

The effect of mental workload and work posture on musculoskeletal disorders of Qazvin hospitals, in 2016

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Abstract

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Background: Due to high prevalence of musculoskeletal risk factors among kitchen workers and their role in causing discomfort, the aim of this study was to investigate the effects of ergonomic factors (mental workload and working posture) on musculoskeletal disorders (MSDs) among workers of training hospitals in Qazvin, Iran.

Materials and Methods: This cross-sectional study was done through census among 60 workers of teaching hospital's kitchens of Qazvin University of Medical Sciences in 2016. Data were collected using pain perception and mental workload questionnaires and Quick Exposure Check (QEC) method was used for posture assessment. Data were analyzed using single and multiple logistic regression tests.

Results: About 85% of the workers reported that their work shift was very heavier than normal. The best and worst exposure score in QEC method were assigned to cooking and trolley responsible tasks, respectively. Seventy percent of working postures were classified in action level 3 (i.e. investigation and changes are required soon) that increased the backache prevalence by nearly about 4 times. Heavy workload in interaction with other influential factors increased the neck discomfort about 5 times and back discomfort by 2.5 times.

Conclusions: Long working hours, heavy workload, stress, high-speed work, long standing and inadequate rest are the factors influencing the increase of MSDs prevalence among the kitchen workers. By increasing numbers of manpower, reducing the workload and working hours and adequate rest, in addition to doing the work properly, MSDs in this group can somehow be reduced.

Keywords: Workload, Musculoskeletal Disorders, Hospitals, Iran

Introduction

Musculoskeletal disorders (MSDs) are injuries that develop in the soft tissue structures of the body such as nerves, muscles, tendons and joints due to repeated or prolonged ergonomic exposures (1). MSDs are the most common occupational injuries (1, 2) that can lead to decreased productivity, impose direct and indirect costs on society, and increase the time loss and work-related disabilities (2-5). They are also the main cause for half of absences from work (6, 7). Back, neck and shoulders pains and disorders are the main reasons for work-related consultations and have a negative impact on work ability and effectiveness (8).

Musculoskeletal pains are strongly associated with adverse psychological factors of working environment (9). Working in the kitchen, both in terms of mental workload (services to individuals, working hours, shift work, etc.) and in terms of physical load (lifting heavy pots, bags, etc.) is accounted as a heavy work (9, 10). Workload defines as the amount of work that a person is expected to do in a specific time. Thus, the mental workload depends on the relationship between the worker's perception of the task demands and

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their ability to perform and adapt to the work demands. So when reviewing the workload, both mental and physical workload should be considered (11), because the incompatibility of physical and mental capabilities of workers can reduce production, increase safety and health problems and increase compensation and physical discomfort (6, 12). So it is expected that musculoskeletal problems can be reduced by optimizing the physical and mental workload (10). According to Haukka's study on kitchen workers, mental factors in the work place are associated with prevalence of musculoskeletal pains (13).

Physical risk factors are such as awkward postures, force, repetition and movement frequency, working time and vibration. From these factors, non-neutral postures are the most important causes of MSDs (6, 14, 15). Accordingly, the body posture analysis during work is the base of assessing the risk factors of MSDs (6, 14). Among the means of assessing the risk of MSDs, posture analysis can be considered as the base of assessment (16). Thus, by identifying the effective risk factors and precise ergonomic risk assessment of these disorders as well as using appropriate methods, the workplace can be improved and the risk of developing MSDs can be reduced (2). One of the methods commonly used for risk assessment of MSDs is QEC (Quick Exposure Check). QEC is a quick and complete method that assesses both physical and psychosocial risk factors in the workplace simultaneously (17-19).

With the progress that has been achieved in preventing manual material handling, still risk assessment in service works such as kitchen were not undertaken in a systematic manner or no assessment has been done (11). According to performed studies on kitchen workers, 75% of workers had reported body pain in the last year and half of them were receiving medical treatment (20). The study of Kohansal on kitchen workers reported the most disorders in low back, neck and back. Also the posture assessment score for 61.9% of them was determined in very high risk level and for

38.1% was in high risk level (21). Fallah reported the most disorders of kitchen workers in low back (51.7%), neck (43.7%) and back (35%) and QEC risk level showed that workplace condition was harmful (22). In the study of Amini in restaurant's workers, backache was demonstrated the most prevalent MSD (7). Although many has been done by researches in the fields of mental workload investigation and prevalence, posture assessment and prevalence, evaluating the role of each factor separately, few studies have investigated simultaneous effects of mental workload and posture assessment on MSDs disorders among kitchen workers especially in teaching hospitals. The main aim of this study was to investigate the effect of mental workload and working posture on musculoskeletal disorders in kitchen workers in Qazvin training hospitals, Qazvin, Iran.

Material and Methods

This cross-sectional study was done among 60 kitchen workers of teaching hospitals of Qazvin University of Medical Sciences in 2016. Data were collected using pain perception and workload checklist and posture assessment was done by QEC method. Oral informed consent was taken from participants in the study. Participants were asked not to complete the questionnaire if they had genetic, neurological, and vascular problems in musculoskeletal system. Inclusion criteria were at least 1 year work experience.

Pain perception self-report checklist with the scale of 0-10 was used to investigate the MSDs prevalence. In this checklist, different regions of body are divided to 8 zones including neck, shoulder, elbow, hands/wrists, lower/upper back, thigh, knees and legs/feet. Zero defines as lack of pain, 3 is light pain, 5 is middle pain and 10 means extreme pain (23).

The mental workload perception survey assessed whether the server felt the observed shift was typical of the work demands for the given day and shift. The survey was composed of 6 questions that asked about: 1) how the

typical shift was relative to the current one being observed (a. significantly lighter than normal, b. slightly lighter than normal, c. typical of normal, d. slightly heavier than normal, e. significantly heavier than normal), 2) How many people they serve per hour on a normal day (a. 1 to 3 people, b. 4 to 6 people, c. 7 to 9 people, d. 10 to 12 people, e. 13 or more people), 3) how many hours a week do they work [a. less than part time (less than 20 hours a week), b. part time (20 hours a week), c. full time (40 hours a week), d. more than 40 hours a week], 4) how long they believe they stand (a. less than an hour, b. greater than an hour but less than 2 hours, c. greater than 2 hours but less than 5 hours, d. greater than 5 hours but less than 8 hours, e. greater than 8 hours), 5) how often they get to take breaks (a. once an hour, b. once a shift, c. whenever you want, d. never), 6) what days do they normally work in a week (a. throughout the entire week b. only weekends, c. only weekdays, d. only mornings, e. only nights) (23). This checklist

was translated to Persian and was confirmed by occupational health experts. Scoring the questions was taken as percentage of each item.

QEC method was used for quick assessment of the exposure level of workers with musculoskeletal risk factors. In this method that was presented by Li and Buckle, the parameters are recorded at the moment that worker is in the worst situation and the postural risk factors and movements are evaluated in four regions of back, neck, hands/wrists and shoulders/arms. Furthermore, to evaluate the mental responses and judgments of employees, they complete a questionnaire containing the maximum displacement load, average displacement time, maximum force exerted by one hand, exposure to vibration, visual needs, speed of work and stress. Body regions exposure level scores based on each region and QEC exposure level with risk factors have been shown in table 1 (24, 25).

Table 1: Exposure level with risk factors and score of any region in Quick Exposure Check

Regions and risk factor	Low	Middle	High	Very high
Back	10-20	21-31	31-40	41-56
Shoulders and arms	10-20	21-30	31-40	41-56
Hands and wrists	10-20	21-30	31-40	41-56
Neck	4-6	8-10	12-14	16-18
Vibration	1	4	9	-
Work speed	1	4	9	-
Stress	1	4	9	16

Exposure levels in 4 regions and worker's judgment were imported to QEC software and the results of body posture assessment were obtained. To calculate the exposure score in whole body, score of any region was calculated and then this number was divided by the highest possible score of the whole body. It should be noted that the maximum score for manual material handling tasks is 176 and for other tasks is 162 (26, 27). After assessment through this method, each case was interpreted according to the action levels (AL) described below:

AL1 ($E \leq 40\%$): acceptable musculoskeletal loading,

AL2 ($41\% < E < 50\%$): further investigation is needed and changes may be required,

AL3 ($51\% < E < 70\%$): investigation and changes are required soon,

AL4 ($70\% \leq E$): investigation and immediate change are required (24, 25). Validity and reliability of this method has been approved (24).

Data were analyzed using single and multiple logistic regression tests in SPSS (version 20.0, IBM Corporation, Armonk, NY, USA). In

order to interpret the relationship between dependent and independent variables, we calculated the odds ratio. Odds ratio for dependent variable shows the change in the event of the occurrence to non-occurrence. To determine the significance of the effects of independent variables on the dependent variables in both single and multivariable, we used the 95% confidence interval for the odds ratio in addition to the possibility of a significant (P-value). If this interval includes the number, the null hypothesis will be confirmed that means no significant independent variable. Otherwise null hypothesis will be rejected and the effect of the

independent variable on the dependent variable is significant (28).

Results

In this study 70% of workers had service work (chef help and trolley responsible) and 30% of them were in cooking activities (head-chef and cooker). The mean age ± standard deviation of participants was reported 38.8 ± 8.55 years and mean weight was 69.3 ± 11.7 kilogram. Mean, standard deviation and percent of other demographic and occupational variables are presented in table 2.

Table 2: Demographic, occupational and musculoskeletal disorders prevalence information in Qazvin teaching hospital kitchen workers, Iran, in 2016 (n = 60)

Information		Mean ± SD or percent	Information		Mean ± SD or percent	
Sex	Male	8.3%	Stress	Yes	53.3	
	Female	93.7%		No	46.7	
Height (cm)		165.9 ± 8.51	Neck		45.5	
Body mass index (Kg/m ²)		25.9 ± 3.82	Shoulder		41.7	
Work experience (year)	Below 5	68.3%	Prevalence in 8 body regions	Elbow	6.0	
	More than 5	31.6%		Hand/wrist	35.0	
Task type	Cooking	Head chef		10%	Back	78.3
		Chef		20%	Thigh	11.7
	Service	Chef help		43.3%	Knee	39.0
		Trolley		26.7%	Leg/feet	10.0

SD: Standard deviation

According to results from investigation of the mental load perception in kitchen workers, 85% of workers reported their work shift heavier than normal and 15% reported their work shift normal. All of the workers claimed that they work more than 40 hours in a week, they serve to more than 13 people in a day and stand more than 8 hours in a shift. Also, 51.7% of the workers rested once in a work shift and 45% of them never rest. About 23.3% of the workers reported that they work in all days of a week and 76.7% of them only work in the non-holiday days.

According to table 3, the best and worst

exposure score in QEC method were assigned to cooking and trolley task, respectively. Among the risk factors, the best and worst state were assigned to cooking tasks (head chef and cooker) and service task (chef help and trolley responsible), respectively. Also the service part was in the action level 3 due to cleaning task, trolley transport and other heavy tasks (table3). According to results of QEC method, 20 percent of the personnel were in action level 1 (below 40%), 10 percent in action level 2 (between 41%-50%) and 70 percent in action level 3 (between 51%-70%).

Table 3: Exposure level score in 4 regions and risk factors based on calculated score in Qazvin teaching hospital kitchen workers, Iran, in 2016

Task type	Exposure level Regions	Exposure level				Risk factors	Exposure level			
		Low	Middle	High	Very high		Low	Middle	High	Very high
Head chef	Low back		22			Vibration	1			
	Shoulder/arm		22			Speed of work		4		
	Hand/wrist		22			Stress		4		
	Neck	6								
	Whole body exposure level									
	Exposure level		N		Percent					
	2	6		10						
Chef	Low back	14				Vibration	1			
	Shoulder/arm		22			Speed of work		4		
	Hand/wrist		22			Stress		4		
	Neck	6								
	Whole body exposure level									
	Exposure level		N		Percent					
	1	12		20						
Chef help	Low back		30			Vibration	1			
	Shoulder/arm		30			Speed of work		4		
	Hand/wrist			36		Stress			9	
	Neck	8								
	Whole body exposure level									
	Exposure level		N		Percent					
	3	26		43.3						
Trolley responsible	Low back			34		Vibration	1			
	Shoulder/arm			36		Speed of work			9	
	Hand/wrist			32		Stress			9	
	Neck	10								
	Whole body exposure level									
	Exposure level		N		Percent					
	3	16		26.7						

The results of investigating the effective risk factors on MSDs in neck, shoulder and back

regions based on single and multiple logistic regression tests have been shown in table 4.

Table 4: Investigating the effective risk factors on musculoskeletal disorders based on single and multivariate regression test in Qazvin teaching hospital kitchen workers, Iran, in 2016

Risk factor	Scale or category	Neck		Shoulder		Back	
		Single (95%CI)	Multivariate (95% CI)	Single (95%CI)	Multivariate (95% CI)	Single (95%CI)	Multivariate (95% CI)
Task type	Chef	1	1	1	1	1	1
	Head chef	0.7 (0.09-5.43)	0.8 (0.01-35.20)	0.7 (0.09-5.43)	0.12 (0.003-5.59)	0.66 (0.07-5.68)	0.03 (0.0-23.21)
	Chef help	0.87 (0.21-3.52)	2.22 (0.12-38.20)	0.87 (0.21-3.52)	0.08 (0.005-1.57)	0.63 (0.13-2.92)	1.71 (0.14-20.50)
	Trolley responsible	2.33 (0.50-10.80)	6.27 (0.16-240.50)	2.33 (0.50-10.77)	4.6 (0.02-13.05)	2.33 (0.32-16.80)	8.05 (0.34-190.5)
Whole body QEC	Exposure level1	1	1	1	1	1	1
	Exposure level2	0.7 (0.09-5.43)	-	0.7 (0.09-5.43)	-	0.66 (0.07-3.67)	-
	Exposure level3	0.27 (0.34-2.65)	-	0.27 (0.34-2.65)	-	3.93 (0.21-5.11)	-
	Exposure level4	-	-	-	-	-	-

Stress	Yes	0.89 (0.32-2.48)	1.95 (0.20-18.70)	0.89 (0.32-2.48)	0.29 (0.03-2.42)	1.69 (0.53-5.36)	4.6 (0.67-31.60)
	No	1	1	1	1	1	1
Work load	Normal	1	1	1	1	1	1
	Heavy	0.44 (0.40-7.89)	4.88 (0.28-84.30)	0.44 (0.40-7.89)	0.37 (0.03-4.21)	1.46 (0.31-6.69)	2.35 (0.02-5.02)
Rest chance	Once in shift	1	1	1	1	1	1
	Never	0.75 (0.27-2.09)	0.05 (0.003-1.05)	0.75 (0.27-2.09)	0.18 (0.01-2.19)	0.64 (0.20-2.05)	0.06 (0.005-0.06)
Work days	6 days in a week	1	1	1	1	1	1
	7 days in a week	2.8 (0.80-9.70)	5.66 (0.07-32.90)	2.8 (0.80-9.70)	5.45 (0.29-28.50)	2.56 (0.15-4.04)	21.8 (0.21-29.40)

Hosmer-Lemeshow goodness-of-fit; Multivariable: neck (0.607), shoulder (0.415) and back (0.592).

Hosmer-Lemeshow goodness-of-fit; Single: 1.00.

QEC: Quick Exposure Check; CI: Confidence interval

Discussion

in this study, all of the workers (100%) worked in standing state during the whole shift, whereas in the study of Pekkarinen 78% of workers were in a standing posture (29). Also, 85% of workers in this study, reported their work shift heavier than normal that with attention to regression result, heavy workload interaction with other risk factors can increase the neck and back pain by 4.8 and 2.3 times, respectively. More than 50% of these workers rested just once during the shift and 45% of them did not have any rest. In the study of Wills, 60% of restaurant workers reported their shift easier than normal and 40% of them rest once along the shift. This result regarding the opportunity to rest is in line with current study, but with regard to workload is in conflict with current study (23).

In this study, the most prevalent disorder was reported in the low back region that is in line with studies of Wills (23), Amini (7) and Kohansal (21). After the low back, regions with high prevalence of disorders were neck, shoulder and knees. Of reasons of high prevalence of low back and knee pain can be the long hours of standing work with 100% worker's response and heavy workload with 85% response. Other reason can be inadequate rest during shift, because just 3.3% of workers could rest when they would like and other workers did not have rest or had just one rest

and in this short time, naturally one would not be able to sit and rest appropriately.

Whole body score in QEC method showed that the level 3 had the highest frequency. This suggests that more study and corrective actions in near future is necessary. In the study of Kohansal, 61.9% of kitchen workers were in action level 4 (21). This difference in the findings can be due to number of employees, more servicing, shift work, number of hospital sections to servicing and etc.

In present study, posture of trolley responsible and help-chef were in action level 3. Also score of back posture was high and it can be derived that the corrective action should be taken in near future in these tasks. According to regression test, workers that were in action level 3 were susceptible to backache by 3.9 times. Increasing the manpower, taking the rest time and using trolley device with adjustable height to avoid continuous bending of back, neck and shoulder are from suggested corrective actions to decrease exposure risk level and MSDs. Kohansal stated the help-chef task in level 3 that is consistent with this study (21).

In the current study, exposure level score and prevalence of pain in neck for trolley responsible showed the highest risk. High level of discomfort in this region can be linked with repeated bending and twisting of it when dragging cover on dishes and putting the food containers into the different stages of trolley.

The highest prevalence of shoulder pain was reported in cooker and trolley responsible that its reason could be mixing food frequently with large mixer and pushing the heavy trolleys (more than 100 kg). This results are in line with researches of Fallah (22) and Kohansal (21) regarding the high prevalence of neck, shoulder pain and QEC level.

Among the tasks, trolley responsible was in risk of MSDs about 2 times more than others and in interaction with other risk factors, this amount reached up to 8 times. Also chef help was in risk of neck and back pain by 2.2 and 1.7 times, respectively. Thus, it can be concluded that hard work increases the backache. Trolley responsible was in risk of neck and shoulder pain about 2 times more and in interaction with other risk factors, the prevalence of neck and shoulder disorder became 6.2 and 4.6 times higher, respectively.

Long working hours, high workload and inadequate rest are factors that affect MSDs in kitchen workers. Working in all days of week, based on single and multivariate regression test, increased neck and shoulder pain by 2.8 and 5.4 times, respectively and increased the backache by 2.5 and 21.8 times. Amini reported the long work time and long-term standing as the reasons of MSDs (7). Therefore, with increasing the number of manpower, reducing the workload and working hours and adequate rest, proper selection of personnel fitness with task type, and work rotation, in addition to proper handling of the work and observing the work origins, MSDs can be reduced the in this group. Also, with regard to high risk of discomfort in trolley responsible, the exposure risk level can be reduced with decreasing the weight of trolley in each servicing and designing a light trolley device with adjustable height. In cookers, light mixers can be used to reduce the mixing force. Stress was reported in more than 50% of the workers and can be due to the activity type, services and work pressure. Stress alone can increase the backache by 2 times and by 4.6 times in interaction with other factors. Serving a huge number of hospital personnel and

patients and high work speed can be the reasons for stress. In this study, the work speed for trolley responsible was reported in high state. In study of Sarsangi, the work speed and stress was reported very high in 50% of workers that is in line with current study (26).

Conclusion

Long working hours, high workload, stress, high work speed, long-term working in the standing state and inadequate time for rest are among the factors owing to the high prevalence of MSDs in kitchen workers. The limitations of this study were low sample size and not investigating the whole employees of kitchens such as restaurants, self-services in universities and etc. So, is suggested that in future studies in addition to performed assessments in this study, the lifting permissible limit evaluation to be done too.

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