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Review Article

Healthy workplace with ergonomics among software engineers: a review

Jasmine Maruthappapandian[1], Vinoth Gnana Chellaiyan[2]*, Fasna Liaquath Ali[1], Deepak Avinash[2]

[1]Department of Community Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth-Deemed to be University, Nellikuppam, Chengalpet, Kancheepuram, Tamil Nadu, India
[2]Department of Community Medicine, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India

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***Correspondence:**
Dr. Vinoth Gnana Chellaiyan,
E-mail: drchellaiyan@gmail.com

ABSTRACT

Estimate on the prevalence of musculoskeletal problems among the software engineers vary widely across globe. The main cause of this work-related musculoskeletal problem is due to improper usage of ergonomics. The objective of this review is to discuss the role or principles of ergonomics on preventing musculoskeletal problem among software engineers. Multiple databases (PubMed, Medline, Embase and Google Scholar) were searched for studies on the prevalence of musculoskeletal problem among software engineers and the implications of ergonomic interventions on these problems. The studies were prioritized according to validity and quality. Only a few studies were done to identify the knowledge or awareness about the ergonomic positions, practise of the ergonomic principles, its association with the prevalence of musculoskeletal problems, do the organisation provides regular ergonomic check of the workstation, do the software professionals have a regular health check-up.

Keywords: Musculoskeletal problem, Ergonomics, Software engineers

INTRODUCTION

The second major determinant of disability globally is the musculoskeletal problems. Unlike before, it is not a disease of old age. Its prevalence is almost throughout the life, affecting mostly adolescent people. Every 1 in 5 people are living with musculoskeletal problem.[1] Musculoskeletal problems are those in which the locomotor system is affected, causing symptoms anywhere in the body. Among the working population, musculoskeletal problem remains one of the main causes of sickness absenteeism.[2] The severity of these disorders may range from simple occasional pain to development of disability, affecting any part of the body like neck, shoulders, back, elbow wrist, hips and ankles.[3] The objective of this review is to discuss the role or principles of ergonomics on preventing musculoskeletal problem among software engineers.

ERGONOMICS

The ergonomics is defined as fitting the job to the people.[4,5] There have been many adverse consequences in the human health with the development of the mechanizations. The main principle of the ergonomics is to reduce these consequences by establishing an apt balance between the work requirement and the working person's capacity.[5] The principles of ergonomics ensure this by, either making the work adapt to the person or through improvement of person's capacity to the work, with the latter be brought about by vocational adjustment or by training. [1]

SOFTWARE ENGINEERS AND MUSCULO-SKELETAL PROBLEMS

Ergonomics practice brings about improvement in work efficiency, comfortable workplace and thus health and safety of the worker is not compromised. During the past decade, the individuals suffering from musculoskeletal disorder has increased 25 percent.[6] Ergonomics in this context is very imperative, because majority of these are computer usage related.[7] Along with the improper posture, prolonged sitting can decrease the circulation and thereby pain and joint stiffness.[8] Appropriate practice of computer workstation ergonomics is very vital to maintain the efficiency and productivity of the software engineers. Apart from training on ergonomics, the employees should be constantly motivated to practice the thought ergonomics appropriately.

Information technology in India was established in 1967, since then there has been a tremendous growth in the field.[9] This is one of the biggest job creators across globe. Software jobs comes with many advantages like lucrative salary, promotions etc. But then it also has many disadvantages in view of the health of the engineers.[10] Software professionals are exposed to many computers related morbidity like visual problems, stress, musculoskeletal disorders etc. With the increase in the computer users, the computer related risk factors also increase.[9]

Software engineers experience strong postural demands, repetitive stress, static muscular load etc. These factors are mainly responsible for the development of musculoskeletal disorders among them.

WORK RELATED MUSCULOSKELETAL DISORDERS

There are many work-related and non-work-related determinants of musculoskeletal problem among the occupational group. WHO has given a definition for Work related musculoskeletal disorders (WRMSDs). "The musculoskeletal disorders which are caused or intensified by work" is called as the Work-related musculoskeletal disorders.[1] The main risk factors for the development of these disorders among the occupational group are high intensity stress, postural demands, long-term muscular strain etc.[1]

Among many causes which attributes to the development of work-related musculoskeletal disorders, Work style plays a very crucial part. The hazardous workstyle with respect to the computer work is also called as "Maladaptive coping behaviours".[11] The interaction between the risk factors like psychosocial and ergonomic, play a vital part in the development of disorders in the locomotor system and limiting their ability.[12,13] The time constraint work and increased work demand give an added disadvantage to the development of WRMSDs.

According to previous literatures or guidelines or organisations, the musculoskeletal disorder related to work could be caused due to two main factors-psychosocial and physical factors.[14,15] Psychosocial factors are the subjective factors as perceived by workers. The factors like work rest schedules, working hours, design of the job, its complexity, interpersonal relationships etc., are some of the main psychosocial factors. The physical factors are the extreme, continuous, awkward postures for a prolonged time.

Duration of computer usage

Usage of computer is progressively viewed as a significant risk factor for the development of musculoskeletal discomfort. They also exert a dose response association with the musculoskeletal discomfort.[16] There are many studies which showed that with the improvement in the ergonomic practice and regular rest in between the work, it is possible to avert the musculoskeletal problems among the software professionals.

IMPLICATIONS OF MUSCULOSKELETAL PROBLEM

Sickness absenteeism

Sickness absenteeism determines the workers performance and could be a major cause for job loss, loss in productivity.[17] According to WHO, the foremost reason for sickness absenteeism is musculoskeletal disorders. The average days lost due to musculoskeletal problem was 17.2 days (16.2 for men and 23.5 days for women) according to a study in a Swedish company.[18] Sickness absenteeism could cost indirectly on the productivity. This is a major management problem. Unless there are regular and periodic health examinations and preventive measures these cannot be reduced leading to increased loss in productivity and thereby economic burden.

IMPACT ON PRODUCTIVITY AND ECONOMICS

Musculoskeletal problem accounts for nearly 70 million visit to doctors. Impact on economic is like an iceberg analogy. Musculoskeletal disorders costs economic burden both directly and indirectly. Direct costs include indemnity payments, medical expenditure, insurance etc. These are usually quantifiable. It was considered that direct cost accounts for only a low proportion. Indirect costs are difficult to measure include sickness absenteeism, compensation with a replacement worker, wages paid while on leave, legal fees etc.[19]

Morbidity

The prevalence musculoskeletal problem in any area of focus ranged from 54-77.5%.[20,21] These wide range could be attributed to the non-homogeneous workstation

environment, level of knowledge and practice between the studies.

Neck and shoulders

The musculoskeletal problems in neck and shoulders range from 16-73% and 11-55.8% respectively. [9,22-30] The causes of neck and shoulder problem are multifactorial. According to the guidelines given by OSHA (California) arm rest should be adjustable, so that when a user rests his arm on them, the shoulders should be relaxed.[31] The arm rest should be adjustable. While resting on the arm rests, the shoulders should not be raised or lowered making the tasks like writing, keying uncomfortable. Leaning down to rest on the arm rest, twisting of the neck to view the monitor etc could be a noteworthy ergonomic cause of neck and Shoulder problems.

Upper and lower back

The musculoskeletal problem in the upper back could be as low as 3-37.4%[9,22,32-34] whereas the morbidity due to lower back is slightly higher ranging from 11.6-94%.[9,22,30-37] Low back pain is considered to be an expensive disorder among the working group globally. Risk factors like prolonged sitting accompanied with awkward posture can lead to the development of low back problems. These risk factors can be reduced by proper work station arrangement like hips should be slightly higher than the hips. Sitting in an awkward position for a longer duration is one of the main determinants of getting musculoskeletal symptoms while in work. Uncomfortable posture makes our muscle tighten and weak and, longer duration of the same uncomfortable posture reduces the blood flow and further making the muscle tired. [31] So being in a comfortable posture and standing or extending in between the work is very essential to prevent the muscle from getting fatigued. So, for this chair should have an adjustable height with back support (both upper and lower back), seat pan can be adjusted etc.

Wrist

Repetitive strain to the wrist can lead to the development of carpal tunnel syndrome in the software professionals.[38] If not intervened at an earlier stage this can lead to weakness and incoordination in the fingers especially thumb. The mouse should be adjacent to the keyboard. The mid-section of the finger should be used to click the mouse rather than the finger tips. It should be placed in a position so that it should not be in an overreaching or awkward position. Guidelines suggest that when the mouse is not used, the hand can be kept on the lap, instead of placing it over the mouse. The wrist problem could be from 5-58%.[9,22-27]

Elbow

The "Mouse elbow" is the term commonly used for lateral epicondylitis. These affect the tendons and muscles of the elbow joint. The main reason for this is the Repetitive strain Injury (RSI) caused by constant tensed position of the arm for a prolonged period.[38] Studies have shown a prevalence of elbow problem among 5-58%.[27,28,36,37,39] These could be averted by proper usage of ergonomic guidelines. When using the key board, the shoulders should be relaxed and the wrists should not be bent. The keyboard platform should be such that when the fingers are positioned on the home row keys, their upper border should be in height with the elbow or slightly lower, but not higher.[31]

Other regions

The prevalence of musculoskeletal problem in other areas like knee and thigh are comparatively lower than the others ranging approximately 4%.[22] The guidelines recommend that between the edge of the chair and the back of the knee, a gap of 2 to 4 inch should be maintained. The seat pan should be adjustable.[31] The gap should not exceed 4 inch nor should it be less than 2 inches. And while sitting feet should be completely rest on the floor.

OBSTACLES IN PRACTISING ERGONOMICS

Enormous usage of computers if not coupled with proper ergonomics, could be a major determinant for many injuries. The barriers of using improper workstation could be due to low knowledge or improper application of the principles of ergonomics.

INSTITUTIONAL POLICY

Most institution don't have rewritten policy. Even if they have some, they don't impose strict guidelines for training and follow up.

KNOWLEDGE OF ERGONOMICS

Assessing the individual's knowledge about ergonomics is very crucial for the computer users, as this is a very cost-effective method to alleviate the musculoskeletal problems. Studies have shown that knowledge about each ergonomic principle was in between 24-90%.[40] Studies have also shown that the prevalence of musculoskeletal problem was dramatically lower among those who had adequate knowledge. Knowledge is of no use, unless it is put into practice. Frequent motivation and health education could improve the regular practice of ergonomic principles.

OUTCOME OF ADHERENCE TO ERGONOMIC PRINCIPLES

Studies have shown that with simple ergonomic interventions many musculoskeletal problems could be averted. Intervention studies have shown a good improvement symptom after implementation of

ergonomic principles and the results are comparable with other treatment like myofeedback training.[41]

POLICY MAKING

Every organisation should have a prewritten policy, principles regarding the workstation design; it should reach attention even during the blue print stage of the workstation. Pre-placement training to the employees by a specialist regarding the principles of ergonomics should be done in every institution. They should also be educated about the hazards and implications of not following the ergonomics. Once they are educated, they should be motivated to practise the principles almost always to prevent the health effects. The employers should organise workshop or team activity apart from the pre-placement training to give refresher training about ergonomics. The employees should also be subjected to periodic medical examination to catch the symptoms early and treat them before developing permanent disability.

INTERNATIONAL LABOUR ORGANISATION[42]

Not just improper posture, even the longer duration of working hours have an impact on health of the workers. It increases stress and thereby leading to many psychosomatic illnesses including muscle ache. ILO has provided a framework for regulated work hours, rest periods etc. They have set a standard at only forty hours of work in a week and not exceeding 8 hours in a day. There should be consecutive 24 hours every week for the workers to enjoy rest.

OCCUPATION SAFETY AND HEALTH ADMINISTRATION

Most of the developed countries have occupational safety acts and occupation safety and health administration which provides specific checklist to be followed while designing workstation, punishments for non-adherence, report and notification.[43-45] But these organisations are less among the developing and least developing countries. The Government bodies could come up with initiatives to draw up specific guidelines according to their local needs.

CONCLUSION

Literatures have shown that the prevalence of musculoskeletal problem is as high as 77.5% among software professionals. According to International Labour Organisation, almost 2.78 million mortality in a year, are due to work related diseases. Along with the mortality there are nearly 374 million non-fatal work related illness. All these have a direct and indirect effect on the productivity and huge economic loss unless intervened at an early stage. The studies have shown that with proper usage of ergonomic principles these problems can be easily averted. The dimensions and the consequences of these problems should be stressed upon and the necessary precautions and the actions through institutional policies, legislations and guidelines should be drafted by the specific authority of the countries.

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