

Burn and Cut Injuries Related to Job Stress among Kitchen Workers in Japan

Yasuo HARUYAMA^{1*}, Hiroe MATSUZUKI^{1,2}, Shigeru TOMITA¹, Takashi MUTO¹,
Takashi HARATANI³, Shigeki MUTO⁴ and Akiyoshi ITO⁵

¹Department of Public Health, Dokkyo Medical University School of Medicine, Japan

²Department of Nutrition and Life Science, Kanagawa Institute of Technology, Japan

³National Institute of Occupational Safety and Health, Japan

⁴Seirei Center for Health Promotion and Preventive Medicine, Japan

⁵University of Occupational and Environmental Health, Japan

Received July 24, 2013 and accepted December 17, 2013

Published online in J-STAGE January 15, 2014

Abstract: To clarify the correlation between kitchen work-related burns and cuts and job stress, a self-administered questionnaire survey was conducted involving 991 kitchen workers among 126 kitchen facilities. The demographics, condition of burns and cuts, job stress with the Brief Job Stress Questionnaire (BJSQ), health condition, and work-related and environmental factors were surveyed. Multiple logistic regression models and trend tests were used according to quartiles (Q1, Q2, Q3, and Q4) of each sub-scale BJSQ. After adjustment for potential confounding variables, burns/cuts were associated with a higher score category (Q4) of job demands (OR: 2.56, 95% CI: 1.10–6.02/OR: 2.72, 95% CI: 1.30–5.69), psychological stress (OR: 4.49, 95% CI: 2.05–9.81/OR: 3.52, 95% CI: 1.84–6.72), and physical stress (OR: 2.41, 95% CI: 1.20–4.98/OR 2.16, 95% CI: 1.16–4.01). The ORs of the burn/cut injuries increased from Q1 to Q4 with job demands (p for trend = 0.045/0.003), psychological stress (p for trend < 0.001/0.001), and physical stress (p for trend = 0.006/0.005), respectively. These findings suggest that kitchen work-related burns and cuts are more likely to be correlated with job stress, and the higher the job stress score, the higher the frequency of burns and cuts among kitchen workers.

Key words: Burns, Cuts, Occupational injuries, Job stress, Kitchen worker

Introduction

Health and safety are priority issues in occupational health worldwide. According to the World Health Organization¹, 100 million workers are injured and 200,000 die each year in occupational accidents. Food service industries including restaurant, hospital, and school canteen kitchens are important areas of employment in the

world^{2–4}. In Japan, there are an estimated approximately 2.6 million kitchen workers, that accounting for 4.1% of the entire employees⁵.

Kitchen work has been reported to involve a marked workload, poor environment, and high risks of work-related diseases and injuries for cooks and food service workers^{3, 6, 7}. Previous studies reported that kitchen worker had a high prevalence of musculoskeletal disorders^{8–10}, skin diseases^{11, 12}, and slipping^{13, 14}. Furthermore, many studies reported a high risk of kitchen work-related burns or cuts among kitchen workers in many countries, such as in the US^{15–17}, Finland¹⁸, Ireland², Canada³, Singapore⁴,

*To whom correspondence should be addressed.

E-mail: yasuo-h@dokkyomed.ac.jp

©2014 National Institute of Occupational Safety and Health

India¹⁴), and Japan¹⁹). In addition, burns injury led to lost working time and public expenses^{3, 13}).

Regarding the causes of burns, personal factors (males, younger, less job experience), work-related factors (night-shift work), and environmental factors were reported^{15, 16, 19}). The ergonomics, equipment, and devices were considered in some previous studies¹⁸). Riina reported that protective garments could reduce the incidence of thermal injuries²⁰). Risk of work-related injuries including cuts and open wounds were higher in younger males²¹), and causes of cuts other than from knives were not reported^{14, 18}).

Non-fatal occupational injuries were reportedly with a large workload, cognitive demands, a marked stress reaction, and low level of job control^{22–25}), but these studies did not refer to burns or cuts during kitchen work. With regard to the association between kitchen work and job stress, the prevalence of low back pain and epicondylitis was investigated^{26, 27}). However, no study discussed the association between kitchen work-related burns and cuts and job stress in kitchen workers. Our hypothesis in this study was that more burns and cuts occur in kitchen workers with a higher job stress.

The purpose of this study was to clarify the correlations between the work-related burns and cuts and job demands, and physical and psychological stress among kitchen workers.

Methods

Subjects and study design

The subjects in this study were 991 workers aged from 17 to 68 yr old in 126 kitchen facilities, which included 103 primary schools (578 workers, 58.3%), 17 hospitals (343 workers, 34.6%), and 6 restaurants (70 workers, 7.1%) in central Japan. The 126 kitchen facilities were recruited from a list that they were compiled by occupational doctors and researchers of this study, as previously reported^{19, 30}). All the schools were public schools, and 81 of them were located in the Chubu region, while 22 were located in the Tokyo metropolitan area. The number of kitchen workers varied from 2 to 20 in each school. The principal task of these workers was to provide lunches for all pupils 5 d a week. The 11 hospitals were regional hub, university and affiliated hospitals. The six nursing homes were related institutes. Nine out of the 11 hospitals were located in the Tokyo metropolitan area, and the others were in Shikoku and Tohoku regions. The number of workers varied from 10 to 60 in each hospital. Five nursing homes were located in the Chubu region, and the

remaining one was in the Tokyo metropolitan area. Five to nine workers worked in each nursing home. Kitchen workers in these institutions provided breakfast, lunch, and dinner for all residents. The six restaurants were located in the Tokyo metropolitan area. The number of workers in the restaurants varied from 7 to 20. All restaurants were open until midnight and two of them were open 24 h. Kitchen workers in these restaurants provided meals at irregular times. A cross-sectional study was conducted involving a self-administered, anonymous questionnaire distributed to all employees during August to November 2006.

The protocol of this study was approved by the Ethics Committee of Dokkyo Medical University. All subjects were fully informed of the purpose of the study, and then gave written informed consent.

Personal questionnaire

1. Demographic and work-related items: The items in the personal questionnaire survey included the age, gender, height, weight, years working in a kitchen, working hours per day, working system, shift, and types of main job. Personal health conditions were assessed with the question: “do you have finger deformation, pain of the lower back, arthralgia, or hand dermatitis requiring medication?” The body mass index (BMI) was calculated as the body weight (kg) divided by the square of the height (m²). There were 809 responders, and the response rate was 81.6%. Of the 809 responders, those with missing values on the gender, age, burns, cuts, and job stress were excluded, and 740 (570 females and 170 males) kitchen workers were identified as the subjects, with an effective response rate of 74.7%.

2. Burns and cuts assessment: The information on burns and cuts was collected from self-reported questionnaire of subjects. The two questions and possible response categories were as follows: 1) have you experienced any burns during kitchen work in the last year? (≤ 5 times/ >5 , ≤ 10 times/ >10 , ≤ 20 times/ >20 times). 2) Have you experienced any cuts during kitchen work in the last year? (≤ 5 times/ >5 , ≤ 10 times/ >10 , ≤ 20 times/ >20 times). For the burns (+) and cuts (+) those who were injured six times or more in the last year were the frequent group, and they were used to analyze the correlation between each factor and injuries according to Tomita’s study¹⁹).

3. Job stress assessment: The Brief Job Stress Questionnaire (BJSQ), a 57-item multidimensional job stress questionnaire, was used to measure job demand (7 items), job control (3 items), human relationship (3 items), fitness of work (3 items), working environment (1 item), physical (11 items), psychological (18 items) stress, social support

Table 1. Characteristics of demographics, health condition, and work-related and environmental factors in kitchen workers

	All ^a	Burns (+) ^b	Burns (-) ^b	<i>p</i> -value ^c	Cuts (+) ^b	Cuts (-) ^b	<i>p</i> -value ^c
	n (%)	n (%)	n (%)		n (%)	n (%)	
Personal factors							
Gender							
Males	170 (23.0)	37 (21.8)	133 (78.2)	0.015	32 (18.8)	138 (81.2)	0.083
Females	570 (77.0)	80 (14.0)	490 (86.0)		144 (25.3)	426 (74.7)	
Age, yr							
≤35	223 (30.1)	43 (19.3)	180 (80.7)	0.205	61 (27.4)	162 (72.6)	0.313
35–55	414 (55.9)	61 (14.7)	353 (85.3)		91 (22.0)	323 (78.0)	
55≤	103(13.9)	13(12.6)	90 (87.4)		24 (23.3)	79 (76.7)	
Health condition							
BMI, kg/m²							
<25.0	590 (84.5)	94 (15.8)	502 (84.2)	0.364	141 (23.7)	455 (76.3)	0.532
≥25.0	109 (15.5)	21 (19.3)	88 (80.7)		28 (25.7)	81 (74.3)	
Finger deformation							
Yes	10 (1.4)	2 (20.0)	8 (80.0)	0.715	4 (40.0)	6 (60.0)	0.225
No	730 (98.6)	115 (15.8)	615 (84.2)		172 (23.6)	558 (76.4)	
Pain of the lower back							
Yes	123 (16.6)	24 (19.5)	99 (80.5)	0.218	38 (30.9)	85 (69.1)	0.043
No	617 (83.4)	93 (15.1)	524 (84.9)		138 (22.4)	479 (77.6)	
Other arthralgia							
Yes	91 (12.3)	21 (23.1)	70 (76.9)	0.042	31 (34.1)	60 (65.9)	0.014
No	649 (87.7)	96 (14.8)	553 (85.2)		145 (22.3)	504 (77.7)	
Dermatitis (hand)							
Yes	43 (5.8)	11 (25.6)	32 (74.4)	0.070	15 (34.9)	28 (65.1)	0.078
No	697 (94.2)	106 (15.2)	591 (84.8)		161 (23.1)	536 (76.1)	
Work-related factors							
Working in a kitchen, yr							
≤2	274 (44.6)	53 (19.3)	221 (80.7)	0.115	68 (24.8)	206 (75.2)	0.282
2 to 5	169 (27.5)	20 (11.8)	149 (88.2)		31 (18.3)	138 (81.7)	
6≤	171 (27.9)	30 (17.5)	141 (82.5)		38 (22.2)	133 (77.8)	
Job hours, hr/day							
<8	217 (30.0)	32 (14.7)	185 (85.3)	0.097	50 (23.0)	167 (76.2)	0.955
8	423 (58.4)	62 (14.7)	361 (85.3)		102 (24.1)	321 (75.9)	
>8	84 (11.6)	20 (23.8)	64 (76.2)		20 (23.8)	64 (76.2)	
Working system							
Part-time							
Regular	258 (35.6)	35 (13.6)	223 (86.4)	0.180	59 (22.9)	199 (77.1)	0.630
Shift	466 (64.4)	81 (17.4)	385 (82.6)		114 (24.5)	352 (75.5)	
Shift							
Day service	536 (74.8)	87 (16.2)	449 (83.3)	0.542	130 (24.3)	406 (75.7)	0.796
Day shift	165 (23.0)	25 (15.2)	140 (84.8)		37 (22.4)	128 (77.6)	
Other	16(2.2)	1 (6.3)	15 (93.8)		3 (18.8)	13 (81.3)	
Type of main job							
Cooking	343 (46.4)	38 (11.1)	305 (88.9)	0.001	75 (21.9)	268 (78.1)	0.521
Washing up	56 (7.6)	7 (12.5)	49 (87.5)		14 (25.0)	42 (75.0)	
Other	341 (46.1)	72 (21.1)	269 (78.9)		87 (25.5)	254 (74.5)	
Output, meals/day							
<750	391 (52.8)	69 (17.6)	322 (82.4)	0.147	87 (22.3)	304 (77.7)	0.300
750≤	349 (47.2)	48 (13.8)	301 (86.2)		89 (25.5)	260 (74.5)	
Environmental factors							
Size of kitchen, m²							
200≤	408 (55.1)	54 (13.2)	354 (86.8)	0.033	99 (24.3)	309 (75.5)	0.733
<200	332 (44.9)	63 (19.0)	269 (81.0)		77 (23.2)	255 (76.8)	
Type of floor condition							
Dry	427 (60.3)	59 (13.8)	368 (86.2)	0.248	97 (22.7)	330 (77.3)	0.593
Semi-wet	109 (15.4)	18 (16.5)	91 (83.5)		29 (26.6)	80 (73.4)	
Wet	172 (24.3)	33 (19.2)	139 (80.8)		44 (25.6)	128 (74.4)	
Type of heat							
Electric	378 (51.1)	49 (13.0)	329 (87.0)	0.030	89 (23.5)	289 (76.5)	0.876
Gas	362 (48.9)	68 (18.8)	294 (81.2)		87 (24.0)	275 (76.0)	
Type of kitchen							
School	393 (53.1)	57 (14.5)	336 (85.5)	<0.001	108 (27.5)	285 (72.5)	0.023
Hospital	292 (39.1)	37 (12.7)	255 (87.3)		54 (18.5)	238 (81.5)	
Restaurant	55 (7.4)	23 (41.8)	32 (58.2)		14 (25.5)	41 (74.5)	

a: Missing values were excluded.

b: Burns and cuts (+) more than 5 times and (-) less than 5 times in the last year by self-report.

c: *p*-value from χ^2 test.

Table 2. Association between burn injuries and job stress using multiple logistic regression models

Sub scales of BJSQ	n	No of burns (>5 times/year)	%	Model 1		Model 2		Model 3		Model 4		Model 5		<i>p</i> for trend
				OR	95% CI									
Job demands, point														
Q1 (<23)	143	17	11.9	1.00		1.00		1.00		1.00		1.00		0.045
Q2 (≥23, <26)	222	33	14.9	1.33	0.71–2.50	1.31	0.68–2.52	1.52	0.73–3.15	1.62	0.82–3.19	1.63	0.73–3.65	
Q3 (≥26, <30)	226	33	14.6	1.37	0.73–2.58	1.32	0.68–2.56	1.38	0.66–2.91	1.61	0.81–3.18	1.50	0.66–3.42	
Q4 (≥30)	149	34	22.8	2.43	1.27–4.63	2.34	1.19–4.59	2.46	1.15–5.26	2.84	1.40–5.76	2.56	1.10–6.02	
Psychological stress, point														
Q1 (<11)	162	15	9.3	1.00		1.00		1.00		1.00		1.00		<0.001
Q2 (≥11, <18)	194	23	11.9	1.29	0.65–2.57	1.21	0.61–2.43	1.17	0.56–2.48	1.77	0.83–3.80	1.60	0.69–3.69	
Q3 (≥18, <25)	176	27	15.3	1.75	0.89–3.43	1.59	0.80–3.16	1.54	0.75–3.19	2.62	1.23–5.57	2.39	1.03–5.54	
Q4 (≥25)	206	52	25.2	3.27	1.76–6.09	2.93	1.56–5.52	3.24	1.66–6.32	4.72	2.33–9.57	4.49	2.05–9.81	
Physical stress, point														
Q1 (<4)	175	23	13.1	1.00		1.00		1.00		1.00		1.00		0.006
Q2 (≥4, <7)	170	21	12.4	1.00	0.53–1.89	0.87	0.51–1.85	0.85	0.42–1.72	1.02	0.51–2.06	0.85	0.39–1.86	
Q3 (≥7, <11)	191	26	13.6	1.13	0.61–2.09	0.96	0.51–1.81	1.05	0.54–2.03	1.23	0.64–2.39	1.02	0.49–2.14	
Q4 (≥11)	203	47	23.2	2.30	1.31–4.04	2.03	1.12–3.66	1.98	1.06–3.71	2.82	1.53–5.21	2.44	1.20–4.98	

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, and health factors included in bmi, finger deformation, dermatitis, pain of the lower back, and other arthralgia. Model 3 adjusted for sex, age, and work-related factors included in experience on kitchen work, working system, job hour, shift, type of main job, and output. Model 4 adjusted for sex, age, and environmental factors included in size of kitchen, type of floor condition, type of heat and type of kitchen. Model 5 adjusted for sex, age, all health, work-related, and environmental factors.

(9 items), and job and family satisfaction (2 items)²⁸). The score was calculated for each item, and the categories were based on a 4-point Likert scale ranging from “strongly disagree”=1 to “strongly agree”=4. A higher score means a higher stressor and stress. In this study, the sub-scales of job demand, physical stress, and psychological stress were assessed. All of these scales have been proven to be acceptable with high levels of internal consistency, reliability, and factor-based validity with high Cronbach’s alpha coefficients (i.e., job demand: 0.70; job control: 0.62; psychological stress: 0.88; physical stress: 0.73)²⁹). In this study sample, Cronbach’s alpha coefficients of 7-item job demands, 11-item physical stress, and 18-item psychological stress were 0.73, 0.85, and 0.92, respectively. To clarify whether the degree of job stress was correlated with injuries, the participants were divided into quartiles (Q1, Q2, Q3, and Q4) according to the 25, 50, and 75 percentiles of job demands and physical and psychological stress scores of this study sample.

Environmental questionnaire

The survey on kitchen facilities included: the output of meals per day, size and type of kitchen, type of floor state (dry, semi-wet, or wet), type of main heat (electric or gas), and type of kitchen (school, hospital-affiliated nursing homes, and restaurant^{19, 30}). All administrators of the 126

kitchens answered the questionnaire on kitchen facilities.

Statistical analysis

The variables of the survey were re-categorized according to our previous studies^{19, 30}) as follows: age (<35/35~55/55≤yr), BMI (<25/25≤kg/m²), years of employment (<3/3≤yr), working hours (<8/8≤hr), working system (regular/part-time), shift (day shift/split shift/other), type of main job (cooking/washing up/other), production level (<750/750≤meals per day), size of kitchen (<200/200≤m²), and type of floor state (wet/semi-dry/dry).

The Chi-square test was for category variables. Multiple logistic regression models (independent variable=burn or cut, dependent variables=job stress (job demands or physical or psychological stress response), and confounding factors were used. To discuss the correlation between burns or cuts and job stress, Model 1 was adjusted for gender and age, Model 2 involved personal health factors, Model 3 involved work-related factors, Model 4 involved kitchen-based environmental factors, and Model 5 was adjusted for all factors.

Probability values <0.05 were considered significant. The IBM SPSS 19 for Windows (IBM SPSS Inc., Tokyo, Japan) was used for all statistical analyses.

Table 3. Association between cut injuries and job stress using multiple logistic regression models

Sub scales of BJSQ	n	No of cuts (>5 times/year)	%	Model 1		Model 2		Model 3		Model 4		Model 5		p for trend
				OR	95% CI									
Job demands, point														
Q1 (<23)	181	25	17.5	1.00		1.00		1.00		1.00		1.00		0.003
Q2 (≥23, <26)	207	42	18.9	1.10	0.64–1.90	1.40	0.72–2.74	1.31	0.69–2.50	1.16	0.66–2.04	1.28	0.64–2.59	
Q3 (≥26, <30)	183	55	24.3	1.46	0.86–2.48	1.60	0.83–3.10	1.52	0.81–2.88	1.52	0.88–2.62	1.63	0.82–3.27	
Q4 (≥30)	169	54	36.2	2.72	1.57–4.72	2.91	1.50–5.83	2.92	1.51–5.67	2.79	1.57–4.96	2.72	1.30–5.69	
Psychological stress, point														
Q1 (<11)	162	26	16.0	1.00		1.00		1.00		1.00		1.00		<0.001
Q2 (≥11, <18)	194	42	21.6	1.43	0.83–2.46	1.57	0.82–3.02	1.41	0.76–2.63	1.62	0.82–2.84	1.56	0.80–3.05	
Q3 (≥18, <25)	176	41	23.3	1.57	0.91–2.72	1.85	0.96–3.58	1.57	0.84–2.63	1.85	1.04–3.29	1.73	0.86–3.46	
Q4 (≥25)	206	66	32.0	2.42	1.45–4.04	3.53	1.90–6.68	3.08	1.72–5.52	2.82	1.64–4.85	3.52	1.84–6.72	
Physical stress, point														
Q1 (<4)	175	32	18.3	1.00		1.00		1.00		1.00		1.00		0.005
Q2 (≥4, <7)	170	29	17.1	0.89	0.51–1.56	0.82	0.42–1.58	0.82	0.43–1.53	0.90	0.50–1.60	0.79	0.40–1.57	
Q3 (≥7, <11)	191	47	24.6	1.38	0.83–2.30	1.37	0.76–2.47	1.33	0.75–2.34	1.41	0.83–2.38	1.17	0.63–2.16	
Q4 (≥11)	203	67	33.0	2.15	1.30–3.45	2.31	1.29–4.12	2.13	1.23–3.70	2.32	1.39–3.86	2.16	1.16–4.01	

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, and health factors included in bmi, finger deformation, dermatitis, pain of the lower back, and other arthralgia. Model 3 adjusted for sex, age, and work-related factors included in experience on kitchen work, working system, job hour, shift, type of main job, and output. Model 4 adjusted for sex, age, and environmental factors included in size of kitchen, type of floor condition, type of heat and type of kitchen. Model 5 adjusted for sex, age, all health, work-related, and environmental factors.

Results

In the total of 740 kitchen workers, the frequencies of four categories were 84.2, 12.4, 2.6, and 0.8% for burns, and 76.2, 17.2, 4.6, and 2.0% for cuts, respectively. Together with 2–4 categories, 117 (15.8%) kitchen workers had experienced burns (more than 5 times) and 176 (23.8%) had experienced cuts (more than 5 times) in the last year.

Table 1 presents the demographic characteristics, personal health conditions, and work-related and environmental factors between those with higher and lower burn and cut rates in kitchen workers. Kitchen workers who had higher burn rates showed correlations with gender, hand dermatitis, arthralgia which excluded lower back pain, size of kitchen, type of heat, working hours, type of main job, and type of kitchen. Kitchen workers who had higher cut rates showed some differences ($p < 0.1$) between genders, hand dermatitis, arthralgia which excluded lower back pain, and pain of the lower back, and type of kitchen.

The workers who had burns (+) from Q1 (lower score) to Q4 (higher score) comprised 11.9, 14.9, 14.6, and 22.8% for the job demand, 9.3, 11.9, 15.3, and 25.2% for the psychological stress response, and 13.1, 12.4, 13.6, and 23.2% for the physical stress response in Table 2. Compared with Q1 of each sub-scale of BJSQ, Q4 in Model 1

showed higher Odds ratios with the 95% confidence interval (CI) of burn injuries (+). Based on Models 2, 3, and 4, the ORs remain higher adjusted for the health condition, and work-related and environmental factors, respectively. Model 5 shows the burns (+) associated with job demands (OR: 2.56, 95% CI: 1.10–6.02), psychological stress (OR: 4.49, 95% CI: 2.05–9.81), and physical stress (OR: 2.44, 95% CI: 1.20–4.98) after adjustment for sex, age, health conditions, work-related factors, and environmental factors. The ORs for higher burn rates increased from Q1 to Q4 with job demands (p for trend = 0.045), psychological stress (p for trend < 0.001), and physical stress (p for trend = 0.006).

Table 3 shows that workers who had cuts from Q1 to Q4 comprised 17.5, 18.9, 24.3, and 36.2% for job demand, 16.0, 21.6, 23.3, and 32.0% for psychological stress, and 18.3, 17.1, 24.6, and 33.0% for physical stress. Compared with Q1 of each sub-scale of BJSQ, Q4 in Model 1 showed higher ORs with 95% CI of cuts. After adjustment for personal health conditions or environmental factors, Models 2, 3, and 4 continued to show an association between job stress and higher cut rates. In the final Model 5, a higher cut rate was associated with the job demand (OR: 2.72, 95% CI: 1.30–5.69), psychological stress (OR: 3.52, 95% CI: 1.84–6.72), and physical stress (OR: 2.16, 95% CI: 1.16–4.01) after adjustment for sex, age, health

conditions, and environmental factors. The ORs of higher burn rates increased from Q1 to Q4 with job stress (p for trend <0.003), psychological stress (p for trend <0.001), and physical stress (p for trend = 0.005).

Discussion

The results of this study suggest that workers with marked job demands and psychological and physical stress show significantly higher frequencies of burns and cuts. To the best of our knowledge, this is the first study to show that job stress included in job demands and psychological and physical stress is an important independent factor related to burns and cuts occurring in kitchen workers after adjustment for confounding factors (age, sex, health condition, and work-related and environmental factors).

Although no previous study has directly discussed the association between job stress and burns and cuts in kitchen workers, some studies showed that job stress was related to work-related injuries in the manufacturing industry^{22, 23}. Kim *et al* reported that a high job demand (OR 1.71, 95% CI 1.13–2.59) and high job strain (OR 3.57, 95% CI 1.62–7.86) were associated with and an increased risk of occupational injury including cuts²⁴. So, these results of previous studies are considered to indirectly support our findings.

Furthermore, it was appropriate to evaluate the job stress of kitchen workers using BJSQ in this study. Previous studies showed that job stress negatively affected job performance^{31, 32} and cognitive performance such as attention, action or memory^{33, 34}. These results of previous studies support our findings from our multiple logistic regression analysis that the risk of occupational burns and/or cut injuries increased with the score of each sub-scale of the BJSQ from Q1 (the lowest quartile) to Q4 (the higher quartile), and that especially, the frequency of the burn and cut injuries significantly correlated with the Q4 quartile.

Strengths and limitations

There are several strengths regarding the present study. 1) All workers of the 126 kitchens were surveyed, with a high response rate and appropriate sample size. 2) Other potential confounding variables concerning the personal health conditions, work-related factors, and working environmental factors were surveyed. 3) The multiple logistic regression models were performed to remove other potential confounding effects of personal health conditions and work-related and environmental factors.

On the other hand, there are several limitations that

should be mentioned. First, because it was a cross-sectional study, a causal relationship between burns or cuts and job stress could not be interpreted. Hereafter, a cohort study should be carried out to investigate the casual relationship between job stress and injuries. Second, the frequency of burns and cuts was evaluated with a self-reported questionnaire, and the severity of burns/cuts was not analyzed. Although the kitchen workers were asked whether they had experienced burns and cuts during the last year, there was some recall bias in the respondents of this study. It is important to use medical care and insurance records, but that unrecorded occupational injuries could not be take account of. Based on Heinrich's law, minor injuries such as unrecorded burns could be included in the self-reported questionnaire and then the results of this study would be more likely to reflect the real condition of workers' injuries and would be more helpful to reduce serious burns and cuts in the work setting. Third, the workers were nested in different kitchens located within different industries, but the analysis did not take this into consideration. Fourth, the one hundred and twenty-six kitchens were non-randomly selected, so a selection bias could not be avoided; therefor, the results of this study should be carefully generalized.

This study showed that health and safety measures must consider job stress as an important factor in food service industries.

Conclusions

Kitchen work-related burns and cuts are more likely to be correlated with job stress. A higher job stress score is correlated with a higher frequency of burns and cuts. This suggests that job stress is an independent risk factor, and the establishment of injury prevention programs for burns and cuts could focus on the reduction of job stress correlated with job demand and psychological and physical stress in kitchen work.

References

- 1) World Health Organization Office of occupational health. Declaration on occupational health for all. Beijing, China: World Health Organization; 11–4 October 1994. http://www.who.int/occupational_health/en/oehdeclaration94e.pdf#search='Declaration+on+occupational+health+for+all.+Beijing%2C'. Accessed March 1, 2013.
- 2) Gleeson D (2001) Health and safety in the catering industry. *Occup Med (Lond)* **51**, 385–91.
- 3) Alamgir H, Swinkels H, Yu S, Yassi A (2007) Occupational

- injury among cooks and food service workers in the healthcare sector. *Am J Ind Med* **50**, 528–35.
- 4) Teo S, Teik-Jin Goon A, Siang LH, Lin GS, Koh D (2009) Occupational dermatoses in restaurant, catering and fast-food outlets in Singapore. *Occup Med (Lond)* **59**, 466–71.
 - 5) The Japan institute for labour police and training. Statistics information. <http://www.jil.go.jp/kokunai/statistics/sansyoku/sansyoku.html>. Accessed March 1, 2013.
 - 6) Buchanan S, Vossen P, Krause N, Moriarty J, Frumin E, Shimek JA, Mirer F, Orris P, Punnett L (2010) Occupational injury disparities in the US hotel industry. *Am J Ind Med* **53**, 116–25.
 - 7) Filippelli C, Verso MG, Amicarelli V, Di Famiani M, Tomei G, Pimpinella B, Casale T, Capozzella A, Ciarrocca M, Rosati MV, Tomei F (2008) [Food service workers and cooks: occupational risk assessment]. *Ann Ig* **20**, 57–67 (in Italian with English abstract).
 - 8) Nakamura R, Ono Y, Horii E, Tsunoda K, Takeuchi Y (1993) The aetiological significance of work-load in the development of osteoarthritis of the distal interphalangeal joint. *J Hand Surg* **18**, 540–2.
 - 9) Pehkonen I, Miranda H, Haukka E, Luukkonen R, Takala EP, Ketola R, Leino-Arjas P, Riihimäki H, Viikari-Juntura E (2009) Prospective study on shoulder symptoms among kitchen workers in relation to self-perceived and observed work load. *Occup Environ Med* **66**, 416–23.
 - 10) Haukka E, Leino-Arjas P, Solovieva S, Ranta R, Viikari-Juntura E, Riihimäki H (2006) Co-occurrence of musculoskeletal pain among female kitchen workers. *Int Arch Occup Environ Health* **80**, 141–8.
 - 11) Gawkrödger DJ, Lloyd MH, Hunter JA (1986) Occupational skin disease in hospital cleaning and kitchen workers. *Contact Dermat* **15**, 132–5.
 - 12) Kanerva L, Estlander T, Jolanki R (1996) Occupational allergic contact dermatitis from spices. *Contact Dermat* **35**, 157–62.
 - 13) Verma SK, Chang WR, Courtney TK, Lombardi DA, Huang YH, Brennan MJ, Mittleman MA, Perry MJ (2010) Workers' experience of slipping in U.S. limited-service restaurants. *J Occup Environ Hyg* **7**, 491–500.
 - 14) Kokane S, Tiwari RR (2011) Occupational health problems of highway restaurant workers of Pune, India. *Toxicol Ind Health* **27**, 945–8.
 - 15) Horwitz IB, McCall BP (2004) Quantification and risk analysis of occupational burns: Oregon workers' compensation claims, 1990 to 1997. *J Burn Care Rehabil* **25**, 328–36.
 - 16) Horwitz IB, McCall BP (2005) An analysis of occupational burn injuries in Rhode Island: workers' compensation claims, 1998 to 2002. *J Burn Care Rehabil* **26**, 505–14.
 - 17) Suzman MS, Sobocinski K, Himel H, Yurt RW (2001) Major burn injuries among restaurant workers in New York City: an underappreciated public health hazard. *J Burn Care Rehabil* **22**, 429–34.
 - 18) Pekkarinen A, Anttonen H, Niskanen J (1996) Assessment of Health Risks in Canteen Kitchens. *Int J Occup Saf Ergon* **2**, 262–7.
 - 19) Tomita S, Muto T, Matsuzuki H, Haruyama Y, Ito A, Muto S, Haratani T, Seo A, Ayabe M, Katamoto S (2013) Risk factors for frequent work-related burn and cut injuries and low back pain among commercial kitchen workers in Japan. *Ind Health* **51**, 297–306.
 - 20) Riina LH, Simpson RL, Gudjonsson O, Glickman LT, Harris SU, Johnson D, Ginocchio M (2000) Burn injury in kitchen workers: a cause for prevention. *J Burn Care Rehabil* **21**, 563–4, discussion 562.
 - 21) McCaig LF, Burt CW, Stussman BJ (1998) A comparison of work-related injury visits and other injury visits to emergency departments in the United States, 1995–1996. *J Occup Environ Med* **40**, 870–5.
 - 22) Nakata A, Ikeda T, Takahashi M, Haratani T, Hojou M, Fujioka Y, Swanson NG, Araki S (2006) Impact of psychosocial job stress on non-fatal occupational injuries in small and medium-sized manufacturing enterprises. *Am J Ind Med* **49**, 658–69.
 - 23) Li CY, Chen KR, Wu CH, Sung FC (2001) Job stress and dissatisfaction in association with non-fatal injuries on the job in a cross-sectional sample of petrochemical workers. *Occup Med (Lond)* **51**, 50–5.
 - 24) Kim HC, Min JY, Min KB, Park SG (2009) Job strain and the risk for occupational injury in small- to medium-sized manufacturing enterprises: a prospective study of 1,209 Korean employees. *Am J Ind Med* **52**, 322–30.
 - 25) Haukka E, Leino-Arjas P, Ojajärvi A, Takala EP, Viikari-Juntura E, Riihimäki H (2011) Mental stress and psychosocial factors at work in relation to multiple-site musculoskeletal pain: a longitudinal study of kitchen workers. *Eur J Pain* **15**, 432–8.
 - 26) Nagasu M, Sakai K, Ito A, Tomita S, Temmyo Y, Ueno M, Miyagi S (2007) Prevalence and risk factors for low back pain among professional cooks working in school lunch services. *BMC Public Health* **7**, 171 .
 - 27) Ono Y, Nakamura R, Shimaoka M, Hiruta S, Hattori Y, Ichihara G, Kamijima M, Takeuchi Y (1998) Epicondylitis among cooks in nursery schools. *Occup Environ Med* **55**, 172–9.
 - 28) Shimomitsu T. Manual of the Brief Job Stress Questionnaire: Reports on the study of job stress and its effects on health in the workplace. 2005. http://www.tmu-ph.ac/topics/stress_table.php. Accessed March 1, 2013.
 - 29) Kato S, Doi Y, Tsutsui S, Makino M (2004) Job stress among Japan Overseas Cooperation volunteers—using the Brief Job Stress Questionnaire. *Sangyo Eiseigaku Zasshi* **46**, 191–200 (in Japanese).
 - 30) Haruyama Y, Muto T, Matsuzuki H, Ito A, Tomita S, Muto S, Haratani T, Seo A, Ayabe M, Katamoto S (2010) Evaluation of subjective thermal strain in different kitchen working environments using subjective judgment scales. *Ind Health* **48**, 135–44.
 - 31) Gandi JC, Wai PS, Karick H, Dagona ZK (2011) The role

- of stress and level of burnout in job performance among nurses. *Ment Health Fam Med* **8**, 181–94.
- 32) Chen SW, Wang PC, Hsin PL, Oates A, Sun IW, Liu SI (2011) Job stress models, depressive disorders and work performance of engineers in microelectronics industry. *Int Arch Occup Environ Health* **84**, 91–103.
- 33) Day AJ, Brasher K, Bridger RS (2012) Accident proneness revisited: the role of psychological stress and cognitive failure. *Accid Anal Prev* **49**, 532–5.
- 34) Wadsworth EJ, Simpson SA, Moss SC, Smith AP (2003) The Bristol Stress and Health Study: accidents, minor injuries and cognitive failures at work. *Occup Med (Lond)* **53**, 392–7.