

Effects of Ergonomic Features and Anxiety on the Productivity of Office Workers

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Abstract

Background: Productivity plays a fundamental role in the global economy. Human resources are the most important factor, causing an increase or decrease in the productivity of an organization. Ergonomics is the scientific theory that studies the relationship between individuals and other elements of a system and the profession applies theories, principles, evidence, and methods to design to optimize human well-being and productivity of the organization. This study aims to investigate the effects of ergonomic features and anxiety on the productivity of office workers.

Methods: In this descriptive-analytical cross-sectional study, 176 office workers (133 female and 43 male) of a university with three years of work experience were randomly selected. Data collection tools included demographic surveys, an inspection checklist, Rapid Upper Limb Assessment (RULA) checklist, the productivity measurement questionnaire, and Beck anxiety inventory.

Results: The study results showed that 70% of workstations need to be changed through ergonomic interventions and changes. According to the results obtained from the linear regression model between productivity and working posture, anxiety, and work environmental factors, there is a positive relationship between working environment conditions and productivity ($P=0.002$).

Conclusion: The main contribution of this research is that productivity should receive attention through changing working environment. The chairs are a vital element of an ergonomic and productive work office.

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Introduction

Productivity

Productivity is a comprehensive concept that has always been considered by politicians, economists, and government officials who have made significant investments in this regard due to its necessity for improving quality of life, welfare, and comfort.¹ Productivity refers to the optimal use of various resources to produce goods and life in all aspects.^{2,3} In this definition, human resource is the most important factor responsible for increasing or decreasing the

productivity of an organization.³ Therefore, many researchers have explained the factors affecting human resource productivity, such as environmental factors (workstations, noise, lighting, and temperature), physical factors (posture), and psychosocial factors (motivation, anxiety, job satisfaction) that among other factors play fundamental roles in employee productivity.⁴⁻⁷

In the present day, with the advancement of technology, computer use has increased and exposure to various kinds of harmful factors has become an important health concern.⁸ Office worker health-related

productivity loss is represented by a combination of both individual and work-related factors.⁹ In addition, they spend long hours at the workplace and have a high prevalence of musculoskeletal disorders compared to many other occupations.^{10, 11} Therefore, an ergonomic workplace is very important to increase productivity.⁹ More details are provided below because of the importance of productivity, employee health, and the factors affecting it.

Productivity and Environmental Ergonomics

Environmental ergonomics is concerned with how people interact with the environment from the perspective of ergonomics.¹² The quality of the work environment in which employees have constant interactions can determine the employees' level of motivation, subsequent performance, and productivity.¹³ Studies have shown that the work environment is the primary determinant of employee performance.¹⁴ Poor work environment conditions affect employees' health and safety, error rates, innovation, cooperation, absenteeism, and productivity.¹⁵ Researchers claim that 86% of productivity problems are related to the physical conditions of the workplace.¹⁶ The investigation of office environmental conditions in any workspace, such as indoor air quality, noise, lighting, and temperature indicate that environmental factors affect employees' attitude, behavior, satisfaction, performance, and productivity by reducing their comfort.¹⁷⁻¹⁹ However, few studies consider the ergonomics of the office environment with productivity.

Productivity and Physical Ergonomics

Physical ergonomics is concerned with human anatomy and some of the anthropometric, physiological, and biomechanical characteristics related to physical activity.²⁰ One of the important issues in this branch of ergonomics is to choose the right equipment and modify the workstation to reduce musculoskeletal disorders.^{21, 22} Musculoskeletal disorders are considered one of the most expensive health conditions that can reduce employee efficiency and productivity.²³ Studies have shown that poor ergonomic conditions and workstations can increase musculoskeletal disorders, fatigue, and decreased productivity.^{22, 24, 25} Recently, office equipment and computer workstations have been selected by Ergonomic Equipment Guidelines. Improving computer workstations, such as the ability to switch between standing and sitting postures, and using adjustable tables and equipment at the workstation, can improve the physical and cognitive performance of human resources, increasing their productivity.^{7, 26} Therefore, it is essential to evaluate the working posture and workstations to increase productivity.⁵

Productivity and Anxiety

Common mental disorders are increasing in the world. According to the World Health Organization, depression and anxiety are predicted to be the most common illnesses, especially among women, toward the end of the 21st century. Trends show that the number of people suffering from depression or anxiety has increased by 50% (over 600 million) between 1990 and 2013.²⁷ Depression and Anxiety Disorders harm the global economy (\$ 1 trillion each year); moreover treating these disorders is costly, about \$ 6,475 for everyone.^{27, 28} As an ongoing mental state (apprehension or dread, irritability, rumination), anxiety can be accompanied by physiological changes such as shortness of breath, sweating and insomnia, high blood pressure, and musculoskeletal disorders.²⁹ It can hinder one's ability to function normally and may reduce performance and productivity over time.^{30, 31} Work environment and working conditions with adverse effects on one's physical and mental health can cause anxiety, ultimately reducing job performance in individuals and organizations.^{32, 33} Anxiety can also increase musculoskeletal disorders, reducing performance and productivity.³⁴ Anxiety has also been associated with decreased work productivity, functional disability, and sickness absence.³⁵ Therefore, it seems that anxiety should be further investigated due to its importance and close relationship with the physical condition of the workplace.

Today, this concept is confirmed by researchers, sociologists, and economists. They believe that a holistic view is necessary to improve quality in any field, and productivity is not an exception. Many studies have been conducted on employees' productivity; however, internal factors such as anxiety and external factors such as environmental and physical conditions of the workplace have not yet been studied simultaneously. Since universities play a major role in each country's productivity, the present study aimed to investigate the effects of physical ergonomics, environmental ergonomics, and anxiety on the productivity of office workers in the university.

Methods

In this cross-sectional study, the study population included office workers of a university. A total number of 176 employees were randomly selected via the convenience sampling method (Table 1), taking into account the inclusion criterion (at least three years of work experience) and exclusion criteria (absence of musculoskeletal and neurological diseases and rheumatoid arthritis). After ensuring the study participants about the confidentiality of their information, they signed a written consent form. For data collection, the evaluator and participants completed the questionnaires. The questionnaires used in this study are as follows:

Table 1: Demographic characteristics and their association with productivity (n=176)

Variable	Statistics	Association with Productivity	
		Type of test	P value
Age (year)	Mean (standard deviation)	38.3 (7.4)	Pearson correlation coefficient 0.17
Weight (kg)	Mean (standard deviation)	68.9 (14.5)	Pearson correlation coefficient 0.15
Height (cm)	Mean (standard deviation)	165.5 (8.5)	Pearson correlation coefficient 0.45
Work experience (year)	Mean (standard deviation)	11.2 (7.1)	Pearson correlation coefficient 0.94
Hours spent per day working at computers	Mean (standard deviation)	2.7 (0.5)	Pearson correlation coefficient 0.59
Hours spent per week exercising	Mean (standard deviation)	2.5 (3.1)	Pearson correlation coefficient 0.49
Gender	Male Female Married	43 (24.5%) 133 (75.5%) 127 (72.2%)	Independent sample T-test 0.34
Marital status	Single High school degree Bachelor's degree Masters' degree Doctorate	49 (27.8%) 20 (11.4%) 87 (49.9%) 65 (36.9%) 4 (2.3%)	Independent sample T-test 0.68
Level of Education			One-way analysis of variance 0.82

Demographic/Occupational Questionnaire

The data on age, sex, height, weight, marital status, work experience in the current job, education, and working hours per day were collected using the demographic survey.

Office Inspection Checklist

The validity and reliability of the checklist have been confirmed by Choobineh et al. This checklist was used to collect the data on work environment conditions, workstations, and working posture. This study did not apply the working posture section since Rapid Upper Limb Assessment (RULA) was used. The work environment assessment section consisted of 11 questions (light, noise, Atmospheric conditions) and the workstation section consisted of 30 questions (office desks: 9 questions, chairs: 10 questions, and computers: 11 questions). This checklist was prepared according to available standard checklists and office environment conditions. All items were answered Yes / No or N/A (N/A was checked if the item was not applicable). The items that received yes were given a score of one, and the items that received No were given a score of zero. The items answered N/A were ignored.³⁶

RULA Evaluation Method for Evaluating Working Posture

One of the methods for assessing the risk of upper limb musculoskeletal disorders in office workers is RULA.³⁷ The risk factors evaluated by this method include the number of movements, static muscular work, and muscle force. With this observational method, each worker is monitored for 20 minutes, and physical conditions in different body organs are observed. Then the worst or most frequent physical postures are evaluated and scored using the relevant tables.³⁷ The postures are evaluated in upper limbs (group A) and neck, trunk, and legs (group B). Each

group has partial scores ranging from 0 to 6 points. Then, the muscle use and load are scored for each group (A and B), which are added to the partial scores. Finally, a total score from groups A and B is obtained, and their values crossed in Table C (Appendix 1) to obtain the final score (from 1 to 7 points). RULA generates an action list, which determines the level of intervention required to reduce the risk of workplace injuries.³⁷ The level of exposure and investigation priorities are classified as acceptable posture if not maintained or repeated for long periods (1 or 2 points); more investigations and changes may be required (3 or 4 points); investigation and changes are required soon (5 or 6 points); investigation and changes are required immediately (7 points).³⁸

Beck Anxiety Inventory

Beck Anxiety Inventory is one of the best tools for measuring the severity of anxiety via self-report. It is a 21-item scale in which the subject chooses one of four options in each item, indicating the severity of anxiety. Four options for each question are graded from 0 to 3. Each test item describes one of the most common symptoms of anxiety (cognitive and somatic symptoms). Therefore, the total score of this questionnaire is in the range of 0 to 63, minimal anxiety (0–7), mild anxiety (8–15), moderate anxiety (16–25), and severe anxiety (26–63). The researchers examined the validity and reliability of the questionnaire.³⁹ Fallahi et al. (2015) reported internal consistency (Cronbach's alpha=0.88) for the Beck Anxiety questionnaire in the Iranian population.⁴⁰

Hersey and Goldsmith Productivity Questionnaire

This 5-point Likert scale questionnaire consists of 26 questions and seven dimensions, including ability, identification, organizational support, motivation, feedback, credit, and compatibility. To obtain the score of each subscale, the scores of each of the questions

related to that subscale were added together, and all the scores of the items were added together to calculate the total score of the questionnaire. The scores of this questionnaire ranged from 26 to 130. The higher the score obtained on this questionnaire, the higher employees' productivity.⁴¹ The reliability and validity of this questionnaire were assessed by Nasirpour et al., in which the Cronbach alpha coefficient was 0.81.⁴²

Before applying statistical tests, the normality of distribution of scores was assessed by Kolmogorov-Smirnov test and homogeneity of variances was explored through Levene's test. Descriptive statistics (frequency and percentage tables) were used for qualitative variables. Central tendency indices such as mean and dispersion indices, such as standard deviation were used for quantitative variables. Inferential statistics, including independent t-test, the correlation coefficient, multiple linear regression (Backward Stepwise technique), and analysis of variance, were used for data analysis using SPSS Software Version 22.

Results

Demographic Characteristics and Productivity

Table 1 shows descriptive and analytical findings related to demographic variables and their association with productivity. No significant association was found between demographic characteristics and productivity.

Assessment of Working Postures Using the RULA Method

Table 2 presents the results of working posture evaluation using the RULA method. Results indicated that 70% of the workstations required the 2nd action level. This level indicates that further investigation is needed, and changes may be required (McAtamney and Corlett, 1993). In examining the upper limb (A section), the highest score was related to the upper arm position. In section B, the highest score was related to the trunk. In other words, the posture of the trunk was worse than that of the head and legs. In two sections A and B, the muscle score was 1 due to static work.

The Association between Productivity, Working Posture, Anxiety, and work Environmental Factors (Table 3)

The Association between Productivity and Work Environmental Factors

It should be noted that the workstation equipment (desk, chair, and computer), lighting, noise, and atmospheric conditions are examined based on the office inspection checklist in the environmental factor. Table 4 shows the association between productivity and work environmental factors using the Spearman test. The results show that there was only a significant association between productivity and chairs among the work environmental factors. In-office inspection checklist, chair-related factors such as seat height, seat width, backrest, backrest angle, seat angle, seat

Table 2: Determining the level of required interventions and their frequency via The Rapid Upper Limb Assessment (RULA) method (n=176)

Action level	Required interventions	Frequency	Percentage
1	Acceptable	0	0
2	Further studies and the need for ergonomic interventions	123	70%
3	Further studies and the need for intervention in the near future	44	25%
4	Further studies and the need for immediate intervention	9	5%

Table 3: Association between productivity, working posture, anxiety, and work environment factors (n=176)

Variable	Productivity		
	Type of test	Pearson correlation coefficient	P value
Anxiety	Pearson	-0.11	0.12
Work environment	Pearson	0.23	0.002*
Posture	Spearman	0.11	0.14

* Statistically significant

Table 4: The association between productivity and work environmental factors (n=176)

Variables	Productivity	
	Pearson correlation coefficient	P value
Lighting	-0.02	0.75
Climate	-0.02	0.78
Noise	-0.03	0.68
Desks	0.11	0.14
Chairs	0.17	0.02*
Computers	0.12	0.90

* Statistically significant

surface, and wheel of the chair were studied. Among the factors studied, the worst condition was related to backrest and seat angle.

The Association between Productivity Components and Anxiety

The population's assessment of anxiety revealed that 54% had experienced no anxiety (level 1), 25% had experienced mild anxiety, 13% moderate anxiety, and 8% severe anxiety. As shown in Table 5, there was a significant association between anxiety and ability, occupational identification, and credit among the productivity components.

Linear Regression Equation

Using a multivariate linear regression test, the authors investigated the relationship between productivity and anxiety, posture, work environment conditions, and demographic characteristics. Based on Table 6 and the equation obtained from the regression test, the productivity score was affected by RULA scores and work environmental factors. For a one-point increase in work environmental factors, the productivity score increased by 1.3. Also, for a one-point increase in the RULA score, the productivity score increased by 3.4. Also, the analysis of variance showed the statistical validity of the whole model ($P=0.002$). The value of the Adjusted R square was equal to 0.059; in other words, this model can predict efficiency changes by 6%.

$$(RULA \times 3.4) + (\text{work environment score} \times 1.3) + 38.9 = \text{productivity}$$

Discussion

This study aimed to investigate the effects of work environment, working posture, and anxiety on the productivity of office workers in a university. Among the factors studied, only a significant association was

found between workplace conditions and productivity ($P=0.002$).

In this study, a questionnaire was used to examine productivity. Studies have shown that researchers use different methods to assess the productivity of office workers, including the extent of work attendance and absenteeism, sick leave, cognitive function tests, physiological methods, and self-assessment forms.^{5,6,43} Although studies have revealed that there is no definite and accepted method for measuring productivity in the office context, it seems that the self-assessment method as a people-centered attitude is one of the most appropriate methods possible in such environments.⁴⁴

The Association between Environmental Ergonomics Factors and Productivity

The workplace conditions in this study refer to lighting, temperature, noise, desks, chairs, and computers investigated using a checklist.¹⁹ The study conducted by Baleshzar et al. (2019) showed a significant association between employee productivity and work environmental factors, including chairs, noise, temperature, lighting, and workplace arrangements. In other words, environmental conditions can affect employees' satisfaction, increasing productivity.⁴⁵ Zakerian et al. (2016) studied the effect of workplace design on the productivity of bank employees. The work environmental factors, including chairs, noise, lighting, temperature, and equipment arrangement were investigated. Among these factors, only the equipment arrangement in the work environment was significantly associated with productivity.⁶ However, in the present study, an association was found between chairs and productivity. Different conditions of office environments may justify this difference. Hence, it can be concluded that environmental conditions such as noise and lighting are favorable in this university, and most of the problems are related to chairs. Given that employees sit an average of 6 hours a day on a chair

Table 5: The association between anxiety and productivity components (n=176)

Productivity components	Anxiety	
	Pearson correlation coefficient	P value
Ability	-0.17	0.01*
Occupational identification	-0.14	0.05
Organization support	-0.13	0.07
Motivation	-0.10	0.16
Performance feedback	-0.10	0.17
Credit	-0.19	0.01*
Environment compatibility	0.07	0.30

* Statistically significant

Table 6: Linear regression model based on the relationships between productivity, work environment conditions, and working posture (n=176)

Variables	Constant		RULA		Workplace conditions		Adjusted R square
	β (sd)	P value	β (sd)	P value	β (sd)	P value	
Productivity	38.9 (12)	0.001	3.4 (1.7)	0.04	1.3 (0.38)	0.001	0.05

in office environments and there is a direct association between chairs and their comfort and health, this study and another similar study showed that ergonomic chairs could boost employee productivity.⁴⁶

The Association between Working Posture and Productivity

RULA method was used to evaluate working posture in this study. With a particular focus on upper limbs, this method is used in many studies to investigate office work.⁴⁷ Consistent with other studies, in this study, 70% of the employee workstations required the 2nd level priority corrective interventions, which require further studies and ergonomic interventions. The studies aimed at investigating the work environment of computer users using the RULA method have shown a high prevalence of musculoskeletal disorders, especially in the waist and neck among employees. Also, employee working postures have mainly been levels 2 and 3 of corrective interventions, which is consistent with the finding of current study.^{31, 48} Studies show that improving working posture through an ergonomic approach increases workers' productivity.^{5, 22}

The Association between Anxiety and Productivity

Few studies have so far been conducted on the association between anxiety and productivity. Most of the studies have examined the association between stress and productivity.⁴⁹ Although no significant association was found between anxiety and productivity in this study, a negative correlation was observed between these two factors; that is, productivity is reduced with increased anxiety. Similar studies have shown that with an increase in anxiety, the quality of life (mental and physical health) decreases, leading to reduced productivity.⁵⁰

The Relationships between Work Environment, Working Posture, and Anxiety

Undesirable postures can lead to musculoskeletal disorders and these disorders are directly associated with increased anxiety. In addition, the findings of Ghanbari et al. (2016) showed a significant and direct relationship between musculoskeletal disorders, anxiety, and depression. Thus, it is necessary to improve the workplace to reduce anxiety and depression in the workplace. Therefore, a better understanding of the relationship between musculoskeletal disorders and depression and anxiety can help design a proper work environment to prevent musculoskeletal disorders in the workplace.

Limitations and Suggestions

This study has some limitations. The results of this study are derived from the administrative system of the university and its various faculties. In addition,

another limitation of the present study was collecting the data using questionnaires, as some people might have refused to answer accurately.

To provide a comprehensive model of the relationship between ergonomics and productivity, other than physical and environmental ergonomics, Cognitive and organizational ergonomics should also be considered. It is also suggested to implement this model in manufacturing organizations.

Conclusion

The main contribution of this research is the estimation of productivity through various dimensions of ergonomics. The results of this study can provide solutions to boost productivity in the organization by improving the work environment.

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