | 1.00        |                 |             |                 |
| Middle                               | 4.55        | 1.76–11.75      | <0.01       | **              |
| Low                                  | 3.00        | 1.17–7.69       | 0.02        | *               |
| Depressive                           | 1.17        | 1.05–1.31       | <0.01       | **              |
| Cyclothymic                          | 1.27        | 1.14–1.42       | <0.001      | ***             |
| Hyperthymic                          | 0.98        | 0.90–1.07       | 0.71        |                 |
| Irritable                            | 1.26        | 1.11–1.42       | <0.001      | ***             |
| Anxious                              | 1.36        | 1.22–1.51       | <0.001      | ***             | 1.33 (1.19–1.49) | <0.001 | *** |
| Age                                  | 1.02        | 0.99–1.05       | 0.19        |                 |
| Gender                               |             |                 |             |                 |
| (Female)                             | 1.00        |                 |             |                 |
| Male                                 | 0.97        | 0.46–2.04       | 0.93        |                 |
| Position classification              |             |                 |             |                 |
| (Non-managerial)                    | 1.00        |                 |             |                 |
| Managerial                           | 1.67        | 0.79–3.51       | 0.18        |                 |
| Occupation                           |             |                 |             |                 |
| (Clerical)                           | 1.00        |                 |             |                 |
| Professional                         | 1.23        | 0.56–2.66       | 0.61        |                 |
| Type of employment                   |             |                 |             |                 |
| (Regular)                            | 1.00        |                 |             |                 |
| Temporary                            | 0.62        | 0.26–1.48       | 0.28        |                 |

OR: Odds Ratio. CI: Confidence Interval.
* p < 0.05,
** p < 0.01,
*** p < 0.001 compared with non-insomnia group.
Parenthesis denotes reference category.
†: Adjusted for all listed variables.

https://doi.org/10.1371/journal.pone.0175346.t003
Discussion

This study identified the relationships between temperaments, occupational stress, and insomnia using the TEMPS-A, GJSQ, and the AIS among Japanese local government employees. The results of the present study indicate the relationships between anxious temperament, role conflict, and insomnia.

Temperaments and insomnia

The anxious temperament is related to many psychological traits, such as, worry, awakening, tension, oversensitivity, unrestful sleep, and gastrointestinal symptoms [25, 47]. The anxious temperament has also been described to make strong predictions about anxieties [38] and suicide attempts [28]. It has been reported that worry, rumination, and a predisposition to worry increase vulnerability to sleep disorders [56]. Moreover, personality profiles associated with insomnia are characterized by the presence of neurotic depression, rumination, chronic anxiety, and a predisposition coupled with the process of conditioning (fear of sleeplessness–internalization of the fear–further emotional arousal and psychological activation). These factors have been found to contribute to the development of chronic insomnia [57]. Ottoni and colleagues reported that the depressive, cyclothymic, irritable, and anxious temperaments were related to worse sleep quality, and that the hyperthymic temperament was associated with better sleep quality [45]. The relationship between the anxious temperament and insomnia was found in this study, and the result is compatible with those of previous studies [45, 56, 57].

On the contrary, relationships between the depressive, cyclothymic, hyperthymic, and irritable temperaments and insomnia were not found in this study. The subjects in Ottoni’s study were recruited through an educational open-access website on bipolar disorder, which determined the inclusion of a significant number of subjects with psychiatric disorders and on psychotropic medication. Moreover, the authors have stated the generalizability of their results to the general population as a study limitation. Although there might be employees who work while having mental disorders, none of the subjects in this study were unemployed, and the results in the current study might therefore be more generalizable to the general population. Differences between the subjects might have had an impact on the results. In sum, workers’ anxious temperament might be associated with insomnia.

Occupational stress and insomnia

The present study showed a relationship between role conflict and insomnia. Few studies have investigated the relationship between these variables. Knudsen and colleagues have reported that role conflict among full-time employees in the United States of America (USA) was positively associated with difficulties initiating sleep and non-restorative sleep, and that conflicting role demands might be related to organizational injustice and interpersonal stressors in the workplace [19]. Györffy and colleagues have reported that intensive role conflict was associated with sleep disorders and that a higher workload might lead to more explicit role conflict among female physicians in Hungary [20]. On the other hand, no relationship between role conflict and insomnia was found among Japanese daytime workers in Nakata’s research [9]. Role conflict is reported to be a situation wherein employees face a lot of pressure from incompatible job demands like group interdependence, a different working style by subordinates, supervisors, and different requirements from people [58], and these factors might cumulatively lead to insomnia.

Some studies have demonstrated the relationships between insomnia and job demand, job control, social support, job insecurity, organizational justice, intragroup conflict, job strain, effort–reward imbalance, employment level, and shift work, among others [8–20]. No
relationship was found with other types of occupational stress, except that between insomnia and role conflict in this study. The effects of the anxious temperament and role conflict on insomnia might be greater than those of other types of occupational stress. These differences might actually derive from differences in occupation, countries, or methods of evaluating occupational stress and insomnia.

The prevalence rate of insomnia

The prevalence rate of insomnia was 36.1%, using the AIS for all study participants. This rate reportedly varies due to differences in applied definitions and diagnostic criteria [59]. Therefore, among studies using the AIS and demonstrating a relationship between insomnia and various types of occupational stress, the prevalence rate was from 23.2% to 39.2% [10–12, 14, 20]. Internet usage has become prevalent and various services are provided for 24 hours. As a result, the work life has changed dramatically, with the work–life balance becoming poor. In the modern society, the line between working hours and private time is ambiguous for 24 hours, workers’ physical and psychological stressors are increasing, and irregular circadian rhythms are a possibility. These remarkable changes in society might explain the increasing prevalence rate of insomnia, as shown by a comparison between the rate before 2003 [10, 14, 20] and that after 2007 [11, 12, 20].

Prevention strategy for workers’ insomnia

First, workers’ recognition of their own personal temperaments, especially the anxious temperament, would contribute towards self-care and a decrease in the prevalence of insomnia. Second, it would be helpful for organizational staff to provide supportive guidance on stress-coping styles according to a cognitive-behavioral therapeutic approach that is based on each worker’s inclination towards an anxious temperament. Third, changing organizational policies, such as clarifying the role and content of diversified work, sharing information, and embracing diversity in the workplace would be needed to reduce role conflict. Fourth, supervisors and coworkers would have to receive training in accordance with the new policy. These strategies would reduce the prevalence of insomnia in the workplace.

Limitations of this study

Several limitations in this study should be mentioned. First, the sample size was small, and only Japanese local government employees were surveyed. Second, occupational stress was evaluated through self-reports; thus, the results may have been influenced by response bias. Third, the moderate response rate for our survey questionnaire (77.3%) might have led to a selection bias. Fourth, it cannot be said with certainty from our data if the relationship between temperament, occupational stress, and insomnia is causal; nor can the direction of any such causality be established. For example, job stressors might affect scores on measures of temperament. This is unlikely; however, given the relative stability of temperament, as compared with stress. Finally, although the TEMPS-A scores may be related to mental status (e.g., depressive symptoms), mental conditions were not evaluated in this study. None of the subjects in this study were unemployed, but there might be employees who work while having mental disorders. Therefore, future studies would have to take sub-threshold mental disorders (e.g., depressive, anxiety symptoms) into consideration. In future research, a cohort or longitudinal design to address the relationships between temperament and the factors in the workplace would be beneficial.
Conclusions

This study has demonstrated the relationships between workers’ anxious temperament, role conflict, and insomnia. Recognizing one’s own anxious temperament would lead to self-insight, and the recognition of the anxious temperament and a reduction of role conflict by supervisors or coworkers would reduce the prevalence of insomnia at workplace. In the future, we hope that temperaments will receive more focus within the study and practice of occupational safety and health.

Supporting information

S1 Table. GJSQ scores, Temperaments and AIS scores by gender (XLSX)
S2 Table. GJSQ scores, Temperaments and AIS scores by type of employment (XLSX)
S3 Table. GJSQ scores, Temperaments and AIS scores by position classification (XLSX)
S4 Table. GJSQ scores, Temperaments and AIS scores by occupation (XLSX)
S5 Table. Age (XLSX)
S6 Table. Service years (XLSX)

Acknowledgments

We thank Dr. Tsuyoshi Akiyama for his kind permission to use the Japanese version of the TEMPS-A.

Author Contributions

Conceptualization: YD SI.
Data curation: YD.
Formal analysis: YD SI.
Funding acquisition: YD.
Investigation: YD SI.
Methodology: YS SI HI KO YF TN TM YN KI.
Project administration: KI.
Writing – original draft: YD SI.
Writing – review & editing: YS SI HI KO YF TN TM YN KI.

References

1. Espie CA, Kyle SD, Hames P, Cyhlarova E, Benzeval M. The daytime impact of DSM-5 insomnia disorder: comparative analysis of insomnia subtypes from the Great British Sleep Survey. J Clin Psychiatry. 2012; 73(12): e1478–84. Epub 2013/01/08. https://doi.org/10.4088/JCP.12m07954 PMID: 23290331
2. Zammit GK, Weiner J, Damato N, Sillup GP, McMillan CA. Quality of life in people with insomnia. Sleep. 1999; 22 Suppl 2: S379–85. Epub 1999/07/08.

3. Hillman DR, Murphy AS, Pezzullo L. The economic cost of sleep disorders. Sleep. 2006; 29(3): 299–305. Epub 2006/03/24. PMID: 16553015

4. Shahly V, Berglund PA, Coulouvrat C, Fitzgerald T, Hajak G, Roth T, et al. The associations of insomnia with costly workplace accidents and errors: results from the America Insomnia Survey. Arch Gen Psychiatry. 2012; 69(10): 1054–1063. Epub 2012/10/03. https://doi.org/10.1001/archgenpsychiatry.2011.2188 PMID: 23026955

5. Kessler RC, Berglund PA, Coulouvrat C, Hajak G, Roth T, Shahly V, et al. Insomnia and the performance of US workers: results from the America insomnia survey. Sleep. 2011; 34(9): 1161–1171. Epub 2011/09/03. PubMed Central PMCID: PMCPMC3157657. https://doi.org/10.5665/SLEEP.1230 PMID: 21886353

6. Baglioni C, Battagliese G, Feige B, Spiegelhalder K, Nissen C, Voderholzer U, et al. Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. J Affect Disord. 2011; 135(1–3): 10–19. Epub 2011/02/09. https://doi.org/10.1016/j.jad.2011.01.011 PMID: 21300408

7. McCall WV, Blocker JN, D’Agostino R Jr., Kimball J, Boggs N, Lasater B, et al. Insomnia severity is an indicator of suicidal ideation during a depression clinical trial. Sleep Med. 2010; 11(9): 822–827. Epub 2010/05/19. PubMed Central PMCID: PMCPMC2936685. https://doi.org/10.1016/j.sleep.2010.04.004 PMID: 20478741

8. Portela LF, Kro¨ ning Luna C, Rotenberg L, Silva-Costa A, Toivanen S, Araujo T, et al. Job strain and self-reported insomnia symptoms among nurses: what about the influence of emotional demands and social support? Biomed Res Int. 2015; 2015: 820610. PubMed Central PMCID: PMCPMC4628716. https://doi.org/10.1155/2015/820610 PMID: 26557699

9. Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Kobayashi F, et al. Job stress, social support, and prevalence of insomnia in a population of Japanese daytime workers. Soc Sci Med. 2004; 59(6): 1719–1730. Epub 2004/07/29. https://doi.org/10.1016/j.socscimed.2004.02.002 PMID: 15279928

10. Utsugi M, Saijo Y, Yoshioke E, Horikawa N, Sato T, Gong Y, et al. Relationships of occupational stress to insomnia and short sleep in Japanese workers. Sleep. 2005; 28(6): 728–735. Epub 2006/02/16. PMID: 16477960

11. Nishitani N, Sakakibara H. Job stress factors, stress response, and social support in association with insomnia of Japanese male workers. Ind Health. 2010; 48(2): 178–184. Epub 2010/04/29. PMID: 20424348

12. Saijo Y, Chiba S, Yoshioke E, Nakagi Y, Ito T, Kitaoka-Higashiguchi K, et al. Synergistic interaction between job control and social support at work on depression, burnout, and insomnia among Japanese civil servants. Int Arch Occup Environ Health. 2015; 88(2): 143–152. Epub 2014/05/24. https://doi.org/10.1007/s00420-014-0945-6 PMID: 24851860

13. Kim HC, Kim BK, Min KB, Min JY, Hwang SH, Park SG. Association between job stress and insomnia in Korean workers. J Occup Health. 2011; 53(3): 164–174. Epub 2011/03/23. PMID: 21422721

14. Yoshioka E, Saijo Y, Kita T, Satoh H, Kawaharada M, Kishi R. Effect of the interaction between employment level and psychosocial work environment on insomnia in male Japanese public service workers. Int J Behav Med. 2013; 20(3): 355–364. Epub 2012/03/14. https://doi.org/10.1007/s12529-012-9230-9 PMID: 22411509

15. Nomura K, Nakao M, Takeuchi T, Yano E. Associations of insomnia with job strain, control, and support among male Japanese workers. Sleep Med. 2009; 10(6): 626–629. Epub 2008/11/01. https://doi.org/10.1016/j.sleep.2008.06.010 PMID: 18974022

16. Akerstedt T, Fredlund P, Gillberg M, Jansson B. Work load and work hours in relation to disturbed sleep and fatigue in a large representative sample. J Psychosom Res. 2002; 53(1): 585–588. Epub 2002/07/20. PMID: 12127175

17. Gadinger MC, Fischer JE, Schneider S, Fischer GC, Frank G, Kromm W. Female executives are particularly prone to the sleep-disturbing effect of isolated high-strain jobs: a cross-sectional study in German-speaking executives. J Sleep Res. 2009; 18(2): 229–237. https://doi.org/10.1111/j.1365-2869.2008.00715.x PMID: 19645966

18. de Lange AH, Kompier MA, Taris TW, Geurts SA, Beckers DG, Houtman IL, et al. A hard day’s night: a longitudinal study on the relationships among job demands and job control, sleep quality and fatigue. J Sleep Res. 2009; 18(3): 374–383. https://doi.org/10.1111/j.1365-2869.2009.00735.x PMID: 19493298

19. Knudsen HK, Ducharme LJ, Roman PM. Job stress and poor sleep quality: data from an American sample of full-time workers. Soc Sci Med. 2007; 64(10): 1997–2007. Epub 2007/03/17. PubMed Central PMCID: PMCPMC1933584. https://doi.org/10.1016/j.socscimed.2007.02.020 PMID: 17363123
20. Györfy Z, Dewek D, Girasek E. Workload, mental health and burnout indicators among female physicians. Hum Resour Health. 2016; 14: 12. Epub 2016/04/04. PubMed Central PMCID: PMCPMC4818422. https://doi.org/10.1186/s12960-016-0108-9 PMID: 27039083

21. Goldsmith HH, Buss AH, Plomin R, Rothbart MK, Thomas A, Chess S, et al. Roundtable: what is temperament? Four approaches. Child Dev. 1987; 58(2): 505–529. Epub 1987/04/01. PMID: 3829791

22. Million T. Disorders of personality: DSM-III, Axis II. New York: Wiley; 1981.

23. Akiskal HS, Akiskal KK, Haykal RF, Manning JS, Connor PD. TEMPS-A: progress towards validation of a self-rated clinical version of the Temperament Evaluation of the Memphis, Pisa, Paris, and San Diego Autoquestionnaire. J Affect Disord. 2005; 85(1–2): 3–16. Epub 2005/03/23. https://doi.org/10.1016/j.jad.2004.12.001 PMID: 15780671

24. Vázquez GH, Kahn C, Schiavo CE, Goldchuk A, Herbst L, Piccione M, et al. Bipolar disorders and affective temperaments: a national family study testing the “endophenotype” and “subaffective” theses using the TEMPS-A Buenos Aires. J Affect Disord. 2008; 108(1–2): 25–32. Epub 2007/11/17. https://doi.org/10.1016/j.jad.2007.09.011 PMID: 18006072

25. Akiskal HS, Mendlowicz MV, Jean-Louis G, Rapaport MH, Kelsoe JR, Gillin JC, et al. TEMPS-A: validation of a short version of a self-rated instrument designed to measure variations in temperament. J Affect Disord. 2005; 85(1–2): 45–52. Epub 2005/03/23. https://doi.org/10.1016/j.jad.2003.10.012 PMID: 15780675

26. Kawamura Y, Akiyama T, Shimada T, Minato T, Umekage T, Noda Y, et al. Six-year stability of affective temperaments as measured by TEMPS-A. Psychopathology. 2010; 43(4): 240–247. Epub 2010/04/29. https://doi.org/10.1159/000331522 PMID: 20424505

27. Vázquez GH, Gonda X, Zarateigui R, Lorenzo LS, Akiskal K, Akiskal HS. Hyperthymic temperament may protect against suicidal ideation. J Affect Disord. 2010; 127(1–3): 38–42. Epub 2010/05/15. https://doi.org/10.1016/j.jad.2010.04.015 PMID: 20466435

28. Karam EG, Itani L, Fayyad J, Hantouche E, Karam A, Mneimneh Z, et al. Temperament and suicide: a national study. J Affect Disord. 2015; 184: 123–128. Epub 2015/06/17. https://doi.org/10.1016/j.jad.2015.05.047 PMID: 26080077

29. Baba H, Kohno K, Inoue T, Nakai Y, Toyomaki A, Suzuki T, et al. The effects of mental state on assessment of bipolar temperament. J Affect Disord. 2014; 161: 1–3. Epub 2014/04/23. https://doi.org/10.1016/j.jad.2014.03.004 PMID: 24751299

30. Kikuchi Y, Nakaya M, Ikeda M, Okuzumi S, Takeda M, Nishi M. Relationship between job stress, temperament and depressive symptoms among female nurses. Int J Occup Med Environ Health. 2014; 27(3): 426–434. Epub 2014/05/21. https://doi.org/10.2478/s13382-014-0270-z PMID: 24840888

31. Tei-Tominaga M, Akiyama T, Sakai Y. Effect of affective temperaments assessed by the TEMPS-A on the relationship between work-related stressors and depressive symptoms among workers in their twenties to forties in Japan. Depress Res Treat. 2012; 2012: 469384. Epub 2012/09/20. https://doi.org/10.1155/2012/469384 PMID: 22991659

32. Tokuyama M, Nakao K, Seto M, Watanabe A, Takeda M. Predictors of first-onset major depressive episodes among white-collar workers. Psychiatry Clin Neurosci. 2003; 57(5): 523–531. Epub 2003/09/03. https://doi.org/10.1046/j.1440-1819.2003.01158.x PMID: 12950708

33. Akiskal HS, Akiskal K, Allilaire JF, Azorin JM, Bourgeois ML, Sechter D, et al. Validating affective temperaments in their subaffective and socially positive attributes: psychometric, clinical and familial data from a French national study. J Affect Disord. 2005; 85(1–2): 29–36. Epub 2005/03/23. https://doi.org/10.1016/j.jad.2003.12.009 PMID: 15780673

34. Hantouche EG, Akiskal HS, Lancrenon S, Allilaire JF, Sechter D, Azorin JM, et al. Systematic clinical methodology for validating bipolar-II disorder: data in mid-stream from a French national multi-site study (EPIDEP). J Affect Disord. 1998; 50(2–3): 163–173. Epub 1998/12/19. PMID: 9858076

35. Matsumoto S, Akiyama T, Tsuda H, Miyake Y, Kawamura Y, Noda T, et al. Reliability and validity of TEMPS-A in a Japanese non-clinical population: application to unipolar and bipolar depressives. J Affect Disord. 2005; 85(1–2): 85–92. Epub 2005/03/23. https://doi.org/10.1016/j.jad.2003.10.001 PMID: 15780679

36. Mazzarini L, Pacchiarotti I, Colom F, Sani G, Kotzalidis GD, Rosa AR, et al. Predominant polarity and temperament in bipolar and unipolar affective disorders. J Affect Disord. 2008; 119(1–3): 29–33. Epub 2009/04/07. https://doi.org/10.1016/j.jad.2009.03.016 PMID: 19346002

37. Mendlowicz MV, Akiskal HS, Kelsoe JR, Rapaport MH, Jean-Louis G, Gillin JC. Temperament in the clinical differentiation of depressed bipolar and unipolar major depressive patients. J Affect Disord. 2005; 84(2–3): 219–223. Epub 2005/02/15. https://doi.org/10.1016/j.jad.2004.01.013 PMID: 15708419

38. Karam EG, Salamoun MM, Yenetzian JS, Mneimneh ZN, Karam AN, Fayyad J, et al. The role of anxious and hyperthymic temperaments in mental disorders: a national epidemiologic study. World Psychiatry. 2010; 9(2): 103–110. Epub 2010/07/31. PubMed Central PMCID: PMCPmc2911090. PMID: 20671899
39. Pacini M, Maremmani I, Vitali M, Santini P, Romeo M, Ceccanti M. Affective temperaments in alcoholic patients. Alcohol. 2009; 43(5): 397–404. Epub 2009/08/13. https://doi.org/10.1016/j.alcohol.2009.05.002 PMID: 19671646

40. Vyssoki B, Blüm V, Gleiss A, Friedrich F, Kogoj D, Walter H, et al. The impact of temperament in the course of alcohol dependence. J Affect Disord. 2011; 135(1–3): 177–183. Epub 2011/08/16. https://doi.org/10.1016/j.jad.2011.07.007 PMID: 21840604

41. Khazaal Y, Gex-Fabry M, Nallet A, Weber B, Favre S, Voide R, et al. Affective temperaments in alcohol and opiate addictions. Psychiatr Q. 2013; 84(4): 429–438. Epub 2013/03/05. https://doi.org/10.1007/s11126-013-9257-3 PMID: 23456370

42. Maremmani I, Pacini M, Popovic D, Romano A, Maremmani AG, Perugi G, et al. Affective temperaments in heroin addiction. J Affect Disord. 2009; 117(3): 186–192. Epub 2009/02/10. https://doi.org/10.1016/j.jad.2009.01.007 PMID: 19201034

43. Akiskal HS, Akiskal KK. Cyclothymic, hyperthymic and depressive temperaments as subaffective variants of mood disorders. In: Tasman A, Riba MB, editors. Washington, DC: American Psychiatric Press; 1992. pp. 43–62.

44. Sakai Y, Iwasaki S, Konishi A, Ishimoto H, Ogawa K, Fukuda Y, et al. Temperament and job stress in Japanese company employees. J Affect Disord. 2005; 85(1–2): 101–112. Epub 2005/03/23. https://doi.org/10.1016/j.jad.2004.03.012 PMID: 15780681

45. Ottoni GL, Lorenzo TM, Lara DR. Association of temperament with subjective sleep patterns. J Affect Disord. 2011; 128(1–2): 120–127. Epub 2010/06/30. https://doi.org/10.1016/j.jad.2010.06.014 PMID: 20584550

46. Deguchi Y, Iwasaki S, Konishi A, Ishimoto H, Ogawa K, Fukuda Y, et al. The usefulness of assessing and identifying workers’ temperaments and their effects on occupational stress in the workplace. PLoS One. 2016; 11(5): e0156339. https://doi.org/10.1371/journal.pone.0156339 PMID: 27227771

47. Akiskal HS. Toward a definition of generalized anxiety disorder as an anxious temperament type. Acta Psychiatr Scand Suppl. 1998; 393: 66–73. Epub 1998/10/20. PMID: 9777050

48. Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. Arch Gen Psychiatry. 1993; 50(12): 975–990. Epub 1993/12/01. PMID: 8250684

49. Hurrell JJ Jr., McLaney MA. Exposure to job stress—a new psychometric instrument. Scand J Work Environ Health. 1988; 14 Suppl 1: 27–28. Epub 1988/01/01.

50. Haratani T, Kawakami N, Araki S. Reliability and validity of the Japanese version of NIOSH Generic Job Questionnaire. Japanese Journal of Industrial Health (in Japanese). 1993; 35: S214.

51. Haratani T, Kawakami N, Araki S, Hurrell JJ, Sauter SL, Swanson NG. Psychometric properties and stability of the Japanese version of the NIOSH job stress questionnaire. The 25th International Congress on Occupational Health, Book of Abstracts; Stockholm: 1996. p. 393.

52. Soldatos CR, Dikeos DG, Paparrigopoulos TJ. Athens Insomnia Scale: validation of an instrument based on ICD-10 criteria. J Psychosom Res. 2000; 48(6): 555–560. Epub 2000/10/18. PMID: 11033374

53. Soldatos CR, Dikeos DG, Paparrigopoulos TJ. The diagnostic validity of the Athens Insomnia Scale. J Psychosom Res. 2003; 55(3):263–267. Epub 2003/08/23. PMID: 12932801

54. Okajima I, Nakajima S, Kobayashi M, Inoue Y. Development and validation of the Japanese version of the Athens Insomnia Scale. Psychiatry Clin Neurosci. 2013; 67(6): 420–425. Epub 2013/08/06. https://doi.org/10.1111/pcn.12073 PMID: 23910517

55. Guilford JP. Fundamental statistics in psychology and education. New York: McGraw-Hill Book Company; 1966.

56. Riemann D, Spiegelhalder K, Feige B, Voderholzer U, Berger M, Perlis M, et al. The hyperarousal model of insomnia: a review of the concept and its evidence. Sleep Med Rev. 2010; 14(1): 19–31. Epub 2009/06/02. https://doi.org/10.1016/j.smrv.2009.04.002 PMID: 19481481

57. Kales A, Vgontzas AN. Predisposition to and development and persistence of chronic insomnia: importance of psychobehavioral factors. Arch Intern Med. 1992; 152(8): 1570–1572. Epub 1992/08/01. PMID: 1497399

58. Rizzo JR, J.House R, Lirtzman SI. Role conflict and ambiguity in complex organizations. Adm Sci Q. 1970; 15(2): 150–163.

59. Ohayon MM. Epidemiology of insomnia: what we know and what we still need to learn. Sleep Med Rev. 2002; 6(2): 97–111. Epub 2003/01/18. PMID: 12531146