Journal of Human Environment and Health Promotion
Print ISSN: 2476-5481 Online ISSN: 2476-549X

An Ergonomic Evaluation of the Office Workplace: Determining the Cut-off Point of Checklists for Workstation Layout and Computer Users' Posture

Seyvan Sobhani [a, b] | **Sara Tabanfar** [a, b] | **Ali Safari Variani** [a] | **Sakineh Varmazyar** [c *]

a. Department of Occupational Health Engineering, Faculty of Health, Qazvin University of Medical Science, Qazvin, Iran.
b. Department of Occupational Health Engineering, School of Public Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.
c. Department of Occupational Health Engineering, Social Determinants Health Research Center and Research Institute for Prevention of Non-Communicable Diseases, Faculty of Health, Qazvin University of Medical Sciences, Qazvin, Iran.

***Corresponding author:** Department of Occupational Health Engineering, Social Determinants Health Research Center and Research Institute for Prevention of Non-Communicable Diseases, Faculty of Health, Qazvin University of Medical Sciences, Shahid Bahonar Bolvar, Qazvin, Iran. Postal Code: 34199-15315. E-mail: svarmazyar@qums.ac.ir

ARTICLE INFO

Article type:
Original article

Article history:
Received: 30 December 2023
Revised: 22 January 2024
Accepted: 2 February 2024

https://doi.org/10.61186/jhehp.10.1.57

Keywords:

Computer
Posture
Users
Workplace
Office

ABSTRACT

Background: This study aimed to evaluate the ergonomics of the office workplace and determine the cut-off point of the workstation layout checklist (WSLC) and the work posture checklist (WPC) of computer users.

Methods: The descriptive-analytical was performed among 200 office staff willing to cooperate at the university. To collect data and evaluate workstations and the posture of employees, the WSLC and WPC were used, respectively. The ROC curve was used to determine the cut point of the final score of the checklists.

Results: The optimal cut-off point value for the WSLC was 14.5 (sensitivity = 91.2, specificity = 77.8, and area under the curve = 0.89). Similarly, the best cut-off point value for the WPC was identified as 8.5, with a sensitivity of 93.9, specificity of 71.8, and area under the curve of 0.88. The evaluation results showed that 25 % of the workstations and 32 % of the working postures of the employees were at an undesirable level.

Conclusion: Determining the cut-off point for valid WSLC and WPC plays a crucial role in evaluating the cost, facilitation, speed, and repetition associated with office workplaces, thereby categorizing them as either desirable or undesirable. A quarter of the workstations and a third of the working postures of the employees were evaluated as undesirable.

1. Introduction

Musculoskeletal disorders are ranked as the second most prevalent work-related disorders [1]. Work-related Musculoskeletal Disorders (WMSDs) can lead to disability, serious injury, and occupational disability [2]. Among computer users, the most critical factors causing musculoskeletal disorders are awkward posture, repetitive movements, and static work [3]. Today, computers are a central and integral part of human life [4]. They are used for work in companies, institutions, and homes [5, 6]. Various studies have reported a high prevalence of musculoskeletal disorders among office staff due to the increasing use of computers [7]. In the last few decades, the prevalence of musculoskeletal disorders, affecting areas, including the neck, shoulder, back, and arm, has exceeded 60 % among office staff [1]. The causes of these disorders can be attributed to the shape, angle, and position of the chair, mouse, keyboard, or monitor, repetitive movements of hands, fingers, and wrists, contact stress in the wrist region, and awkward forearm and wrist postures [8, 9]. In addition, sitting for a long time in an inappropriate position, not adjusting the monitor's height, placing the mouse far from the body, and non-adjustable chairs contribute to these

How to cite: Sobhani S, Tabanfar S, Safari Variani A, Varmazyar S. An Ergonomic Evaluation of the Office Workplace: Determining the Cut-off Point of Checklists for Workstation Layout and Computer Users' Posture. *J Hum Environ Health Promot.* 2024; 10(1): 57-62.

disorders [1, 10-12]. One of the goals of ergonomics is the proper design and maintenance of a workstation to increase the health and productivity of individuals [13]. Workstation design is related to the shape, dimensions, and layout (i.e., location and orientation) of various material elements around people. These elements are chairs, work surfaces, desks, equipment, tools, controls, and displays used during work [14, 15]. When working with a computer, the chair and the desk are two main parts that affect the user's posture. Therefore, in addition to ensuring comfort, these elements must be standard and conform to the dimensions of the user's body. Otherwise, they can negatively affect the health and productivity of users, especially those who work with computers for long hours every day [16]. Due to the high prevalence of occupational risk factors among computer users, the optimal fit is necessary to maintain people's health [17]. Since awkward posture is one of the most common occupational risk factors of musculoskeletal disorders in office staff, it has been considered the basis of evaluation in many methods for assessing musculoskeletal disorders [18]. Various instruments such as Quick Exposure Check (QEC) [19], Rapid Entire Body Assessment (REBA) [20], Rapid Upper Limb Assessment (RULA) [21], Ovako Working Posture Analysis System (OWAS) [22], Loading on the Upper Body Assessment (LUBA) [23], and Rapid Office Strain Assessment (ROSA) [9] are for have been developed for evaluating posture during work. Using simple checklists and self-reports to comprehensive assessments with sophisticated equipment is the most effective approach to performing a computer workstation ergonomic assessment and on-site assessment by a trained professional [24]. Computer operators may be unable to identify necessary changes to their workstations, such as equipment relocation or new equipment purchases [25, 26]. However, ergonomic experts often use a checklist to ensure that all possible problems have been resolved [24]. This technique is widely used due to its cost-effectiveness, user-friendliness, applicability, reproducibility in different work conditions, and non-interference with computer work [27]. Navidi *et al.* (2022) developed checklists for ergonomics assessing workstation layout and posture among computer users [17]. In their study, they did not set a cut-off point to determine whether the final score of the checklists was desirable or undesirable. The good or poor workstation and posture levels can quickly identify the amount of intervention needed to eliminate risk factors in the workplace [9]. Knowing the boundary between the desirable or undesirable posture and the workstation layout can help in making decisions to improve people's posture or purchase new equipment. Therefore, the present study aimed to investigate the ergonomics of the office work environment and determine the cut-off point of the WSLC and WPC checklists.

2. Materials and Methods

2.1 Participants and checklists

The descriptive-analytical study was conducted among office staff at the university. The workstation layout and posture of 200 employees willing to cooperate who worked with computers were investigated in this study. The tools and methods included a checklist, observation, and user interviews. Researchers completed checklists by observing the work posture of staff and workstations and conducting interviews with staff if necessary. Data was collected using the WPC and the WSLC of the computer users, which were developed by Navidi *et al.* (2022) [17]. The researcher evaluated items such as proper angles and normal posture of limbs in the WPC, as well as items like reach and correct layout of equipment in the WSLC through direct observation. Items such as performing sports movements and changing posture during work in the WPC and the ability to adjust the chair and monitor in the WSLC were assessed through interviews with individuals. The WSLC and WPC include 23 items and 16 items, respectively. Questions are replayed by yes (desirable) and no (undesired). In the present study, a scoring system was employed where a score of 1 was assigned for a positive response (yes) and a score of 0 was assigned for a negative response (no).

2.2 The method of determining the cutting point

Data analysis was performed using SPSS version 24 statistical software. The ROC curve (Receiver Operating Characteristic) was used to determine the cut-off point of the final score. To obtain the ROC curve associated with the WSLC and WPC, consultation was taken with two ergonomic specialists. Considering the crucial role of seat height and the support provided to the low back by the chair backrest in designing an appropriate workstation, item number 17 from the WSLC checklist (minimum seat height) and item number 6 from the WPC checklist (supporting the low back by the chair backrest) were chosen as the reference items, respectively. Then, the base items were considered zero (non-compliance) and 1 (compliance) as a state variable in SPSS software, and the sum of other questions except base items as the test variables. Finally, regarding the sensitivity and specificity of the ROC curve, the optimal cut-off point for the WSLC and WPC of computer users was obtained.

3. Results and Discussion

3.1 Completing checklists

This study included 137 females (68.5 %) and 63 males (31.5 %). The mean age of the participants was 31.7 ± 6.1 years. The results of the WSLC evaluation are presented in Table 1. Based on this, the highest score related to the items, the suitability of the monitor size for a better view of the content, and the use of a chair with the suitable material, with 100 % compliance. Also, the lowest score with 0 % compliance belonged to the item of placing the copy holder (document holder) directly in front of the person (without angling the neck or trunk) (Table 1). The results of the examination of the workstations indicated the lack of a copyholder (document holder) in the employees' workplace. Kumar *et al.* (2017) stated that the presence of a copyholder can be effective in computer work activities [4]. The lack of a copyholder is

associated with the angulation of the neck and torso of the users. So, the employee has to constantly change the angles of his neck between the document and the monitor to write [28]. An increase in the neck angle can lead to the severity of neck pain and an increase in musculoskeletal disorders. In the study by Tabanfar *et al.* (2022), an increase in neck pain intensity was reported due to an increment in the head and neck angle [29].

Table 1. Compliance rate (percentage) of appropriate principles of computer users' workstation layout (n = 200)

Number	Questions	Compliance percentage
1	Placing the top edge of the screen slightly below the eye level (the viewing angle of 15-20° relative to the center of the screen)	69.5
2	Adjustable the screen slope (the slope should not exceed 10-20°)	76.5
3	Observing the 20-40-inch distance (100-50 cm) between the user and the screen	82.5
4	Choosing a suitable screen size for better viewing (38-50 cm)	100
5	Placing the mouse and the keyboard at the same level	61.5
6	Properly reaching the mouse without stretching	81.5
7	Using ergonomic pads	70
8	Using the proper mouse (in terms of shape and size)	92
9	Placing the screen directly in front of the person (without the neck or the lower back angled)	66
10	Placing the copy holder directly in front of the person (without the neck or lower back angled)	0
11	Availability of items of frequent use within the reach range of 0-30 cm	69
12	Providing sufficient space underneath the work surface to move legs	86
13	Availability of items of occasional use within the reach range of 30-50 cm	78
14	Choosing a desk of suitable height (the working desk height being as high as one's elbows)	71.5
15	Not using a glass plate on the table surface	42
16	Using the proper seat to rotate 360° around one's axis	70
17	Using a seat with a minimum height of 16 inches (40 cm)	68.5
18	Not blocking seat handles for reaching the workstation	68.5
19	Using a chair made of soft material (softcover)	100
20	The keyboard is placed at elbow height	66
21	Observing the 5-10 cm distance between the edge of the desk and the keyboard slot	64
22	Providing suitable workplace lighting for the computer (about 540-215 lux)	77.5
23	Properly position the screen relative to the window (natural light sources located at 90° relative to the screen)	70

According to the results of this study, it was found that the monitor size used for office work was suitable. How to arrange the monitor, such as placing the upper edge of the monitor slightly below the eye level of the users, adjustable monitor tilt, keeping a suitable distance between the user and the monitor, and placing the monitor directly in front of the person without angling the neck or trunk of the user, approximately 20 % to 30 % were reported as undesirable. Based on previous studies, the monitor viewing angle and the user distance from the monitor are among the main parameters for designing computer workstations [4, 30]. Therefore, to be vision better, the monitor should be placed in a way that prevents eye fatigue and neck pain caused by stretching movements [14]. In the examination of the chairs, it was found that the chair materials used by the employees were suitable. However, in almost 30 % of the workstations, the chair items rotate 360° around their axis, and appropriate height and not obstructing the seat handle for easy reach to the workstation was undesirable. In past studies, it has been suggested that there should be a suitable space for the feet to move under the computer desk to avoid stillness and leg fatigue [4]. In the present study, 86 % of the workstations had a suitable space under the work surface for moving the legs. According to the results of Table 2, in the WPC, the highest percentage of employees' compliance was related to item number 2 (placing the arm and elbows close to the body) while doing work. Also, the lowest percentage of employee compliance was related to item number 11; therefore, more than 80 % of employees did not regularly exercise during working hours.

Table 2. Compliance rate (percentage) of the working posture of computer users (n = 200)

Number	Questions	Compliance percentage
1	Placing forearms horizontally at an angle of 90° relative to the arms	61.5
2	Placing arms and elbows close to the body	80
3	Horizontally placing the hips at an angle of 90-110° relative to the lower back	72.5
4	Feeling comfortable in the shoulders and arms while doing work (the correct position)	64
5	Holding one's head straight when looking at the screen without bending forward, back, and to the sides	66.5
6	Supporting the lower back by the seat backrest	57.5
7	Placing wrists without angles when using a keyboard or a mouse	71.5
8	Not placing wrists and hands on sharp or hard edges when resting or working	37.5
9	Placing foot soles on the ground or the footrest	57
10	Not working continuously with the computer during the day (10-15 minutes for a working hour)	61
11	Taking regular muscle exercise (at least 15 minutes at the end of the work)	19.5
12	Frequently changing proper postures during work shifts	61.5
13	Looking at a point over 6 m every 20 minutes	61
14	Not rotating the lower back when sitting on a chair	70
15	Not rotating the neck when working with the screen	70
16	Positioning the head comfortably when using the phone	79

Examining the working posture of the users in the present study showed that in 38.5 % of the employees, the forearms were not horizontal at an angle of 90° to the arm.

Accordingly, in item number 4 (comfortableness of shoulders and arms while doing work), the shoulders and arms 36 % of the employees were not in a comfortable position. It can be said that not placing the forearms at an angle of 90° to the arm can be one of the reasons for maintaining an awkward posture in the shoulders and arms, which can lead to musculoskeletal disorders for a long time, especially in the neck region [31]. Moreover, 42.5 % of the employees did not use the chair back support while working. Curran *et al.* (2015) reported that the chair back support can strengthen the spine by maintaining proper posture [32]. Not leaning on the back of the chair leads to the muscles receiving static loads repeatedly. Therefore, musculoskeletal complaints in muscles, joints, tendons, intervertebral discs, peripheral nerves, and vasculature systems can develop acutely to chronically [33]. Almost two-thirds of employees put their hands and wrists on hard or sharp edges while working. Gerding *et al.* (2021) reported that the work surface of nearly half of the participants had hard or sharp edges. They stated that the sharp edge of the work surface has a significant relationship with the increase of disorders in the upper back and shoulders, which is the reason for the change in the position of the arm in response to the contact pressure on the forearms [34]. Also, placing the hand and wrist on the hard edge can increase the probability of other musculoskeletal disorders and cumulative trauma disorders (CTDs) in computer users. More than 80 % of the participants replied negatively to the item of doing muscle exercises regularly. Previous studies have shown regular exercise can significantly reduce the risk of musculoskeletal disorders [35-37]. In 30 % of the employees, back and neck rotations were observed while working with the monitor. Various studies have shown that back and neck rotations during work can worsen the working posture, increase pressure on the musculoskeletal system, and increase the risk of musculoskeletal disorders such as neck pain [28, 29]. In incorrect positions of the bending and twisting of the head, neck, or body muscles adopted for more than 3 or 4 seconds, the muscle pump begins to limit itself so that the muscles cannot supply optimally oxygenated blood. In this case, the muscles responsible for these movements become tighter and shorter and apply asymmetric forces, while the opposite muscles become loose and weaker. As a result, the blood flow decreases, and lactic acid accumulates in the muscles and causes muscle pain and fatigue [38].

3.2 Determining the cutting point

In the ROC curve, the closer the line is to the left corner of Figure 1, the more accurate it is. This is because the actual positive rate (sensitivity) is "one", and the false positive rate (1-specificity) is "zero". In the diagnostic test of the ROC curve, the best value of the cut-off point to detect the desirable and undesirable layout of the workstation of computer users 14.5 was selected with a sensitivity of 91.2 and a specificity of 77.8, and the area under the curve of 0.89, (Figure 1). In the diagnostic test of the ROC curve, the best value of the cut-off point for the desirable or undesirable employees' working posture was 8.5, selected with a sensitivity of 93.9 and a specificity of 71.8, and the area under the curve of 0.88 (Figure 2). According to the drawn ROC curve, the area under the curve for WSLC and WPC users was calculated as 89 % and 88 %, respectively. These values confirm the high diagnostic amount of these checklists in the desirable or undesirable levels.

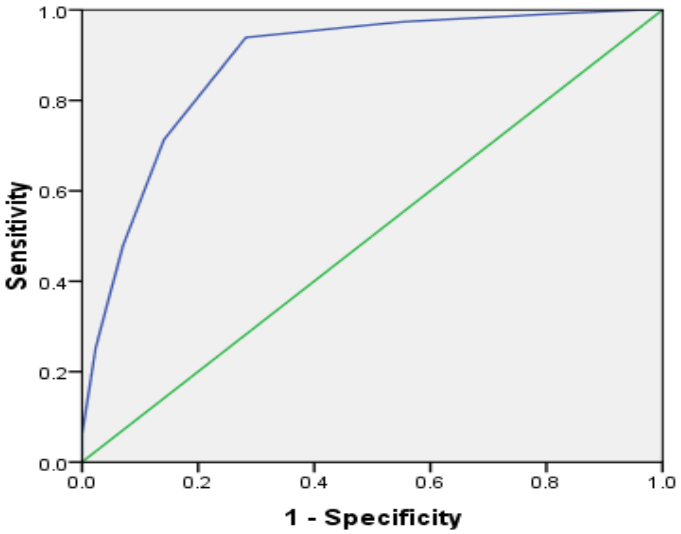

Figure 1. ROC curve (blue line) of workstation layout checklist

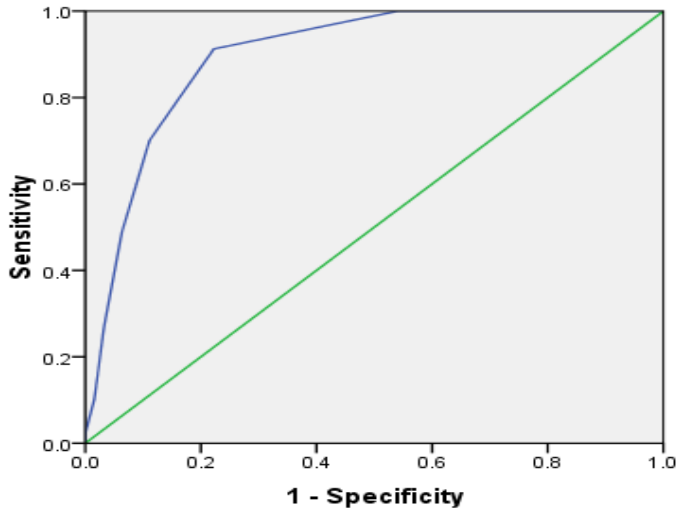

Figure 2. ROC curve (blue line) of work posture checklist

Based on the current study, the areas under the ROC curve for the WSLC and WPC of computer users are 89 % and 88 %, respectively, which indicates the high diagnostic value of these checklists between desirable and undesirable levels. Therefore, these checklists can be widely used in the workplaces of computer users due to their ease of use with short training for experts and even for computer users. In the present study, the mean total score obtained from a survey of the workstation layout checklists and the work postures

of the employees were evaluated at a desirable level. Given the results, the mean and standard deviation of the WSLC and WPC of employees were 16.3 ± 2.3 and 9.9 ± 2.3, respectively. Also, based on the cut-off point of the checklists, 75.5 % had a desirable workstation layout, and 68 % of the employees had a desirable working posture (Table 3). Finally, even though the mean total score of both checklists was evaluated at a desirable level. 25 % of workstations and 32 % of employees' working postures were undesirable. Because the mean score of the workstation layout and undesirable posture was close to the cut-off point, it is possible to increase the favorability percentage with few changes in the arrangement of workstations and the employee's posture.

Table 3. The mean and standard deviation of the scores of the WSLC and WPC (n = 200)

Variable	Category	Number	Percentage	Minimum	Maximum	Mean ± SD
Workstation layout checklist (WSLC)	< 14.5	49	24.5	10	14	13 ± 0.9
	> 14.5	151	75.5	15	21	17.3 ± 1.5
	Total	200	100	10	21	16.3 ± 2.3
Work posture checklist (WPC)	< 8.5	64	32	4	8	7.7 ± 0.9
	> 8.5	136	68	9	15	11.2 ± 1.4
	Total	200	100	4	15	9.9 ± 2.3

4. Conclusion

This study showed that the area under the ROC curve (blue line) for the workstation layout and work posture checklists was 89 % and 88 %, respectively. These areas indicate the high diagnostic value of these checklists in the desired and undesired levels. About 25 % of the assessed workstations' layouts and 32 % of the employees' working postures were found to be unsuitable. Considering that the mean score for the total workstation layout and the employees' posture was calculated close to the cut-off point, with few changes such as providing a copyholder, proper height of the monitor, observing the suitable distance to the monitor, placing the monitor directly in front of the user, the ability to rotate and adjustable of the chair, training of proper workstation layout and posture during work, and regular exercise program can significantly enhance the ergonomic conditions of the workplace. Therefore, it is suggested that supervisors and managers of the centers try to improve the ergonomics of the workplace by making changes and modifications in the layout of the workstation and the working posture of the employees. It is also suggested that future studies investigate the relationship between the workstation layout and the computer users' posture with musculoskeletal disorders through the present checklists.

Authors' Contributions

Seyvan Sobhani: Conceptualization; Data curation; Investigation; Resources; Writing. Sara Tabanfar: Data curation; Investigation; Resources; Writing. Ali Safari Variani: Conceptualization; Methodology. Sakineh Varmazyar: supervision; Formal analysis; Methodology; Project administration; Writing; Writing-review & editing.

Funding

This research received no funding.

Conflicts of Interest

None of the authors of this study has a conflict of interest in publishing this article.

Acknowledgements

The authors would like to express their appreciation and thanks to all Qazvin University of Medical Sciences office workers who cooperated with the research team in conducting this study.

Ethical considerations

It should be noted that this article is taken from the thesis approved by the Ethics Committee of the Qazvin University of Medical Sciences (IR.QUMS.REC.1399.374).

References

1. Mianehsaz E, Tabatabaei M, Kashani MM, Badi HZ, Rahimi H. Evaluating Musculoskeletal Disorders and Their Ergonomic Risk Factors Among Office Workers of a Large Public Hospital in Iran. *Int Arch Health Sci.* 2022; 9(1): 35.

2. Chinedu OO, Henry AT, Nene JJ, Okwudili JD. Work-related Musculoskeletal Disorders Among Office Workers in Higher Education Institutions: A Cross-Sectional Study. *Ethiop J Health Sci.* 2020; 30(5).

3. Choobineh A, Rahimifard H, Jahangiri M, Mahmoodkhani S. Musculoskeletal Injuries and Their Associated Risk Factors in Office Workplaces. *Iran occup health.* 2012; 8(4).

4. Kumar SR, Kumar CN. Design of Workstations for Computer Users: A Review. *Iconic Res Eng J.* 2017; 1(4): 24-34.

5. Shikdar AA, Al-Kindi MA. Office Ergonomics: Deficiencies in Computer Workstation Design. *Int J Occup Saf Ergon.* 2007; 13(2): 215-23.

6. Singh S, Wadhwa J. Impact of Computer Workstation Design on Health of the Users. *J Hum Ecol.* 2006; 20(3): 165-70.

7. Motamedzadeh M, Jalali M, Golmohammadi R, Faradmal J, Zakeri HR, Nasiri I. Ergonomic Risk Factors and Musculoskeletal Disorders in Bank Staff: An Interventional Follow-up Study in Iran. *J Egypt Public Health Assoc.* 2021; 96(1): 1-10.

8. Robertson MM, Ciriello VM, Garabet AM. Office Ergonomics Training and a Sit-stand Workstation: Effects on Musculoskeletal and Visual Symptoms and Performance of Office Workers. *Appl Ergon.* 2013; 44(1): 73-85.

9. Sonne M, Villalta DL, Andrews DM. Development and Evaluation of an Office Ergonomic Risk Checklist: ROSA-rapid Office Strain Assessment. *Appl Ergon.* 2012; 43(1): 98-108.

10. Ardahan M, Simsek H. Analyzing Musculoskeletal System Discomforts and Risk Factors in Computer-using Office Workers. *Pak J Med Sci.* 2016; 32(6): 1425.

11. Rahnama R, Nikbakht R, Hosseini-Koukamari P. Work-related Musculoskeletal Disorders Among a Sample of Iranian Computer Users. *Int J Musculoskelet Pain Prev.* 2020; 5(3): 367-72.

12. Rezaee-Hachesu V, Hokmabadi R. Ergonomic Evaluation of Computer Users by Rapid Office Strain Assessment (ROSA) Method and Its Relationship with the Prevalence of Musculoskeletal Disorders. *J Community Health Res.* 2022; 8(2): 63-75.

13. Lindholm C, Stricklin D, Jaworska A, Koivistoinen A, Paile W, Arvidsson E, et al. Premature Chromosome Condensation (PCC) Assay for Dose Assessment in Mass Casualty Accidents. *Radiat Res.* 2010; 173(1): 71-8.

14. Kibria M, Rafiquzzaman M. Ergonomic Computer Workstation Design for University Teachers in Bangladesh. *Jordan J Mech Ind Eng.* 2019; 13(2).

15. Marmaras N, Nathanael D. Workplace Design. Handbook of Human Factors and Ergonomics. 2021: 368-82.

16. Workineh SA, Yamaura H. Multi-position Ergonomic Computer Workstation Design to Increase Comfort of Computer Work. *Int J Ind Ergon.* 2016; 53: 1-9.

17. Navidi SF, Keramat Kar M, Jahan MG, Varmazyar S. Effects of Ergonomics Training and Corrective Exercises on Musculoskeletal Disorders Among Office Computer Users at Qazvin Province Gas Company. *J Occup Health Epidemiol.* 2022; 11(3): 246-55.

18. Pajoohnia M, Roveshti MM, Valipour F, Raei M. Ergonomic Assessment of Risk Factors for Musculoskeletal Disorders of the Administrative Staff in Military Center Using ROSA. *Paramed Sci Mil Health.* 2022; 16(4): 1-9.

19. Li G, Buckle P. Current Techniques for Assessing Physical Exposure to Work-related Musculoskeletal Risks, with Emphasis on Posture-based Methods. *Ergon.* 1999; 42(5): 674-95.

20. Hignett S, McAtamney L. Rapid Entire Body Assessment (REBA). *Appl Ergon.* 2000; 31(2): 201-5.

21. McAtamney L, Corlett EN. RULA: A Survey Method for the Investigation of Work-related Upper Limb Disorders. *Appl Ergon.* 1993; 24(2): 91-9.

22. Karhu O, Kansi P, Kuorinka I. Correcting Working Postures in Industry: A Practical Method for Analysis. *Appl Ergon.* 1977; 8(4): 199-201.

23. Kee D, Karwowski W. LUBA: An Assessment Technique for Postural Loading on the Upper Body Based on Joint Motion Discomfort and Maximum Holding Time. *Appl Ergon.* 2001; 32(4): 357-66.

24. Baker NA, Livengood H, Jacobs K. Reliability and Concurrent Validity of the Computer Workstation Checklist. *Work.* 2013; 45(2): 213-21.

25. Schreuer N, Myhill WN, Aratan-Bergman T, Samant D, Blanck P. Workplace Accommodations: Occupational Therapists as Mediators in the Interactive Process. *Work.* 2009; 34(2): 149-60.

26. Shaw W, Hong QN, Pransky G, Loisel P. A Literature Review Describing the Role of Return-to-work Coordinators in Trial Programs and Interventions Designed to Prevent Workplace Disability. *J Occup Rehabil.* 2008; 18: 2-15.

27. Sukadarin E, Deros B, Ghani J, Nawi N, Ismail A. Postural Assessment in Pen-and-paper-based Observational Methods and Their Associated Health Effects: A Review. *Int J Occup Saf Ergon.* 2016; 22(3): 389-98.

28. Romadhoni DL, Ramadhani AN, Lidiana EH. Relationship of Work in Pandemic Era with Increased Risk of Musculosceletal Disorders that Lead to Change in Cervical Posture. *J Epidemiol Public Health.* 2021; 6(3): 347-54.

29. Tabanfar S, Safari Variani A, Sobhani S, Varmazyar S. The Effect of Self-management Exercises on Neck Pain and Head and Neck Angles among Iranian University Employees: An Interventional Study. *J Occup Health Epidemiol.* 2022; 11(2): 138-47.

30. Woo E, White P, Lai C. Ergonomics Standards and Guidelines for Computer Workstation Design and the Impact on Users' Health-a Review. *Ergon.* 2016; 59(3): 464-75.

31. Ertekin E, Günaydın ÖE. Neck Pain in Rounded Shoulder Posture: Clinico-radiologic Correlation by Shear Wave Elastography. *Int J Clin Pract.* 2021; 75(8): e14240.

32. Curran M, O'Sullivan L, O'Sullivan P, Dankaerts W, O'Sullivan K. Does Using a Chair Backrest or Reducing Seated Hip Flexion Influence Trunk Muscle Activity and Discomfort? A Systematic Review. *Hum Factors.* 2015; 57(7): 1115-48.

33. Tanzila RA, Prameswarie T, Hartanti MD, Denaneer T. The Correlation between Position and Duration Use of Laptops with Musculoskeletal Disorders (MSDs). *Mutiara Medika J Kedokt Kesehatan.* 2021; 21(2): 9-15.

34. Gerding T, Syck M, Daniel D, Naylor J, Kotowski SE, Gillespie GL, et al. An Assessment of Ergonomic Issues in the Home Offices of University Employees Sent Home Due to the COVID-19 Pandemic. *Work.* 2021; 68(4): 981-92.

35. Mehrparvar AH, Heydari M, Mirmohammadi SJ, Mostaghaci M, Davari MH, Taheri M. Ergonomic Intervention, Workplace Exercises and Musculoskeletal Complaints: A Comparative Study. *Med J Islam Repub Iran.* 2014; 28: 69.

36. Shariat A, Tamrin SB, Arumugam M, Danaee M, Ramasamy R. Office Exercise Training to Reduce and Prevent the Occurrence of Musculoskeletal Disorders Among Office Workers: A Hypothesis. *Malays J Med Sci.* 2016; 23(4): 54-8.

37. Tersa-Miralles C, Bravo C, Bellon F, Pastells-Peiró R, Arnaldo ER, Rubí-Carnacea F. Effectiveness of Workplace Exercise Interventions in the Treatment of Musculoskeletal Disorders in Office Workers: A Systematic Review. *BMJ Open.* 2022; 12(1): e054288.

38. Rafeemanesh E, Khooei A, Niroumand S, Shirzadeh T. A Study on Musculoskeletal Complaints and Working Postures in Pathology Specialists in Iran. *BMC Musculoskelet Disord.* 2021; 22(1): 1-8.