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The Relation Between Workplace Ergonomics and Body Composition with Productivity and Job Involvement of Employees in Kermanshah Oil Refining Company

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Abstract

Background: Inadequate ergonomics can affect factors such as productivity and job involvement that play an important role in the sustainable development of organizations. To this end, the present study investigated the effect of workplace ergonomics and body composition on productivity and job involvement of employees in Kermanshah Oil Refinery.

Methods: The participants in this descriptive cross-sectional study were 160 persons who were selected using convenience sampling from refinery employees. The data were collected using the In-Body: Body Composition Analyzer, the Rapid Office Strain Assessment (ROSA), Rapid Upper Limb Assessment (RULA), Employee Productivity Scale (Achieve), and Job Involvement Scale. The data were analyzed using simple and multivariate linear regression analysis with SPSS 25 software at the significance level of 0.05 (P = 0.05).

Results: The findings of the present study showed that the decreased level of workplace ergonomics has a negative and significant effect on productivity (p = 0.0001) and job involvement (p = 0.0001) of employees in Kermanshah Oil Refinery. Furthermore, employees' body mass index (BMI) had a negative and significant effect on productivity (p = 0.031) and the waist-to-hip ratio (WHR) had a negative and significant impact on employees' job involvement (p = 0.039).

Conclusion: Inadequate workplace ergonomics, high body mass index, and a high waist-to-hip ratio (WHR) can negatively affect the productivity and job involvement of oil refinery employees. Therefore, in addition to evaluating workplace ergonomics, managers are suggested to adopt strategies to provide proper ergonomics and promote employees' health by holding training courses on healthy nutrition.

Keywords: Ergonomics, Body composition, Productivity, Job involvement, Musculoskeletal disorders

Background

Musculoskeletal disorders (MSDs) are among the most common occupational and work-related injuries, to the extent that the World Health Organization (WHO) and the International Labor Organization have come up with a common approach for combating these diseases and injuries (1). According to released statistics, work-related musculoskeletal disorders (WMSDs) are currently the most common occupational diseases and the main cause of absenteeism (2). Many of these MSDs have been attributed to poor ergonomics and adopting unsuitable postures over a long period. According to documents from the Statistical Center of Iran and the Ministry of Health, 79% of employees in various occupations had poor ergonomic conditions (3).

Ergonomics is a science that tries to design tools, devices, work environments, and jobs to fit human physical and intellectual abilities and interests. This science has been developed to increase the health, safety, and well-being of human resources (4), prevent absenteeism and fatigue at work, and promote national productivity and economic growth (5). Due to ergonomic exposures, when the equipment and tools are not designed according to ergonomic principles and are not suitable for the user, they create a fixed long-term inappropriate physical position, leading to MSDs in occupations (6). On the other hand, industrial managers are looking for top global strategies for sustainable development and improving the productivity of their organization. To this end, they have turned to state-of-the-art knowledge. Currently, many researchers in the field of development have highlighted the importance of human resources in increasing the productivity and efficiency of organizations and have introduced the high quality and health of human resources as one of the most important factors in improving the productivity of organizations (7). In fact, an organization can only attain continued profitability if it does not ignore the issue of productivity and uses effective strategies such as healthy and motivated employees to achieve it (8). Therefore, the study of factors affecting the promotion of human resource productivity is of considerable importance (9).

According to previous studies, MSDs caused by improper ergonomics can lead to an imbalance between job requirements and a person's abilities (3). As a result, MSDs lead to psychological distress followed by emotional problems, anxiety, sleep disorders, and headaches, which result in behaviors such as lack of job involvement, absenteeism (10), and ultimately reduced productivity (11). Job involvement is a determining factor in organizational effectiveness and individual motivation and it is considered as an effective variable in job performance and turnover. In fact, the job-dependent employee has a significant effect on many important organizational outputs (5). For example, Kinicki et al. suggested that attitudinal variables such as job involvement have important effects on job outputs (12). However, whether inadequate ergonomics can affect important factors such as productivity and job involvement that play a vital role in the sustainable development of organizations has not yet been studied and needs to be investigated. Thus, understanding the impact of workplace ergonomics on employee productivity and job involvement is of considerable importance. Another factor that can indirectly affect employee productivity and job involvement is body composition (13-15). According to LeMura et al. and Gharakhanlou et al., increased body fat percentage is associated with many diseases such as hypertension, high cholesterol, and musculoskeletal pain (16, 17). Consequently, increasing body fat percentage and obesity can indirectly cause psychological distress in employees and accordingly reduce their job involvement and productivity.

Given the importance of human resources and their role in improving organizational productivity and efficiency, identifying risk factors for employee productivity and job involvement is of considerable importance. On the other hand, the prevalence of MSDs in employees in recent years caused by non-compliance with ergonomic principles can endanger employees' physical health. To this end, the present study aimed to investigate the relationship between workplace ergonomic factors and body composition with productivity and job involvement of employees in Kermanshah Oil Refinery.

Methods

The population in the present cross-sectional

study consisted of all employees of Kermanshah Oil Refinery (n=300), of whom 160 employees were selected using convenience sampling as the participants in the research sample. First, the members of the research team attended the refinery industrial medicine site for two months during the annual evaluations of the refinery staff conducted from August to November 2019. Then, the researchers had the general information forms, consent forms, and questionnaires completed by the participants. Finally, the collected data on the research variables were evaluated by two corrective movement experts. The protocol for the present study was confirmed under the code IR.RAZI.REC.1398.006 by the Ethics Committee of Razi University.

Workplace agronomics was assessed using the Rapid Office Strain Assessment (ROSA) and the Rapid Upper Limb Assessment (RULA). The Rapid Office Strain Assessment (ROSA) is a new method for assessing ergonomic risk factors among office workers and those who work with computers and is administered as a 10-point scale (18). This scale evaluates the body posture, office equipment, and the relation between the final score and the degree of physical discomfort, and determines the required level of corrective action. This method quickly determines the risks of musculoskeletal injuries associated with office tasks and computer work in different workstations with seats, monitors, telephones, mice, and keyboards, and measures the level of risks in these sections. Each of the risk factors identified in each station was scored from 1 to 3. The posture retention time score was also added to the score estimated in the previous stage. Finally, the score for each station entered the corresponding matrix and the final score of 0 to 10 was obtained from the output matrix. If the final score was more than 5, the task was assessed as a high-risk task that needed immediate correction. A higher score indicated a higher level of risk associated with a particular task (19).

The Rapid Upper Limb Assessment (RULA) method is an observational assessment technique that was developed in 1993 by McAtamney and Corlett, two professors from the University of Nottingham, UK. After observing the person during the work shift and selecting the dominant physical position (physical-behavioral position of the person while working), the final RULA score is determined based on four factors: number of movements, static muscle work, the applied force, and postures during work. First, the scores for group A (hand, wrist, forearm, and arm) and group B (neck, trunk, and legs) are determined. Then, using the relevant tables, these two scores are combined and the final score ranging from 0 to 10 is determined. This final score is divided into four levels of measures, with scores 1 and 2 indicating acceptable working position, scores 3 and 4 indicating the potential MSD risks and the need for further investigation, scores 5 and 6 indicating the potential MSD risk needing to be further investigated and corrective changes in the working position may be required shortly. Furthermore, a score of 7 indicates a high MSD risk and thus the person's working position should be corrected immediately (5). ROSA was used to assess office workers' ergonomic risk factors and RULA was used for determining MSD risks among operational staff. To this end, a specialist in workplace ergonomic standards attended the participants' workplace and filled in a special evaluation form according to the working and environmental conditions (20).

In-Body, Body Composition Analyzer was used to evaluate the participants' body composition. To this end, the participants were asked to lay on the device without shoes, socks, and any metal objects. After entering their general information, they were asked to hold the two handles of the device vertically at a 30-degree angle from the body. After about 30 seconds, the device provided information on the person's body composition, including body weight, ideal weight, BMI, waist-to-hip ratio (WHR), body fat percentage, muscle mass, and body water. The data extracted from the device software were used for additional analysis (ICC $\geq$ 0.88) (21).

The Productivity Scale (Achieve) was used to measure employee productivity. This 3 2-item tool measures productivity using a five-point Likert scale (1=very low to 5=very high), with the total score ranging from 32 to 160. The reliability of the scale was reported to be 0.89 (22). Moreover, the Job Involvement Scale (Kanungo Scale) was used to assess the participants' job involvement. This 19-item instrument assesses the respondents' job

involvement using a five-point Likert scale (1=strongly disagree to 5=strongly agree), with the total score ranging from 10 to 50. The Cronbach's alpha was reported to be 0.82 for this scale (23).

The collected data were analyzed using descriptive and inferential statistics. The data were summarized using descriptive statistics including measures of central tendency and dispersion (mean, frequency and percentage). Workplace ergonomics and body composition (BMI and WHR) were considered as the independent variables and productivity and job involvement were taken as the dependent variables. To assess the effect of the independent variables on the dependent variables, simple and multivariate linear regression analysis was performed. All statistical analyses in this study were performed using SPSS 25 software at an error level of 0.05.

Results

The Kolmogorov-Smirnov test was run to check the normality of data distribution. The results indicated that the data for all research variables including age (p=0.06), height (p=0.41), weight (p=0.073), BMI (p=0.92), productivity (p=0.045), job involvement (p=0.78), the waist-to-hip ratio (WHR) (p=0.56), and workplace ergonomics (p=0.069) were normally distributed. Tables 1 and 2 show the descriptive statistics for the research variables.

Table 1. The descriptive statistics for BMI and waist-to-hip ratio (WHR)

Variable	Gender	Status	Mean	SD
BMI	Male	Total	27.01	3.392
		Office workers	26.54	3.205
		Operational staff	27.15	3.448
	Female	Total	27.19	3.475
		Office workers	27.19	3.475
		Operational staff	-	-
WHR	Male	Total	0.915	0.054
		Office workers	0.923	0.048
		Operational staff	0.912	0.055
	Female	Total	0.838	0.046
		Office workers	0.838	0.046
		Operational staff	-	-

Table 2. The descriptive statistics for workplace ergonomics, productivity, and job involvement

Variables	Status	Mean	SD
Ergonomics (0-10)	Total	5.25	1.859
	Office workers	5.60	2.03
	Operational staff	5.08	5.08
Productivity (32-160)	Total	118.23	17.166
	Office workers	114.37	16.282
	Operational staff	120.04	17.342
Job involvement (10-50)	Total	33.00	7.119
	Office workers	31.37	8.049
	Operational staff	33.77	6.539

The data in Table 2 indicate that the mean score of workplace ergonomics for all participants was 5.25 out of 10, suggesting that workplace ergonomics could lead to a high level of risk. However, the higher scores of the office workers showed the ergonomic factors were more unfavorable for this group of workers compared to operational staff. The productivity scores of the operational staff confirmed their higher productivity level. Furthermore, office workers had a moderate level of job involvement, while the operational staff reported a high level of job involvement.

Table 3 shows the results of simple linear regression analysis predicting productivity and job involvement in employees of Kermanshah Oil Refinery based on workplace ergonomics. As it can be seen, about 54.2% of the variations in employee productivity can be explained by workplace ergonomics. Given that an increase in the workplace ergonomic score indicates an increase in risk in the workplace, the results indicated that for increasing one unit in workplace ergonomics, employee productivity decreases by 6.804 units. Furthermore, about 72% of the variations in employee job involvement

can be explained by workplace ergonomics. The data indicated that for every one-unit increase in workplace ergonomics, employee job involvement decreases by 3.263 units.

Table 3. The effect of workplace ergonomics on productivity and job involvement

Regression model	R	R^2	F	Sig.	B	Std. error	Beta	t	Sig.
Productivity model	0.736	0.542	181.944	0.001*					
Constant					154.168	2.811	-	54.837	0.001*
Ergonomics					-6.804	0.504	-0.736	13.489	0.001*
BMI					-0.902	0.414	-0.192	-2.180	0.031*
WHR					-6.207	25.944	-0.021	-0.239	0.11
Job involvement model	0.848	0.720	395.046	0.001*					
Constant					50.021	0.915	-	54.676	0.001*
Ergonomics					-3.263	0.164	-0.0848	-19.876	0.001*
BMI					-0.047	0.172	-0.024	-0.272	0.786
WHR					-22.466	10.774	-0.184	-2.085	0.039

As can be seen, for a one-unit increase in BMI, employee productivity decreases by 0.902 units. However, the waist-to-hip ratio (WHR) did not have a significant effect on employee productivity. Moreover, for a one-unit increase in the waist-to-hip ratio (WHR), employee job involvement decreases by 22.46 units. Conversely, BMI did not have a significant effect on employee job involvement.

Discussion

The findings of this study indicated that workplace ergonomics had a significant effect on productivity and job involvement of employees in Kermanshah Oil Refinery. This implies the better the workplace ergonomics (the lower workplace ergonomics scores), the higher will be employee productivity and job involvement. In fact, adopting incorrect positions in sitting, standing, walking, carrying objects, using unsuitable work postures, and anthropometric features inconsistent with the workplace ergonomics can cause atrophy and imbalance in the agonist and antagonist muscles, eventually leading to skeletal abnormalities. Thus, improper ergonomic conditions, in the long run, lead to the imbalance in the musculoskeletal system, disturb joint surfaces in terms of joint arthrokinematics, and finally cause wear of joint surfaces, involvement of nerve roots, tissue damage, cumulative damage, and ultimately chronic musculoskeletal pain (24).

In line with these findings, Hassanzadeh et al. stated that the failure to pay attention to workplace ergonomics will be associated with the prevalence of MSDs and job stress-related consequences (24). Musculoskeletal pain with employees' mental and physical involvement and repeated medical absences can negatively affect employee productivity and job involvement as indicated in previous studies (25-28). Sohrabi and Mahdavi reported that the use of workplace ergonomics can improve employee job satisfaction and motivation (25). Ghorbanpour et al. also suggested the use of ergonomic factors in the workplace to be effective in increasing employee self-efficacy and improving their job performance (26). Therefore, following the findings of this study and given the effect of workplace ergonomics on the productivity and job involvement of oil refinery employees, the standardization of workplace tools and equipment and providing training on postures with lower risks of musculoskeletal injuries can help employees minimize musculoskeletal fatigue, reduce energy expenditure, minimize the prevalence of musculoskeletal pain, and reduce psychological distress, leading to enhancing job involvement and productivity. According to the Institute for Work & Health (IWH), 90 minutes of training to better understand ergonomic principles and ergonomic self-assessment skills for employees of a computer company, encouraged employees to make changes in the workplace using resources. This increased their efficiency and performance and made the company more profitable (3).

Workplace ergonomic professionals can improve systems performance by optimizing the fit between humans, machines, and the environment. Thus, it can be suggested that attention to workplace ergonomics is more than a tool and has turned into a strategy to improve system productivity, job creation, job involvement, prevention of work-related accidents and diseases, and improve efficiency and performance. Tabatabaei et al. also stated that MSDs are one of the cumulative workplace

injuries that affect employees' quality of life (29). Workplace ergonomics refers not only to the physical condition but also to the working hours of employees. As Abdi points out, an increase in weekly working hours indicates that most employees spend their time with illness, injury, and unauthorized absences (13). Increasing working hours leads to declining hourly and weekly production, causing workers to waste their time. Conversely, a reduction in weekly working hours is associated with an increase in hourly and weekly production and a reduction in employee absenteeism. Previous studies have shown that if the weekly working time does not exceed 40 hours, employee efficiency will be higher. Thus, ergonomics is no longer independent of organizational considerations and management strategies. Yu et al. also reported that employees who worked more than 55 hours per week had higher psychological distress and reported a history of high-risk injury (30, 31).

The data in this study indicated that body composition has a significant effect on productivity and job involvement of employees in Kermanshah Oil Refinery, as also reported in previous studies (15, 17, 32, 36). The present study also indicated as the body mass index and waist-to-hip ratio (WHR) increase, employee productivity and job involvement decrease. Over the past few decades, with technological advancements and reduced physical activity, changing eating habits and lifestyle, overweight and obesity are on the rise in both developed and developing countries. Overweight among employees can be influenced by various occupational factors such as shift work and the nature of their work. Being overweight with coronary artery involvement and fat deposition can lead to a heart attack. On the other hand, many joint diseases are directly related to being overweight. In fact, being overweight can lead to secondary diseases in people by affecting other physiological factors such as blood pressure and changes in the body's skeletal system (including lumbar lordosis due to abdominal fat). Thus, it can lead to a decrease in employee productivity or sick leave, which will also have a direct and negative impact on the overall productivity of the organization.

Hence, given that employee health is directly associated with organizational productivity, investing in the health and safety of employees is of great importance. Human capital is an essential requirement for future-oriented development in the organization. Thus, an important precondition for investing in labor is to pay attention to manpower. Accordingly, Anderson et al. reported that employee overweight leads to reduced productivity, increased absenteeism, and the occurrence of occupational injuries and MSDs (15). Faundez et al. also suggested that overweight and inactivity are the cause of various diseases, reduced ability to work, and early retirement of employees in the future (37). In addition, Shams Ghahfarokhi reported that one of the main criteria for improving employees' work outcomes is their physical conditions (13). Fathi et al. also stated that aerobic exercise improves the quality of life by improving physical composition and increasing cardiovascular endurance (32). As a result, using techniques to reduce employees' weight and ultimately their body mass index can improve their quality of life and promote their job involvement and productivity.

The waist-to-hip ratio (WHR) is used to measure central body fat, although it varies between men and women. According to the data in this study, body fat can lead to reduced productivity and job involvement in employees. Gharakhanlou et al. stated that the waist-to-hip ratio (WHR) can be reduced by sports activities and thus help reduce harmful fats in the body. They also suggested that WHR is the best predictor of cardiovascular risk factors in men and women (17). Improper diet and lack of physical activity are the most important causes of overweight and obesity which are the most important causes of non-communicable diseases. Both total body fat index and central fat distribution, including abdominal visceral fat, are closely linked to diabetes, hypertension, hyperlipidemia, and cardiovascular disease. However, some studies have attached more importance to central fat distribution (38). Secondary diseases occur due to high body mass index and WHR in employees and reduce their ability at work to the extent that even if employees are present at work, they cannot perform their duties well. Thus, employees have lower levels of job involvement, consequently reducing individual and organizational productivity. For this reason, providing training on a healthy lifestyle in terms of physical activity and healthy nutrition should be incorporated in nutrition plans for

restaurants and sports programs of the oil refinery workers to increase employee's health and activity and improve organizational productivity in the refinery.

The present study was conducted with some limitations. For instance, it was not possible to measure all variables for all participants in a common period (either in the morning or in the evening) and this may have affected the measurement of their body composition (39).

Conclusion

The findings of this study indicated that workplace ergonomics had a significant negative effect on productivity and job involvement of oil refinery employees. Moreover, the body mass index and waist-to-hip ratio (WHR) had a significant negative effect on employee job involvement and productivity. One of the implications of this study is the evaluation of workplace ergonomics and the physical composition of the employees and the incorporation of the outcomes with the results of annual evaluations of the industrial medicine center of the oil refinery company. Therefore, the use of preventive methods with the help of workplace ergonomics, proper posture maintenance training, and optimal interventions to control body composition can be effective in improving employee productivity and job involvement. On the other hand, when employees perceive that their health is important to the organization and managers are ready to pay for it, they are more likely to develop higher levels of commitment and attachment to the organization, leading to higher productivity.

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Conflict of interest

The authors reported no conflict of interest.

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