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Investigation of Ergonomic Risk Factors, Musculoskeletal System Problems, and Physical Workload in Kitchen Workers

Mutfak Çalışanlarında Ergonomik Risk Faktörleri, Kas İskelet Sistemi Problemleri ve Fiziksel İş Yükünün İncelenmesi

ABSTRACT

Objective

The prevalence of musculoskeletal problems in kitchen workers is quite high. Factors such as the high physical workload of kitchen workers, low physical activity levels, non-ergonomic working conditions and job stress have been associated with this high prevalence. Therefore, the aim of our study was to investigate ergonomic risk factors, musculoskeletal system problems, and physical workload in kitchen workers.

Material and Methods

This is a cross-sectional study conducted between November 2022 and February 2023 with 87 participants working in various dining hall, restaurant and cafe kitchens. Participants were asked about their demographic information and ergonomic risk factors. Physical workload was assessed using the Physical Workload Questionnaire and musculoskeletal problems were assessed using the Nordic Musculoskeletal Questionnaire.

Results

The median length of occupation was 5.00 (2.00-15.00) years and the median daily working time was 9.00 (8.00-10.00) hours. The ergonomic risk factors that bothered the kitchen workers the most were stress, hot working environment and closed area, respectively. The parts of the body where kitchen workers had the most musculoskeletal problems, both in the last 12 months and in the last 7 days, were the low back, upper back, neck and shoulders. When comparing the physical workload of kitchen workers according to their occupation, there was no significant difference between the groups (p=0.257).

Conclusion

Kitchen workers are at high risk of musculoskeletal disorders. Interventions such as ergonomic risk assessment of the work environment, ergonomic training and rest breaks are needed to reduce the risk of musculoskeletal problems in kitchen workers.

Key Words

Kitchen workers, Musculoskeletal problems, Physical workload,
Ergonomic risk factors

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ÖZ

Amaç

Mutfak çalışanlarında kas iskelet sistemi problemlerinin görülme oranı oldukça yüksektir. Mutfak çalışanlarının yüksek fiziksel iş yükü, düşük fiziksel aktivite düzeyleri, ergonomik olmayan çalışma koşulları ve iş stresi gibi faktörler bu yüksek prevalans ile ilişkilidir. Bu nedenle, çalışmamızın amacı mutfak çalışanlarında ergonomik risk faktörleri, kas iskelet sistemi problemleri ve fiziksel iş yükünü araştırmaktır.

Gereç ve Yöntemler

Bu çalışma, Kasım 2022 ile Şubat 2023 tarihleri arasında çeşitli yemekhane, restaurant ve kafe mutfaklarında çalışan 87 katılımcı ile yürütülen kesitsel bir çalışmadır. Bireylerin demografik bilgileri ve ergonomik risk faktörleri sorgulandı. "Fiziksel İş Yükü Anketi" ile fiziksel iş yükleri, "İskandinav Kas İskelet Sistemi Anketi" ile kas iskelet sistemi problemleri sorgulandı.

Bulgular

Ortanca meslek süresi 5,00 (2,00-15,00) yıl ve ortanca günlük çalışma süresi 9,00 (8,00-10,00) saatti. Mutfak çalışanlarını en çok rahatsız eden ergonomik risk faktörleri sırasıyla stres, sıcak çalışma ortamı ve kapalı alan olmuştur. Mutfak çalışanlarının hem son 12 ayda hem de son 7 günde en çok kas iskelet sistemi problemi yaşadığı vücut bölgeleri sırasıyla bel, sırt, boyun ve omuzdu. Mutfak çalışanları mesleklerine göre fiziksel iş yükü düzeyi açısından karşılaştırıldığında gruplar arasında anlamlı fark gözlenmedi (p=0.257).

Sonuç

Mutfak çalışanları kas-iskelet sistemi rahatsızlıkları açısından yüksek risk altındadır. Mutfak çalışanlarında kas-iskelet sistemi sorunları riskini azaltmak için çalışma ortamının ergonomik risk değerlendirmesi, ergonomik eğitim ve dinlenme molaları gibi müdahalelere ihtiyaç vardır.

Anahtar Kelimeler

Mutfak çalışanları, Kas iskelet sistemi problemleri, Fiziksel iş yükü, Ergonomik risk faktörleri

INTRODUCTION

The prevalence of musculoskeletal problems (MSP) in kitchen workers is quite high, at approximately 86 percent (1, 2). Musculoskeletal system problems occur as a result of staying in the same position for a long time or working intensely. These problems involve isolated or multiple problems in muscles, tendons, joint tissue nerves, fascia and ligaments, with or without tissue degeneration, caused by work. They are characterised by the occurrence of concomitant or non-concomitant symptoms, including pain, numbness, a feeling of heaviness and fatigue (3). A study conducted in Taiwan reported that 84% of hotel kitchen workers had MSP. These problems were most common in the shoulder (58%), neck (54%), low back (53%) and hands (46.5%) (4). A high prevalence of MSP in the shoulders (41.1%), hands/wrists (38.2%) and low back (40.1%) was reported in another study of catering workers (5).

The high physical workload of kitchen workers and low levels of leisure-time physical activity increase the incidence of musculoskeletal problems. However, this high prevalence is also linked to factors such as the ergonomic conditions of the working environment and job stress. Repetitive movements (such as dishwashing and food preparation), poor posture (especially neck and trunk flexion), tasks requiring excessive force, prolonged standing, heavy lifting and long working hours are risk factors that increase the physical workload of kitchen workers. These ergonomic risk factors increase the load on the muscles in one or more parts of the body, which in the first instance leads to muscle fatigue and in the long term to MSP (6-8). Both physically and psychologically, kitchen work is very demanding. Workers are exposed to both time pressure and physical and mental risk factors. Hanukkah et al. reported that high physical workload predicted the occurrence of MSP in female kitchen workers over a 2-year period, and that the problems caused by high physical workload were persistent (9).

There is a need for easily applicable measurement methods for the assessment of musculoskeletal problems and physical workload. This will allow early diagnosis, treatment and the planning of preventive health services. However, the number of studies investigating kitchen workers' physical workload is very limited. In addition, no study has been found that examines the ergonomic risk factors, the MSP, and the level of physical workload of the kitchen workers together. Therefore, the aim of our study was to investigate ergonomic risk factors, MSP and physical workload levels in kitchen workers.

MATERIAL and METHODS

This study was conducted between November 2022 and February 2023 with 87 participants working in different dining halls, restaurants, and cafe kitchens. All participants had worked in the kitchen for at least 2 months. A data collection form was used to collect descriptive information and ergonomic risk factors from the participants. In addition, the "Physical Workload Questionnaire (PWQ)" was used

to assess the employees' physical workload and the "Nordic Musculoskeletal Questionnaire (NMQ)" was used to assess musculoskeletal problems.

Ethical Approval

This study was approved by Tarsus University Faculty of Health Sciences Research Ethics Committee (approval number:2022/15, approval date: 27/10/2022) and performed in accordance with the Declaration of Helsinki principles. All subjects willing to participate signed a written informed consent.

Sample size

It has been reported in the literature that the prevalence of musculoskeletal problems in kitchen workers is 86% (2). Based on this prevalence, a minimum sample size of 80 subjects with an 80% confidence interval and 80% power was calculated using OpenEpi, version 3. Taking into account the possibility of participants dropping out during the study, 87 participants were included in the study.

Inclusion criteria

- Being a kitchen worker
- 18 years or older
- Consent to participate in the study

Exclusion criteria

- Not willing to participate in the study
- Having a disorder that might prevent them from understanding and completing the survey.

Data collection tools

Demographic information: Demographic characteristics of the participants were questioned. Additionally, the participants were asked about their regular exercise habits. People were considered to have regular exercise habits if they exercised for at least half an hour 3 days a week, as recommended by the World Health Organisation.

Ergonomic risk factors: Working time, environment, break frequency and duration, heavy lifting status (>10 kg), and psychosocial factors were questioned. The level of stress at the workplace was questioned as mild, moderate and severe according to the participant's perception of stress.

Physical Workload Questionnaire (PWQ): It contains 19 items describing different work situations. Five items describe trunk postures (T1, T2, T3, T4, T5), three items examine arm positions (A1, A2, A3), five items ask about the positions of the legs (L1, L2, L3, L4, L5) and six items describe weight lifting (Wu1, Wu2, Wu3, Wi1, Wi2, Wi3). All items are answered on a Likert-type scale with five options ranging from never to very often (never=0, rarely=1, sometimes=2, often=3, very often=4). The survey total score is calculated by the formula. The formula is as follows: 0.974 x score of T2 + 1.104 x score of T3 + 0.068 x score of T4 + 0.173 x score of T5 + 0.157 x score of A2 + 0.314 x score of A3 + 0.405 x score of L3 + 0.152 x score of L4 + 0.152 x score of L5 + 0.549 x score of Wu1 + 1.098 x score of Wu2 + 1.647 x score of Wu3 + 1.777 x score of Wi1 + 2.416 x score of Wi2 + 3.056 x score of Wi3. The scale has Turkish validity and reliability. The internal consistency of the Turkish version of the PWQ for all items, measured by the Cronbach's alpha coefficient, is excellent (alpha =0.812) (10).

Nordic Musculoskeletal Questionnaire: The Nordic Musculoskeletal Questionnaire includes 27 items that examine the MSP occurring in 9 parts of the body (in the last 7 days and 12 months) additionally, this questionnaire investigates the prevention from carrying out daily work because of MSP. All answers are given based on a binary 'yes/no' answer. The scoring followed the criteria proposed in the instrument, measuring frequencies and percentages for affected body regions. This questionnaire was developed to identify and characterize reports of musculoskeletal symptoms. Turkish validity and reliability were reported by Kahraman et al. The internal consistency of the Turkish version of the NMQ, measured by the Cronbach's alpha coefficient (alpha=0.896), is excellent (3).

Statistical analysis

In the study, the data obtained from the data collection instruments were analysed using the SPSS 22 package. Compliance of variables with normal distribution was analysed by visual (histogram graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk test, skewness and kurtosis values). Descriptive statistics of dependent and independent variables were presented as frequency values, normally distributed data were expressed as mean and standard deviation, and non-normally distributed data were expressed as median and interquartile range. To compare the mean physical workload scores between participants who received training in occupational ergonomics and those who did not, the independent groups t-test was used. The Kruskal-Wallis test was used to compare levels of physical workload by occupational group and workplace. Associations between physical workload and other variables were assessed using Spearman's rank correlation coefficients. Correlation coefficients; 0 - 0.19 = very weak, 0.20 - 0.39 = weak, 0.40 - 0.69 = moderate, 0.70 - 0.89 = strong, 0.90 - 1.0 = very strong. A p value of <0.05 was accepted statistically significant (11, 12).

RESULTS

Eighty seven kitchen workers (39 female and 48 male) participated in the study. 44.8% of the participants were female and 55.2% were male. The mean age of the participants was 37.38±1.78 years. The mean daily working time was 9.00 (8.00-10.00) hours and the mean weekly working time was 54.00 (48.00-63.00) hours. Other demographic characteristics of the participants are shown in Table I.

Table I. Demographic characteristics of the participants.

	n=87
Variables	**Mean±SD n, %**
Gender (n,%)	
Female	39 (44.8)
Male	48 (55.2)
Age (year)	37.38±11.78
Height (m)	1.71±0.09
Weight (kg)	76.70±14.60
Body Mass Index (kg/m²)	26.11±4.64
Tobacco use (n,%)	34 (39.1)
Regular exercise habit (n,%)	20 (23.0)
Occupation (n,%)	
Chef	19 (21.8)
Assistant chef	13 (14.9)
Kitchen bellboy	9 (10.3)
Waiter/Waitress	28 (32.2)
Dishwasher	9 (10.3)
Other	9 (10.3)
Workplace	
Cafe	23 (26.4)
Restaurant	24 (27.6)
Dining hall	34 (39.1)
Other	6 (6.9)

The median length of employment was 5.00 (2.00-15.00) years. The ergonomic risk factors that most concerned kitchen workers were stress, hot working environment and closed space. However, only 30.4% of the kitchen workers had previously received training in occupational ergonomics. No statistically significant difference was found between the groups when comparing the physical workload of participants who had received training in occupational ergonomics with those who had not (independent samples t-test, p=0.704). Characteristics such as other ergonomic risk factors, occupational injury history, stress and job satisfaction are listed in Table II.

Table II. Ergonomic risk factors.

	n=87
Risk factors	**Median (IQR) n, %**
Occupation time (year)	5.0 (2.0-15.0)
Working time-daily (hour)	9.0 (8.0-10.0)
Working time-weekly (hour)	54.0 (48.0-63.0)
Number of breaks (hour)	2.0 (1.75-3.25)
Total duration of breaks (hour)	45.0 (30.0-60.0)
Use of equipment for heavy materials (n,%)	
Yes	11 (12.6)
No	76 (87.4)
Disturbing factors in the workplace (n,%)	
Stress	46 (52.9)
Noise	28 (32.2)
Structure of the workplace	10 (11.5)
Cold	7 (8.0)
Hot	37 (42.5)
Working hours	19 (21.8)
Closed area	33 (37.9)
Excessive workload	13 (14.9)
Occupational injury history (n,%)	.
Yes	15 (17.2)
No	72 (82.8)
Ergonomic education (n,%)	
Yes	30 (34.5)
No	57 (65.5)
Stress level at working (n,%)	
Mild	27 (31.0)
Moderate	49 (56.3)
Severe	11 (12.6)
Work satisfaction (n,%)	
Less satisfied	15 (17.3)
Medium satisfied	35 (40.2)
Very satisfied	37 (42.5)

IOR : Interquartile Range

In addition, the incidence rate of MSP was compared between kitchen workers with and without stress in the work environment. It was found that the incidence rate of MSP was 57.7% in those with stress and 42.3% in those without stress. As a result, the incidence rate of MSP was significantly higher in the stressed workers (p = 0.011, Fisher's exact test).

The parts of the body where kitchen workers experienced the most MSP in both the last 12 months and the last 7 days were the low back, upper back, neck and shoulders. In addition, MSP was at levels that prevented individuals from working, mainly in the low back, upper back, neck and shoulders (Table III).

Table III. Prevalence of musculoskeletal system problems in kitchen workers.

n=87	Body region with MSP	MSP within the last 12 months n (%)	MSP prevents daily activities n (%)	MSP within the last 7 days n (%)
	Neck	45 (51.7)	23 (26.4)	25 (28.7)
	Shoulder	43 (49.4)	17 (19.5)	31 (35.6)
	Elbow	12 (13.8)	4 (4.6)	8 (9.2)
	Wrist/hand	31 (35.6)	9 (10.3)	15 (17.2)
	Upper back	47 (54.0)	18 (20.7)	33 (37.9)
	Low back	47 (54.0)	29 (33.3)	36 (41.4)
	Hip	13 (14.9)	9 (10.3)	9 (10.3)
	Knee	29 (33.3)	13 (14.9)	19 (21.8)
	Ankle	39 (44.8)	16 (18.4)	22 (25.3)

When kitchen workers were compared in terms of physical workload levels according to their occupation, no significant difference was found between the groups. Similarly, there was no statistically significant difference in physical workload between those working in cafes, restaurants, dining halls and other kitchens (p>0.05). However, when the average physical workload was examined, it was found that the workload of dishwashers, kitchen bellboys and cooks was particularly high (Table IV).

Table IV. Physical workload levels according to occupation and workplace.

Groups	**Physical workload**
	Median (IQR)
Occupation (n,%)	p=0.257*
Chef	18.79 (14.27-26.42)
Assistant chef	8.78 (3.83-20.22)
Kitchen bellboy	21.99 (11.48-30.58)
Waiter/Waitress	17.93 (11.01-27.83)
Dishwasher	18.45 (13.10-30.44)
Other	16.09 (6.00-32.33)
Workplace	p=0.171*
Cafe	12.77 (5.76-22.25)
Restaurant	18.26 (10.77-26.12)
Dining hall	17.72 (13.97-29.36)
Other	23.48 (10.90-33.69)

*Kruskal Wallis Test

When the relationship between the physical workload of the participants and their daily and weekly working hours, the number of breaks during work and the duration of the breaks was examined, a weak negative correlation was found between the physical workload and the number of daily breaks (r=-0.411, p<0.001). There was no significant correlation between physical workload and any of the other parameters (Table V).

Table V. Correlations between Physical workload and weekly working hours, daily working hours, number of breaks, and duration of breaks.

Variables	Physical workload	
	Spearman Rho	p
Weekly working hours	-0.005	0.961
Daily working hours	-0.042	0.704
Number of breaks	-0.411	<0.001*
Duration of breaks	-0.232	0.065

* Spearman's rank correlation

MSP, one of the outcome measures, was assessed using the Nordic Musculoskeletal Questionnaire, and the prevalence of MSP observed in individuals and in which region it occurred was determined by scoring this scale. MSP was observed in 78 participants (89.7%), while it was not observed in 9 participants (10.3%). When the groups with and without MSP were compared in terms of physical workload, there was no significant difference between the groups. However, the distribution of the number of participants in the groups was not proportional (p=0.794, Mann Whitney U test).
According to the power analysis result calculated with the Open Epi program after the study, the power of the study was found to be 90.31% at a significance level of 0.05.

DISCUSSION

This study was designed to investigate ergonomic risk factors, MSP and physical workload levels in kitchen workers. The main findings of our study are as follows: Firstly, stress, hot and closed workplace are the most disturbing ergonomic risk factors according to kitchen workers. Secondly, the low back, upper back, neck and shoulders are the parts of the body where MSP has been experienced most frequently by kitchen workers in the last 12 months and the last 7 days. Thirdly, when kitchen workers are compared by workplace and occupation, their physical workloads are similar.

Musculoskeletal problems

Musculoskeletal problems and injuries are now the most common form of occupational disease in Europe, and the food and drink industry ranks second in terms of the incidence of work-related musculoskeletal disorders (13). Kitchen workers sometimes have to retire due to MSP-related disability (14). There have been studies in the literature investigating MSP in kitchen workers. In a systematic review examining the prevalence and risk factors for MSP among kitchen workers in the food and beverage industry, the prevalence of MSP was reported to be between 10% and 75%. However, the most commonly affected parts of the body have been reported to be the low back, neck, shoulder, elbow, leg and foot (2). Similarly, in a study of male kitchen workers in India, low back pain (65.8%), shoulder pain (62.3%), finger/wrist pain (43.9%), knee/foot pain (42.1%) and neck pain (38.6%) were reported in the past year (5). In a study of hotel and restaurant kitchen workers in Taiwan, 84% of the study population reported MSP in the previous month. The shoulder (58%), neck (54%) and low back (53%) regions were shown to have the highest rates of reported MSP (3). In another study conducted with cooks, it was reported that 85.2% of the participants had MSP-related complaints (shoulder 63.5%, neck 59.9% and low back 56.9%) (15). The majority of studies in the literature show that the most affected areas are the low back, neck and shoulders. However, there are also studies that show a high prevalence of hand, ankle and elbow involvement. Possible reasons for this could be the different individual characteristics of the participants, the different cuisines in which they work and differences in workload. In our study, similar to the literature, the parts of the body where most MSP was experienced in both the last 12 months and the last 7 days were the low back, upper back, neck and shoulders. In our study, unlike other studies in the literature, we not only investigated the prevalence of MSP, but also questioned whether these problems affect the performance of individuals in their daily work. The kitchen workers in the study reported that 33.3% were prevented from working due to low back problems, 26.4% due to neck problems, 20.7% due to upper back problems and 19.5% due to shoulder problems.

Physical workload

The main factors contributing to the development of MSP in kitchen workers are repetitive manual activities, heavy lifting, movements requiring strength and poor posture. In addition, long and uninterrupted working hours, prolonged standing and walking long distances are other factors that cause MSP (16). MSP can occur as a result of these risk factors causing excessive loads on the musculoskeletal system. Kitchen workers face four main risk factors:
- Posture: Neck posture during cooking, excessive reaching
- Strength: Heavy lifting, carrying kitchen utensils
- Repetition: Repetitive movements such as chopping
- Duration: Long working hours, insufficient number and duration of breaks, etc (2).

Considering all these factors, in this study, we investigated the prevalence of musculoskeletal problems in kitchen workers and also tried to determine the physical workload of the kitchen workers by investigating their standing and sitting postures, frequency of walking and frequency of lifting heavy objects. In the literature, the number of studies investigating the physical workload of kitchen workers is quite limited. Therefore, the number of publications with which we could compare the physical workload results of our study is quite small. However, in a study by Haukka et al, which looked at sickness absence due to musculoskeletal pain among kitchen workers, they also asked about the physical and psychological workload of the workers. They reported that 50.8% of the

workers had a high level of physical workload (17). As the physical workload questionnaire used in our study is different, physical workload is not categorised as low or high. As the physical workload questionnaire we used gives an average, it allows us to make comparisons between groups. Thus, we found that the physical workload of kitchen workers was similar when we compared them by place of work or occupation. However, when we looked at the average physical workload by occupation, we found that dishwashers, kitchen bellboys and cooks had relatively higher workloads. The study also found that the physical workload of kitchen workers decreased as the number of breaks increased. This study, in parallel with the studies by Chyuan, Liu, Ansari and Tomita, showed that the most common musculoskeletal problem was in the low back (3, 15, 18, 19). It has been suggested that the long standing hours and high physical workload of kitchen workers may explain the high prevalence of low back pain (20). Another reason may be inadequate rest during the workday. It seems that as the number of breaks during the workday increases, the physical workload of workers decreases.

Risk factors

In addition to physical risk factors, individual characteristics of the worker and psychosocial risk factors such as stress levels and job satisfaction may increase the risk of developing MSP (2, 21). Furthermore, environmental exposures other than those related to psychosocial workload (ergonomics of the working environment, noisy, hot, cold, uncomfortable working environment, etc.) may also play a role for the development and persistence of MSP (22). For all these reasons, in our study, in addition to physical workload and MSP, we also examined workers' stress levels, job satisfaction and general health, and ergonomic risk factors that will affect their performance in the work environment. The kitchen workers who participated in our study complained most about work stress (%52.9) and the temperature of the working environment (%42.5). Alam et al. reported that the excessive heat of the kitchen environment may increase workers' job dissatisfaction in their study conducted in the university canteen (23). In addition, Matsuzuki et al. reported in a study conducted in hospital kitchens that reducing the temperature of the environment and increasing ventilation reduced the work-related stress of kitchen workers (24). Our study also supports that one of the most important risk factors in kitchens is the ambient temperature. However, it is also reported in the literature that changing ergonomic factors reduces physical load and improves musculoskeletal health (25, 26).

Limitations

It is a limitation of this study that the data of the study were obtained from a self-reported survey, but we think that this has an insignificant impact on the study, as surveys with sufficient validity and reliability levels are preferred. Another limitation is the presence of selection bias due to the use of a questionnaire in this study.

CONCLUSION

Kitchen workers are at high risk of musculoskeletal disorders. To reduce the risk of musculoskeletal problems in kitchen workers, interventions such as ergonomic risk assessment of the work environment, ergonomic training and provision of rest breaks are needed. In addition, teaching correct posture and body use during repetitive tasks and the use of appropriate equipment are key points that can prevent musculoskeletal problems by reducing physical workload. Prospective studies are therefore needed to confirm the associations shown in the current cross-sectional study.

Ethical Compliance Statement

This research complies with all the relevant national regulations, institutional policies and is in accordance the tenets of the Helsinki Declaration, and has been approved by the Non-Interventional Research Ethics Committee of Tarsus University Faculty of Health Sciences (approval number: 2022/15, approval date: 27/10/2022).

Author Contributions

Concept – E.G., A.G.; Design - E.G., A.G, Supervision E.G., A.G; Resources A.G.; Materials - E.G., A.G.; Data Collection and/or Processing - E.G., A.G; Analysis and/ or Interpretation E.G., A.G; Literature Search – E.G.; Writing Manuscript - E.G., A.G; Critical Review - E.G., A.G.

Conflict of Interest

The authors have no conflict of interest to declare.

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