A study on knowledge and practice of Ergonomics among the Software Engineers in a private firm, Chennai, Tamil Nadu

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Abstract

Background and Aims: Due to multiple reasons like prolonged sitting and postural demands, software engineers are prone to develop musculoskeletal problems, which can be easily alleviated by practicing proper Ergonomic posture in their workstation. The main objective of the study was to assess the knowledge of Ergonomics Principles and Workplace Practice among the software engineers working in a private firm. **Methodology:** This was a cross-sectional study conducted among 403 software engineers working in a private firm, Chennai. **Results:** Among the 403 study participants, 85.6% had musculoskeletal problem in any area of focus. Only 9% had adequate ergonomic knowledge and only fewer among them practice it adequately. **Conclusion:** The study revealed higher prevalence of musculoskeletal problem, lower prevalence of knowledge about Ergonomic principles and much lower prevalence of appropriate practice of Ergonomic principles. This can be alleviated by a simple primary care like ergonomic education and practising.

Keywords: Ergonomics, occupation, workplace, workstation

Introduction

Many jobs are associated with the development of musculoskeletal problem due to varied reasons. The most common job to produce these types of strains are those who uses computers every day during their work. Since the establishment of Information Technology industries in India, there has been an enormous growth in that field.[1] Due to varied reasons in their work like prolonged sitting and postural demands, the software engineers develop Musculoskeletal Problems.

In 1949, K. F. H Murrell coined the term "Ergonomics" which came to prominence in 1950.[2] Ergonomics is defined as "fitting the job to the people".[3] The main aim of the ergonomics is to adapt the work to the person and vice versa. According to International Labour Organisation, Occupational Safety and Health (OSH) has been defined as "the science of anticipation, recognition, evaluation and control of hazards arising in or workplace that could impair the health

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and wellbeing of the workers".[4] It is the basic right of the employees to work in a safety environment. The main ironic issue is that all these work-related musculoskeletal disorders can be easily averted by simple ergonomic interventions. Practice of Ergonomics can improve the work efficiency and thus the health of the work is not compromised. Studies have shown that by providing primary care regular medical screening and health education on practising Ergonomics can avert majority of the musculoskeletal problems experienced by the Software Engineers.

There are many studies which has shown that there was a phenomenal improvement in the symptoms of the computer users after intervening with the simple ergonomic changes in their workstation.[5-7] Only few studies concentrating on awareness and practice of ergonomics and its association with the development of musculoskeletal problem among the Software engineers are done in Chennai. So, the aim of the present study was toassess the knowledge and practice of Ergonomic principles among the Software Engineers working in a private firm, Chennai.

Objectives

The main objective of the study was to assess the knowledge of Ergonomics Principles and Workplace Practice among the Software Engineers working in a private firm.

Methods

Study design and setting

This study was a cross-sectional study conducted in a private Information Technology firm in Chennai, Tamil Nadu.

Study population

The study was conducted among software engineers working in a private firm, Chennai.

Inclusion criteria

i.   Software engineers who have an experience of more than 2 years in the same company
ii. Software engineers with the age less than 40 years and both gender.

Exclusion criteria

i.   Software engineers who had a past history of spine surgery or diseases in Spine like disc prolapse, discitis, arthritisetc.
ii. Orthopedically physically challenged
iii. Pregnant women.

Sample size calculation

With the prevalence of 64.5%[8] and allowable error of 5%, the sample size was calculated as 366. To account for the non-response rate, 10% of the sample is added to arrive at the final sample of 403.

Sampling method

The sampling method used was Simple Random Sampling.

Study instrument

A standardised pre-tested semi structured questionnaire was used.

Section 1

This section includes the details of the participants like age, gender, years of experience and the duration of computer usage.

Section 2

This section includes the details of prevalence of musculoskeletal problem.

Section 3

This section had questions to analyse the awareness/knowledge of computer workstation ergonomics based on the guidelines given by Occupational Safety and Health Administration (OSHA).[9] This section tests the awareness of the participants about certain important ergonomic features like the features of the ergonomic chair, position of the head and neck, foot, arm rest, hips and knees. This section also had questions about the position of the key board, mouse, work space arrangement, height of the monitor.

Section 4

This section had questions about the practice of the ergonomics and the practice of stretching exercise in between. The participants were asked about the practice of each position.

Data collection

Software engineers who were selected, were explained about the study and its purpose. All participants, after obtaining informed consent, were interviewed with the semi structured questionnaire. Collected information was kept confidential.

Statistical analysis

Data collected was then entered in the Microsoft excel sheet (MS excel 2010). The normality of the data was checked. Data was coded and analysed in Statistical Package for the Social Sciences (SPSS) version 21.0 software (institutional licensed). Descriptive analysis for all the variables was expressed in frequency and proportions. Age was expressed in median. For bivariate and multivariate analysis, Chi square test was done. P value of less than 0.05 was considered significant.

Ethical consideration

Approval from Institutional ethical committee was obtained (IHEC No: 65/IHEC/9-16). Permission was also obtained from the private software firm in Chennai. All the selected participants were informed about the purpose, procedure and confidentiality of the study in the language they

understand. Written informed consent was obtained from the study participants. Confidentiality was maintained throughout the study.

Results

The median age of the study participants were 26 years with 61.5% males. 47.1% had work experience between less than 4 years and almost all the study participants (96%) had more than 5 hours of computer usage in a day [Table 1].

Among the 403 study participants, 85.6% had musculoskeletal problem in any area of focus [Table 2].

In knowledge section [Table 3], each correct answer was given 1, and wrong answer was given 0. Out of 12 knowledge questions, those who have score more than 75% was considered as adequate knowledge. Out of the 403 participants, only 9% had adequate ergonomic knowledge.

Among those who had musculoskeletal pain (345), only 8.1% had adequate knowledge and 91.9% had inadequate knowledge about the ergonomic principles of computer workstation.

Among those who have adequate knowledge, those who practice that always and most of the time was considered as having appropriate practice [Table 4].

It was found that the prevalence of musculoskeletal problem was higher among those who didn't follow the proper relevant ergonomic principle [Table 5].

Discussion

Occupation related health problem is increasing alarmingly in India. Software Engineers being a major workforce in India are subjected to tremendous amount of occupation related injury which can be easily averted. The present study was conducted in a private IT firm (Chennai, Tamil Nadu), among 403 software professionals. The present study showed a prevalence of 85.6% musculoskeletal problem in the previous one year. Slightly similar report has been obtained by the study done by Sharma AK *et al.*[10] and Talwar R *et al.*[11]

On assessing the knowledge about arm rest only 49.9% of the study participants were aware about them. In a study done by Khan R *et al.*,[12] the knowledge about the arm rest was present only for 24%. The higher prevalence could be attributed to the fact that in the study lead by Khan R *et al.*,[12] the study participants were computer users in the workplace and not specifically Software Engineers (homogenous group). In the present study more than 50% prevalence was present for the knowledge about ergonomic principles of keyboard, mouse, monitor height and stretching in between

the work. Similar report was shown in the study done by Khan R *et al.*[12] 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.

Among those who had adequate knowledge about the ergonomics, not everyone practiced that correctly in the present study. For instance, the present study showed that out of those who had adequate knowledge about arm

Table 1: Profile of Study Participants (*n*=403)		
Profile	Frequency	Percentage
Age		
23-26	207	51.4
27-30	148	36.7
31-34	31	7.7
35-38	11	2.7
>39	6	1.5
Gender		
Male	248	61.5
Female	155	38.5
Experience (Years)		
2-4	190	47.1
5-7	147	36.5
8-10	48	11.9
11-13	9	2.2
>14	9	2.2
Total Duration of Computer Usage in a day (Hours)		
3-5	16	4
5-7	67	16.6
7-9	194	48.1
>9	126	31.3
Total duration of Continuous Computer Usage without Break in a typical day (Hours)		
<1	77	19.1
1-3	231	57.3
3-5	68	16.9
5-7	19	4.7
>7	8	2

Table 2: Distribution of study participants according to the prevalence of any musculoskeletal problems in the past 1 year (*n*=403)		
Variable	Frequency	Percentage
Musculoskeletal problems in the last 1 year		
Yes	345	85.6
No	58	14.4
Prevalence of Musculoskeletal problems in*		
Neck	226	56.1
Lower back	217	53.8
Wrists/Hands	199	49.4
Shoulders	170	42.2
Ankles/Feet	163	40.4
Hips/Thighs	162	40.2
Upper Back	136	33.7
Knees	89	22.1
Elbow	64	15.9

Table 3: Distribution of study participants according to the knowledge about Ergonomic Principles (*n*=403)

Knowledge about Ergonomic principles	Correct (%)	Incorrect (%)
Height adjustment of Ergonomic chair	60 (14.9)	343 (85.1)
Position of Head and neck with respect to torso	196 (48.6)	207 (51.4)
Position of Foot with respect to floor	199 (49.4)	204 (50.6)
Position of Knee and Hip while sitting in a chair	68 (16.9)	335 (83.1)
Gap between front edge of chair and back of knee while sitting	92 (22.8)	311 (77.2)
Position of Arm rest with respect to shoulders	201 (49.9)	202 (50.1)
Position of Keyboard in relation to elbow height	253 (62.8)	150 (37.2)
Position of Wrist while using keyboard	178 (44.2)	225 (55.8)
Position of Mouse in relation to the keyboard	225 (55.8)	178 (44.2)
Other activity performed on the dominant side in the workstation	122 (30.3)	281 (69.7)
Level of monitor with respect to eye	233 (57.8)	170 (42.2)
Stretching Exercises in between computer usage	273 (67.7)	130 (32.3)

Table 4: Distribution of study participants according to appropriate practice of Ergonomic principles

Adequate knowledge about the Ergonomic principles	Appropriate Practice of Ergonomic principles		*P*
	Yes (%)	No (%)	
Arm rest (*n*=201)	107 (53.2)	94 (46.8)	0.000
Position of Wrist (*n*=178)	74 (41.6)	104 (58.4)	0.439
Height adjustment of chair (*n*=60)	24 (40)	36 (60)	0.042
Position of foot (*n*=199)	101 (50.8)	98 (49.2)	0.054
Position of mouse (*n*=225)	108 (48)	117 (52)	0.015
Position of hip (*n*=68)	25 (36.8)	43 (63.2)	0.587
Stretching (*n*=273)	214 (78.4)	59 (21.6)	0.000

Chi square test applied, *P*<0.05 was considered significant

rest (201), only 107 practiced that correctly and amongst the 60 who had adequate knowledge about the height adjustment of the chair, only 24 had correct practice. This corresponds with the Khan R *et al.*[12] study which stated that the practice of arm rest or chair height adjustment was not substantial when compared with the knowledge. The present study showed that among those who had inappropriate practice of foot position, 23.5% and 17.4% developed the musculoskeletal symptoms in foot and ankle respectively. In a study steered by Kausalya R *et al.*,[8] it was found that among those 82, who had inappropriate position of legs, 54 (65.9%) developed the symptoms, Similar finding was also found in another study lead by Suparna K *et al.*,[13] which showed a prevalence of 69.8% among those who did not have an appropriate practice. A study done by Sasikumar V[14] and Kashif M *et al.*[15] confirms the present study finding stating that postural factor among the software engineers is significantly correlated with the prevalence of musculoskeletal problem.

To summarize, the study revealed higher prevalence of musculoskeletal problem, lower prevalence of knowledge about Ergonomic principles and much lower prevalence of appropriate practice of Ergonomic principles. On observing the association between the appropriate practice and the musculoskeletal problem, the study revealed that the musculoskeletal problem was higher among those who had inappropriate Ergonomic practices.

Conclusion and Limitations

The musculoskeletal problems can decrease the efficiency of the software engineers, thereby decreasing productivity. The employees should be motivated to practice the attained knowledge of Ergonomic principles. Constant monitoring and evaluation of the employees' health is very crucial to alleviate these problems at the root level. The main limitation is the evaluation of practice of ergonomics by the questionnaire. Evaluation of the Practice of Ergonomics principles, if done by observation, could yield a better picture of their practices than by asking through the questionnaire.

Recommendation

Ironically the root cause for such work- related musculoskeletal problem can be easily averted through simple primary care such as ergonomic education and training at the start of the career. The higher prevalence of the musculoskeletal symptoms makes it imperative for the organisation to impart knowledge about Ergonomics. Continued learning is the key to bring about a change in the affective domain. To impart the knowledge, the concerned organisations/Employers should have a regular training session for the employees. The employees should be educated about the coping strategies for preventing these type of health hazards.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Table 5: Distribution of musculoskeletal problems in the specific area according to practice of respective Ergonomic principles		
Practice of Ergonomic principles	Musculoskeletal problem in the past 12 months in	*P*
	Neck	
	Yes (%) / No (%)	
Chair principles (*n*=60)		0.023
Appropriate	7 (29.2) 17 (70.8)	
Inappropriate	20 (55.6) 16 (44.4)	
	Lower Back	
	Yes (%) / No (%)	
Chair principles (*n*=60)		0.418
Appropriate	10 (41.7) 14 (58.3)	
Inappropriate	21 (58.3) 15 (41.7)	
	Shoulders	
	Yes (%) / No (%)	
Arm rest principles (*n*=201)		0.000
Appropriate	31 (29) 76 (71)	
Inappropriate	54 (57.4) 40 (42.6)	
	Elbow	
	Yes (%) / No (%)	
Arm rest principles (*n*=201)		0.008
Appropriate	9 (8.4) 98 (91.6)	
Inappropriate	12 (12.8) 82 (87.2)	
	Wrist	
	Yes (%) / No (%)	
Wrist principles (*n*=178)		0.297
Appropriate	17 (23) 57 (77)	
Inappropriate	23 (22) 81 (77.9)	
	Hands	
	Yes (%) / No (%)	
Wrist principles (*n*=178)		0.045
Appropriate	11 (14.9) 63 (85.1)	
Inappropriate	20 (19.2) 84 (80.8)	
	Hip	
	Yes (%) / No (%)	
Hip principles (*n*=68)		0.120
Appropriate	12 (48) 13 (52)	
Inappropriate	14 (32.6) 29 (67.4)	
	Knee	
	Yes (%) / No (%)	
Hip principles (*n*=68)		0.252
Appropriate	3 (12) 22 (88)	
Inappropriate	7 (16.3) 36 (83.7)	
	Ankle	
	Yes (%) / No (%)	
Foot principles (*n*=199)		0.017
Appropriate	8 (7.9) 93 (92.1)	
Inappropriate	19 (17.4) 79 (80.6)	
	Foot	
	Yes (%) / No (%)	
Foot principles (*n*=199)		
Appropriate	18 (17.8) 83 (82.2)	0.284
Inappropriate	23 (23.5) 75 (76.5)	

Chi square test applied, *P*<0.05 was considered significant

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