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SHORT COMMUNICATION

Workers' load and job-related stress after a reform and work system change in a hospital kitchen in Japan

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Abstract
Objectives Many kitchen work environments are considered to be severe; however, when kitchens are reformed or work systems are changed, the question of how this influences kitchen workers and environments arises. The purpose of this study is to examine whether there was a change in workload and job-related stress for workers after a workplace environment and work system change in a hospital kitchen.
Methods The study design is a pre–post comparison of a case, performed in 2006 and 2008. The air temperature and humidity in the workplace were measured. Regarding workload, work hours, fluid loss, heart rate, and amount of activity [metabolic equivalents of task (METs)] of 7 and 8 male subjects pre- and post-reform, respectively, were measured. Job-related stress was assessed using a self-reporting anonymous questionnaire for 53 and 45 workers pre- and post-system change, respectively.
Results After the reform and work system change, the kitchen space had increased and air-conditioners had been installed. The workplace environment changes included the introduction of temperature-controlled wagons whose operators were limited to male workers. The kitchen air temperature decreased, so fluid loss in the subjects decreased significantly. However, heart rate and METs in the subjects increased significantly. As for job-related stress, although workplace environment scores improved, male workers' total job stress score increased.
Conclusions These results suggest that not only the workplace environment but also the work system influenced the workload and job stress on workers.

Keywords Workplace environment · Work load · Job-related stress · Work system · Kitchen

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Introduction

Labor shortages are a major problem for the food industry in advanced countries, as documented in countries such as Japan [1, 2] and Canada [3]. In Japan in 2009, 1.21 million people were hired in the lodging and food service industries. In 2009, although the hiring rate in these industries was 33.2 %, the labor turnover rate was 32.1 % [4]. In particular, the part-time worker rate was 69.9 %, the highest rate among major industries [5]. The work environment in the food service industry is considered to be severe due to the necessity of extended standing and working in a hot environment. Also, work is conducted at irregular working hours in schools [6–9] and hospitals [10, 11], and with a heavy workload on the musculoskeletal system [12, 13].

Increased time pressure increases perceived workload, and increased overtime leads to a significant rise in job

stress [14]. Heavy workload and job stress are associated with lower practical performance [15]. Poor control over working hours predicts increased sickness absence among men [16].

Following a serious food-poisoning incident in a Japanese school cafeteria in 1996 [17], the Ministry of Health, Labor, and Welfare of Japan designed a Mass Cooking Facility Sanitation Manual to prevent food-poisoning incidents [18]. This includes two critical points. First, it is recommended to keep the air temperature below 25 °C and humidity below 80 % in kitchen environments; therefore, reform of kitchens to be fully equipped with cooling devices is necessary. Second, the temperature of meals and food must be kept over 65 °C or below 10 °C. To achieve these criteria, introduction of hot and cold holding wagons or storage is necessary.

Work organization and system changes affect workers' physical and mental load [19]. When kitchens are reformed or work systems are changed, the question of how this influences kitchen workers arises; therefore, the purpose of this study is to examine the impact of kitchen reform and work system changes on the workplace environment, and workload and job-related stress of workers.

Subjects and methods

The study design was a pre–post comparison of a case. A hospital kitchen for patients was renovated from February to May 2007 to reconstruct a decrepit kitchen and ensure an appropriate work environment for food handling. Measurements were performed in September 2006 and 2008, respectively, pre- and post-reform. The weather was fine during both the pre- and post-reform survey periods. This study was approved by the Ethics Committee of Dokkyo Medical University School of Medicine and complied with the Helsinki Declaration. All subjects were fully informed of the purpose, procedures, and possible risks of the study, and then gave written informed consent.

Reform details and working hours

The reform details, production facility, employee, work shift, and operation hours were reviewed by an administrator of the Department of Nutrition of the hospital. We classified male workers' duties into cooking, dish preparation using a conveyor, wagon operation, and others during 9:00 a.m. to 12:00 p.m. using a 30-s interval snap-reading method.

Work environments

For the kitchen environment, the kitchen and outdoor air temperature and humidity were measured using an air temperature–humidity data logger (TR-72U; T and D Co. Ltd.) consecutively every 30 s for the 2 days of the study. The measuring instruments were fixed to the kitchen on an outside wall that was not affected by sunlight, rain, wind, or exhaust from the kitchen.

Workload

Regarding workload, fluid loss, heart rate, and amount of activity (METs) were measured from 9:00 a.m. to 12:00 p.m. The subjects were 7 (41.2 ± 7.7 years) and 8 (42.9 ± 8.9 years) men pre- and post-reform, respectively. They were accustomed to the heat stress of the kitchen environment as full-time male cooks. Age and height were asked by questionnaire before measurement.

The subjects were weighed using a digital scale (FG-150KBM; A&D Co.) before and after measurement, wearing only underwear. Fluid loss assessed the difference between before and after weight, with added water intake. METs were estimated using a wrist accelerometer (ACTICAL activity monitor; Mini Mitter Co., Ltd.). Heart rate was estimated using ACTIHR (Mini Mitter Co., Ltd.) every minute. Averages of these values were used in this study.

Job-related stress

Subjects were asked about sex, age, years of employment in current job, type of employment, and job-related stress using a self-reporting anonymous questionnaire. The survey subjects were kitchen workers, excluding clerical workers. Fifty-three workers participated in the pre-reform phase and 45 in the post-reform phase. Job-related stress was measured using part of the Brief Job Stress Questionnaire developed by Shimomitsu et al. [20]. The questionnaire includes eight job-related stress factors regarding quantitative overload (number of items, 3), qualitative overload (3), physical load (1), job control (3), skill discretion (1), interpersonal relationships (3), workplace environment (1), and job fitness (2). Respondents rated their agreement on a 1–4 scale: agree, somewhat agree, somewhat disagree, and disagree.

Statistical methods

We compared variables pre- and post-reform. The chi-square test was used for subjects' characteristics. Student's unpaired t test was used for air temperature, humidity, age, height, weight, body mass index (BMI), fluid loss, heart rate, and METs, since the compared subjects were not identical. Job-related stress was divided into males and females, and compared by the Mann–Whitney U test. Analysis was performed using SPSS version 15.0 (SPSS Japan, Tokyo). In the two-sided test, $p < 0.05$ was considered significant.

Table 1 Kitchen reform details and employees characteristics

	Pre (2006)	Post (2008)
Production facility		
Productivity (meal time)		
Amount of production	840	816
Productivity (meals/worker)	20.5	19.9
Floor space (m^2)	778.0	915.2
Cooling device		
Air conditioner	0	32
Spot cooler	18	0
Delivery wagon		
Type	Normal	Hot and cold holding wagon
Weight (kg)	63.5	265.0
Operator	Female	Male
Employees		
Number of employees/day[a]	41	41
Male workers/day	16	16
Full time workers/day	11	11

[a] Department of hospital food service staff, excluding diet counselors and clerks

Table 2 Work shift and male workers' working hours

	Pre (2006)	Post (2008)
Work shift		
Full-time workers		
Early morning shift	5:30–13:40	5:10–13:00[a]
Daytime shift	8:50–17:00	8:50–17:00
Late shift	11:00–18:00	11:00–19:10[b]
Part-time workers		
Early morning shift	5:30–10:40	5:00–10:20[a]
Morning shift	6:00–12:00	6:00–12:00
Daytime shift	8:50–17:00	8:50–17:00
Late shift	13:15–20:15	13:15–20:15
Working hours rate/male cook (9:00 a.m.–12:00 p.m.)[c]		
Cooking (%)	72.3	50.0
Dish preparation using conveyor (%)	24.4	32.2
Wagon operation (%)	0.0	17.8
Others (%)[d]	3.3	0.0

[a] Start time became earlier

[b] Finish time became later

[c] 30 s interval snap-reading method

[d] Others: meeting, recording and rest

Results

Table 1 presents kitchen reform details and employees. Both pre- and post-reform, meal production per meal time, number of employees per day, and the rate of male workers remained almost the same. After reform, kitchen space had increased by 18 %, so the workers' flow line was extended, and 32 air-conditioners had been installed. A new wagon (265.0 kg; Panasonic Co., Ltd.) replaced the old wagon (63.5 kg; Erecta International Corp.); wagon weight increased by 3.2 times, and their operation became limited to male workers.

Table 2 presents work shift and male workers' working hours. Workers perform several work shifts from early morning to night. The start time of full-time workers' early morning shift was changed from 05:30 to 05:00. The finish time of full-time male workers' late shift was changed from 18:00 to 19:10. With the introduction of hot and cold holding wagons, male workers had to operate the wagons. Due to these work system changes, specialized cooking work decreased, and dish preparation using a conveyor and carts increased.

Table 3 presents the work environment pre- and post-reform. Regarding the work environment, although the outdoor temperature post-reform was higher than pre-reform, the kitchen temperatures decreased ($p < 0.001$). Outdoor and kitchen humidity post-reform were higher than pre-reform.

Table 4 presents physical workload pre- and post-reform. Subject's age, height, body weight, and BMI showed no significant difference between pre- and post-reform. Subjects' fluid loss decreased, and heart rate and METs post-reform increased significantly compared with pre-reform.

Table 5 presents workers' characteristics, job stress, and social support scores. Fifty and 45 workers answered the questionnaire pre- and post-reform, respectively. The response rates were 94 and 100 % pre- and post-reform, respectively. Both male and female subjects were middle-aged, although almost women were temporary employees, and men were permanent employees. There was a difference in the job-related stress change between men and women. For men, total job stress scores increased. On the job stress subscales, quantitative overload, poor job control, and poor job fitness increased, whereas workplace environment scores improved significantly for both men and women. For women, the total job stress score and job stress subscales, except environment scores, showed no significant difference. Both men and women's social support scores showed no significant differences pre- and post-reform.

Discussion

The originality of this study is that we measured work environments, workers' physical workload, and job-related

Table 3 Work environment pre- and post-reform

	Pre (2006)		Post (2008)		*P* value[b]
	N[a]	Mean (SD)	*N*	Mean (SD)	
Workplace environment					
Air temperature (°C)					
Kitchen	5300	29.7 (1.1)	4976	24.1 (3.1)	<0.001
Outdoors	5293	20.7 (2.0)	4931	25.5 (1.8)	<0.001
Humidity (%)					
Kitchen	5300	41.7 (7.1)	4976	67.4 (8.5)	<0.001
Outdoors	5293	58.0 (9.7)	4931	74.2 (10.6)	<0.001

[a] Measurement number

[b] Non-paired *t* test

Table 4 Workload pre- and post-reform

	Pre (2006)		Post (2008)		*P* value[a]
	N	Mean (SD)	*N*	Mean (SD)	
Subjects					
Age (year)	7	41.2 (7.7)	8	42.9 (8.9)	n.s.
Height (cm)	7	165.4 (3.5)	8	168.4 (1.4)	n.s.
Weight (kg)	7	66.3 (15.2)	8	67.7 (12.2)	n.s.
BMI	7	23.3 (3.3)	8	23.9 (4.0)	n.s.
Workload					
Fluid loss (kg)	7	0.99 (0.31)	8	0.70 (0.30)	<0.01
Heart rate (bpm)	7	105.1 (18.9)	8	110.7 (25.8)	<0.001
METs	7	2.2 (0.9)	8	3.3 (0.7)	<0.001

[a] Non-paired *t* test

stress simultaneously and compared them pre- and post-reform in a hospital kitchen. Reforms consisted of the following: air-conditioners had been placed in the kitchen, the air temperature improved significantly, and after hot and cold holding wagons had been introduced to prevent food-poisoning incidents, the work system was changed, with the result that male workers increased their heart rate, METs, and subjective job stress.

This reform had a structural building limitation, and introduced a change to the work system. The reform was constrained by the existing building structure, so the elevator shafts could not be modified. When large hot and cold holding wagons were introduced, the number of wagons in the elevator fell from 3 to 2 per trip. Additionally, due to the introduction of heavy, large wagons, their operation was restricted to male workers only; therefore, the work system underwent 4 changes: The starting time was 30 min earlier, the cooking hours decreased and time pressure increased, the flow line was expanded, and nonspecialized work increased for male workers.

In this study, the workplace reform decreased the kitchen temperature, so workers' evaluation of the workplace environment improved. This was the main purpose of the reform. Post-reform, workplace temperatures were improved to reach almost the same as the national guideline [18], so fluid loss decreased significantly post-reform. In this study, although we performed the measurements in almost the same season, we could not control the outdoor environment. Because the intake air system in the kitchen was using outdoor air directly, the kitchen's humidity was affected by outdoor air.

Regarding workload, although there is no report on the amount of activity in mass cooking facility work, the amount of activity in home cooking, washing dishes, and transporting dishes is 2.0, 2.3, and 2.5 METs, respectively [21]. METs in this study were higher than activity in the home because our study workers operated heavy, large wagons and moved around a large kitchen and hospital. It was reported that time pressure increased perceived workload and heart rate [14], consistent with our results; however, the workload in this study was not extensive compared with construction and farming [21], so heart rate and METs were not high enough to affect the physical load on the job-related stress subscale.

In this study, male workers were middle-aged full-time workers. As a result of the reform, these workers, who had worked for many years in the same workplace, had to engage in nonspecialized work, such as wagon operation and dish washing. So, male workers' job-related stress increased since the amount of work and its content changed. We consider that these conditions might have

Table 5 Workers' characteristics and job stress score

	Items	Male					Female				
		Pre (2006)		Post (2008)		*P* value[a]	Pre (2006)		Post (2008)		*P* value[a]
		N	Mean (SD)	*N*	Mean (SD)		*N*	Mean (SD)	*N*	Mean (SD)	
N		19		19			31		26		
Age (year)		19	46.4 (8.4)	19	50.3 (9.2)	n.s.	31	47.6 (13.4)	25	44.6 (14.7)	n.s.
Years of employment in current job		18	22.2 (7.3)	18	23.2 (9.1)	n.s.	24	7.8 (8.0)	23	5.1 (4.0)	n.s.
Type of employment											
Permanent employee (%)		19	(100.0)	18	(94.7)	n.s.[b]	7	(22.6)	10	(38.5)	n.s.[b]
Temporary employee (%)		0	(0.0)	1	(5.3)		17	(77.4)	13	(61.5)	
Job stress score (total)	17	17	28.9 (4.7)	15	35.7 (5.8)	<0.01	21	34.3 (6.8)	21	32.8 (5.6)	n.s.
Quantitative overload	3	17	5.2 (1.6)	19	7.3 (1.6)	<0.001	26	6.7 (1.8)	23	6.5 (1.7)	n.s.
Qualitative overload	3	18	5.9 (2.0)	19	6.4 (1.3)	n.s.	27	6.5 (1.5)	24	6.2 (1.7)	n.s.
Physical load	1	18	2.2 (0.7)	19	2.5 (0.5)	n.s.	30	2.6 (0.6)	26	2.7 (0.9)	n.s.
Poor job control	3	18	4.6 (2.1)	18	6.7 (1.4)	<0.01	27	5.6 (2.3)	26	5.5 (2.2)	n.s.
Poor skill discretion	1	18	1.6 (0.9)	18	1.5 (0.9)	n.s.	27	1.2 (0.9)	23	1.6 (0.9)	n.s.
Poor interpersonal relationship	3	18	4.8 (1.8)	16	5.6 (2.0)	n.s.	24	5.0 (2.2)	23	5.9 (1.4)	n.s.
Poor workplace environment	1	18	2.6 (0.5)	19	1.9 (0.7)	<0.01	30	2.7 (0.6)	24	1.4 (0.9)	<0.001
Poor job fitness	2	18	3.6 (0.7)	19	5.5 (0.9)	<0.001	28	4.4 (1.3)	23	4.8 (1.4)	n.s.

[a] Manny–Whitney *U* test

[b] Chi-square test

influenced the male workers' subjective evaluation of the quantitative overload, job control, and job fitness. Our result was consistent with previous studies that found that job control, physical activity, and psychological distress are related [22], that male permanent workers experienced high job stress [23], that low job control was associated with poor work control [16], and that organization and work system change increased job-related stress [19].

There are four weaknesses to this case study. First, because the questionnaires were anonymous, it was difficult to clarify intra-individual changes due to the system change. Second, because it was a case study, we cannot generalize the results to all kitchen reform, and further studies are required to evaluate renovation and the effects of changes to work systems. Third, because the subjects of the pre- and post-reform surveys were not exactly the same, we had to compare changes in the group instead of in individuals. Over the 2-year period, some workers quit or retired and others were hired. Fourth, workload was measured only once, so repeatability is doubtful.

Finally, although there were some problems concerning the work system, the reform was focused on improving the work environment. Our study found that workplace reform does not equal work system improvement. This reform was subject to various structural constraints, so middle-aged, long-term male workers had to accept more demanding nonspecialized work and an earlier starting time, and encountered a bottleneck created by the lack of elevator capacity. On the other hand, for female workers, job-related stress did not increase because there were few work system changes. In a society with labor shortages, it is necessary for work environments and systems to accommodate the elderly and women. Further studies to research the relationship between job-related stress and performance, safety, and workers' health at many worksites are required to evaluate reform and work system effects. These results suggest that not only the workplace environment but also the work system influenced the workload and job stress on workers. To improve institutions and work systems, it is necessary to consider the impact of the workload and job-related stress on workers.

Conflict of interest The authors declare they have no conflicts of interest. We have no financial relationship with the organization that sponsored the research.

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