



Effect of Educational Intervention Based on the Ergonomic Principles of Working with Computers in Promoting Behaviors Preventing Musculoskeletal Disorders among Health Care Providers

ARTICLE INFO

Article Type Original Research

Authors

Jila Khorasani¹ Msc
Sedigheh Sadat Tavafian¹ PhD,
Fateme Zarei¹ PhD

How to cite this article

Khorasani J, Tavafian SS, Zarei F. The Effect of Educational Intervention Based on the Ergonomic Principles of Working with Computers in Promoting Behaviors Preventing Musculoskeletal Disorders on Health Care Providers. International Journal of Musculoskeletal Pain Prevention. 2019; 4(2): 192-201.

¹Department of Health Education,
Faculty of Medical Sciences, Tarbiat
Modares University

*Correspondence

Address: Tehran, Jalal Al Ahmad,
Nasr Bridge, Tarbiat Modares Uni-
versity, Faculty of Medical Scienc-
es, Health Education Department.
P.O. Box: 14115-111
Phone: +98 (21) 82884547
Fax: +98 (21) 82884555
Email: tavafian@modares.ac.ir

Article History

Received: July 20, 2019
Accepted: August 1, 2019
ePublished: September 22, 2019

ABSTRACT

Aims: Health care providers working in comprehensive health centers are considered as one of the main computer users and are subject to musculoskeletal disorders caused by computer work. This study was conducted to determine the effect of educational intervention based on the ergonomic principles of working with computers on knowledge, attitude and practice of health care providers working in comprehensive health centers of Sirjan, Iran.

Instrument & Methods: This study was performed with 110 health care providers working in comprehensive health centers of Sirjan. Census method was used for sampling. A man-made questionnaire was used to assess the effect of education on the improvement of behaviors preventing the MSD caused by working with computers. The training program in the intervention group consisted of three one-hour sessions. Data were collected at the beginning and 3 months after the intervention; and they were analyzed using spss16 software and Chi-square, independent T-test, and Wilcoxon and Mann-Whitney tests.

Findings: According to the results, despite the homogeneity of the two groups in terms of all the variables studied, the interventional group, after education, had a significant difference in knowledge, attitude and practice regarding observing the ergonomic principles of work with computers in comparison with the control group ($p < 0.0001$). Furthermore, in the intervention group three months after the training, there was a significant difference in the mean score of two variables of attitude and practice.

Conclusion: The results of this study showed that educational programs based on ergonomic principles of working with computers can promote behaviors preventing the MSD in computer users. Therefore, educational interventions are recommended in order to improve the behaviors preventing musculoskeletal disorders.

Keywords: Musculoskeletal Disorders, Ergonomic Principles, Computer Users, Educational Interventions.

Introduction

According to the World Health organization (WHO), Musculo Skeletal Disorders (MSDs) are associated with work, only when working activities and work conditions considerably resulted in their expansion and renewal. of course, these activities are not the only factors affecting their MSDs occurrence [1]. MSDs are one of the most common and costly problems associated with work in all countries of the world, which affect not only the individuals, but also the organization and community in which they live [2]. Today, computers are an integral part of working environments, especially the office environments [3]. Scientific reports and published

articles indicate that the risk of MSDs is high in computer users compared to other occupations [4]. New innovations, though seeking to reduce the injuries of MSDs associated with administrative work, have actually caused them to increase with increasing repetitive movements, static conditions during work, disregarding ergonomics, and job stress [5]. Symptoms of these disorders include pain, paresthesia, tingling, sensitivity to touch, inflammation, and movement limitations, loss of strength and energy, and sensory disorders in parts of the body. of the factors and risk factors of work-related musculoskeletal disorders, inappropriate postures are among the most important

ones [6].

According to the statistics of Work Health Center of Iran's health ministry, about 36 percent of the country's employees have bad postures during work. Then, in a near future, more employees will be subject to Work-related WMSDs [7]. Based on the report of the medical commission of the Social affairs organization of Tehran province, 14.4% of the prevalence of various disabilities is due to skeletal-muscular diseases [6]. Results of the research on 1428 computer users showed the prevalence of MSDs in 12 months as following: head and neck 42%, lower back 34%, upper waist 24%, wrist and hand 20%, shoulder 16%, ankle and leg 13%, knee 12%, pelvis 6% and elbow 5% [8]. In Gorgi et al., the most and least disabilities were observed in the neck area (32.3%) and ankle and elbow areas (6.5 to 7%), respectively [9]. According to the American International Institute of Safety and occupational Health Report, MSDs rank second among work-related diseases in terms of importance, frequency, severity and the probability of progression, so that skeletal disorders caused by work are the most important factors in losing work time, increasing costs, and damage to workforce [10]. Studies have shown that teaching ergonomic principles in order to maintain proper body postures in the workplace can reduce the prevalence of work-related MSDs among the health care personnel [11]. Today, due to the importance of this issue, a big part of research in the human engineering science has focused on methods of assessing work postures and presenting methods for preventing the musculoskeletal injuries [12]. Therefore, recognizing these risks and anticipating adverse effects are necessary, and since health care providers working in comprehensive health centers are also computer users, they are at risk of musculoskeletal disorders. The aim of this study was to determine the effect of

educational interventions of the principles of work-with-computer ergonomics on knowledge, attitude and performance of health care providers working in comprehensive health centers of Sirjan in 2018.

Instrument and Methods

Design of the study

This quasi-interventional study was conducted on two groups of control and intervention group with a 3-month follow-up period on 110 health care providers. After obtaining permission from the health centers of Sirjan, under the supervision of Sirjan University of Medical Sciences and an approval from the Research Council of Tarbiat Modares University.

Research population

The research population consisted of health care providers working in comprehensive health centers of Sirjan and the sample of the study consisted of 110 health care providers with the inclusion criteria. The study's inclusion criteria included being a health care provider working at Sirjan comprehensive health centers, working with computers, and participating voluntarily; and those reluctant to participate were excluded from the study.

Census method was used to determine the sample size. In Sirjan, 12 comprehensive health centers are under the supervision of Sirjan University of Medical Sciences, with 123 eligible health providers working in these 12 centers, of which 110 individuals were willing to participate in the study. They were randomly divided into two groups of control and intervention, and 55 individuals were randomly assigned to each group (Figure1). This sample size is estimated according to similar studies [13].

Educational intervention program

In order to achieve educational goals, an

Transparent reporting of trials

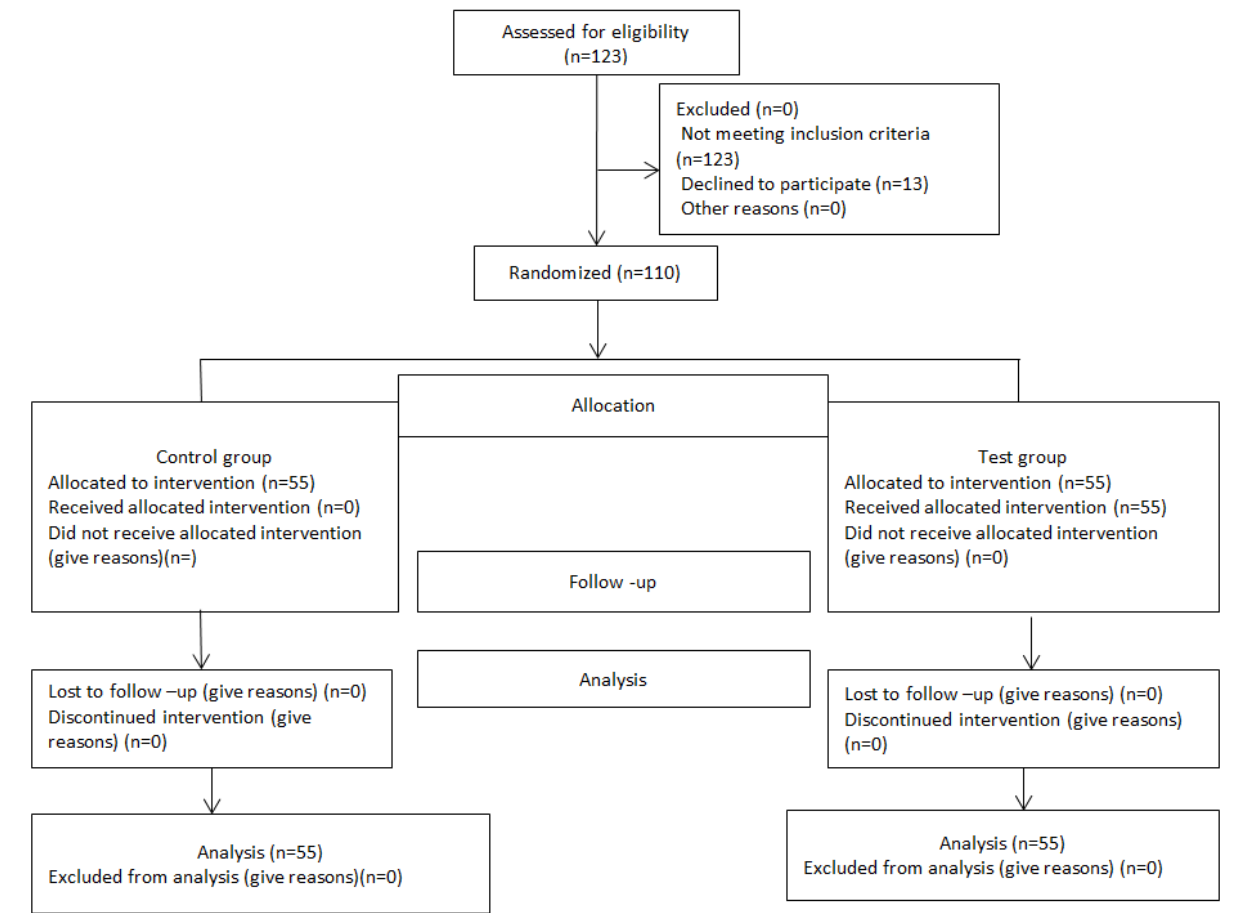


Figure 1) Flowchart of study's sampling procedure

educational intervention program was formulated, based on the information obtained in the first phase and reviewing the relevant literature [14, 15], including reference books, guidelines, thesis, published articles, and asking the opinions of experts and research teams. Moreover, it was implemented in six selected centers during three training sessions in the intervention group. In the first session, an overview of the relationship between not considering ergonomic principles of working with computers and related illnesses, also a selection of the available statistics in the world were first presented. The participants in the class were given an opportunity to discuss and interact with each other and the lecturer provided the participants with the opportunity to comment on the topics provided, along

with their comments on the principles of ergonomics of working with computers and cares preventing the MSD were discussed and questioned. The first session was held to inform health care providers about the prevalence of MSD and their preventive steps. The second session was aimed at improving the participants' attitudes regarding how to work with computers, which was held with the participation of health care providers in a group discussion. In each session, about 9 to 10 health care providers participated. In this session, according to the information obtained in the first session, the audience discussed with each other and with the lecturer. Participants were given the opportunity to state their opinions in an intimate and friendly atmosphere. It was tried that care providers come to the understanding that

they are able to improve their own health by simple care methods.

The third session was held by an occupational health specialist with the aim of establishing a correct performance regarding work with computers. Using educational videos, booklets, as well as a demonstration of how to properly sit and use computer-related devices while working with computers, participants were trained and they were eventually asked to sit behind the desks and practice the correct method of working with the computer. Also, for reminding and practicing, educational slideshows and videos were installed on the computers used by the health care providers.

In all the sessions, it was attempted to benefit from the principles and techniques of effective communications with the audience, and the atmosphere of the training sessions was that of respect and intimacy, along with providing the ground for participation in group discussions. In case some participants did not attend group training sessions, individual training sessions (face to face) were held for them.

Measurements

A man-made questionnaire was used to assess the health care behaviors (knowledge, attitude and practice) about the ergonomic principles of work with computers. To determine the validity and reliability of the questionnaire, using the psychometric properties of the questionnaire, face validity (by the end users' views on the questionnaire), and content validity were assessed both quantitatively (by calculating cvi and cvr), and qualitatively (using 10 specialists in the panel of experts of occupational health, ergonomics and health education). The minimum acceptable CVR value, based on the Lawshe table, is %0.62. The reliability of the questionnaire was assessed in order to measure the internal correlation of the questions of the questionnaire. The results of

the validity and reliability of the mentioned questionnaire are shown in Table 1.

Table 1. Results of validity and reliability of the man-made questionnaire

variables	CVI	CVR	Cronbach's alpha
Knowledge	0.99	1	0.8
Attitude	0.99	0.90	0.7
practice	0.97	0.94	0.8

The questions in this man-made questionnaire were classified with the aim of assessing the effect of education on knowledge, attitude and the practice of the target community in three areas of knowledge (11 questions), attitude (6 questions) and practice (9 questions). The questions were designed based on reviewing the available literature [16,17]. The final number of the questions was determined to be 20 after assessing the validity and reliability of the questionnaire. The response index differs according to the nature of each domain, meaning that the mean score of knowledge was set with a two-value scale (score 2 for 'Yes', and score 1 for 'No', and score 0 for 'I do not know'), and attitude with a five-option Likert scale (5 points for 'I completely agree', 4 points for 'I agree', 3 points for 'I have no idea', 2 points for 'I disagree', and 1 point for 'I totally disagree'). Moreover, regarding the questions of performance, for the response 'yes' 2 points and for the response 'no' 1 point were considered.

Evaluation

Process evaluation

During the implementation of the training program, each stage of formulation and implementation was compared with the previously designed timetable, so that the program could proceed in parallel with the timetable.

In order to evaluate the effect of the training program, a pre-test was administered by a

psychometric man-made questionnaire to all subjects (in the intervention and control groups). Then, the statistical analysis of the questionnaires was carried out and based on the obtained results as well as the guidelines, the educational intervention was also carried out, and 3 months after the pre-test, a post-test was completed by the intervention and control groups. In both stages of the pre-test and post-test, a man-made questionnaire was developed.

Statistical analysis

The data were analyzed using SPSS16 software, and Chi-square, independent t-test, Wilcoxon and Mann-Whitney tests.

Findings

The results showed that the age range of the subjects in the intervention group was from 24 to 49, with a mean of 36.57, and in the

control group it was from 22 to 49, with a mean of 35.48; also there was no significant difference between the two groups in terms of age. The rest of the characteristics of the two groups at the beginning of the study is shown in Table 2. The statistical data showed that the two groups are similar regarding the demographic characteristics of the study. A nonparametric test was used for the comparison test of the knowledge, attitude and performance variables in the two groups of intervention and control before and after the intervention, according to the results obtained from the Kolmogorov-Smirnov test. The results are presented in the following table. The highest score of knowledge is 2 and the lowest is zero. Regarding attitude, the highest score is 5, and the lowest is zero, and in performance, the highest score is 2 and the lowest is 1.

Table 2. Comparison of other demographic characteristics of the subjects in the interventional and control groups at the beginning of the study

Demographic qualitative variables	Answer	Intervention group		Control group		Total answer		Chi-square	
		N	%	N	%	N	%		
Marital status	Single	9	18.8	11	10	20	18.20	0.403	
	Married	46	41.82	44	40	90	81.8		
Extracurricular activity	Yes	3	2.73	3	2.73	6	5.45	0.661	
	No	52	47.27	52	47.27	104	94.55		
Working time	8 hours	54	50	54	09.49	108	99.10	0.591	
	>10 hours	1	0.9	0	0	1	0.9		
Physical activity	Yes	7	6.36	7	6.36	14	13	0.583	
	No	48	43.64	46	41.82	94	86		

According to the table 3, none of the factors in the two groups of intervention and control were significant before the intervention, as the p-value is greater than the default error value of 0.05. Note that the degree of effectiveness of knowledge, attitude and practice in both groups of intervention and control is the same and they will not have a significant difference with a confidence level of 95%. Moreover, because of the value of p-value which is less than the default value of 0.05, the effect of all factors in the two groups of intervention and control is different after the intervention, and due to the high mean values in the intervention group, the degree of the effect of these factors is more than the control group. The degree of the effectiveness of intervention in the subjects of the two groups of intervention and control is presented in the Table 3. To achieve the results, using the Wilcoxon test,

three effective factors of knowledge, attitude, and practice in groups of intervention and control are compared before and after the intervention. As you can see in the Table 3, the attitude and practice of individuals in working with computers in the intervention group after the intervention have changed and improved, while there has not been any change in the control group.

Discussion

This research was conducted to achieve the general goal of determining the effect of educational intervention of the ergonomic principles of working with computers on knowledge, attitude and practice of health care providers working in comprehensive health centers of Sirjan in 2018. In this study, 110 health care providers working in comprehensive health centers were selected

Table 3. Comparison of the two groups of the intervention and control in knowledge, attitude, and performance before and after the intervention

Time	Variable	Group	mean	standard deviation	Man Whitney	Difference
Before intervention	Knowledge	Intervention	1.83	0.31	0.148	>0.05
		Control	1.71	0.28		
	Attitude	Intervention	3.83	0.4	0.765	>0.05
		Control	3.82	0.55		
	Practice	Intervention	1.26	0.15	0.649	>0.05
		Control	1.29	0.17		
After intervention	Knowledge	Intervention	1/83	0.17	<0.0001	>0.05
		Control	1.71	0.18		
	Attitude	Intervention	4.66	0.38	<0.0001	>0.05
		Control	3.74	0.36		
	Practice	Intervention	1.76	0.04	<0.0001	>0.05
		Control	1.27	0.14		

by the census method and were divided into two equal groups of intervention and control and they completed the related questionnaire in the form of self-statement. In the current study, the mean difference of the knowledge score before and after the educational intervention in the interventional group had a minor change and did not increase significantly, indicating that training does not always increase the knowledge of the target group. Of course, it should be taken into account that health care providers who were the target group of this study, due to their occupation, had a relatively high knowledge of computer-related disorders. Furthermore, the results of the study by Menshadi et al., in 2008, with the aim of assessing the level of knowledge, attitude and practice of female students participating in the osteoporosis training session, showed that about 80 percent of girls with educated parents had knowledge about osteoporosis and did not show any increase in knowledge after the intervention ^[18]. This study also corresponded with Anderson's study on Canadian girls ^[19] and perhaps we can state that for a behavior change, having knowledge alone is not enough, and there is a need to change attitudes, as, despite having knowledge, the health care providers did not have a proper performance for working with computers before the study. Based on the results obtained in this study, the mean scores of attitude of the interventional group increased 3 months after the training, and this increase was statistically significant because training on how to correctly work with the computer caused a positive attitude in them in terms of the usefulness and necessity of these skills for the computer users. In this regard, in the results of the research conducted by Zaidi et al. ^[20] entitled "the effect of educational intervention on improving the knowledge, attitude and ergonomic practice of individuals", the mean

study on Canadian girls ^[19] and perhaps we can state that for a behavior change, having knowledge alone is not enough, and there is a need to change attitudes, as, despite having knowledge, the health care providers did not have a proper performance for working with computers before the study. Based on the results obtained in this study, the mean scores of attitude of the interventional group increased 3 months after the training, and this increase was statistically significant because training on how to correctly work with the computer caused a positive attitude in them in terms of the usefulness and necessity of these skills for the computer users. In this regard, in the results of the research conducted by Zaidi et al. ^[20] entitled "the effect of educational intervention on improving the knowledge, attitude and ergonomic practice of individuals", the mean score of the attitude significantly changed in the intervention group after the intervention. Also another study by Zaidi et al. ^[21], entitled "investigating factors predicting the practice of operating room personnel for observing the proper postures using the planned practice theory", suggested that attitude is presented as the most important factor in explaining the practice of observing the proper posture. Results of this study showed that the mean score of health care providers' practice after the intervention significantly increased, indicating the effect of the educational intervention on improving the skills of working with computers and using these skills as efficiently as possible. The results also showed that interventions based on the mentioned patterns of behavior change in computer users could increase the stages of behavior change in relation to preventive behaviors of musculoskeletal disorders.

In this regard, various studies confirm the results of this study. In a study aiming at evaluating the effect of the ed-

educational program on the prevention of MSDs in school teachers after conducting a participatory ergonomic training program and an eight-week professional health education, it was shown that the level of attitude and practice improved. The self-report of the prevalence of MSDs in the neck, shoulders, low and high back pain and also the severity of disorders showed a significant decrease after the intervention ^[21]. Also, a study in 2014, investigating the effect of an educational program on the life quality of women with chronic low back pain showed that their social practice after the intervention increased ^[22]. In line with the present study, previous studies ^[19, 20] showed that training improves the behavior of individuals in maintaining the right spine posture. In the present study, according to the Chi-square results, there is no significant difference between the intervention and control groups, regarding the variables such as age, exercise level, extracurricular activity, daily work hours and type of activity. According to the findings of the current survey, the average of people's age is 36.3 and the standard deviation is 6.98 and the youngest and the oldest are 22 and 49, respectively. In the present study, there was no relationship between age and musculoskeletal disorders. This is also reflected in other researchers' reports. In two study of Chubine and delshad there was also no significant relationship between age and the degree of MSDs in most areas of the body ^[23,24]. In this study, in order to persuade users to accept and adhere to the correct habits of ergonomics, and especially the correct state of the body, it was essential to provide them with necessary knowledge and information, skills and appropriate supportive environments. In this study, users were provided with information about the ergonomics of the work environment and ergonomic skills such as seat adjustments, and also the benefits of observing the correct postures were explained for them.

By displaying the correct state of the body, users found out that observing and maintaining the states and following the requested recommendations were easy. Computer users, by getting involved in face-to-face training and work station adjustments had active participation in the intervention program and were thus encouraged to initiate and continue practice changes.

Training can prepare users to play a more active role in identifying and controlling risks, and provides them with an opportunity to acquire and share this knowledge with health professionals. Following knowledge acquisition, changing attitudes and learning the skills needed, we may see improvements in body states and other ergonomic habits. One of the strengths of our research was education based on the information obtained in the initial assessment.

In addition, our study evaluated the application of behavioral change in occupational health interventions and identified factors affecting the users' behavior change in relation with observing the physical states and ultimately the prevention from musculoskeletal disorders. The intervention group also showed a higher level of behavioral change leading to the reduction of inappropriate postures and lower pressure on the musculoskeletal system. By increasing the knowledge and skills regarding work-with-computer ergonomics, users were probably more likely to try adjusting the workstation, the seat height, and other work environment devices according to the ergonomic rules.

Conclusion

Educational intervention based on the ergonomic principles of working with computers can enhance behaviors preventing the MSDs in computer users. Therefore, if the same results are repeated in future study,

the training program is recommended to be communicated to all organizations whose employees work with computers.

Acknowledgements

This study is the result of MSc thesis the department of health education and health promotion of TMU. Hereby, we appreciate the financial and spiritual supports of the vice chancellor for Research at TMU in supporting this research project. No conflicts of interest have been reported in this study.

Conflicts of interest

No conflicts of interest have been reported in this study.

Author's contribution

J.K. was primary researcher author/assistant in methodology and in statistical analyst and discussion section SST. supervised all sections of the study.

F.Z. was advisor of the study. All authors read the manuscript and approved it.

Ethical permission: This study approved by ethics committee of TMU. The Code of Ethics (IR.TMU.REC.1396.661), the information gathering phase was initiated.

Funding

This study was supported by Tarbiat Modares University (TMU).

References

1. World Health Organization. Health promotion for working populations: report of a WHO expert committee [meeting held in Geneva from 9 to 15 June 1987].
2. Cheng, H., Cheng, C, Ju Y. Work-related MSD and ergonomic risk factors in early intervention educators. *Appl Ergon*, 2013. 44(1): 134-141
3. Shariat, A., et al., Effects of stretching exercise training and ergonomic modifications on musculoskeletal discomforts of office workers: a randomized controlled trial. *Brazilian journal of physical therapy*, 2018. 22(2): 144-153.
4. Gerr, F, Marcus M., Monteilh C. Epidemiology of MSD among computer users: lesson learned from the role of posture and keyboard use. *J Electromyogr Kinesiol*, 2004. 14(1): 25-31.

5. Kraatz, S., Lang, J., Kraus, T., Muenster, E., Ochsmann, E. The incremental effect of psychosocial workplace factors on the development of neck and shoulder disorders: a systematic review of longitudinal studies. *Int Arch Occup Environ Health*, 2013. 86(4): 375-395.
6. Choobineh, A., Methods of posture assessment in occupational ergonomics. Hamadan: Fanavaran, 2003:79-96.
7. Harisinghani, M. G., Blake, M. A., Saksena, M., Hahn, P. F. Importance and effects of altered workplace ergonomics in modern radiology suites. *Radiographics*, 2004. 24(2): 615-627.
8. Hoogendoorn, W. E., van Poppel, M. N., Bongers, P. M., Koes, B. W. Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine*, 2000. 25(16): 2114-2125
9. Gorgi, Z., Assadollahi, Z., Ghaffarian, A., Rezaeian, M. The Prevalence of MSD in the Employees of Office Systems at Rafsanjan University of Medical Sciences in 2012. *Journal of Rafsanjan University of Medical Sciences*, 2014. 12(12): 991-1002.
10. Mouodi, M., Hasanazadeh H., CTD from ergonomics and occupational medicine viewpoint. 2004(1)10:9-
11. Sheikhzadeh, A., Gore, C., Zuckerman, J. D. Nordin, M. Perioperating nurses and technicians' perceptions of ergonomic risk factors in the surgical environment. *Applied ergonomics*, 2009. 40(5): 833-839.
12. Choobineh, A., Hosseini, M., Lahmi, M. Musculoskeletal problems in Iranian hand-woven carpet industry: Guidelines for workstation design. *Appl Ergon*, 2007. 38(5): 617-624.
13. Rafieipoor A, Rafieipoor E, Sadeghian M., Effectiveness of ergonomic principles to reduce the risk of MSDs by Rula in Computer users. *Ergonomics magazine Quarterly Journal of Iranian Ergonomics and Human Factors Engineering*, 2015. 3, (1), 25-32.
14. Fleiss, J.L., Levin, B., Paik M.C. Statistical methods for rates and proportions. 2013: John Wiley & Sons.
15. Cork, R.C., et al., A comparison of the verbal rating scale and the visual analog scale for pain assessment. *The Internet Journal of Anesthesiology*, 2004. 8(1): 23-38.
16. Ohlsson, K., Attewell, R. G., Johnsson, B., Ahlam, A., S. An assessment of neck and upper extremity disorders by questionnaire and clinical examination. *Ergonomics*, 1994. 37(5): 891-897.
17. Palmer, K., Smith, G., Kellingray, S., Cooper, C. Repeatability and validity of an upper limb and neck discomfort questionnaire: the utility of the standardized Nordic questionnaire. *Occupational medicine*, 1999. 49(3): 171-175.
18. Menshadi, F., Azari, A., Kuhpayeh Zadeh, J., Ghasemi, M. Knowledge, attitude and practice of osteoporosis among a group of Iranian adolescent females. *Journal of Modern Rehabilitation*, 2009. 2(3): 47-54.
19. Anderson, K.D., K.E. Chad, Spink, K.S. Osteoporosis knowledge, beliefs, and practices among adolescent females. *Journal of Adolescent Health*, 2005. 36(4): 305-312.

20. Mohammadi, Z.I. Mohammadi Z.B. The effect of stage-matched educational intervention on reduction in MSD among computer users. 2012.
21. Mohammadi Zeydi, E., Heydarnia, A. Niknami S. Predicting factors of worker behavior for proper working posture based on planed behavior theory. *Armaghane danesh*, 2008. 13(3): 111-122.[Persian]
22. Tavafian, S. S., Jamshidi, A., Mohammad, K., Montazeri, A. Low back pain education and short term quality of life: a randomized trial. *BMC musculoskeletal disorders*, 2007. 8(1): 21.
23. Choobineh, A. R., Daneshmandi, H. A., Aghabeigi, M., Haghayegh, A. Prevalence of musculoskeletal symptoms among employees of Iranian petrochemical industries: October 2009 to December 2012. *Int J Occup Environ Med (The IJOEM)*, 2013. 4(4):195-204.
24. Delshad, M. H., Tavafian, S. S., Kazemnejad, A., identification of the factors predicting the Stretching Exercise Behavior among Office employees with reinforcing and developing the performance of the Health Promotion Model. *NeuroQuantology* 2019; 17(08):49-56.