

## Preplanned Studies

## Occupational Stress and Risk Factors Among Workers from Electronic Manufacturing Service Companies in China

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### Summary

#### What is already known about this topic?

Occupational stress and workplace health have become issues of significant concern for both employees and employers. The workers from electronic manufacturing services (EMS) industry in China are exposed to increasing occupational hazards and injuries. Despite the fact that it is a known health risk for psychological and medical disorders, only few studies have investigated the prevalence of occupational stress and risk factors among EMS workers.

#### What is added by this report?

Analysis of data from the EMS industry of Occupational Stress Surveillance Program with a sample of 21,362 participants from 20 EMS companies. Results show that the prevalence of high strain and effort-reward imbalance were 19.5% and 15.8%, respectively, which are significantly differed by selected socio-demographic and job characteristics. Participants who are migrant, or working in the assembly-line position or in shift are exposed to higher stress level.

#### What are the implications for public health practice?

EMS workers are liable to be at risk for occupational stress and for developing psychological disorders and diseases. The findings of this study contribute to an evidence-base which inform the development and implementation of strategies aimed at reducing occupational stress of EMS workers should be at organizational and individual level.

Occupational stress contributes to a wide range of health problems, including acute traumatic injuries, psychological issues, musculoskeletal disorders, and cardiovascular diseases. As a group, these disorders are responsible for much morbidity, mortality, and disability, as well as healthcare utilization (1). According to the National Institute for Occupational Safety and Health, occupational stress is defined as the stress that occurs when the needs of the job poorly

align with the abilities of the employee, available resources, and expectations of the employer and this stress is thought to cause harmful physical and emotional responses (2). The electronic manufacturing services (EMS) industry refers to the companies that engaged in testing, distribution, and providing return and repair services for electronic components and assembling for original equipment manufacturers. With further industrialization and modernization, EMS workers are exposed to increasing occupational psychological problems have gained attention from all social sectors (3). Occupational Stress Surveillance Program (OSSP) is an ongoing, nationwide, surveillance program that collects self-reported information on psychosocial conditions and well-being at workplace, in order to explore occupational stress level of key population from typical industry and to improve mental health and well-being among occupational populations. It is administered by National Institutes of Occupational Health and Poison Control, China CDC, in collaborating with participating local occupational disease prevention institutions.

In the present report, we analyzed combined OSSP data from years of 2015, 2016, and 2017 that focusing on EMS industry of the survey. Response rates for the 3 years of surveys ranged from 91.0% to 94.4% and it produced a 3-year sample of 21,362 participants from 20 electronic manufacturing companies. Among those, as the typical areas of EMS industry in China, five distributed in the central and western regions (Sichuan and Hunan), seven around Bohai Rim (Beijing and Tianjin), two around Yangtze River Delta (Jiangsu), and six around Pearl River Delta (Guangdong) regions.

All questionnaires and group interviews were completed during July to September of each year. Participants were considered to be working at current position for at least more than half a year and without any history of mental disorders or relative medications. Specifically, they were asked to complete a self-report questionnaire consisting of socio-demographic

characteristics (examples including age, gender, and education level), job characteristics (such as hours of work, number of shifts, etc.) and occupational stress, as well as symptoms of other mental disorders (not involved in this report).

Occupational stress was assessed using the Chinese short version of occupational stress inventory, which is developed based on two extensive used theoretical frameworks, Job-Demand-Control and Effort-Reward-Imbalance models, and demonstrated with good reliability and validity (4-5). It consists of a set of 38 items that assess 6 dimensions of psychosocial factors: work demands, job control, social support, effort, reward, and over-commitment. Each item is measured on a five-point Likert scale ranging from one (never) to five (almost all the time). Each variable was then added up separately. Each sum of demand and control was dichotomized into high and low using the median of the distribution as cut-off. Then high strain was labelled according to dichotomized variables (high job demand with low control). Another two summed variables, effort and reward, were divided ( $\sum_{\text{effort}} / \sum_{\text{reward}}$ ) and then multiplied with a correction factor (0.4545), thus creating the effort-reward ratio. A larger ratio indicates a greater imbalance between effort and reward. The effort-reward imbalance was characterized when the ratio is greater than one.

Prevalence for high strain and effort-reward imbalance were calculated overall and by socio-demographic characteristics and job characteristics. The chi-square test was used to determine statistically significant difference between groups. All statistical assessments were considered significant at  $p < 0.05$ . Statistical analyses were performed using SPSS statistical software (version 22.0, SPSS Inc, Chicago, IL, USA).

Among all respondents, the prevalence of high strain and effort-reward imbalance were 19.5% and 15.8%, respectively (Table 1). Characterized by socio-demographic factors, the prevalence of high strain were significantly differed by age, education and income level, while the prevalence of effort-reward imbalance were significantly differed by gender and income level. Compared to those working at other job positions, assembly-line workers present higher level of occupational stress. Specifically, 20.9% of assembly-line workers were exposed to high strain due to high demand with low control job and 17.4% of them were exposed to effort-reward imbalance. Migrant workers among those respondents reported significantly higher

prevalence of high strain and effort-reward imbalance (21.1% and 16.5%) than non-migrant workers. For those working in a shift position, the prevalence of high strain were significantly higher (20.0%) compared to non-shift workers. Exposed to long working hours may increase the risk of occupational health, for those who has been working over 50 hours per week averagely had higher level of high strain (20.8%) and effort-reward imbalance (18.3%).

## Discussion

Occupational stress is a prevalent and costly problem of pandemic proportions in today's workplace affecting millions of people across the world (6). As reported, those working at machine-paced assembly-line is high stressful with 20.9% of them were exposed to high strain job. This type of work requires vigilance yet is monotonous and repetitive, which typically presents a harmful combination of short interval demands with lack of control. Technical development in assembly-line work has often resulted in more meticulous and complicated tasks for the workers who may have to work at the highest intensity for hours, and, consequently, more stress.

Migrant workers, mostly from rural areas of their original residence to urban areas, are a unique phenomenon occurring developing countries with experiencing economic transformations. Previous studies showed that because of their exposure to poor working conditions, hazards and long working hours, migrant workers have suffered from the highest incidences of occupational diseases in all labor force in China (7). In this report, migrant workers from EMS industry were exposed to higher stress level. The degree of acceptance felt in a new home, relationships with coworkers, job-related and behavior customs may lead to occupational stress for migrant workers. It may be further exacerbated by fear of job loss or deportation, particularly among those without job authorization. The International Labour Organization (ILO) calls for policies that recognize the contributions made by migrant workers and promote decent work opportunities and social protections, including ensuring that wages are regularly and directly paid to the workers, protecting social security benefits, and promoting written employment contracts.

Preventing or reducing occupational stress is challenging, given the economic, political, and labor-market factors that are increasing stressors at work.

TABLE 1. Prevalence of occupational stress among EMS workers based on JDC and ERI models by selected demographic and job characteristics (n=21,362).

Characteristics	Number	High strain (high demand – low control)		Chi-square test	p value	Effort reward imbalance (E/R ratio >1)		Chi-square test	p value
		Number	%			Number	%		
Overall	21,362	4,159	19.5			3,376	15.8		
Gender									
Male	10,039	2,023	20.2			1,948	19.4		
Female	11,323	2,136	18.9	5.623	0.018	1,428	12.6	184.526	<0.001
Age (years)									
18–25	2,391	436	18.2			402	16.8		
26–30	6,999	1,365	19.5			1,101	15.7		
31–35	3,411	1,346	21.0			1,023	16.0		
36–40	3,215	633	19.7			484	15.1		
≥41	2,346	379	16.2	29.328	<0.001	366	15.6	3.401	0.493
Education									
<high school	5,811	1,066	18.3			896	15.4		
≥high school	15,551	3,093	19.9	6.439	0.011	2,480	15.9	0.888	0.346
Marital status									
Married	13,721	2,659	19.4			212	15.5		
Unmarried	7,641	1,500	19.6	0.199	0.656	1,255	16.4	3.445	0.063
Income (¥)									
<3,000	9,380	1,752	18.7			1,423	15.2		
3,000–5,000	9,762	1,933	19.8			1,545	15.8		
>5,000	2,220	474	21.4	9.447	0.009	408	18.4	13.889	0.001
Migrant worker									
Yes	16,819	3,541	21.1			2,777	16.5		
No	4,543	618	13.6	126.628	<0.001	599	13.2	29.736	<0.001
Position									
Assembly-line	10,222	2,135	20.9			1,778	17.4		
Others	11,140	2,024	18.2	25.109	<0.001	1,598	14.3	37.246	<0.001
Shift									
Yes	12,224	2,448	20.0			1,964	16.1		
No	9,138	1,711	18.7	5.655	0.017	1,412	15.5	1.485	0.223
Work hours									
≤50 h	10,528	1,907	18.1			1,398	13.3		
>50 h	10,834	2,252	20.8	24.329	<0.001	1,978	18.3	99.456	<0.001

Developing and implementing multiple types of preventive measures is necessary to protect and promote worker health and well-being. Based on a large number of practical examples, there are many practical ways of eliminating occupational stress for assembly-line workers, ranging from strengthening the individual's response to stress, to improving the physical work environment and changing the organization of work. A combination of organizational

change and stress management is often the most useful approach for preventing stress at work. Activities at organization level include adjusting workload to workers' abilities, defining role and responsibilities clearly, promoting interaction among workers, and establishing good communication about workplace issues, etc. Most stress management approaches focus on individual level to teach coping skills and techniques for reduction of stress, such as exercise,

progressive relaxation, Yoga, and so forth. The National Institute for Occupational Safety and Health (NIOSH), for example, recommends the “Total Worker Health” (TWH) approach (8), which integrates health promotion and stress management aimed at individuals with “health protection” (occupational health), with the goal of reducing both physical and psychosocial hazards in the workplace. The TWH approach has the potential to identify and change barriers behaviors, such as inflexible schedules, shift work, and long duration of work, and to reduce risks of chronic disease caused by stressful work.

The findings in this report are subject to at least three limitations. First, data are self-reported and therefore subject to inherent biases. Second, this study is a cross-sectional survey, being cautious for the causal relationship between occupational stress and relevant risk factors. Thirdly, the study population was from selected areas only, and the generalization of the findings may be limited.

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## Conflict of Interests

No conflicts of interest were reported.

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