Chapter 8
Work Stress and Health: The Case of Japan

Akizumi Tsutsumi

8.1 Work Stress and Policy Responses in Japan: A Brief Overview

The Japanese Ministry of Health, Labour, and Welfare has conducted a representative survey of companies and employees in Japan every 5 years since 1982. Currently, more than 50 % of employees in Japan report strong worry, anxiety, or stress at work or in their working life. The number of suicides among employees increased from about 6000 per year in 1997 to about 9000 per year in 1998 and remained stable until 2009. However, there has been a declining trend in recent years. In 2014, a total of 1456 claims were submitted requesting worker compensation for work-related mental disorders, and among these, 213 were suicide-related. Yet, only 497 claims for mental disorders were approved for compensation in 2014. The number of claims for mental disorders increased almost five times during the last 14 years. At the macro level, some calculations of the economic burden of mental health problems were conducted. Assuming there were neither suicides nor depressive disorders in Japan, the economic benefit for a single fiscal year was estimated to amount to 26 billion USD. Likewise, an increase of GDP by some 16 billion USD within 1 year (2010) was estimated (Ministry of Health, Labour and Welfare 2010). Another estimation of the annual national cost of major depressive disorder among adults 20 years and older in Japan showed that the economic burden of depression was approximately 11 billion USD (Okumura and Higuchi 2011). Worker compensation for work related physical health problems due to psychosocial risk have been monitored, too. In 2014, 763 claims were submitted and 277 cases were compensated due to cerebro-cardiovascular disorders.

A. Tsutsumi (✉)
Department of Public Health, Kitasato University School of Medicine, Kanagawa, Japan
e-mail: akizumi@kitasato-u.ac.jp

J. Siegrist, M. Wahrendorf (eds.), *Work Stress and Health in a Globalized Economy*, Aligning Perspectives on Health, Safety and Well-Being,
DOI 10.1007/978-3-319-32937-6_8

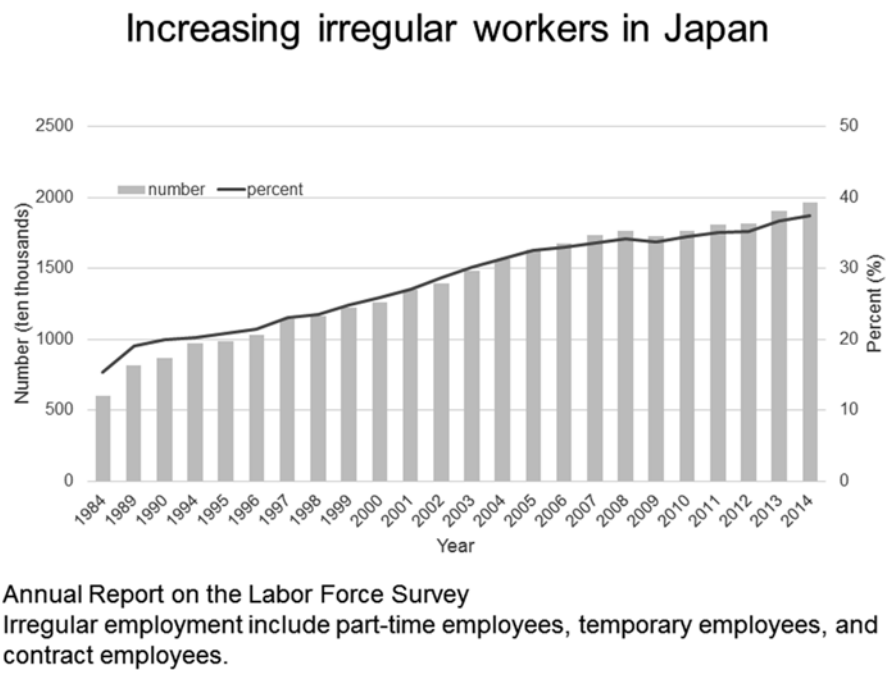

Fig. 8.1 Increasing irregular workers in Japan

The number of workers in atypical or irregular employment has steadily increased. To date, 40 % of the entire workforce belong to this category, as showed in Fig. 8.1, thus contributing to widening income inequalities in this country. Moreover, according to OECD data Japan was among the countries ranking on the top of all OECD countries with regard to long working hours. As a result, the combination of a high amount of overtime work with atypical employment and low pay has been considered a serious cause of workers' distress. As shown later, this stress-enhancing combination is captured by the model of effort-reward imbalance at work.

Japanese legislation on health and safety at work to some extent addresses psychosocial health risks. The Japanese Industrial Health and Safety Law states that employers are responsible for protecting the health and safety of their employees, and this responsibility includes preventing health-adverse psychosocial work environments. To enhance effectiveness of the law, the government released several guidelines. In 1999, the Labor Standard Bureau released an official standard for judging the work-relatedness of psychiatric diseases, which has been updated in 2009 and 2012 by adding "harassment at work" as a possible cause. Consequently, the 'Guideline for Promotion and Maintenance of Mental Health of Workers' and the 'Guideline for Return-to-Work of the Mentally Ill' were released and updated several times.

Among the guidelines, the 'Guideline for Promotion and Maintenance of Mental Health of Workers' is of core relevance. It is not mandatory for employers to follow the Guideline. However, recent court decisions refer to it as a standard practice in mental health care at the workplace. This latter development has motivated several large-scale companies to apply the Guideline to their employees. More specifically, the Guideline requires employers to establish procedures to maintain and improve the mental health of workers at particular workplaces, based on a participatory approach including the employer, employee representatives, and occupational health professionals belonging to the safety and health committee of the workplace. These procedures should implement evaluations, thus contributing to continuous improvement of processes. Furthermore, the system and plan should ensure that "four types of care" are provided, requiring that each one of the following four groups of personnel (employees, managers/supervisors, occupational health professionals, and service providers external to the workplace) meets the demands and responsibilities described in the Guideline. The Guideline emphasizes the importance of protecting the health information and privacy of employees in activities related to workplace mental health.

In this country, a fundamental law on the prevention of suicide was issued and enforced in 2006, addressing the whole population, not just working people. Detailed measures were developed in 2007 and revised in 2012. Although there has been a trend of declining suicide rates, these rates are still rather high, and of special concern is an increasing recent rate of suicides among younger people aged 20–40'.

A further important law concerns preventive measures against Karoshi (death from overwork). It was enforced on Nov 1, 2014. This law aims to create a society where people can be free from threats of Karoshi and can continue to work productively in good health, with a reasonable work-life balance. There are four pillars to guarantee that the aims of the law are met: (1) to encourage research on the causes and mechanisms of Karoshi; (2) to strengthen education to better understand, identify, and prevent the danger of Karoshi; (3) to establish counseling services for workers at risk of work overload; and (4) to support nongovernmental organizations to raise awareness through preventive activities and campaigns.

The Industrial Safety and Health Law has been amended several times. Important amendments related to psychosocial factors at work include the 'Doctor's Interview of Workers with Long Working Hours'. This amendment issued in 2006 targeted specifically the prevention of job stress-related diseases, such as cerebrocardiovascular diseases and depressive disorders. Accordingly, employers are obliged to refer those employees who accumulated 100 or more hours of overtime work and complained of fatigue, to a professional consultation and health checkup with a physician if they asked for a respective activity.

Most recently, in 2014, this law was extended to include a Stress Check Program where regular yearly screenings of high psychosocial stress in the workplace is mandatory in enterprises with 50 or more employees. The program requires an employer to (1) provide a survey of psychosocial stress of workers, (2) report the individual's result to each worker, (3) arrange an interview by a physician with a

worker with high stress at the worker's request, and (4) follow the recommendations of the physician by respective improvement of adverse working conditions.

Taken together, Japan by now has a set of regulations and laws to protect the working people's health and wellbeing, addressing specifically the growing problem of work-related psychosocial stress. It remains to see to what extent these regulations are observed in practice and to what extent they may contribute towards reducing the burden of work-related diseases.

8.2 Relevance of Effort-Reward Imbalance for Working People in Japan

The Japanese economic background briefly described and several widely prevalent behavioral patterns and attitudes of Japanese workers are very closely related to the core notions of the effort-reward imbalance (ERI) model. Japan has suffered from a prolonged economic recession which forced companies to restructure their business, especially so around the late 1990s, following the burst of an economic bubble and the challenges of economic globalization. Many Japanese workers lost their feeling of job security that they had enjoyed for a long time (Kawakami and Haratani 1999; Tsutsumi et al. 2015). Precarious work has been increasing, and even workers in regular employment with more secure jobs were threatened by occupational instability (Tsutsumi et al. 2015). Contrary to many Western societies, a solid safety net against unemployment has not been established in Japan (Kawahito 2014). Due to the current situation of increasing job insecurity a large number of Japanese workers are suffering from this threat, given the fact that they enjoyed permanent employment and were rarely exposed to forced mobility for a long period (Brinton 2010).

Over-commitment reflects a cognitive-motivational pattern of coping with demands based on elements of Type A behavior. The concept of over-commitment has some elements in common with the conceptualization of a 'Japanese coronary-prone behavior' as described in a Japanese multi-center study (Hayano et al. 1997). This behavioral pattern is characterized by a job-centered lifestyle and a strong social dominance, in some analogy to the excessive job involvement inherent in the concept of 'over-commitment'. It is therefore likely that this latter concept may contribute to the explanation of work-stress related health risks in Japanese workers.

As clearly stated in Chap. 1 of this book, the model of effort-reward imbalance at work maintains that failed contractual reciprocity in terms of high cost and low gain is often experienced by people who have no alternative choice in the labor market, by those exposed to heavy job competition, and by those who are overcommitted to their work. We repeatedly demonstrated that this assumption also holds true in the Japanese setting and that health consequences are particularly pronounced under these conditions (Tsutsumi et al. 2002b). Despite the national

development described above, the recent amendment of the Worker Dispatching Act concerning the prevention of work-related stress has not gone far enough in its analysis and intervention. It has therefore provoked a vivid public debate. The Government party insisted that the enforcement of the law would have beneficial effects by increasing the number of regular workers. However, the opposite parties and labor organizations claimed that the law would prevent irregular workers from becoming regular workers. Given these latter restrictions, those irregularly employed workers who are striving to get a permanent job may be particularly susceptible to the continued experience of effort-reward imbalance at work.

8.3 Reviewing Research on the ERI Model in Japan

8.3.1 Validation of the ERI Model

In accordance with the development and revision of the original ERI questionnaire, the Japanese versions of the ERI questionnaire have been developed and updated several times. The original ERI questionnaire was developed through a back-translation process (Tsutsumi et al. 2001a). Since then, the ERI model has been tested in many studies, and a high internal consistency of the ERI scales was confirmed throughout the studies. Validation studies on the Japanese ERI questionnaire are ample (Tsutsumi et al. 2002a). The ERI indices including over-commitment were associated with several health outcomes, strengthening their validity. Confirmatory factor analyses replicated the theory-driven factorial structures of the scales (Tsutsumi 2004), and explanatory factor analyses resulted in comparable findings (Tsutsumi et al. 2001a). Furthermore, the dynamic responsiveness of the ERI measures to a series of organizational changes occurring over time was demonstrated (Tsutsumi et al. 2002a). In a longitudinal analysis of 543 employees who experienced several measures of organizational restructuring in terms of exposure to more competitive work environments exhibited a respective substantial increased of their ERI measures over time.

The reliability and validity of the short version of the ERI questionnaire were also confirmed (Kurioka et al. 2013). The internal consistency and test-retest reliability were acceptable. It was also confirmed that the ER-ratio was associated with an elevated risk of psychiatric disorder. However, the ER ratio based on the short version is not strongly correlated with the ER ratio based on the original questionnaire and runs the risk of producing a high number of false-positive cases.

Several Japanese studies showed that the over-commitment scale was internally reliable (Tsutsumi et al. 2002a). The over-commitment scale was also validated in several Japanese settings. One of the validations was done by examining the theoretical association between the person-specific model component and a measure of motivational behavior at workplace, using a path analytic approach as well as showing the standard psychometrics (Tsutsumi et al. 2008b). In this study, motivation

was significantly and positively associated with over-commitment, and over-commitment was significantly and *positively* associated with psychiatric disorder measured by the GHQ, whereas motivation was significantly *negatively* associated with the GHQ score.

8.3.2 ERI at Work and Health Outcomes

In the first part of this section, I review a summary of research published so far on ERI at work and health outcomes in Japan from three perspectives: (1) health outcomes; (2) subjects studied; and (3) causality of reported associations. Following this, findings regarding the associations of ERI/over-commitment with other occupational stress components and with socioeconomic status are summarized, and a few findings on the interaction of ERI with over-commitment are added.

A variety of studies examined associations between ERI and *psychological distress* in various occupations. *Depression* is the health measure most often studied in association with the ERI model (Kikuchi et al. 2010; Sakata et al. 2008; Tsutsumi et al. 2001b, 2012), including over-commitment (Kikuchi et al. 2010). The relative risks shown in these studies range from 2.8 to 8.8 for the ER ratio (or single scales), and from 1.3 to 2.6 for the scale over-commitment. Other than depression, ERI was found to be associated with general psychological distress (Inoue et al. 2010), and with fatigue (Takaki et al. 2006). As for an objective outcome, Inoue et al. (2011) showed in their study of 756 permanent and fixed-term male workers that ERI was associated with increased utilization of the company's clinic for mental health concerns.

Musculoskeletal disorders were also well studied (Tsutsumi et al. 2001a; Yokoyama et al. 2014), in particular among employees engaged in the jobs with physically strenuous work in combination with high psychological strain. Dental technicians are a profession characterized by this combination as their work is characterized by constant posture over a long time period and by psychological demands, such as meeting deadlines, working overtime, and working with high precision and responsibility. In addition, there are socio-emotional stressors given an obvious discrepancy between high amounts of work spent and low monetary rewards received in turn. Tsutsumi et al. (2001a) revealed a significantly elevated risk of musculoskeletal symptoms in dental technicians exhibiting a high level of over-commitment (Odds ratio (OR) = 4.6; 95 % CI 1.4–12.6). A large physical burden among eldercare workers is well known. Yokoyama et al. (2014) showed a high ERI prevalence among eldercare workers and an association of ERI with low back pain (OR = 1.96; 95 % CI 1.02–3.77).

In a cross-sectional study of 1198 male and female workers, Nakagawa et al. (2014) showed that reward at work significantly enhanced *job performance*, using the WHO-HPQ measurement. This is a new finding with potential policy impact. Furthermore, ERI was shown to be negatively associated with health-related quality of life. Watanabe et al. (2008) conducted a cross-sectional study of 1057 male

workers using the SF-8 scale and showed that ERI was associated with the *poor health functioning*, as indicated by a physical and a mental summary score, and that these associations remained significant after adjustment for relevant confounding factors.

Health-related behaviors define another category of relevant outcome measures. In this respect, ERI was associated with several health-damaging behaviors. Takaki et al. (2010) found that *over-eating* was more frequent among people with work stress (ERI), and an interactive effect of ERI and body mass index on over-eating was suggested. *Angry driving* in traffic may be health-damaging as well, and a study by McLinton and Dollard (2010), using the Driving Anger scale, concluded that ERI may spillover to driving anger among Japanese workers. Concerning a further, very important health-related behavior, *smoking cessation*, it appears however that ERI has no respective effect. Ota et al. (2010), in their 2-year follow-up study of 579 male smokers, did not find that ERI was associated with smoking cessation at follow-up.

Other cross-sectional studies showed that ERI was related to *insomnia* (Ota et al. 2005; Utsugi et al. 2005). Of particular relevance are the results obtained from a prospective study where Ota et al. (2009) followed 1022 workers for 2 years. The authors observed that ERI had a significant association with the persistence of insomnia (adjusted OR = 2.40; 95 % CI 1.13–5.10). Moreover, over-commitment was significantly related to future onset of insomnia (OR = 1.75; 95 % CI 1.16–2.66). In this study, occupational stress factors other than ERI were also tested, but ERI showed the relatively strongest impact on insomnia, followed by work social support (OR = 2.00; 95 % CI 1.18–3.40).

Compared with the job demand-control (DC) model, evidence on 'hard' health outcomes based on the ERI model is rather scarce in Japan. While ERI was found to be associated with unfavorable *lipid profiles* (Irie et al. 2004; Kobayashi et al. 2005), an association with a respective clinically relevant outcome measure, *arterial stiffness*, was not found (Utsugi et al. 2009).

Finally, several investigations explored the role of ERI in association with *biological markers* that are suspected to be involved in stress mechanisms. In one such investigation, Irie et al. (2004) studied employees of a recently downsized manufacturing company where they found that ERI was associated with increased GPT and that over-commitment was associated with elevated blood glucose. However, these changes were not associated with cortisol and biopyrrins. Inoue et al. (2009) found no association between ERI and urinary 8-OHdG. As some types of oxidative biomarkers may mediate the association of ERI with coronary heart disease, their study offers an interesting new perspective. Takaki (2013) showed in a study of 567 male and female workers that ERI is associated with urinary H_2O_2, but not with 8-OHdG.

In summary, while substantial evidence on associations of ERI with a variety of health markers has been reported in recent research from Japan, it seems premature to draw firm conclusions, given the paucity of prospective studies and the limited knowledge on psychobiological pathways.

8.3.3 Subjects Included in the Studies

ERI was often tested to have stronger impact among workers with economically disadvantageous status than among those with more favorable socioeconomic circumstances. In a cross-sectional study of a medium-sized manufacturing company, the two complementary models of ERI and of job strain were simultaneously tested (Tsutsumi et al. 2001b). ERI was found to be more frequent among employees in lower socioeconomic positions, defined by indirect support tasks that were at risk of being downsized. Among these workers, a high prevalence of depressive symptoms was observed. After adjustment for several confounding factors, ERI was significantly associated with depression, and this association was particularly strong in the subgroup suffering from potential job loss.

ERI and health problems were often studied among medical professionals in Japan. There is evidence suggesting that the prevalence of ERI among them is higher than is the case among other professions (Tsutsumi et al. 2002a, 2012). In addition, in these professions the relationships of ERI with adverse health seem to be particularly strong (Sakata et al. 2008; Tsutsumi et al. 2012).

While a majority of studies addressed employed populations, there is very limited research available on the effect of occupational stress among self-employed people, as well as among administrators involved in management. Private practice physicians are one such self-employed group exposed to severe market competition and economic fluctuation. In a study of private practice physicians, 57 % of physicians were exposed to stressful work in terms of high ERI (Tsutsumi et al. 2012). In this professional group, high effort in combination with low organizational reward was most often experienced, and the effect of this imbalance on depression was clearly more pronounced than the effects of the two remaining reward components (see Fig. 8.2 and discussion). This finding underlines the importance of considering employment contexts both in terms of scientific knowledge and implications for practical intervention.

8.3.4 Causality of Associations

Scarce knowledge based on prospective studies obtained so far in Japan precludes any assessment of potential causal links between ERI and health outcomes. However, two panel studies addressed this problem and provided some interesting insights. In a three-wave panel study of 211 male workers, Shimazu and de Jonge (2009) analyzed and discussed reversed effects of employees' adverse health on ERI. They pointed to a possible mechanism by which reduced health may contribute to changes in the perception of effort and reward at work. At the same time, stressful work may also affect their health, thus resulting in a reciprocal relationship between ERI and health. The second investigation was performed by Oshio and his colleagues (2015). They confirmed a robust association between ERI and

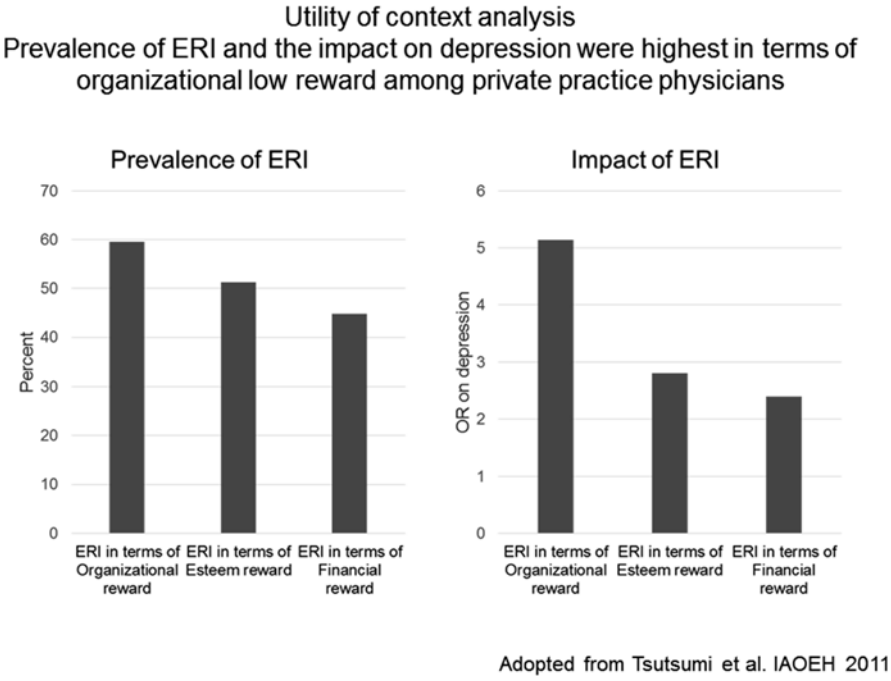

Fig. 8.2 Utility of context analysis prevalence of ERI and the impact on depression were highest in terms of organizational low reward among private practice physicians

psychological distress that was independent of employees' personality traits such as neuroticism and negative affectivity. Using panel data from three to four waves of an occupational Japanese cohort survey, focusing on 31382 observations of 9741 individuals who participated in at least two consecutive waves, they estimated mean-centered fixed effects models to explain psychological distress by ERI indicators. Mean-centered fixed effects models reduced the magnitude of the association between ERI and psychological distress of those observed from pooled ordinary least squares substantially. However, the association remained highly significant even after controlling for unobserved time-invariant confounders.

8.3.5 Associations of ERI with Other Components

Associations of ERI or over-commitment with other occupational stress models were well tested in several Japanese studies. As described in the former section, Tsutsumi et al. (2001b) suggests a complementary association between the ERI and DC models. Utsugi et al. (2005) observed in their large-scale cross-sectional study (6997 male and 1773 female workers) that ERI was related to insomnia and short sleep for men and women and the associations were stronger than in case of

DC. Oshio et al. (2014) demonstrated that workplace social capital had mediate or moderate effects on the association between ERI and psychological distress. Watanabe et al. (2004) showed that workplace social support mediated the association between ERI and depression. On the positive side of the ERI model's predictions, Inoue et al. (2010), in a cross-sectional analysis of 243 men and women, observed that r*eward at work* significantly mediated associations of procedural and interactional justice with psychological distress. Although there are scarce studies showing the interaction between ERI and over-commitment, Takaki et al. (2006) found an interactive association between ERI and over-commitment. They studied 94 overtime workers and found that ERI was associated with fatigue, and increase of fatigue accompanying the increase of ERI was greater in individuals with high over-commitment than in those with low over-commitment.

Despite some evidence the observation of a *social gradient of ERI* does not necessarily hold true for every working population, assuming that work stress is more prevalent among lower SES groups than higher SES groups. One reason of inconsistent findings may be that high levels of effort are often more prevalent among higher SES groups (Inoue et al. 2011; Tsutsumi 2004, 2010). However, evidence did show that the impact of ERI was different across occupational classes (Kawaharada et al. 2007), such that the effect on health was stronger among lower than higher SES groups (Tsutsumi et al. 2001b; Yoshioka et al. 2013). Using a big database of 6423 male and 1606 female workers, Kawaharada et al. (2007) examined occupational class and occupational stress models. They found that ERI and the DC indices provided different results with regard to occupational class groups with high stress level and concluded that ERI and DC played a complementary role in predicting health effects. Yoshioka et al. (2013) conducted a cross-sectional study of 5951 male employees of local governments where they found that ERI, Job strain and employment levels were each associated with insomnia. More specifically, a significant relative excess risk due to the interaction between employment level and ERI components (ERI and over-commitment) was observed. Further analyses revealed an interaction with employment level and ERI/over-commitment that was not observed for the job strain model. Inoue et al. (2011) demonstrated different aspects of adverse psychosocial work environments according to the workers' status. In their study, permanent workers exhibited a higher amount of distress about job pressure or unrewarded efforts in their job, whereas fixed-term workers were more distressed by job insecurity and the lack of job promotion prospects. These latter findings suggest that the inclusion of employment contexts into the analysis of work stress and health may enrich future findings.

8.4 Discussion and Conclusion

The ERI model defines an effective approach towards elucidating adverse working conditions in current Japan. Recent economic circumstances and job insecurity have strengthened this conclusion. In addition to the environmental aspects, the

coronary-prone behavioral pattern of Japanese workers characterized as 'job-centered life-style' (i.e., devoting oneself to work) shares some basic notions with the concept of over-commitment. As Karoshi provides an extreme problem where workers devote themselves too much to work, whether forced or not, the evidence produced by the ERI model could offer some guidance on how to reduce the risk of Karoshi.

A series of Japanese research efforts produced unique, internationally relevant contributions to the methodology, especially to the problem of scaling of ERI. It is difficult to develop completely compatible scales between areas with culturally different background. However, application of a new test theory such as item response theory could give us the clue to fine-tune the differences (Tsutsumi et al. 2008a, 2009). Accordingly, validation studies have been performed from several Asian countries (Buapetch et al. 2008; Li et al. 2012).

Although prospective studies are scarce and studies with hard outcome such as cardiovascular diseases are limited, there have been important studies in Japanese settings. Psychological distress including depression was consistently found to be associated with ERI and over-commitment, and their robust associations were confirmed by panel studies. So far, there are no definite studies showing associations of ERI with hormonal dysregulation such as excretion of cortisol (Irie et al. 2004; Ota et al. 2014). Moreover, an association between ERI and oxidative damage reported from other places was not observed in Japanese studies (Inoue et al. 2009; Takaki 2013). Therefore, further studies in this field are required. Importantly, a newly detected association of ERI with job performance (Nakagawa et al. 2014) can have direct policy implications by motivating employers to improve their work environment along the principles inherent in the ERI model.

In the recently enforced Stress Check Program, the government's recommendation on the surveillance (screening) tool in order to screen workers with high psychosocial stress in the workplace is based on the job demand-control model. As three dimensions (demand, control and support) cannot appropriately cover the wide range of psychosocial occupational hazards, we need more relevant tools to cover them. Considering the reflection on current working situations as well as the predictive value of the ERI model with regard to health outcomes, the ERI questionnaire may be a prominent candidate to strengthen respective screening and preventive efforts. More intervention studies would certainly be useful to convince potential users of the suitability of this approach. Beneficial effects of organizational-level environmental improvements of work settings according to the ERI model were demonstrated in a relevant study from Canada (Bourbonnais et al. 2011; Tsutsumi and Kawakami 2004), and such intervention needs employers' approval and commitment because organizational-level interventions are necessary. Interestingly, in a recent study in Japan, high reward was found to be associated with high job performance (Nakagawa et al. 2014). As mentioned, this finding may motivate employers to adopt workplace improvement according to the ERI model. We also need to conduct cost-benefit studies to provide a convincing case to employers.

Although environment-level improvement is the first line to prevent occupational stress-related disorders, the ERI model offers an interpersonal and an individual

level of intervention as well. Irie et al. (2003) administered an ERI questionnaire to employees of a production company. They then selected those 69 employees who had reported long working hours, and they conducted individual counseling to modify the Type A behavior pattern. Comparisons between intervention and control groups 1 year following the intervention suggested that an individual approach towards modifying Type A behavior leads to a reduction in over-commitment, self-reported sleepiness, dullness, and the frequency of burnout symptoms.

Several pathways through which ERI leads to health outcomes provide entry points for intervention. Workplace social capital could mediate/moderate the effect of ERI on psychological distress (Oshio et al. 2014), and workplace social support was shown to mediate the association between ERI and depression (Watanabe et al. 2004). Additional measures complementing the ERI model might be instrumental in developing favorable working environments in terms of *social capital at work*. Combining research on ERI with research on personality traits could offer new knowledge of scientific and practical interest. Kikuchi et al. (2013) conducted a cross-sectional analysis of 296 female nurses and showed that temperament predicted part of the variance of ERI ratios (18–27 %). Temperament may exert an influence on over-commitment as well. Tei-Tominaga et al. (2009) showed that temperament explained 36 % of the variance of over-commitment (the variance was more than that of working hours); temperament explained 27 % and 14 % of the variance of Effort and Reward, respectively. As cognitive-behavioral therapy may assist workers in adopting more constructive coping patterns when exposed to stressful work circumstances, as well as in helping them to reflect on the motivations underlying their need to be over-committed (Preckel et al. 2005), mental health practitioners might offer intervention strategies in accordance with the client's individual temperament (Kikuchi et al. 2013). The same study also revealed that long working hours had a strong impact on high effort (Tei-Tominaga et al. 2009), which suggests that reduction of overtime work is an important approach in decreasing high effort (Tsutsumi and Kawakami 2004). McLinton and Dollard (2010) discussed the hypothesis that ERI exerts an indirect effect on driving anger through its mediating influence on trait anger. Anger control could therefore to some extent reduce the adverse effects of ERI on health.

Finally, according to my personal view, the ERI model can play a unique role in emphasizing intervention dimensions that reach beyond single workplaces. This characteristic is unique as other established work stress models are more limited in this regard. Importantly, this model includes three different reward factors where salaries and job promotion/job security address regional or even national policy frameworks. At least one study included in this review elucidates this latter aspect. A cross-sectional questionnaire study of 1103 private practice physicians involved in management and exposed to severe market competition and economic fluctuations demonstrated that ERI in terms of low organizational reward was most relevant and most strongly associated with depression (Tsutsumi et al. 2012). Additional qualitative analyses confirmed that respondents proposed an increase in remuneration of medical services as a priority measure.

In *conclusion*, ERI is particularly important for Japanese workers because of the current economic situation and their behavioral attitudes towards work. A large number of empirical studies showed robust associations between ERI and psychological distress, but stronger evidence derived from prospective studies with hard outcomes and from studies examining biological mechanisms is desirable. As is the case for other work stress models as well, intervention studies bridging theory with practice are badly needed. Because the ERI model has a promising potential to include broader policy dimensions beyond single workplaces it should be addressed by those who are responsible for work-related health in a societal perspective.

References

Bourbonnais, R., Brisson, C., & Vezina, M. (2011). Long-term effects of an intervention on psychosocial work factors among healthcare professionals in a hospital setting. *Occupational & Environmental Medicine, 68*(7), 479–486. doi:10.1136/oem.2010.055202.

Brinton, M. C. (2010). *Lost in transition: Youth, work, and instability in postindustrial Japan*. Cambridge, MA: Cambridge University Press.

Buapetch, A., Lagampan, S., Faucett, J., & Kalampakorn, S. (2008). The Thai version of Effort-Reward Imbalance Questionnaire (Thai ERIQ): A study of psychometric properties in garment workers. *Journal of Occupational Health, 50*(6), 480–491. doi:JST.JSTAGE/joh/L8017 [pii]

Hayano, J., Kimura, K., Hosaka, T., Shibata, N., Fukunishi, I., Yamasaki, K., Mono, H., the Type A Behavior Pattern (TABP) Conference. (1997). Japanese coronary-prone behavior in Japan: JCBS scale C. *Type A (in Japanese, English abstract), 8*(1), 39–45.

Inoue, A., Kawakami, N., Ishizaki, M., Tabata, M., Tsuchiya, M., Akiyama, M., Kitazume, A., Kuroda, M., & Shimazu, A. (2009). Three job stress models/concepts and oxidative DNA damage in a sample of workers in Japan. *Journal of Psychosomatic Research, 66*, 329–334. doi:10.1016/j.jpsychores.2008.09.016.

Inoue, A., Kawakami, N., Ishizaki, M., Shimazu, A., Tsuchiya, M., Tabata, M., Akiyama, M., Kitazume, A., & Kuroda, M. (2010). Organizational justice, psychological distress, and work engagement in Japanese workers. *International Archives of Occupational and Environmental Health, 83*(1), 29–38. doi:10.1007/s00420-009-0485-7.

Inoue, M., Tsurugano, S., & Yano, E. (2011). Job stress and mental health of permanent and fixed-term workers measured by effort-reward imbalance model, depressive complaints, and clinic utilization. *Journal of Occupational Health, 53*(2), 93–101. http://doi.org/10.1539/joh.L10098.

Irie, M., Tsutsumi, A., & Kobayashi, F. (2003). Effort-reward imbalance and workers' health in a period of structural economic change. *Occupational Health Journal (in Japanese), 26*(2), 69–74.

Irie, M., Tsutsumi, A., Shioji, I., & Kobayashi, F. (2004). Effort-reward imbalance and physical health among Japanese workers in a recently downsized corporation. *International Archives of Occupational and Environmental Health, 77*, 409–417.

Kawaharada, M., Saijo, Y., Yoshioka, E., Sato, T., Sato, H., & Kishi, R. (2007). Relations of occupational stress to occupational class in Japanese civil servants – analysis by two occupational stress models. *Industrial Health, 45*(2), 247–255. http://doi.org/10.2486/indhealth.45.247.

Kawahito, H. (2014). *Karo Jisatsu (suicide from over work)* (2nd ed.). Tokyo: Iwanami.

Kawakami, N., & Haratani, T. (1999). Epidemiology of job stress and health in Japan: Review of current evidence and future direction. *Industrial Health, 37*, 174–186. http://doi.org/10.2486/indhealth.37.174.

Kikuchi, Y., Nakaya, M., Ikeda, M., Narita, K., Takeda, M., & Nishi, M. (2010). Effort-reward imbalance and depressive state in nurses. *Occupational Medicine, 60*(3), 231–233. doi:10.1093/occmed/kqp167.

Kikuchi, Y., Nakaya, M., Ikeda, M., Takeda, M., & Nishi, M. (2013). Job stress and temperaments in female nurses. *Occupational Medicine, 63*(2), 123–128. doi:10.1093/occmed/kqs212.

Kobayashi, Y., Hirose, T., Tada, Y., Tsutsumi, A., & Kawakami, N. (2005). Relationship between two job stress models and coronary risk factors among Japanese part-time female employees of a retail company. *Journal of Occupational Health, 47*(3), 201–210. http://doi.org/10.1539/joh.47.201.

Kurioka, S., Inoue, A., & Tsutsumi, A. (2013). Optimum cut-off point of the Japanese short version of the effort-reward imbalance questionnaire. *Journal of Occupational Health, 55*(5), 340–348. http://doi.org/10.1539/joh.12-0235-OA.

Li, J., Loerbroks, A., Jarczok, M. N., Schollgen, I., Bosch, J. A., Mauss, D., Siegrist, J., & Fischer, J. E. (2012). Psychometric properties and differential explanation of a short measure of effort-reward imbalance at work: A study of industrial workers in Germany. *American Journal of Industrial Medicine, 55*(9), 808–815. doi:10.1002/ajim.22018.

McLinton, S. S., & Dollard, M. F. (2010). Work stress and driving anger in Japan. *Accident Analysis & Prevention, 42*(1), 174–181. doi:10.1016/j.aap.2009.07.016.

Ministry of Health, Labour and Welfare. (2010). *Economic benefit of suicide and depression prevention* [Press release]. http://www.mhlw.go.jp/stf/houdou/2r9852000000qvsy.html. Accessed 16 Nov 2015.

Nakagawa, Y., Inoue, A., Kawakami, N., Tsuno, K., Tomioka, K., Nakanishi, M., Mafune, K., & Hiro, H. (2014). Job demands, job resources, and job performance in Japanese workers: A cross-sectional study. *Industrial Health, 52*(6), 471–479. http://doi.org/10.1539/joh.14-0212-BR.

Okumura, Y., & Higuchi, T. (2011). Cost of depression among adults in Japan. *Primary Care Companion for CNS Disorders, 13*(3). doi: 10.4088/PCC.10m01082.

Oshio, T., Inoue, A., & Tsutsumi, A. (2014). The mediating and moderating effects of workplace social capital on the associations between adverse work characteristics and psychological distress among Japanese workers. *Industrial Health, 52*(4), 313–323. http://doi.org/10.2486/indhealth.2014-0032.

Oshio, T., Tsutsumi, A., & Inoue, A. (2015). Do time-invariant confounders explain away the association between job stress and workers' mental health? Evidence from Japanese occupational panel data. *Social Science & Medicine, 126*, 138–144. doi:10.1016/j.socscimed.2014.12.021.

Ota, A., Masue, T., Yasuda, N., Tsutsumi, A., Mino, Y., & Ohara, H. (2005). 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. *Sleep Medicine, 6*(4), 353–358. doi:10.1016/j.sleep.2004.12.008.

Ota, A., Masue, T., Yasuda, N., Tsutsumi, A., Mino, Y., Ohara, H., & Ono, Y. (2009). Psychosocial job characteristics and insomnia: A prospective cohort study using the Demand-Control-Support (DCS) and Effort-Reward Imbalance (ERI) job stress models. *Sleep Medicine, 10*(10), 1112–1117. doi:10.1016/j.sleep.2009.03.005.

Ota, A., Masue, T., Yasuda, N., Tsutsumi, A., Mino, Y., Ohara, H., & Ono, Y. (2010). Psychosocial job characteristics and smoking cessation: A prospective cohort study using the demand-control-support and effort-reward imbalance job stress models. *Nicotine & Tobacco Research, 12*(3), 287–293. doi:10.1093/ntr/ntp212.

Ota, A., Mase, J., Howteerakul, N., Rajatanun, T., Suwannapong, N., Yatsuya, H., & Ono, Y. (2014). The effort-reward imbalance work-stress model and daytime salivary cortisol and dehydroepiandrosterone (DHEA) among Japanese women. *Scientific Reports, 4*, 6402. doi:10.1038/srep06402.

Preckel, D., von Kanel, R., Kudielka, B. M., & Fischer, J. E. (2005). Overcommitment to work is associated with vital exhaustion. *International Archives of Occupational and Environmental Health, 78*(2), 117–122.

Sakata, Y., Wada, K., Tsutsumi, A., Ishikawa, H., Aratake, Y., Watanabe, M., Katoh, N., Aizawa, Y., & Tanaka, K. (2008). Effort-reward imbalance and depression in Japanese medical residents. *Journal of Occupational Health, 50*(6), 498–504. http://doi.org/10.1539/joh.L8043.

Shimazu, A., & de Jonge, J. (2009). Reciprocal relations between effort-reward imbalance at work and adverse health: A three-wave panel survey. *Social Science & Medicine, 68*(1), 60–68. doi:10.1016/j.socscimed.2008.09.055.

Takaki, J. (2013). Associations of job stress indicators with oxidative biomarkers in Japanese men and women. *International Journal of Environmental Research and Public Health, 10*(12), 6662–6671. doi:10.3390/ijerph10126662.

Takaki, J., Nakao, M., Karita, K., Nishikitani, M., & Yano, E. (2006). Relationships between effort-reward imbalance, over-commitment, and fatigue in Japanese information-technology workers. *Journal of Occupational Health, 48*(1), 62–64. http://doi.org/10.1539/joh.48.62.

Takaki, J., Minoura, A., Irimajiri, H., Hayama, A., Hibino, Y., Kanbara, S., Sakano, N., & Ogino, K. (2010). Interactive effects of job stress and body mass index on over-eating. *Journal of Occupational Health, 52*(1), 66–73. http://doi.org/10.1539/joh.M9006.

Tei-Tominaga, M., Akiyama, T., Miyake, Y., & Sakai, Y. (2009). The relationship between temperament, job stress and overcommitment: A cross-sectional study using the TEMPS-A and a scale of ERI. *Industrial Health, 47*(5), 509–517. http://doi.org/10.2486/indhealth.47.509.

Tsutsumi, A. (2004). *Development and application of the Japanese version of effort-reward imbalance questionnaire*. Report of Research Project, Grand in Aid for Scientific Research (C), 2001–2004.

Tsutsumi, A. (2010). *Epidemiological study on association between occupational class and health inequality: Role of occupational stress*. Report of Research Project, Grand in Aid for Scientific Research (C), 2007–2009.

Tsutsumi, A., & Kawakami, N. (2004). A review of empirical studies on the model of effort-reward imbalance at work: Reducing occupational stress by implementing a new theory. *Social Science & Medicine, 59*(11), 2335–2359. doi:10.1016/j.socscimed.2004.03.030.

Tsutsumi, A., Ishitake, T., Peter, R., Siegrist, J., & Matoba, T. (2001a). The Japanese version of the effort-reward imbalance questionnaire: A study in dental technicians. *Work and Stress, 15*(1), 86–96. doi:10.1080/02678370118173.

Tsutsumi, A., Kayaba, K., Theorell, T., & Siegrist, J. (2001b). Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models. *Scandinavian Journal of Work, Environment & Health, 27*(2), 146–153. doi:10.5271/sjweh.602.

Tsutsumi, A., Kayaba, K., Nagami, M., Miki, A., Kawano, Y., Ohya, Y., Odagiri, Y., & Shimomitsu, T. (2002a). The effort-reward imbalance model: Experience in Japanese working population. *Journal of Occupational Health, 44*(6), 398–407.

Tsutsumi, A., Nagami, M., Morimoto, K., & Matoba, T. (2002b). Responsiveness of measures in the effort-reward imbalance questionnaire to organizational changes: A validation study. *Journal of Psychosomatic Research, 52*(4), 249–256. http://doi.org/10.1016/S0022-3999(02)00291-X.

Tsutsumi, A., Iwata, N., Wakita, T., Kumagai, R., Noguchi, H., & Kawakami, N. (2008a). Improving the measurement accuracy of the effort-reward imbalance scales. *International Journal of Behavioral Medicine, 15*(2), 109–119. doi:10.1080/10705500801929718.

Tsutsumi, A., Nagami, M., Morimoto, K., & Kawakami, N. (2008b). Motivation, overcommitment, and psychological health at work: A path analytic approach. *Journal of UOEH, 30*(3), 279–292.

Tsutsumi, A., Iwata, N., Watanabe, N., de Jonge, J., Pikhart, H., Fernandez-Lopez, J. A., Xu, L., Peter, R., Knutsson, A., Niedhammer, I., Kawakami, N., & Siegrist, J. (2009). Application of item response theory to achieve cross-cultural comparability of occupational stress measure-

ment. *International Journal of Methods in Psychiatric Research, 18*(1), 58–67. doi:10.1002/mpr.277.

Tsutsumi, A., Kawanami, S., & Horie, S. (2012). Effort-reward imbalance and depression among private practice physicians. *International Archives of Occupational and Environmental Health, 85*(2), 153–161. doi:10.1007/s00420-011-0656-1.

Tsutsumi, A., Inoue, A., Shimazu, A., Takahashi, M., Kawakami, N., Kurioka, S., Eguchi, H., Miyaki, K., Enta, K., Kosugi, Y., & Totsuzaki, T. (2015). Income and mental health in Japanese working population: The mediating effect of job insecurity. *Journal of Health and Welfaire Statistics (in Japanese), 62*(11), 1–8.

Utsugi, M., Saijo, Y., Yoshioka, E., Horikawa, N., Sato, T., Gong, Y., & Kishi, R. (2005). Relationships of occupational stress to insomnia and short sleep in Japanese workers. *Sleep, 28*(6), 728–735.

Utsugi, M., Saijo, Y., Yoshioka, E., Sato, T., Horikawa, N., Gong, Y., & Kishi, R. (2009). Relationship between two alternative occupational stress models and arterial stiffness: A cross-sectional study among Japanese workers. *International Archives of Occupational and Environmental Health, 82*(2), 175–183. doi:10.1007/s00420-008-0319-z.

Watanabe, M., Irie, M., & Kobayashi, F. (2004). Relationship between effort-reward imbalance, low social support and depressive state among Japanese male workers. *Journal of Occupational Health, 46*(1), 78–81. http://doi.org/10.1539/joh.46.78.

Watanabe, M., Tanaka, K., Aratake, Y., Kato, N., & Sakata, Y. (2008). The impact of effort-reward imbalance on quality of life among Japanese working men. *Industrial Health, 46*(3), 217–222. http://doi.org/10.2486/indhealth.46.217.

Yokoyama, K., Hirao, T., Yoda, T., Yoshioka, A., & Shirakami, G. (2014). Effort-reward imbalance and low back pain among eldercare workers in nursing homes: A cross-sectional study in Kagawa Prefecture, Japan. *Journal of Occupational Health, 56*(3), 197–204.

Yoshioka, E., Saijo, Y., Kita, T., Satoh, H., Kawaharada, M., & Kishi, R. (2013). Effect of the interaction between employment level and psychosocial work environment on insomnia in male Japanese public service workers. *International Journal of Behavioral Medicine, 20*(3), 355–364. doi:10.1007/s12529-012-9230-9.