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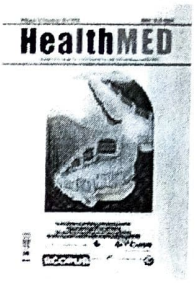

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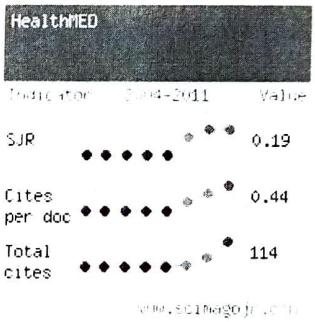

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Evaluation of computer workstation ergonomics and prevalence of the musculoskeletal symptoms - A cross sectional study of Macedonian office workers

Viktorija Prodanovska-Stojcevska[1], Jovica Jovanovic[2], Tanja Jovanovska[1], Rozalinda Isjanovska[3]

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Abstract

The aim of this paper is to evaluate a computer workstation in an office environment and to identify the ergonomic deficiencies in typical offices and prevalence of the musculoskeletal symptoms for employees at a computer work stations. A cross-section study was conducted during the period of May and June in 2010 in Bitola, Republic of Macedonia. This study included 100 employees with computer workstations from 3 companies with a separate primary function. The criterion was that the employee has to perform at least 1 hour working at the computer during their working hours. The instruments for the study were display questionnaire and Nordic questionnaire for musculoskeletal symptoms. Most of the workstations fulfilled the criteria of the checklist. The deficiency in the postures at the workplace was registered in few questions: 28% of the employees had a monitor reflection, 65% replied that the electrical line were not secured and 62% of the employees do not have a copy holder. As with the usage of Nordic Questionnaires, musculoskeletal problems were identified for the computer employees in duration of 12 months in the last 7 days. As of this period, the most prevalent were the symptoms in the neck area 48%, upper beck in 48% and the lower part of the beck in 42%. Computer workstations in offices should be laid out following ergonomics standards, guidelines, and recommendations. Employees must be trained in ergonomic layout and organization of their workstations. With regard to musculoskeletal symptoms, preventive measures should focus on neck and shoulder disorders.

Key words: Computer workers, workstation, musculoskeletal symptoms

Introduction

Computer availability has made workers work faster, easier, neater and less frustrating to the one that are using (1). Computers (video display terminals) have become increasingly common in both workplace and homes over the past 20 years (2).

Visual and musculoskeletal symptoms and disorders are the most common occupational health problems among computer users (3). These problems include sustained pain in the neck and upper extremities, such as wrist tendonitis, epicondylitis and trapezius muscle strain (4). The risk factors in the workplace include hours of computer use, sustained awkward head and arm postures, poor lighting conditions and work organizational factors (5-13).

Ergonomics is the science and technology of fitting the activities and environment to the abilities, dimensions and needs of people to improve performance while enhancing comfort, health and safety (14). By applying ergonomic principles the efficiency of human-computer interaction, health and the user's safety can be improved (15). Eason (16) developed a classical ergonomic framework and identified factors that affect human performance. These factors include task characteristic, user issues, environmental factors and human-computer interaction (16).

The position of the head of the computer user is to put the minimum stress on the neck muscle and the recommended viewing angle is 15°-30° (17). The position of a video display terminal relative to eyes can influence visual strain and the two main parameters are the viewing distance from the eyes to the screen and the height of the visual target relative to the eyes (18).

The common devices of the computer are keyboard and mouse. While using these devices the optimal posture of the wrist is to keep the wrist straight and free from extension or flexion and ulnar deviation so can minimize stress (17). Different layouts of a VDT workstation were studied like Sotoyama, Jonai, and Saito(19). They recommended desk height to be adjustable to the user's height and the monitor to be set loser to the keyboard to provide a smaller ocular surface area.

The positive effect in reducing computer workstation symptoms has shown ergonomics training (15). Proper training to computer operators are needed on how to maintain a correct posture and adjust their workstations (20,21). Ivergard (22) provided some ground rules in the design of an education and training program for a computer workstation.

Effective training programs and producing positive changes in workstation configuration and posture have reducing the severity of symptoms and making the improvement in productivity (23).

A lot of research has been conducted in this area; it is believed implementation of ergonomics in the office environment is somewhat limited, especially in developing countries like Republic of Macedonia. The objective of this research was to study and identify ergonomic deficiencies in computer workstations in typical offices, prevalence of the musculoskeletal symptoms at the computer employees and their possible association with the workplace; and suggest strategies to reduce or eliminate these deficiencies to improve occupational health and safety.

Material and methods

There was a cross-section study conducted during the period of May and June in 2010 in Bitola, Republic of Macedonia. This study included 100 employees with computer workstations from 3 companies with a separate primary function. Employees that were involved in the study had to perform at least 1 hour working at the computer during their working hours. After the notification for consent, the employees fulfilled the questionnaire regarding ergonomic features at their workplace and a standardized questionnaire for possible musculoskeletal symptoms. The time needed to answer the questionnaire was limited for 30-40 min. In order to improve the condition at the workplace for this group of employees, they were advised with recommended safe and comfortable work positioning. Within the same context, there was a guidelines suggested by OSHA (*Occupational Safety and Health Administration*) where many suggestion for diminishing and eliminating of the identified issues were given as well as a possibility to create own " adjusted position" during the computer work performance.

Workstation checklist

The checklist was based on a German VDT questionnaire (BiFra), which has been used since 1995 to evaluate various VDT workstations throughout Germany, and is also available in French and English(24). The checklist used in this survey contains 32 items regarding display (e.g. size, reflections; 5 items), keyboard/mouse (e.g. area in front of the keyboard or for mouse movement; 6 items), desk and arrangement of the VDT and accessories (e.g. adjustability of height, space for legs; 7 items), chair (e.g. adjustability of height; possibility of changing working postures: 4 items), ambient and environmental conditions (e.g. lighting of office and desk: 10 items).

Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms

The questionnaire consists of structured, forced, binary or multiple choices and was used as self-administered questionnaire (25). The purpose of the questionnaires is to serve as instrument in the screening of musculoskeletal symptoms in an ergonomics context. The general questionnaire is designed to answer the following question: , Do musculoskeletal troubles occur in a given population, and if so in what parts of the body are they located?,,

The questionnaire is composed of two sections. First basic part is composed of questions that refer the appearance of the musculoskeletal symptoms according the anatomic area (neck, shoulders, elbow, wrist and hand and finally the upper and the lower part of the beck). An additional classification of the symptoms according the period of the appearance within last 12 months and during last 7 days was done as well.

Second part of the questionnaire includes additional questions regarding the symptoms for each

anatomic localization, functional influence, and durability as well as the musculoskeletal symptoms during last 7 days.

Statistical analysis

Data bases were formed by using specific software intended for this purpose. The data collected are presented in charts. This study includes percentage of the structure in order to present the prevalence (in percentage as well). The attributive statistical series are analyzed by determining the percentage of structure. Confirmation of the statistical significance among the detected differences using Chi- square test for two attributive variables and a statistical significance for $p<0.05$.

Results

Demographic characteristics of the study population

100 employees out of whom 70% are females and 30% males fulfilled the questionnaire. The mean age was 40.06 (± 10.8) years. All of them were full-time employed, 8 hours per day, 5 days a week. 75% of them are performing computer work more than 4 hours per day and 25% do 1-4 hours per day.

Workstation characteristics

The VDT workstations were checked with regard to the ergonomic and spatial features given on the checklist (BiFra). Most of the workstations fulfilled the criteria of the checklist. Occasionally, reflections on the visual displays due to shortcomings in the lighting equipment were documented. With regard to the 100 workstations, for which the employees' questionnaires were available, many of the ergonomic features of VDT workstations were fulfilled: At 94% of them the monitor screen is not flickering, 90% the monitor could be easily positioned; 91% have an adequate space in front of the keyboards to lean the thumbs and the forearms, 87% the keyboard is not sliding on the work desk, 88% have an adequate space for the mouse movement, 79% have an adequate volume of the desk space, 82% enough space for their feet and 96% the height of the desk is sufficient to their needs.

As of the analysis of the question regarding the chair 75% of the examined have replied not having a comfortable body posture during the work performance, 64% cannot change the body posture during their work and 52% from the employees do not have an ergonomic designed chair. (Figure 1).

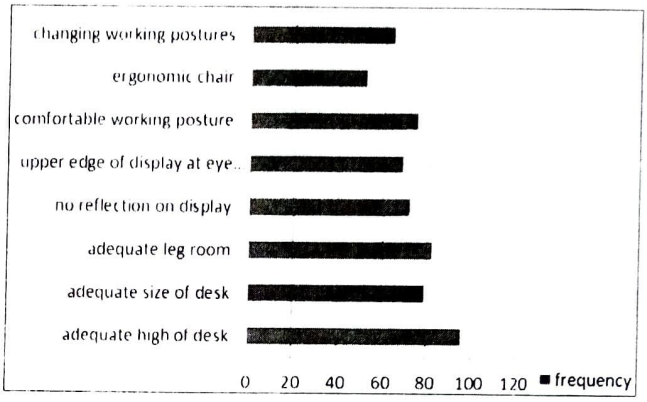

Figure 1. Characteristics of evaluated computer station n=100

The deficiency in the postures at the workplace was registered in few questions: 28% of the employees had a monitor reflection, 65% replied that the electrical line were not secured and 62% of the employees do not have a copy holder.

Symptoms appearance

As with the usage of Nordic Questionnaires, musculoskeletal problems were identified for the computer employees in duration of 12 months in the last 7 days. As of this period of 12 months, the most prevalent were the symptoms in the neck area 48%, upper beck in 48% and the lower part of the beck in 42%. 17% have registered symptoms in the right shoulder, right wrists/ hands, and 15% was registered in the elbow. Within the recent 7 days, 22% of them have registered a neck problems and 16% pain in the upper part of the beck (Figure 3).

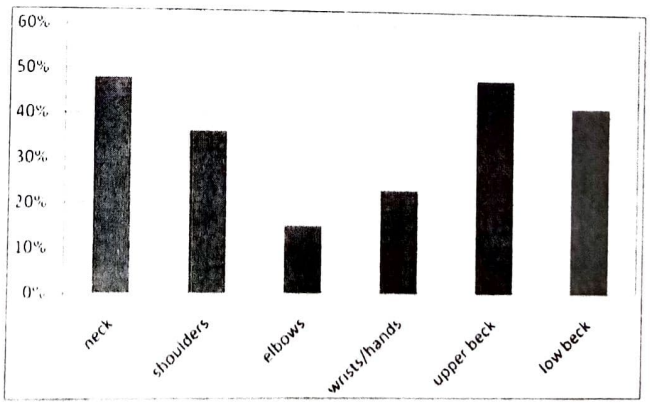

Figure2. Prevalence percentage of the musculoskeletal symptoms separated in areas for the examined in the last 12 months

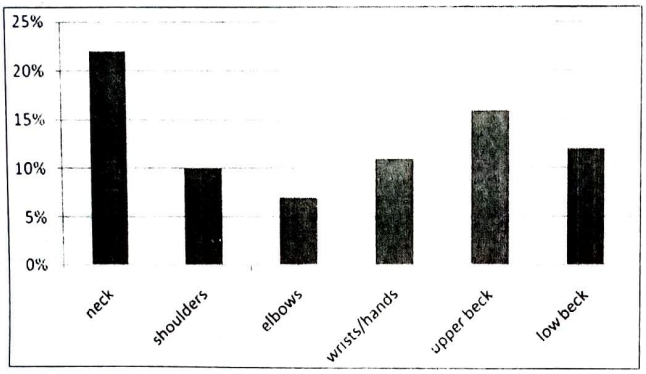

Figure 3. Prevalence percentage of the musculoskeletal symptoms separated in areas for the examined in the last 7 days

Regarding the time for performing computer work during daily working hours 5% of the responders who work 1-4 hours per day have musculoskeletal symptoms of the upper extremities. 30% of the workers who spend more than 4 hours at the computer during working hours reported musculoskeletal symptoms at the given anatomic area. As for sex distribution 95 % of the employees who reported symptoms of the upper extremities are female.

The statistical significance is registered between the symptoms of the neck and gender (Pearson Chi Square=84,005; df=3; p=0,0001), odds ratio 3,67 (95% Confidence Interval from 1,4359 to 9,3632) respectively the high risk of getting symptoms in female population .

Association is registered between the question for safe and rhythmical stroke technique of the keyboard and pain in the wrist/hand during last 7 days Pearson Chi-square: 5,18407, df=1, p=0,022797. Seemingly, there is a association registered between safe and rhythmical stroke technique of the keyboard and pain in the hand ankle during last 7 days among the employees that spend more than 1 hour at the computer Pearson Chi-square: 5,10500, df=1, p=0,023859.

Discussion

The primary aim of this study was to depict and assess the computer workstation and the period prevalence for the appearance of the musculoskeletal symptoms especially in the area of the upper extremities among those employees within the Macedonian offices and administration workplaces.

As for the examination, the study included 100 office workstations with an office employee in each of them. Even though that the sample was with an insignificant amount yet it represented a typical computer workstation setting. The outcome received is dully applicable for computer employees respectively.

The evaluation results have shown that most of the criteria for posture at the workplace are satisfied. This refers especially to the questions that include the monitor (setting, legibleness, screen flickering and positioning), setting of the keyboard and mouse (safe and rhythmical stroke, sufficient amount of space for movement of the mouse and mouse pad), the volume of the work space and the height positioning of the desk.

The research conducted in Germany regarding the features at the workplace considering the computer work has shown that generally, the ergonomic conditions at the investigated workstations can be considered as good or very good. The majority of the working places fulfilled all criteria of the checklist (26).

As of the deficiencies in the postures at the workplace the following could be mentioned: screen reflection, unsecured electrical lines, shortage in copy holders, no possession of ergonomic designed chair and not sufficient space for work that might allow a change of the body posture during the working hours. Those deficiencies are due to the fact that such workstations are not specialized for computer workers but they represent a regular workstations adapted with the necessities for the institutions with an additional supplying with computer equipment.

Similar to those results i.e. deficiencies were identified in the study that was conducted in Oman where computer workstation facilities and furniture were inadequate, which may have contributed to ergonomic deficiencies in terms of layout and workstation organization (15) most employees did not have document holders that are important for minimizing back and neck bending, especially for those who spend a lot of time on data entry.

The researches have shown that the percentage of the registered musculoskeletal symptoms is increased in the period on 12 months than the one that shows the results from the last 7 days. As of the anatomic localization of symptoms, most of them are registered in the area of the neck, upper and lower part of the beck. The appearance of the

musculoskeletal symptoms in the neck area probably comes up because of the deficiencies in the position of the chair such as: not sufficient work space, absence of document holder as well as not having a ergonomic designed chair.

The results from the conducted Norwegian study (27) regarding the prevalence of the musculoskeletal symptoms showed higher prevalence of neck and shoulder complaints in the study population compared to arm, elbow and hand complaints.

Similar results are received from the research done with the Nordic questionnaires. As with the 12-month symptom prevalence, 1-week prevalence results revealed that the neck and shoulder symptoms were clearly more prevalent than the hand/ wrist and elbow/forearm symptoms (26). With regard to the 12-month prevalence of the whole sample, the highest values were found in the neck (55%) and shoulder (38%) region. The least pronounced prevalence was found in the hand/wrist and elbow/forearm, with values of 21% and 15%, respectively.

Positive association is registered between the safe and the rhythmical stroke technique of the keyboard with the symptoms in the wrist/hand that appeared within the last 7 days, especially to those employees that work for more than 1 hour at the computer.

A similar exposure ("keying") was reported by Gerr et al. to be positively associated with hand/ arm symptoms and disorders (28, 10). In two Japanese studies, effects of the duration of daily VDT work on physical symptoms (29) on the general health status (30) were documented.

Conclusion

The computer workstation mainly fulfills the conditions especially those related to setting of the monitor, keyboard, mouse then, the adequate space and height of the desk and the comfort of the feet. The deficiencies in terms of the setting of the workplace appear in the body posture and the possibility of its change during the work, lack of an ergonomic chair, reflection of the monitor and the lack of a copy holder. The most prevalent musculoskeletal symptoms are in the neck, the upper and the lower part of the beck and neck during the period of 12 months. As for the prevalence of the symptoms within last 7 days, the most present were those on the neck and the upper beck. The musculoskeletal symptoms are more prevalent in the computer workers that work more than 4 hours per day then the employs that work 1-4 hours per day. Regarding the sex distribution symptoms are registered mainly in the female employees. An association is registered between the techniques of the keyboard punch and the appearance of symptoms in the wrist/hand for the period of last 7 days.

Computer workstations in offices should be laid out following ergonomics standards, guidelines and recommendations. Employees must be trained in ergonomic layout and organization of their workstations. With regard to musculoskeletal symptoms, preventive measures should focus on neck and shoulder disorders. The data gathered in this survey can be used as a reference for further studies with comparable outcomes and in occupational safety and health campaigns addressing the ergonomic characteristics of VDT workstations.

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