Archives of Occupational Health | Volume 4 | Issue 2 | April 2020 | 563-9.

Original

Investigating the Musculoskeletal Disorders among Computer Users of Lordegan Health Network by ROSA Method and CMDQ Questionnaire

Yasser Jalilpour[1*], Leila Ebrahimi Ghavamabadi[2] , Behzad Fouladi Dehaghi[3], Hassan Rajabi-Vardanjani[4] ,Mojtaba Jahanifar[5]

[1]MSc of HSE Management, Shahrekord University of Medical Sciences, Shahrekord, Iran• [2]Assistant Professor, Department of Health, Safety and Environmental Management, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran• [3]Associate Professor, Department of Occupational Health, School of Health, Ahvaz Jundishapour University of Medical Sciences, Ahvaz, Iran• [4]Department of Environmental Health Engineering, School of Public Health, Shahrekord University of Medical Sciences, Shahrekord, Iran• [5]Faculty member of shahid chamran university of Ahvaz, Ahvaz, Iran• *Corresponding author: Yasser Jalilpour, Email: yasser_sat@yahoo.com, Tel: +98-38-34443230

Abstract

Background: Musculoskeletal disorders are common consequences of inappropriate computer work conditions. Employees are job groups who spend many office hours working on computers. The present study was conducted to investigate the prevalence of musculoskeletal disorders among computer users of the health network of Lordegan city and its impact on their daily activities. **Methods:** This research was applied in terms of purpose and was determined as one of the quantitative researches. This descriptive-analytical study was performed with the use of systematic random sampling, and the samples were picked from the statistical population of 500 employees of Lordegan Health Network. A sample size of 217 persons was selected, which had at least one year of work experience and at least 3 hours a day working in front of a computer. The Cornell questionnaire was applied in order to specify the rate of pain and discomfort and its effect on the employees' daily activities. Then, the ROSA method was utilized to assess the ergonomics of the office strain rate of users. The results were analyzed with the use of the chi-square test and SPSS v.25 software. **Results:** A significant difference was seen between the rate of pain and discomfort and the effect of pain on daily activities in different body parts of computer users based on age, work experience ($P<0.05$). Also, there was a significant difference between ROSA final score and age variables and work experience ($P<0.05$). The results of the ROSA evaluation declared that 53.9% of persons were exposed at medium to high-risk levels. **Conclusion:** The ROSA method was appropriate for detecting risk factors for office work and was able to identify deficiencies existed in workstations. Concerning the postures and jobs in the office department, the ROSA method was able to identify musculoskeletal disorders of the office employees in health care. The CMDQ questionnaire could determine the rate and effect of pain and discomfort on different body parts for these employees.

Keywords: Musculoskeletal Disorders; Computer Users; ROSA; Cornell Questionnaire

Introduction

The increasing spread of modern technology and knowledge in human life led to an increase in the speed of work, the production rate, and efficiency. But on the other hand, some side effects such as inactivity, fatigue, neuromuscular pressures, and an increase in the prevalence of musculoskeletal disorders (Work Musculoskeletal Disorders: WMSDs) were also imposed on people.[1] Musculoskeletal disorders, muscle disorders,

Citation: Jalilpour Y, Ebrahimi Ghavamabadi L, Fouladi Dehaghi B, Rajabi-Vardanjani H, Jahanifar M. **Investigating the Musculoskeletal Disorders among Computer Users of Lordegan Health Network by ROSA Method and CMDQ Questionnaire.** Archives of Occupational Health. 2020; 4(2): 563-9.

Article History: Received: 15 December 2018; Revised: 20 February2019; Accepted: 15 June 2019

Copyright: ©2020 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

peripheral nerves, tendons, blood vessels, joints, bones, and dorsal discs were other consequences of this technology.[2] Musculoskeletal disorders were one of the most considerable problems of Occupational Health Engineering and the major leading factor of disability,[3] which had a significant role in economics.[4] Typically, 40% of all work-related costs around the world were spent on WMDSs.[5] The annual rate of damages to the US economics caused by WMDs was estimated as 45 to 55 billion dollars.[6]

Based on the conduction researches in the US, 60% of whole new cases of diseases were related to WMDs, so that their prevalence rate reached 30% in 1991 from 5% in 1981 with significant growth.[7] Among the most important assets of any organization was the human force of that organization. Therefore, the health of each employee affected the efficiency of the organization. The office personnel was more prone to these disorders concerning the kind of their duties. Some factors, such as long-term sitting during work hours, improper body posture during work, and occupational strain, were effective in the occurrence and prevalence of these disorders.[8, 9] Nowadays, the use of computers was required in most jobs, and fewer jobs could be found to perform tasks without a computer.[10] The computer is an integral part of human life and workplaces, and many people spend many hours of day and night working with it.[11] For those people, who spend a lot of their time working in front of computers, its disorders and side effects become a serious problem.[12, 13] The results of scientific research indicated that the risk of suffering from musculoskeletal disorders for computer users was high.[14] Many pieces of evidence, especially in industrialized developing countries, revealed that the lack of fitness between technology, user and workplace led to negative results such as low levels and product quality and high disorders and incidents caused by work. Many of these problems in the workplace were eradicated by the help of "ergonomic" methods.[15]

The computer use rate is rapidly increasing among employees of different occupations, i.e., 60% of employees in Sweden in 2001 and 60% of employees in Canada were required to carry out some parts of their daily tasks with the computer. Also, 80% of them mentioned that they performed a central part of their activities with the computer. This rate was 30% in Sweden, it was 39% in Canada in 1989, and was 50% in 1994. More than 60% of employees in the office department in developing countries are complaining of physical discomfort, many of which are related to musculoskeletal disorders. The prevalence of musculoskeletal disorders among developing countries was reported 15% to 75% concerning the type of computer work and the duration of contact with the workstation.[16] The researches declared that the feeling of pain and discomfort in different parts of the musculoskeletal system was one of the main problems in workplaces, considered as the main cause of absenteeism in the workplace. Also, the reason for more than half of the workplace absences was musculoskeletal disorders. Today, prevention of WMSDs is considered as a national necessity and priority in many countries.[17, 18]

In some cases, modern technologies not only eliminated work-related musculoskeletal disorders but also increased it by repetitive actions and static situations while working and lack of attention to ergonomics and occupational strain.[19] Ongoing and prolonged work with computers and performing tasks in static and sitting postures can be known as one risk factor for musculoskeletal disorders. Employees must spend many hours working with computer due to the significance of preventing musculoskeletal disorders in workplaces and determining the prevalence of musculoskeletal disorders in computer users and with regard to the existence of different office automation systems and specialized software at all levels of health network including network headquarters, health care centers and local health departments with the aim of accessing health care information for the clients. So, this study was conducted with the objective of evaluating musculoskeletal disorders among the employees of Lordegan Health Network and determining effective factors on the occurrence of these disorders with the use of methods of Rapid Office Strain Assessment (ROSA) and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).

Methods

The number of 217 volunteer participants in this study was selected among the statistical population of 500 employees working with computers in the health network of Lordegan with the use of a systematic random sampling method. First, the payslip of all personnel was taken from departments. Then all employees with more than one year of experience with computers working at least 3 hours per day were randomly selected with three rows coefficient of payslip. Then, the employees suffered from musculoskeletal disorders such as lumbar disc, knee osteoarthritis, arthropathy, and spine-related diseases that were removed from this study, and other participants were randomly replaced. All the participants were working as part-time employees and their working hours were from 8 am to 3 pm. The questionnaires were completed and analyzed in coding and anonymous manner to protect the privacy and observe confidential and ethical instructions.

Research Tools

Data were collected with the use of a questionnaire and interview. Also, the method of the final score calculation was taken place with the ROSA method in the form of observational paper-pen. ROSA is a pen-paper and observational method that can specify ergonomic risk factors and has good reliability to assess musculoskeletal disorders. The evaluation steps in this method encompassed three main parts and the scores were placed in the related tables in the different parts of chair, posture of the individual while sitting, screen, telephone, mouse and keyboard and the posture of the individual while using these tools and the use duration of each of these tools, and the final ROSA score was determined. To use this method, at first, the workstation and posture of the individual were scored at different parts with respect to pay slip, and one final score between 0 and 10 was reached. The score of 0 to 3 was low-risk level, the score 3 to 5 was medium risk level, and the score 5 to 10 was high-risk level. In this study, the demographic data and CMDQ were applied. Validity and reliability of the Cornell Questionnaire were carried out in one research by Alireza Choobineh, Hossein Afifizadeh Kashani et al.[20] entitled "Validity and Reliability of the Persian Edition of the Cornell Musculoskeletal Disorders Questionnaire (CMDQ)." Also, Cronbach's alpha coefficient for this questionnaire with 41 items was calculated 0/856 in the present study, which was a good and acceptable value. This questionnaire had enough reliability to measure the variables of this study. This questionnaire was regulated in three parts of the frequency of discomfort, severity of discomfort, and impact on work power. The questionnaire had a body map and analyzed 12 body parts that were 20 areas of the body. The results of three parts of the questionnaire were multiplied for each member, and the final result was a number between 0 and 90.[20] This study was applied in terms of type, was descriptive-analytical in terms of purpose, and was cross-sectional in terms of time.

Data Analysis Method

Statistical indices such as frequency, mean, facade, frequency percentage, standard deviation, variance, maximum, minimum, etc. were applied in order to describe the data. Since the most variables that existed in the study were stratified, the statistical test of the non-parametric Chi-square (x^2) was used for hypothesis testing. The reasons for the use of the non-parametric for hypothesis testing were the stratified responses range for questionnaires and the existence of discrete and stratified variables in the study. After a systematic random selection of samples, the researcher went to the workplace of the selected samples to complete the Cornell questionnaires. After the interviewee was fully trained, s/he completed the information cited in the questionnaire accurately, correctly, and completely confidentially. In the next step, while the subject was naturally working with the computer-based on normal routine of work and recording daily information or working with the desired system, the expert completed the form related to ROSA for each user, which was one observational pen-paper method, and recorded the relevant information according to instructions. Then, all data obtained from CMDQ and ROSA was analyzed with the use of SPSS software.

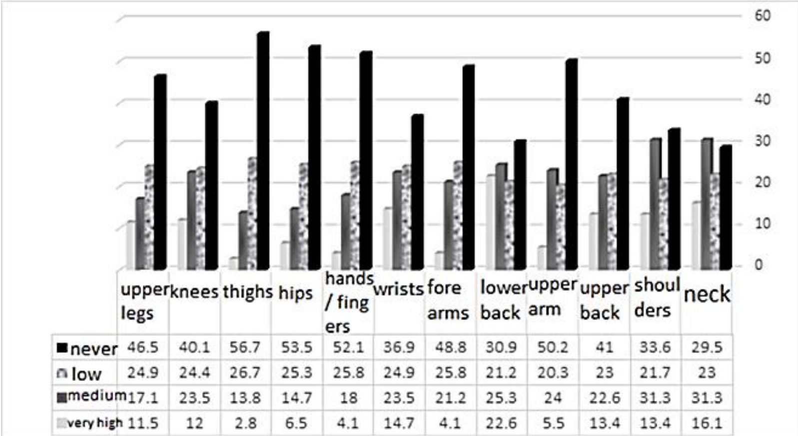
Results

In this part, the conclusions extracted from the demographic questionnaire and CMDQ will be discussed after summarizing and classifying. As observed in the chart 1, the highest rates of pain and discomfort in the body parts were related to neck (70.4%), lower back (69.1%) and shoulders (66.4%), and the least rates of pain and discomfort were respected to thigh (43.3%), hips (46.5%) and hand/finger (47.9%).

As shown in figure 2, the highest rates of pain effect on daily activities were related to neck (56.7%), lower back (54.4%) and shoulders (41.2%), and the least rates of pain effect were respected to thigh (23%), hips (24.4%) and hand/finger (29.5%).

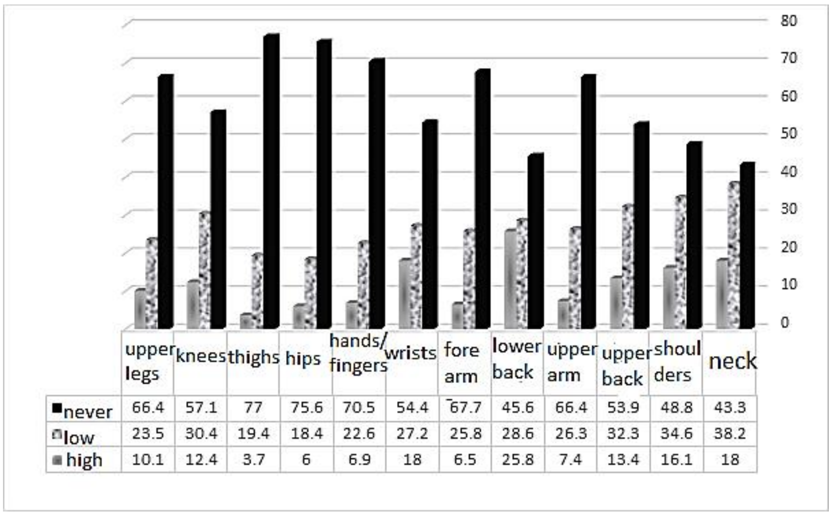
As cleared in figure 1, the proportion of male and female participants in this research was approximately equal, and 76.5% of participants were under 40 years, and 56.7% of them had more than five years of work experience with the computer. The results of the ROSA test indicated that 53.9% of participants were in the medium to high-risk range.[21]

The results cited in table 2 indicated that gender did not have an impact on the pain rate in terms of statistics ($P>0.05$). The pain rate in all levels of age, work experience, and ROSA score was different in all body parts with a 95% confidence coefficient. The pain rate had a significant relationship between variables of age, work experience, and ROSA score.



	upper legs	knees	thighs	hips	hands / fing ers	wrists	fore arms	lower back	upper arm	upper back	shoul ders	neck
never	46.5	40.1	56.7	53.5	52.1	36.9	48.8	30.9	50.2	41	33.6	29.5
low	24.9	24.4	26.7	25.3	25.8	24.9	25.8	21.2	20.3	23	21.7	23
medium	17.1	23.5	13.8	14.7	18	23.5	21.2	25.3	24	22.6	31.3	31.3
very high	11.5	12	2.8	6.5	4.1	14.7	4.1	22.6	5.5	13.4	13.4	16.1

Figure 1. Pain rates and discomfort in different body parts



	upper legs	knees	thighs	hips	hands/ fingers	wrists	fore arm	lower back	upper arm	upper back	shoul ders	neck
never	66.4	57.1	77	75.6	70.5	54.4	67.7	45.6	66.4	53.9	48.8	43.3
low	23.5	30.4	19.4	18.4	22.6	27.2	25.8	28.6	26.3	32.3	34.6	38.2
high	10.1	12.4	3.7	6	6.9	18	6.5	25.8	7.4	13.4	16.1	18

Figure 2. Pain affect rates on daily activities in different body parts

Table1. Frequency of stratified data by segregation of gender, age, work experience, and ROSA score

Variable	Class	Number	Percentage
Gender	man	100	46.6
	woman	117	53.4
Age (year)	≥30	87	40.1
	30-40	79	36.4
	≤40	51	23.5
Work experience (year)	≥5	94	43.3
	5-15	76	35.0
	≤15	47	21.7
ROSA score	3≤	100	46.1
	3-5	60	27.6
	5<	57	26.3

The results cited in table 3 revealed that gender did not have an impact on the pain rate in terms of statistics ($P>0.05$). The pain rate in all levels of age, work experience, and ROSA score was different in all body parts with a 95% confidence coefficient. The pain rate had a significant relationship between variables of age, work experience, and ROSA score. The results exhibited that gender did not affect the final ROSA score in terms of statistics ($P>0.05$). Also, the pain rate varied in all levels of age, work experience, and ROSA score with a 95% confidence coefficient, and there was a significant relationship between ROSA score and the variables of age and work experience.

Table2. Relationship between pain and discomfort in body parts and gender, age, work experience, and ROSA score (chi-squared values)

Pain and Discomfort in Body Parts	Gender	Age	Work experience	ROSA score
Neck	4.133 (0.247)	50.379	54.354	98.937
Shoulders	3.224 (0.358)	35.868	38.144	89.358
Upper back	1.199 (0.753)	37.854	39.933	67.548
Upper arms	3.050 (0.384)	37.940	35.323	57.886
Lower back	0.727 (0.867)	37.008	41.706	68.202
Forearms	2.445 (0.485)	19.305	26.673	47.022
Wrists	1.959 (0.581)	48.006	54.399	75.526
Hands/ fingers	4.954 (0.175)	28.044	23.689	44.793
Hips	2.154 (0.541)	34.685	35.509	50.706
Thighs	6.797 (0.079)	23.510	26.976	38.412
Knees	1.164 (0.762)	48.098	64.782	73.081
Lowe's legs	2.533 (0.469)	33.756	43.610	69.783

Note: all P-values in above table are less than 0.05 (P<0.05) except Gender that is reported in parenthesis.

Table3. Relationship between the effect of pain rate in body parts on daily activities and gender, age, work experience, and ROSA score (chi-squared values)

The impact of pain on body parts	Gender	Age	Work experience	ROSA score
Neck	0.315 (0.804)	40.643	39.417	86.244
Shoulders	1.062 (0.768)	27.264	27.322	77.878
Upper back	2.907 (0.406)	18.356	18.010	45.162
Upper arms	0.188 (0.910)	12.404	16.311	39.527
Lower back	0.665 (0.055)	29.910	36.107	72.698
Forearms	0.715 (0.679)	10.630	13.775	37.239
Wrists	1.999 (0.573)	30.151	40.720	71.016
Hands/ fingers	0.648 (0.723)	14.734	18.089	40.309
Hips	1.292 (0.524)	12.415	14.482	29.172
Thighs	2.177 (0.068)	10.423	13.886	32.013
Knees	2.502 (0.069)	42.202	50.755	66.400
Lowe's legs	0.268 (0.875)	23.949	36.136	46.737

Note: all *P*-values in above table are less than 0.05 (P<0.05) except Gender that is reported in parenthesis.

Discussion

The aim of this study was to evaluate the prevalence of musculoskeletal disorders in computer users of health care centers in Lordegan. The results of chart 1 indicated that long-term work with the computer caused pain in various parts of the body, such as the neck, lower back, and shoulder. The results of this study were confirmed by the research conducted by Binogile and Korhan[22] and Yektai et al.[16] The present research declared that the prevalence of musculoskeletal disorders in shoulder and neck parts was higher than in other parts. The study conducted by Ghanbari Sertang and Habibi[23] and by Eun et al.[24]

approved the results of this study. As exhibited in the chart 2, pain in different body parts such as shoulder, neck, and lower back caused from work with computer was effective for daily activities, which was in line with the results of the study carried out by Kalick et al.[25] and Choobineh et al. [26] The research results declared that work with computers caused musculoskeletal disorders in different parts of the body. Findings obtained from the study by Dukrell et al.[27] also confirmed the results of this study. Concerning the findings of this study, a significant relationship was observed between pain and discomfort in different parts of the body and the ROSA final score, which was consistent with the results of the study conducted by Agha Nasab et al. [28] and Sohrabi et al.[29] The findings of the present study cleared that there existed a significant relationship between pain and discomfort rate in different body parts and work experience, which was confirmed by the study done by Saeedi et al.[30] and Sohrabi et al.[29]

Conclusion

The results obtained from this study indicated that the expression of pain in all body parts, as well as the effect of pain on daily activities, was not related to gender. The results of this study revealed that the anatomical conditions of men and women in expressing pain and its effect on daily activities did not show any difference while working with the computer. This result was achieved due to the same working conditions of men and women for computer users participating in this study. For example, the workstations and tools used by men and women for computer work were the same, and it was natural that the pain in body parts did not differ between men and women. There was a significant difference between pain rate and discomfort in different parts of the body and the effect of pain in different parts of the body on daily activities with varying ranges of age. The results indicated that these ratios had significant differences. Since the increase in age caused the fatigue of the musculoskeletal system and weakened the muscles, bones, and joints, the feeling of pain and the effect of pain on daily activities were not the same and were increased by increasing the age. The anatomical conditions of men's and women's bodies in expressing pain when working with a computer were not different, and achieving this result was due to the same working conditions of men and women in the Health network. For example, the workstations and tools used by men and women to work with computers were the same, and it was natural that the expression of pain or painless was not different between men and women.

The results revealed that there was a significant difference between pain rate and discomfort as well as its effect on the individuals' daily activities of different parts of the body concerning the levels of work experience. Also, the expression of pain in all parts of the body depended on the work experience and different statements were recorded about pain and its impact on daily activities, so that individuals with higher work experience had more pain than those with less work experience. Also, the effect of the pain rate on daily activities was higher in those with higher work experience. It was not far-fetched since the rate of fatigue of the musculoskeletal system was increased with increasing the working periods and increasing the use of the computer as well as increasing the age. So, the strength of muscle, bone, and joint structure was eliminated, and this structural weakness led to different pain expressions at different levels of work experience. Based on the obtained results from inferential statistics, the rate of pain and discomfort in different parts of the body, as well as the rate of pain effect on daily activities, were different concerning different levels of ROSA score. Individuals with more pain expression and more pain effects on daily activities also had a high level of risk. This was because a high ROSA score meant inappropriate posture, undesirable workstation, or improper equipment. Therefore, the expression of pain and its effect on daily activity in body parts at different levels of ROSA was predictable and undesirable workstations, incorrect postures and equipment resulted in pain expression and its impact on daily activities among users.

In terms of nature, the present study was one of the applied researches. So, the following applicable suggestions that were based on research findings could be presented to improve the working conditions with computers in environments such as health networks and so on: As noted in the results, most of the pain expressions in the research participants and ROSA scores were associated with body parts such as the neck, shoulder, lower back, and wrist. So, the redesign of workstations based on the anthropometric dimensions of the population of the desired society, as well as applying proper equipment and facilities for performing the job correctly, could reduce the risk level of musculoskeletal disorders and pain.

One of the most important abusive factors of pain in the musculoskeletal system was the lack of adequate awareness about the basic principles of ergonomics and its use in the workplace. So, it was supposed that managers and supervisors, who were at risk of musculoskeletal disorders, should design training programs after examining their employees in terms of awareness of ergonomics principles as well as their attitude towards these principles. Considering the mental characteristics and employees' interests, they could teach the ergonomics principles with simple but effective language concerning their occupational conditions. This training program should be in such a way to provide feedback on the levels of learning, remembering, and practicing and evaluate its effectiveness. Changes in managerial approaches, including working quality, proper work division, duty circle-rest, and promotion of the culture of corrective movements during work, could be considerable and effective in eliminating these disorders.

Acknowledgment

In the end, we want to extend our gratitude to the management and personnel of Lordegan Health Network for their generous cooperation in this research. This paper was extracted from the thesis and was approved entitle the code 10650508952005 at the Islamic Azad University of Ahvaz.

References

1. Mirmohammadi S, Mehrparvar A, Soleimani H, Lotfi M, Akbari H, Heidari N. Musculoskeletal disorders among video display terminal (VDT) workers comparing with other office workers. Iran Occupational Health. 2010;7(2):11-14. [Persian]
2. Haghi A, Ghanbari M, Yartireh HA, Rajabi-Vardanjani H, Jalilpour Y. Prevalence survey and assessment of risk factors of

musculoskeletal disorders among municipality workers in Isfahan city. Shahrekord University Medical Sciences. 2015;17(1):7-15. [Persian]
3. David G, Woods V, Li G, Buckle P. The development of the Quick Exposure Check (QEC) for assessing exposure to risk factors for work-related musculoskeletal disorders. Applied Ergonomics. 2008;39(1):57-69.
4. Koehoorn M, Cole DC, Hertzman C, Lee H. Health care use associated with work-related musculoskeletal disorders among hospital workers. Occupational rehabilitation. 2006;16(3): 402-15 .
5. Morken T, Riise T, Moen B, Hauge SH, Holien S, Langedrag A, et al. Low back pain and widespread pain predict sickness absence among industrial workers. BMC Musculoskelet Disorders. 2003;4(21).
6. Korhan O, Mackieh A. A model for occupational injury risk assessment of musculoskeletal discomfort and their frequencies in computer users. Safety science. 2010;48(7):868-77.
7. Vanwonterghem K. Work-related musculoskeletal problems - some ergonomics considerations. Human Ergology. 1996;25(1):5-13
8. Mosavi Fard A, Zarei F. Assessment of muscle skeletal disorders and analyze working posture of karaj medical science school's staffs with RULA method by using ErgoIntelligence-UEA software and nordic standard questionnaire. Alborz university of medical sciences. 2013;2(4):245-50. [Persian]
9. Choobineh AR, Tabatabaei SHR, Mokhtarzadeh A, Salehi M. Musculoskeletal problems among workers of an Iranian rubber factory. Occupational health. 2007; 49(5):418-23.
10. Ghanbari-Sartang A, Habibi H. Evaluation of musculoskeletal disorders to method Rapid Office Strain Assessment (ROSA) in computer users. Preventive medicine. 2015;2(1):47-54. [Persian]
11. Zarei F, Rajaei B, Nikpey A, Varmazyar S, Safari-Variani A. Review the proportion of university seats with body dimensions of students at the School of Public Health of Qazvin University of Medical Sciences in 1388. Iran Occupational Health. 2011;8(3) :39-46. [Persian]
12. Habibi E, Soury Sh, Abolghasemian M. The effect of three ergonomics intervention on work-related posture and musculoskeletal disorders in office workers (computer users) Gas Company of Isfahan. Health system research. 2013;9(10):1041-9. [Persian]
13. Abbasi A, Kouhnavard B, Mehrparvar AH, Mihanpour H. The effect of education on improving the working conditions of computer users. Archives of occupational health. 2018;2(4) :225-32.
14. Gerr F, Marcus M, Monteilh C. Epidemiology of musculoskeletal disorders among computer users: Lesson learned from the role of posture and keyboard use. Electromyography and kinesiology، 2004;14(1):25-31.
15. Mosadeghrad AM. Relationship between nurses' knowledge about ergonomy and their job injuries. Shahrekord University of medical sciences. 2004;6(3):21-32. [Persian]
16. Yektaee T, Tabatabaee Ghomshe F, Piri L. The effect of ergonomic principles education on musculoskeletal disorders among computer users. Rehabili. 2013;13(4):108-116. [Persian]
17. Choobineh A, Daneshmandi H, Deilami F, Khoshnami S. Ergonomic workplace assessment and survey of musculoskeletal injuries in a generator manufacturing company. Health System Reserch. 2013;9(7):720-30.
18. Yaghobee S, Esmaeili V. Evaluation of the effect of the ergonomic principles' instructions on the dental students' postures; an ergonomic assessment. Dental Medicine-Tehran University of Medical Sciences. 2010;23(2):121-7. [Persian]
19. Sadeghi N, Habibi,E. The survey of relation between Musculoskeletal Disorders and Anthropometric Indices in the bus drivers in Isfahan. Iran Occupational Health. 2009;6(1):6-14. [Persian]
20. Afifehzadeh-Kashani H, Choobineh A, Bakand S, Gohari MR, Abbastabar H, Moshtaghi.Validity and reliability of farsi version of Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Iran occupational health. 2011;7(4):69-75. [Persian]
21. Sonne M, Villalta DL, Andrews DM. Development and evaluation of an office ergonomic risk checklist, ROSA-rapid office strain assessment. Applied Ergonomics. 2012; 43(1):98-108.
22. Binboga Yel E. Korhan O. A Survey of students participating in a computer-assisted education programme. International Journal of Research in Education and Science (IJRES). 2015;1(2):131-41.
23. Ghanbari Sartang A, Habibi E. Evaluation of musculoskeletal disorders among computer users in Isfahan. Iranian journal of health, safety & environment. 2015;2(3):330-4.
24. Evans O, Patterson K. Predictors of neck and shoulder pain in non-secretarial computer users. International journal of industrial ergonomics. 2000;26(3):357-65.
25. Calik BB, Yagci N, Gursoy S, Zencir M. Upper extremities and spinal musculoskeletal disorders and risk factors in students using computers. Pakistan Journal of Medical Sciences. 2014;30(6):1361-6.
26. Choobineh A, Rahimi Fard H, Jahangiri M, Mahmood Khani S. Musculoskeletal injuries and their associated risk factors. Iran occupational health. 2012;8(4):70-81. [Persian]
27. Dockrell S, Bennett K, Culleton-Quinn E. Computer use and musculoskeletal symptoms among undergraduate university students. Computers & education. 2015;85102-9.
28. Mardi G, Kouhnavard B, Ahmadipanah V, Aghanasab M. An investigation of rapid office strain assessment and rapid upper limb assessment in visual display terminal users. Health research in community. 2015;1(3):25-32. [Persian]
29. Sohrabi M, Faridizad AM, Farasati F. Comparing results of musculoskeletal disorders evaluation in computer users with CMDQ, RULA, and ROSA methods. Ilam university of medical sicences. 2015;23(4):53-62. [Persian]
30. Musavi S, Saeidi C, Dastaran S. Evaluation of the risk factors of musculoskeletal disorders and its relation to the workload of employees at 118 call center in sanandaj, Iran. Health and development. 2016;5(2):110-21. [Persian]