

Prevalence of Musculoskeletal Disorders and Ergonomic Risk Factors among Bread-Bakers

ARTICLE INFO

Article Type Original Article

Authors

Javad Torkaman^{1*} MSc
Seyed Ghavamedin Attari^{2,3} PhD

How to cite this article

Torkaman J., Attari SGH, Prevalence of Musculoskeletal Disorders and Ergonomic Risk Factors among Bread-Bakers. IJMPP. 2022; 7(2): 720-727.

¹ Department of Ergonomics, School of Health, Hamadan University of Medical Sciences, Hamadan, Iran

² Department of Environmental and Occupational Health Engineering, Hamadan University of Medical Sciences, Hamadan, Iran

³ Department of Occupational Health and safety Engineering, Borujerd Branch, Islamic Azad University, Borujerd, Iran

* Correspondence

Address: Department of Ergonomics, School of Health, Hamadan University of Medical Sciences, Hamadan, Iran.
Tel: 08138263016
Fax: 08138260530
Email: ja.to91@yahoo.com

Article History

Received: Feb 5, 2022
Accepted: Mar 4, 2022
ePublished: Apr 20, 2022

ABSTRACT

Aim: Musculoskeletal Disorders (MSDs) are the most common work-related problem in many bakery workers in developing and industrialized countries. This study aimed to assess the rate and ergonomic risk factors of MSDs among traditional bread bakers in Hamadan.

Method and Materials: This cross-sectional descriptive-analytic study was conducted on 310 traditional bread bakers in Hamadan, Iran. The prevalence of MSDs was assessed using the Nordic Questionnaire (NQ), body map, and Visual Analogue Scale (VAS). Analysis of data was performed in SPSS (version 20) using Chi-square and independent T tests.

Findings: The Mean and Standard Deviation (M \pm SD) of work experience, height, weight, Body Mass Index (BMI) and age were respectively, 4 \pm 6.82 (Year), 1.6 \pm 0.08 (M), 60 \pm 12.76 (kg), 24.65 \pm 4.70 and 43.5 \pm 12.60 (Year). The involved organs in baking consisted of the neck, shoulder, back, waist, elbow, arm, hand, thigh, knee, shin and ankle. The highest prevalence rates of pain in the studied workers referred to the middle back (N=38; %92.68), knees (N=33; %80.49), shoulders (N=13; %30.95), forearms (N=11; %26.19) and wrists (N=11; %26.19) respectively. The prevalence of MSDs correlated with BMI and work experience significantly (P \leq 0.05).

Conclusion: As, this study revealed that the rate of musculoskeletal disorders in the different body regions of bread bakers were high, proper interventional preventive management are strongly recommended to be designed and implemented to eliminate the disorders among this target group.

Keywords: Body Map, Nordic Questionnaire (NQ), Musculoskeletal Disorders (MSDs), Visual Analog Scale.

Introduction

Musculoskeletal Disorders (MSDs) are one of the major causes of morbidity which have a significant influence on health and quality of life. Furthermore, it has been discussed that this disorder imposes an enormous burden of cost on the suffered individuals and healthcare system of the societies all over the world^[1].

Studies have reported that poor posture, repetitive work, high force (e.g., exposed to higher loads), vibration, MMH, bending and twisting, and extreme temperatures are associated with Work-related Musculoskeletal Disorders (WMSDs). Regarding, causal relationships have been found between some physical risk factors (such as poor posture and repetitive tasks) and neck,

knee or wrist pain among workers in various industries^[2,3]. Pain in the neck and lower back is the most common MSD which often leading to disability and sick leave. It has been reported as one of the most costly health problems in Western society. Based on evidences MSD was defined as all complaints related to muscles, joints, tendons, ligaments and bones^[4].

The risk factors for musculoskeletal disorders are very diverse, but one of the most important causes of these disorders is awkward posture. These disorders will be reduced and eliminated by improving of awkward posture^[5-7]. According to the reports obtained from World Health Organization (WHO) and others, MSDs are the second globally leading factor of disability which

accounts for approximately 20% of the total life years of individuals^[8].

Work-related musculoskeletal disorders usually involve vertebra of lumbar and cervical spine as well as upper limbs of bodies^[9, 10]. Reported that the Iranian workers mostly suffered from the MSDs symptoms, particularly in the lower back (48.9%), shoulder (45.9%), neck (44.2%), upper back (43.8%), and knees (43.8%). In fact, the phenomenon of work-related musculoskeletal disorders (WMSDs) augments in number in developing countries^[7]. Musculoskeletal Disorders are caused by excessive mechanical load and play a significant social and economic role in causing these disorders because they are one of the main causes of disability and absenteeism. Disorders depend on work patterns and do not belong to a particular industry or occupation. Therefore, many workers are at risk for MSD^[3]. Most bread-making operations in Iran, especially in the city of Hamedan, are traditionally performed by these people. Therefore, the incidence of risk factors such as repetitive movements, Cumulative Trauma Disorders (CTD), awkward posture, psychological-social factors and poor environmental conditions, prolonged standing and repetitive movements in this job is high. These disorders in the upper and lower limbs happens. Upper Limb Disorders (ULDs) are pain, tension, and disorders that affect every part of the arm and fingers from shoulder to neck or neck, and are often caused or exacerbated by work stress^[11].

Given the above explanations and the importance of WMSDs and this issue that the workstation has the most important role in increasing productivity in various industries such as bread baking industry this study is guaranteed. This study aimed to investigate the rate of MSDs in the upper limbs in the traditional bread baking process in order

to be able to design proper interventional program.

Method and Materials

This descriptive-analytical study was conducted among 310 bread baking workplaces in Hamadan, Iran in 2019. In these workplaces, three types of bread named Sangaki, Barbari and Lavash (flatten bread) were baked. These workplaces were selected randomly by using cluster sampling. In these workplaces three person including Shater (the person who places the bread in the oven), Chanehgir (the person who cut and measure the dough), and Nangir (the person who removes the bread from the oven) were studied. Participants with at least one year of work experience, spending most of their times in baking bread were entered into the study. It should be noted that those bread bakers who suffered from previous accident, suffered from musculoskeletal injuries such as fractures and dislocations and who involved with second job were excluded from the study.

All participants were provided with full explanation regarding study procedures and then written, informed consent forms were read and signed by them prior to be involved in the study.

Demographic information such as age, gender, body weight, work experience as well as time of workshifting were collected from each participant by demographic questionnaire. Ergonomic risk factors of bakery such as repetitive movements of the hands awkward posture, force assessment and environmental risk factors like inappropriate work station, unfavorable noise and lighting were asked through self-assessment questionnaire.

To assess ergonomic risk factors related to hand and wrist activities, videos of each task were recorded and assessed. for force assessment Visual Analog Scale (VAS) was

used to measure pain severity^[12]. This scale is usually composed of a line with a length of 100 mm and a label on its two ends. In Figure 1, the VAS is shown with two labels of convenience and severe discomfort at the two ends. Participants put a mark on the scale to show the level of discomfort in different parts of the body. The advantages of VAS is its' easy management, its' sensitivity and ability to respond to analytical statistics (strong parametric statistics). According to a study, measuring the pain through VAS has some defects such as incorrectly understanding by elderly and illiterate subjects^[13], so that these people have most difficulty in this regard. Since, participants in this study were were literate and illiterate, so this scale was firstly set qualitatively in order to

make it easier for less literate and illiterate bakers, and as compared to small sample like potential participants, showed just few errors in these individuals. The options of this scale is painless (score 0), low pain (score 10-20), moderate pain (score 20-50), severe pain (score 50-80) and very severe (score 80-100) which was determined by the participants regarding their pain severity of each different body parts determined by the body map^[12].



Figure 1) Visual Analog Scale

The descriptive statistics for demographic,

Table1) Participants' socio-demographic and health characteristics

Variables	Mean \pm SD		Totally	p-value
	Female (M \pm SD)	Male (M \pm SD)	N	T-test
Age (yrs)	37.03 \pm 14.03	36.83 \pm 8.33	303	P=0.88
Job experience(M)	14.3 \pm 12.3	16.4 \pm 8.6	309	P= 0.10
Working hours in week	52.47 \pm 36.16	49.28 \pm 15.16	309	P=0.37
BMI (kg/m2)	24.65 \pm 4.70	23.73 \pm 3.50	306	p<0.05
	N(%)	N(%)		Chai- squer
Left handed	7(50)	7(50)	14	P<0.001
Right handed	83(31)	182(69)	265	
Musculoskeletal disorders in the past 12 months (Yes)	65(34)	129(67.5)	191	P<0.01
Without History of previous illness	4(23.5)	13(67.5)	17	P=0.14
With History of previous illness	104(36.8)	178(63.2)	282	
Smoker (Yes)	28(32.5)	58(67.4)	86	P=0.20
Training about ergonomic principles (Yes)	108(37.2)	182(62.8)	290	P=0.02
Awared of danger	73(33.6)	144(66.34)	217	P<0.01
Unawared	45(48.9)	47(51.1)	92	

* independent sample t-test

Table 2) Frequency of musculoskeletal disorders which experienced by bakers in the last 12 months

Body areas	Male N(%)	Female N(%)	Total N(%)	p	Responded N(%)
Neck	11(5.8)	17(15.3)	28 (9.3)	.006	301(97.0)
Left shoulder	4 (3.1)	3 (2.7)	7 (2.3)	.701	
Right shoulder	6 (3.2)	6(5.4)	12 (4)	.369	
Upper back	9 (4.7)	5(4.5)	14 (4.7)	.926	
Middle back	15 (7.9)	5 (4.5)	20 (6.6)	.255	
Lower back	33(17.4)	29 (26.1)	62 (20.6)	.070	296(95.4)
Palm of the left hand	0	4 (3.8)	4 (1.4)	.016	
Palm of the right hand	8 (4.5)	10 (15.6)	18 (7.5)	.010	240(77.4)
Fingers of left hand	11 (5.8)	43 (38.7)	54 (17.9)	.001	301(97)
Fingers of right hand	0	35 (31.5)	35 (11.6)	<.001	
Right knees	45 (23.7)	16 (14.4)	61(20.3)	.054	
Left Knees	45(24.7)	17 (15.3)	64(21.3)	.054	
left elbow	12 (6.3)	12 (10.8)	24(8)	.165	
Right elbow	17 (63.2)	10 (92.8)	27 (93)	.583	
Right thigh	30 (%15.8)	35 (%31.50)	65 (%21.6)	.001	
Left thigh	19 (%10)	19(%17.1)	38(%12.6)	.071	
One or two ankles	7(%3.7)	42 (%37.8)	49(%16.3)	<.001	
Others	65 (%36.9)	26 (%40.6)	91 (%37.9)	.602	

* independent sample t-test

Table3) Frequency distribution of knee pain severity among studied bakers

VAS scale	Male N(%)	Female N(%)	P value
Painless (0)	38 (7.21)	11(16.2)	0.001
Low pain(1-20)	49 (28)	19 (10)	
Moderate pain (20-50)	29 (3.10)	37 (51.5)	
Severe pain (50-80)	57 (3.30)	0	
Very severe (80-100)	15 (4.7)	3 (4.4)	
Total	188 (100)	70	

There was a significant relationship between pain severity in male and female($p < 0.001$). (Chi-square)

occupational, and non-occupational information reported by calculation of the rate of MSDs that gathered by Nordic questionnaire. Moreover, self-reported musculoskeletal pain and independent variables analyzed by chi-square tests. Data were entered into SPSS software and analyzed.

Findings

This study was conducted among 310 bakery workers including 129 female (40.3%) and 181 male (59.7%) in three tasks of bread baking including Shateri [Female 65(53.7%) and Male 89(47.6%)], Chanehgir (Female 31(25.6%) and

Table4) Frequency of experienced MSDs among bakers in the last week that prevented daily activities

Body area	Men N(%)	Women N(%)	Total	P-value	Responded rate N(%)
Neck	9 (5.1)	7 (9.1)	16 (6.3)	0.262	255(82. 2)
Left shoulder	0	0	0	0	256(82. 5)
Right shoulder	14 (7.9)	28 (35.9)	42(16.4)	<0.001	
Upper back	18 (10.1)	27 (35.1)	45 (17.6)	<0.001	255(82. 2)
Lower back	21 (11.8)	4 (5.1)	25 (9.8)	0.098	256(82. 5)
Wirsts	8 (4.5)	2 (2.6)	10 (3.9)	0.062	301(97)
Knees	20 (11.2)	8 (10.4)	28 (11)	0.200	
Elbow	12 (1.1)	6(2.6)	20 (1.6)	0.586	
Legs	15 (8.4)	0	15 (5.9)	<0.001	
Ankles	25 (13.6)	11 (14.1)	36 (13.7)	1.000	

Male 51(27.33%)] and Nangir [Female 25(20.7%) and Male 47(25.1%)]. There was no difference between them in termes of its rating. There was a statistically significant relationship between gender and type of task in the bakery (P<0.001). Table 1 shows the rest of socio-demographic and health characteristics.

Frequency of MSDs in different parts of bodies of studied bakers during 12 past months hsrve been shown in Table 2.

In this study, bakers had the most frequent pain in the lower limb and knee (Table2). Therefore, it was decided that the severity of pain in these organs be evaluated using the VAS. Due to the fact that the most people in the study population were Shater or flat bread, and these workers performed their tasks in sitting position, workers reported the most pain intensity in these organs. The results showed that there was no significant statistical relationship between pain intensity in the lumbar and knees joints with the age of women (P= 0.1). However there was a statistically significant relation with the work experience of women bakers and

pain severity in the lumbar and knees.

Discussion

In this study bakery workers were assessed regarding their WMSDs. According the findings all women bakers had sitting position and all men had standing position in their workplaces and they were suffering from different musculoskeletal disorders because of involving with repetitive movements inappropriately. In the findings of Hasheminejad et al., it was found that the upper limb disorders among bakery workers was high. As well they found, most bakers suffered from MSDsin four areas of neck, shoulder, hand / wrist and and lower back because the bakery workers were standing and had repetitive shoulder and neck movements^[14].

In present study, bakers responded to musculoskeletal disorders problems in their bodies during the past 12 months and past 7 days. The highestrate of problems was shown in the upper limbs of the women with sitting posture included right and right elbows, left fingers, one or two ankles , right fingers,

right leg and the left leg respectively. Among men, the highest rate in the upper limbs was related to standing position including the forearm and right elbow, the left knee, right thigh, lower lumbar, and right leg. It could be argued that the reason of high rate of disorders in the men bakers can be related to the physical improper posture and the type of work standing. These disorders were high in bakeries where men were standing. But in the bakeries where women were sitting in the sitting position inappropriate foot / back posture, leg fatigue and body weight were risk factors that probably contributed to a higher prevalence of abnormality in the lower leg and waist compared to men. Moreover, due to the preparation of the dough (kneading) which were done by more use of the hands, the prevalence of these disorders was higher in fingers, forearms and elbows in women compared to men.

Prolonged standing in men and possibly risk factors for occupational skeletal dysfunctions such as repetitive movements, manual handling, body rotation and body weight caused further disorders in the body organs such as forearm, elbows, lower limbs, thighs and knees among them.

The result of a study on male bachelors in Sabzevar showed the most repetitive posture in Shater employees while working is related to sticking bread inside the oven. In this position, the neck, shoulders, back and arms were not in their normal position. Therefore, due to the long duration of this task and also working standing up has caused disorders in the neck and shoulders, as well as elbows and back^[15]. Compared to the present study, the highest prevalence of right and left elbow problems were seen in men and women. In another study, it was found that the traumatic cumulative disorder was observed in the four areas of the neck, shoulder, hand / wrist and lower back. It was higher in upper limbs among bakery workers. The most commonly

cumulative disturbances observed among all participants in the study were neck, shoulder, wrist, and lower limbs, due to standing tasks and repetitive movements in shoulder areas and neck^[14].

In present study, high intensity pain of organs was measured based on VAS scale. After recognizing the prevalence of abnormalities in the limbs, their severity was measured using the VAS method and it was found that there was no significant statistical relationship between the amount of pain intensity in the lumbar and knees joints with the age of women. But there was a statistically significant relationship with the work experience of women bakers, and this likely be women have a long history of baking bread to help support themselves and their families and they are represented intensity pain.

In line of present study, other research reported the most common disorders were in the shoulders and back, which had constant movements. Furthermore, there was a statistical significant relationship between the type of occupation and the occurred injuries. Also, there has been shown a significant relationship between work experience and knee disorders^[16]. In present study, the rate of musculoskeletal disorders was related to body mass index and women were more likely to suffer from MSDs. This difference maybe due to this reason that they had a higher body mass index than men and because they were less sedentary while performing their duties while sitting.

The results of these studies revealed that the rate of musculoskeletal disorders associated with this occupation is high. Therefore, it can be said that the bakery occupation is one of the high risk of due to musculoskeletal disorders, especially in the lower limbs, such as legs and lower back and upper limbs, such as shoulders and hands. Therefore, prevention of these disorders in the workplace and the

elimination of relevant risk factors should be considered. This makes it clear that in the ergonomic intervention program in the work environment, corrective actions in this occupation are prioritized. According to the findings of this study, engineering interventions and management interventions are proposed to reduce and even eliminate musculoskeletal disorders^[17]. Based on engineering methods, redesigning of the workstation in bakery is recommended^[3], so that the activity of workers will have done without taking extra moves and awkward. Furthermore, to prevent workers from bending and twisting, the equipment needed for doing the work should be within the workers' reach. Other suggested solutions include the use of electrical shaker instead of manual work, the design of the workstation for the task of spreading the dough instead of the traditional method and putting the tool a bit lower than the shoulder. The use of these methods reduce the musculoskeletal disorders in workers^[18]. Proposed management interventions include: training baker workers about musculoskeletal disorders, the prevention and control strategies for such disorders, arranging work and rest schedules, performing athletic exercises in the workplace at a specific time, and modifying bread baking devices in accordance with ergonomic standards are recommended. By using these interventions, it is possible to modify the methods of work in a more efficient and optimal way, in which the least damage to the musculoskeletal system, especially the knee and back, is introduced. Therefore, to improve the status, it is best to use ergonomic control techniques that are considered as the most important part of any ergonomic program, and their impact on reducing the amount of musculoskeletal disorders associated with work has also been proven. Also, the use of a combination of management and engineering methods can increase the efficiency of bakery workers.

Although this study conducted among a large sample which is its strong points, there are some limitation for this study.

The survey instruments were limited, so that there were not any instrument for measuring the bakers workload, factors might have alleviated its physical burdens-such as work-rest strategies (i.e. alternating between light and heavy tasks, taking regular breaks, etc.) that might affect on musculoskeletal disorders. Future studies of bakers should incorporate questions on work-rest strategies. Moreover, future researches should incorporate more descriptive assessments that explore other factors of pain increasing.

Conclusion

This study showed that WMSDs occur at a large number of bakers which seems that the major ergonomic problems are inappropriate postures, manual load carrying, rotating and bending of the body Which should be assessed in future studies

Acknowledgements

The authors thank everyone who made this research be completed. The authors thank the research deputy of HMUMS for providing funding for the study .

Authors Contribution: JT was the main investigator. He did all stages of the research. SGHA was advisor of the research. He helped in all stages of the study. Both authors read the manuscript and confirmed it.

Conflict of Interest:

There is no conflict of interest for this study.

Ethical Prtmision: This study was approved by the Ethics Committee of the Hamadan University of Medical Science with code (Ir. Umsha.Rec. 1396.339).

Funding

This research was financially supported by research deputy of Hammedan Universit of Medical Scienc (HMUMS).

References

- Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *The Lancet*. 2013;382(9904):1575-86. [https://doi.org/10.1016/S0140-6736\(13\)61611-6](https://doi.org/10.1016/S0140-6736(13)61611-6).
- Anwer S, Li H, Antwi-Afari MF, Wong AYL. Associations between physical or psychosocial risk factors and work-related musculoskeletal disorders in construction workers based on literature in the last 20 years: A systematic review. *Int. J. Ind. Ergon.* 2021;83:103113. <https://doi.org/10.1016/j.ergon.2021.103113>.
- Beheshti MH. Evaluating the potential risk of musculoskeletal disorders among bakers according to LUBA and ACGIH-HAL indices. *JOHE*. 2014;3(2):72-80. <https://doi.org/10.18869/acadpub.johe.3.2.72>.
- Stjernbrandt A, Hoftun Farbu E. Occupational cold exposure is associated with neck pain, low back pain, and lumbar radiculopathy. *Ergonomics*. 2022;1-10. <https://doi.org/10.1080/00140139.2022.2027030>.
- Najafi-Dolatabadi S, Malekzadeh J, Mohebi-Nobandegani Z. Patients satisfaction before and after implementation of paying per case for employees. *Iran. J. Nurs. Res.* 2011;23(68):39-46. <http://ijn.iiums.ac.ir/article-1-912-en.html>
- Santos AC, Bredemeier M, Rosa KF, Amantéa VA, Xavier RM. Impact on the Quality of Life of an Educational Program for the Prevention of Work-Related Musculoskeletal Disorders: a randomized controlled trial. *BMC public health*. 2011;11(1):60. <https://doi.org/10.1186/1471-2458-11-60>.
- Pratiwi I, Brillyanto V, Ratnanto Fitriadi MA, Abdol MN. Postural Evaluation and Hand Activity Level at Batik Cap Process using LUBA and ACGIH HAL Methods. *Int J Late Technol Eng*. 2019;8(3):2552-60. <https://doi.org/10.35940/ijrte.C4765.098319>.
- Dixon SJ, Chidiac P. Editorial overview: Musculoskeletal: New therapeutic targets and delivery systems. *Curr Opin Pharmacol*. 2018. <https://doi.org/10.1016/j.coph.2018.06.002>.
- Aghilinejad M, Choobineh AR, Sadeghi Z, Nouri M K, Bahrami Ahmadi A. Prevalence of Musculoskeletal Disorders among Iranian Steel Workers Iran Red Crescent Med J. 2012 Apr; 14(4): 198-203.
- Joudakinia L AD, Saki A, Bigdeli A. Evaluation of biomechanical risk factors for neck and back disorders in traditional bakers during a work-day: Implications for ergonomics intervention. *Arch Environ Occup Health*. 2021;76(2):86-93. [doi:10.1080/19338244.2020.1783504](https://doi.org/10.1080/19338244.2020.1783504).
- Motamedzade Torghabeh M, Torkaman J, Attari SQ, Golzar Khojasteh B, Ghafari ME, Saadatfar A. An enquiry into the prevalence of musculoskeletal disorders and ergonomic risk factors among Hamadan-based bakers in 2017. *Journal of Birjand University of Medical Sciences*. 2017;24(4):313-23. <http://journal.bums.ac.ir/article-1-2292-en.html>.
- Nadri HNA, Rohani B, Fasih Ramandi F, Amin Sobhani M. Assessment of musculoskeletal disorders prevalence and discomfort among dentists by visual analog discomfort scale. *JMDS*. 2015;39(4):363-72. <https://doi.org/10.2238/JMDS.2015.5809>.
- Karwowski W, Marras WS. Occupational ergonomics: engineering and administrative controls: CRC Press; 2003. <https://doi.org/10.1201/9780203507926>.
- Tajvar A, Hasheminejad N, Bahrampour A, Chubineh A, Jalali A. Musculoskeletal disorders among small trades workers: A survey in the bakeries. *Bimonthly Journal of Hormozgan University of Medical Sciences*. 2012;15(4):304-10. <http://eprints.hums.ac.ir/685/1/hmj-v15n4p304-en.pdf>
- Ahmadi Asour A MH, Malihi A, Rakhshani MA, Khamirchi RA. Assessment of Musculoskeletal Disorders Risk in Traditional Bakers of Sabzevar, Iran (2012). *Journal of Sabzevar University of Medical Science*. 2014;21(5):942-950
- Ghamari F, Mohammad Beygi A, Tajik R. Ergonomic assessment of working postures in Arak bakery workers by the OWAS method. *sjsph*. 2009; 7(1): 47-55 |. 2009;7(1):47-55. <http://sjsph.tums.ac.ir/article-1-125-en.html>
- Torkaman J, Motamedzadeh M, Attari S G, & Roshanaei G. Assessment of compressive force on back of hamadan building construction workers during manual load handling by utah method in 2015: a short report. *Journal of Rafsanjan University of Medical Sciences*. 2017;16(8):797-804. <http://journal.rums.ac.ir/article-1-3602-en.html>
- Habibi EKS, Hasanazadeh A. Evaluation of ergonomic risk factor by OCRA Method in assembly industry. *Iran Occup. Health*. 2008;5(1-2):70-6. <http://ioh.iiums.ac.ir/article-1-119-en.html>