International Journal of Occupational Safety and Ergonomics

ISSN: 1080-3548 (Print) 2376-9130 (Online) Journal homepage: www.tandfonline.com/journals/tose20

The effect of ergonomics training given to office workers on musculoskeletal disorders and working postures

Ali Ağar, Gülay Yeginoğlu & Belkız Kızıltan

To cite this article: Ali Ağar, Gülay Yeginoğlu & Belkız Kızıltan (2025) The effect of ergonomics training given to office workers on musculoskeletal disorders and working postures, International Journal of Occupational Safety and Ergonomics, 31:2, 460-467, DOI: 10.1080/10803548.2025.2457186

To link to this article: https://doi.org/10.1080/10803548.2025.2457186

Published online: 17 Feb 2025.

INTERNATIONAL JOURNAL OF OCCUPATIONAL SAFETY AND ERGONOMICS (JOSE)
2025, VOL. 31, NO. 2, 460–467
https://doi.org/10.1080/10803548.2025.2457186

The effect of ergonomics training given to office workers on musculoskeletal disorders and working postures

Ali Ağar [a], Gülay Yeginoğlu [b] and Belkız Kızıltan [b]

[a]Department of Elder Care, Artvin Çoruh University, Artvin, Turkey; [b]Department of Nursing, Avrasya University, Trabzon, Turkey

ABSTRACT

Objectives. This study aimed to determine the impact of ergonomics training given to office workers on their risk scores for musculoskeletal disorders (MSDs) and their working postures. *Methods*. The study was conducted in a university located in a province in the east of Turkey's Black Sea region, with a total of 60 office workers randomly assigned to two groups (30 in the experimental group, 30 in the control group). The results were analyzed using the Wilcoxon and Friedman tests. *Results*. After the training, there was a significant decrease ($p < 0.05$) in the average scores of rapid office strain assessment (ROSA), rapid upper limb assessment (RULA), and spine and upper extremity discomfort, whereas no significant change was found in lower extremity discomfort ($p > 0.05$). In pairwise comparisons, 1 week after the training there was a decrease in the average scores of ROSA and RULA compared to before the training ($p < 0.001$), and this trend was maintained in the RULA score average after 12 weeks ($p < 0.001$), while it could not be maintained in the ROSA score average ($p > 0.05$). *Conclusion.* The ergonomics training intervention provided to the office employees was effective in improving their working postures and reducing MSDs, thereby creating awareness.

KEYWORDS
educational program; office worker; rapid office strain assessment; rapid upper limb assessment

1. Introduction

Musculoskeletal disorders (MSDs) are among the most common problems related to work, and the increasing prevalence of MSDs among office workers has become a significant concern for health and productivity [1,2].

Office workers, who spend the majority of their time sitting, are exposed to symptoms associated with MSDs, e.g., upper extremity and lower back prevalence exceeding 50% [3]. Furthermore, pain and discomfort caused by MSDs in the neck, shoulders and legs due to prolonged sitting positions are common among office workers. Therefore, globally, MSDs result in both socioeconomic and personal damage [1]. Additionally, studies have shown that the prevalence of MSDs among office workers ranges from 20 to 90% [1,4,5].

Ensuring the prevention of MSDs among office workers necessitates the precise identification of occupational hazards. To accomplish this, numerous approaches and resources have been devised to identify occupational risks associated with MSDs. These tools are categorized into three groups based on the measurement techniques: self-report, direct measurement and observational methods [6]. Observational methods are the most common approach used to assess physical workload and monitor the effects of ergonomic changes [7,8]. Among observational methods, rapid upper limb assessment (RULA) and rapid office strain assessment (ROSA) are considered reliable and valid methods for evaluating different postures involving computer-based office workstations and the upper limbs [6].

Despite increasing interest among employers in improving office workplaces, there are few studies examining the effects of ergonomic interventions on employee health [9–11]. Guduru et al. [12] conducted a systematic review investigating how prolonged sitting affects the health of individuals. The review noted that prolonged sitting was associated with health issues such as cardiovascular diseases, MSDs, diabetes and depression. Another systematic review by Frutiger and Borotkanics [13] examined factors that could be effective in reducing neck pain among office workers. This review indicated that neck strengthening and personalized workstation changes were supported by low-quality evidence in reducing neck pain. However, another systematic review investigating individual and workplace factors associated with the development of non-specific neck pain among office workers found limited or conflicting evidence. Furthermore, the lack of prospective studies examining the relationship between the physical work environment, individuals' work practices, their physical condition and the development of neck pain was emphasized [14].

When examining studies conducted with office workers in Turkey, it is observed that employees have not received any training on office ergonomics [15]. It is also evident that the existing furniture used by office workers is not ergonomic, which consequently increases the risk of MSDs [16,17]. While it is plausible that ergonomic interventions can mitigate the risk of work-related MSDs in the upper extremities and neck among office workers, the existing evidence is not definitive [9,11,18].

Hence, it is crucial to conduct further research to establish conclusive evidence regarding the effectiveness of ergonomics training interventions in reducing MSDs among office workers. The findings of such studies hold potential for informing the advancement of different work techniques tailored for office workers, as well as the implementation of regular maintenance routines that effectively mitigate work-related

CONTACT Ali Ağar aliagar828@gmail.com

injuries. Consequently, it is imperative to identify, assess and apply appropriate interventions and remedies to alleviate ergonomic risk factors and minimize the occurrence of MSDs among office workers. This study seeks to investigate the effects of an ergonomics training program on the prevalence of MSDs and work postures among office workers.

2. Methods

2.1. Study design

This study is a randomized controlled quasi-experimental study conducted to determine the effect of ergonomics training given to office workers on their working postures and MSDs.

2.2. Participants

The study population consisted of 186 office workers employed at a state university located in the eastern Black Sea region of Turkey. The sample size for the study was determined based on the total mean ROSA scores pre-test and post-test from a similar study, with an effect size of $d = 1.31$ [19]. Using G∗Power version 3.1.9.7 for a power analysis of independent t tests, it was decided that a minimum of 28 participants, with 14 in the experimental group and 14 in the control group, would be required for a two-tailed test with $\alpha = 0.05$ (95% significance) and $1 - \beta = 0.90$ (power = 0.90) parameters [20]. Considering the possibility of attrition during the research and the requirement for each group to have at least 30 individuals to meet parametric assumptions, 16 participants were added to each group, resulting in a total of 60 employees (30 in the control group and 30 in the experimental group) to complete the study [21]. The inclusion criteria were as follows: not having any diagnosed MSD according to a physician, not being pregnant, working in a job that requires working at the computer, working in an ergonomic chair, having no communication barriers, being willing to participate in the study and having a body mass index (BMI) below 30. The exclusion criteria were the absence of a fixed workstation, sharing the workstation with a colleague, using a laptop computer, having undergone surgery within the last 6 months, using two monitors and expressing a desire to withdraw from the study [1,5,22].

The nature of the study did not allow for participant blinding. The researcher included office workers who met the inclusion and exclusion criteria for the study. The participants were not informed of their group assignment until the research began. As the ergonomics training for the experimental group was provided by the researcher, the researcher could not be blinded. However, during the data analysis stage, the statistician analyzing the data was kept unaware of the group assignments to ensure blinding. Thus, the data analysis phase was blinded.

2.3. Randomization

The experimental and control groups were randomly assigned by an impartial faculty member who did not participate in the study, using a randomization software program (https://randomizer.org/). From a pool of 100 individuals who met the research criteria and volunteered to participate, one set of 60 unique numbers was generated. The MedCalc package version 23.1.6 was then used to allocate these 60 individuals randomly to the experimental and control groups. The functions available in the MedCalc program were utilized to assign the participants to either the control group, labeled '1', or the experimental group, labeled '2', in a random manner.

2.4. Ethics statement

This study was approved by the Scientific Research Ethics Committee of a university in Turkey (Decision No: E-18457941-050.99-121647). Permission was obtained from the administrators of the university where the research was conducted. Additionally, the participating employees were provided with information about the conduct of the research and written informed consent was obtained from them. At the end of the study, the same training was provided to the office workers in the control group as well.

2.5. Data gathering tools

The data were collected through face-to-face interviews using the following instruments: a demographic questionnaire form, the ROSA tool, the RULA tool and the Cornell musculoskeletal discomfort questionnaire (CMDQ).

2.5.1. Demographic questionnaire

A total of 10 questions were included in the questionnaire form used, which encompassed demographic information such as age, gender, educational level, marital status, total years of work experience, physical exercise habits, previous participation in ergonomics training, presence of chronic diseases and BMI [1,6,8,23].

2.5.2. Rapid office strain assessment

ROSA, developed by Sonne et al. in 2012 [24], is an ergonomic analysis method that involves assessing and scoring employees' working postures (chair height, seat depth, armrests, back support, posture while using the telephone, monitor, keyboard and mouse) and the equipment they use. It can be performed using pen and paper or by taking photographs [16,25,26]. During ROSA scoring, the equipment used by the employees is evaluated in three separate sections. Section A involves the interaction of the employee with the chair, and different scores are given for each sitting position. Section B includes the interaction of the employee with the screen and telephone on their desk. The proximity and distance of the screen and telephone to the employee are taken into account for scoring. Section C encompasses the interaction of the employee with the keyboard and mouse on their desk. Scoring is based on observations of how the keyboard and mouse are used during work [24]. Risk factors are scored for each subsection. After scoring, relevant matrix tables are used to calculate the scores for each section, resulting in a total ROSA score [5].

The total ROSA score is interpreted as follows. If the ROSA final score is ≤ 4, it indicates a correct working posture between the employee and office equipment, leading to a decreased probability of MSDs. On the other hand, if the ROSA final score is ≥ 5, it signifies an incorrect working posture between the employee and office equipment, resulting in an increased probability of MSDs [1].

2.5.3. Rapid upper limb assessment

RULA is an ergonomic risk assessment tool designed by McAtamney and Corlett in 1993 [27]. It assesses whether employees are exposed to musculoskeletal risk factors in their left and right limbs (such as neck, trunk, arms, wrists, etc.) while performing their tasks, through observation, photography or video recording [27–29]. During the assessment, only one side of the body, specifically the most affected and dominant side, is analyzed [29].

RULA scoring is based on three sections: section A, upper arm–lower arm–wrist; section B, neck–trunk–legs; and section C, wrist–arm score and neck–trunk–leg score. Risk scores are assigned to the postures adopted by the limbs in sections A and B, and these scores, along with the values for static muscle activity and force, are used to calculate the total RULA score in section C [29].

The total RULA score ranges from 1 to 7, and a score of ≥ 5 indicates incorrect posture during work, increasing the probability of developing MSDs [30].

2.5.4. Cornell musculoskeletal discomfort questionnaire

The CMDQ is a data collection tool that was developed by Hedge et al. in 1999 [31] and later validated in Turkish by Erdinç et al. in 2011 [32].

The CMDQ assesses the frequency, intensity and work interference of MSDs over the past 7 days using a body map illustrating 18 body regions. It is utilized as a data collection method to gather information about the occurrence and impact of MSDs. In the frequency section, the following scoring is used: 0 points for not experiencing discomfort at all in the past week, 1.5 points for experiencing discomfort one or two times during the week, 3.5 points for experiencing discomfort three or four times during the week, 5 points for experiencing discomfort once a day and 10 points for experiencing discomfort multiple times a day. Severity is scored as follows: 1 point for mild pain, 2 points for moderate pain and 3 points for severe pain. Work interference is scored as follows: 1 point for no interference with work, 2 points for slight interference with work and 3 points for significant interference with work. The total discomfort score obtained for each body region ranges from 0 to 90. A high CMDQ score indicates an increase in musculoskeletal discomfort for the individual [32].

To facilitate easier and more understandable interpretation of the CMDQ results, the method used by Acquah et al. [33] was employed. According to this method, the CMDQ is evaluated in three sections: spine (neck–back–lower back), lower extremities (hips–upper legs–knees–lower legs) and upper extremities (shoulders–upper arms–lower arms–wrists) [33].

2.6. Implementation of the research

First, the data were collected from the employees in both groups through face-to-face interviews using the demo graphic questionnaire and the CMDQ. Additionally, the participants were asked by the researcher to work at their workstations for 8–10 min while their postures during computer use were analyzed using the RULA and ROSA scores. The participants' working postures and interactions with computers were observed, and photographs were taken. Photographs were taken using a tablet with a screen resolution of 2360 × 1640 pixels to capture all elements of the workstation and the postures of the employee. The employees in the experimental group received training, and at the end of the training, written and visual training brochures containing the content of the presentation were distributed. One week after the training, the interim test data (CMDQ, ROSA and RULA score calculations) were collected to determine the effectiveness of the training. Twelve weeks after the training, the final test data (CMDQ, ROSA and RULA score calculations) were collected. During the collection of interim and final test scores (ROSA and RULA) for the experimental group employees, it was ensured that their natural positions were maintained without causing them to adopt unnatural postures. The participants were observed and photographed at any time during working hours, with the understanding that their initial working postures upon encountering the researcher would be considered if they attempted to suddenly change their posture upon seeing the researcher. No training was provided to the employees in the control group, and the data were collected at two different times: pre-test and post-test, which coincided with the data collection times for the experimental group. After collecting the post-test data, independent of the research, the employees were provided with ergonomics training related to their working postures during computer use, and written and visual training brochures containing the content of the ergonomics training were distributed. The data collection procedures are illustrated in Figure 1.

2.7. Ergonomics training program

The development of ergonomics training for office workers relied on national [34,35] and international [36,37] guidelines, as well as input from an expert with a PhD degree in occupational health and safety specializing in ergonomics and MSD research. The training took place in the university's senate meeting room and was delivered in the form of a PowerPoint presentation with visual photographs illustrating proper seating and working postures. The training lasted for 45 min. At the end of the study, a meeting was held with the experimental group in the university's senate hall to discuss the training provided. Feedback was collected during this meeting. Overall, the feedback from the experimental group regarding the training was generally positive. The content of the training included the definition of MSDs; the prevalence of MSDs among office workers; risk factors and preventive measures for MSDs; the definition of ergonomics; proper seating and equipment use in office ergonomics; the importance of taking breaks during work; chair, keyboard and mouse positioning; monitor and phone positioning; and the importance of environmental factors and minimum requirements. At the end of the training, brochures on office ergonomics and the use of equipment were provided to the office workers in the experimental group. At the conclusion of the study, all employees were provided with ergonomics training and an ergonomics training brochure.

2.8. Statistical analysis

Statistical analysis of the data was performed using IBM SPSS version 22.0. Summary values for categorical variables were presented as frequencies (n) and percentages (%). Summary values for numerical variables were presented as the mean ± standard deviation.

To test the normality of numerical variables, the Kolmogo rov–Smirnov test p value, histograms and probability plots were considered. The independent-samples t test was used for comparing the two groups for numerical variables that showed a normal distribution, while the Mann–Whitney U test was used for numerical variables that did not show a normal distribution.

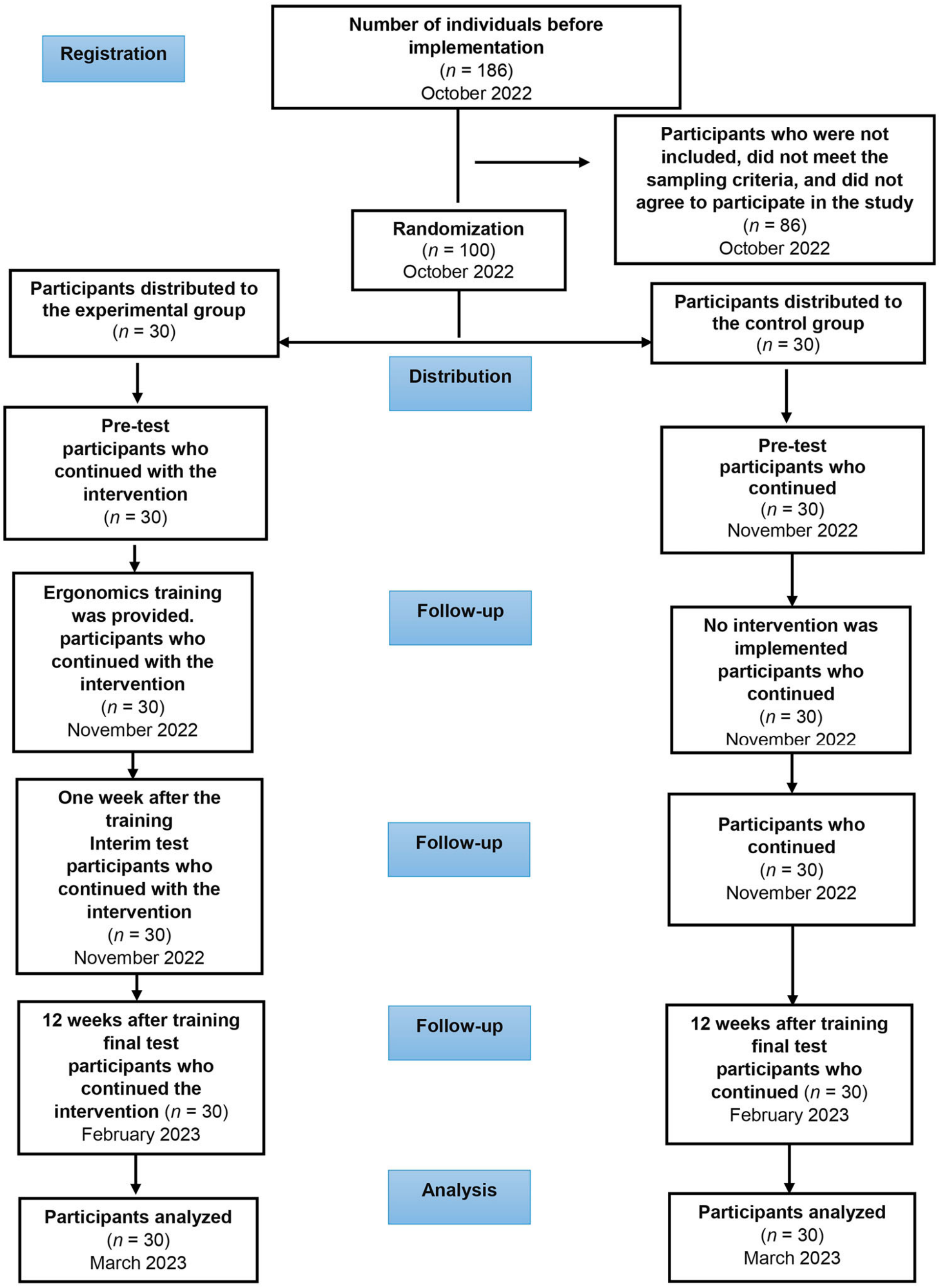

Figure 1. Flow chart of data collection process.
Note: n = number of individuals.

The relationship between categorical variables was examined using χ^2 analysis. Additionally, the Wilcoxon signed-rank test and the Friedman test were used to compare the mean scores of the control and experimental groups. The Wilcoxon signed-rank test with Bonferroni correction was performed to determine which group or groups the difference originated from. The p value was divided by the number of comparisons for Bonferroni correction in pairwise comparisons between groups. The analysis resulted in significant findings when $p < 0.05$. Since three different time periods were compared in this study, pairwise comparisons were considered significant when $p < 0.0167$. The other statistical analysis results were considered significant when $p < 0.05$.

The mean and standard deviation values of the ROSA variable for the experimental and control groups were used as references for power analysis conducted after the study. According to the post-hoc power analysis based on the independent-sample t-test results (effect size $d = 1.56$, $\alpha = 0.05$), the power of the study was calculated to be 0.99.

3. Results

Table 1 presents the demographic characteristics of the participants involved in the study. It was determined that the demographic variables of both groups were similar ($p > 0.05$).

Table 2 presents the pre-training and post-training ROSA and RULA scores for both groups. Before the training, the ROSA and RULA final scores were similar between the two groups. After 12 weeks of training, a statistically significant difference was observed in the ROSA and RULA final scores between the groups ($p < 0.05$). Upon examining within-group comparisons, no statistically significant decrease was found in the ROSA final score for both groups before and after the training ($p > 0.05$), while a statistically significant decrease was observed in the RULA final score ($p < 0.05$).

Table 1. Personal and demographic data for the control and experimental groups.

Variable	Experimental group	Control group	p
Sex			
Female	9 (30)	11(36.7)	0.78
Male	21 (70)	19 (63.3)	
Age (years)			
18–25	13 (43.3)	16 (53.3)	0.6
26–35	17 (56.7)	14 (46.7)	
Education			
Undergraduate	25 (83.3)	24 (80)	1.000
Graduate	5 (16.7)	6 (20)	
Marital status			
Married	16 (53.3)	17 (56.7)	1.000
Single	14 (46.7)	13 (43.3)	
Job seniority (years)			
1–10	16 (53.3)	18 (60)	0.79
≥ 11	14 (46.7)	12 (40)	
Exercise status			
No	5 (16.7)	8 (26.7)	0.53
Yes	25 (83.3)	22 (73.3)	
Receiving ergonomics training status			
Yes	1 (3.3)	2 (6.7)	1.000
No	29 (96.7)	28 (93.3)	
Chronic illness status			
Yes	0 (0)	3 (10)	0.24
No	30 (100)	27 (90)	
	EG	CG	p
BMI	26.47 ± 2.38	25.60 ± 2.14	0,14

Note: Data presented as number (%) or mean $\pm$ standard deviation. p values were calculated using the independent-samples t test for continuous variables and the χ^2 test for categorical variables. BMI = body mass index.

Table 2. Mean values of ROSA, RULA and CMDQ subgroup final scores in the control group and experimental group pre training (0) and 12 weeks post training.

Parameter	Group	Before the training (0)	After 12 weeks of training	p
ROSA	EG	4.90 ± 0.84	4.76 ± 0.67	0.415
	CG	5.10 ± 0.92	5.20 ± 0.61	0.499
p		0.525	**0.015***	
RULA	EG	4.43 ± 1.07	3.40 ± 0.49	**0.000***
	CG	4.36 ± 1.15	3.86 ± 0.81	**0.003***
p		0.777	**0.021***	
CMDQ				
Spine	EG	4.34 ± 6.53	3.07 ± 6.53	**0.020***
	CG	2.51 ± 5.47	2.88 ± 6.49	0.103
p		0.103	0.738	
Upper extremities	EG	1.52 ± 2.74	0.35 ± 0.78	**0.001***
	CG	0.81 ± 1.38	3.86 ± 0.81	**0.006***
p		0.402	0.524	
Lower extremities	EG	2.42 ± 6.94	0.54 ± 1.08	0.196
	CG	0.96 ± 2.45	1.05 ± 2.68	0.317
p		0.594	0.788	

*Significant at $p < 0.05$.
Note: Data presented as mean $\pm$ standard deviation. Within-group comparisons calculated using the Wilcoxon test, and between-group comparisons determined using the Mann–Whitney U test, with p values reported. CG = control group; CMDQ = Cornell musculoskeletal discomfort questionnaire; EG = experimental group; ROSA = rapid office strain assessment; RULA = rapid upper limb assessment.

Table 3. Comparison of ROSA and RULA final score averages in the experimental group before training (0) and 1 week and 12 weeks after training.

Variable	Measurement	n	$M \pm SD$	Rank average	Friedman	SD	p
ROSA	0	30	4.90 ± 0.84	2.28			
	1 week	30	4.16 ± 0.83	1.63	14,0	2	**0.001***
	12 weeks	30	4.76 ± 0.67	2.08			
RULA	0	30	4.43 ± 1.07	2.53			
	1 week	30	3.36 ± 0.49	1.72	23,30	2	**0.000***
	12 weeks	30	3.40 ± 0.49	1.75			

*Significant at $p < 0.05$.
Note: The Friedman p value was calculated for repeated measurements. ROSA = rapid office strain assessment; RULA = rapid upper limb assessment.

Table 2 presents the mean sub-scores of the CMDQ for both groups before and 12 weeks after the training. Before the training, the average scores for the spine, upper extremities and lower extremities were similar between both groups ($p > 0.05$). After 12 weeks of training, no statistically significant difference was observed in the average scores for the spine, upper extremities and lower extremities between the two groups ($p > 0.05$).

Upon examining within-group comparisons, a statistically significant difference was observed in the average scores for the spine and upper extremities before and after the training in the experimental group ($p < 0.05$), while no significant difference was found in the average scores for the lower extremities ($p > 0.05$). In the control group, no significant difference was observed in the average scores for the spine and lower extremities before and after the training ($p > 0.05$), but a statistically significant difference was found in the average scores for the upper extremities ($p < 0.05$).

Table 3 presents the repeated-measures scores of ROSA and RULA for the experimental group. Through repeated measurements conducted with the participants in the experimental group, a statistically significant difference was found in the mean scores of ROSA and RULA ($p < 0.05$). To determine between which groups this difference occurred, the Wilcoxon signed-rank test was conducted with Bonferroni correction, and the results are presented in Table 4.

The pairwise comparisons of the mean final scores of ROSA and RULA in the experimental group are presented in Table 4. Based on the pairwise comparisons of the ROSA mean scores, it was determined that the measurements taken before the training, 1 week after the training and 12 weeks after the training were statistically significant ($p < 0.0167$). The negative ranks in favor of the difference scores before and 1 week after the training indicated a decrease in the mean ROSA score 1 week after the training, while the positive ranks in favor of the difference scores 1 week after the training and 12 weeks after the training indicated an increase in the mean ROSA score 12 weeks after the training, thus indicating that the decrease was not sustained.

Based on the pairwise comparisons of the RULA mean scores, it was determined that the measurements taken before the training and 1 week after the training, as well as the measurements taken before the training and 12 weeks after the training, were statistically significant ($p < 0.0167$). The negative ranks in favor of the difference scores between before and 1 week after the training indicated a decrease in the mean RULA score 1 week after the training, while the negative ranks in favor of the difference scores between before and 12 weeks after the training indicated that the decrease in the RULA score was sustained 12 weeks after the training.

Table 4. Comparison of pairwise mean scores for ROSA and RULA before training (0) and after 1 week and 12 weeks of training in the experimental group.

		Measurement								
		0–1 weeks			1–12 weeks			0–12 weeks		
Variable		*n* (%)	Mean rank	Total rank	*n* (%)	Mean rank	Total rank	*n* (%)	Mean rank	Total rank
ROSA	Negative ranks	14 (46.6)	7.5	105	1 (3.4)	2	2	6 (20)	7.75	46.50
	Positive ranks	0 (0)	0	0	9 (30)	5.89	53	9 (30)	7.17	73.50
	No difference	16 (54.4)			20 (66.6)			15 (50)		
p		**0.001***			**0.009***			0.415		
RULA	Negative ranks	16 (54.4)	8.5	136	5 (16.7)	6	30	17 (56.6)	9.85	167.5
	Positive ranks	0	0	0	6 (20)	6	36	1 (3.4)	3.5	3.5
	No difference	14 (46.6)			19 (63.3)			12 (40)		
p		**0.000***			0.763			**0.000***		

*Significant at $p < 0.0167$.
Note: *p* value calculated using the Friedman test with Bonferroni correction for pairwise comparisons. ROSA = rapid office strain assessment; RULA = rapid upper limb assessment.

4. Discussion

This study aimed to determine the impact of ergonomic intervention on the working postures and MSDs of office workers. The final ROSA and RULA scores of the participating office workers were collected through observation and photography. The data collection method is consistent with other studies found in the literature [6,38,39].

In this study, significant differences were found between the groups in ROSA and RULA final scores after 12 weeks of training. In the experimental group, it was observed that the ROSA final score did not maintain its significance after the first week, while the RULA final score remained significant.

A review of the existing literature reveals that ergonomics training is commonly employed to enhance the ergonomic set-up of workstations and decrease the incidence of MSDs among individuals who extensively use computers and office workers [2,40]. Our findings regarding the average ROSA score before and after ergonomics training are consistent with the findings of previous studies in the literature [19,41]. In our study, the significant decrease in the ROSA final score in the experimental group after 12 weeks of follow-up indicates that the effectiveness of ergonomics training was high in a short period of time. Employee training, ergonomic workstation design, physical modifications to workstations and the replacement of some non-ergonomic equipment through education reduced the risk level to acceptable levels. However, the lack of sustained significance in the ROSA final score at the end of 12 weeks suggests that ergonomic training alone may not be sufficient for physical changes in workstations. Additionally, providing the ergonomic training program only once over a 12-week period may not effectively raise awareness among employees.

Ekinci et al. [40] conducted a study evaluating the effectiveness of ergonomics training using the RULA ergonomic risk assessment method among computer users. They found that individuals who received ergonomics training had lower RULA scores. According to their RULA scores, ergonomics training was effective in reducing the risk level of MSDs [40]. In a study focusing on ergonomic interventions for video display terminal workers, it was also reported that employees who received interventions had lower RULA scores [42]. Our findings regarding the average RULA score before and after ergonomics training are consistent with the findings of previous studies in the literature [42,43].

In our study, after a 12-week follow-up period in the experimental group, it was observed that the RULA final score significantly decreased after the first week, indicating the high effectiveness of ergonomics training in a short period of time. Furthermore, the fact that the positive decrease in the RULA final score maintained its significance after 12 weeks indicates the significant role of ergonomics training in improving work postures and body mechanics. According to studies in the literature, for long-term effectiveness on MSDs among office workers, it was suggested that relying solely on ergonomic modifications may not yield optimal results, and that incorporating stretching exercises would be more beneficial [44,45]. Another study indicates that focusing solely on the physical aspects of the work environment while ignoring psychosocial or organizational factors may limit the effectiveness of reducing and alleviating MSDs among computer workers [46].

Ergonomics training can serve as a tool to increase employees' knowledge about how to adjust their workstations, maintain optimal postures while working, use office equipment correctly, and adjust chair and monitor heights effectively [19]. Distributing brochures to employees regarding proper equipment usage helped increase the users' knowledge by enabling them to adjust their workstations independently throughout the workday. Consequently, significant improvements were observed in work postures, monitor height, telephone usage, keyboard–mouse usage, chair adjustment and body mechanics. The significant decrease in the ROSA and RULA final scores between the groups after 12 weeks of ergonomics training confirms these findings.

In this study, no significant differences were observed in the mean scores of the CMDQ subgroups, which are the spine, upper extremities and lower extremities, between the groups after 12 weeks of training. However, significant differences were only found in the spine and upper extremity scores between the experimental group's employees before and after the training.

When looking at the literature, it is stated that in an interventional study conducted after a 12-week follow-up period, the intervention applied to office workers had no effect on upper extremity and lower extremity discomfort, only resulting in a decrease in back pain [47]. In another study involving ergonomic intervention, no statistical difference was reported between the experimental and control groups regarding MSDs [4]. Looking at studies yielding different results from these, in a study where a workplace sitting reduction intervention was implemented, it was noted that reducing the sitting time of computer workers decreased lower back pain (LBP) [47]. However, other studies indicated that individuals with LBP may not adequately address the dosage of required sitting and standing time [48,49]. The sit–stand model may have benefits in preventing/reducing LBP.

The literature indicates that evidence regarding the effectiveness of physical ergonomic interventions, organizational ergonomic interventions and ergonomics training in preventing MSDs among office workers is not definitive and conclusive. The importance of conducting higher-quality studies is emphasized in order to ascertain the effectiveness of these interventions specifically targeted toward office workers [50–52]. Therefore, the lack of a statistically significant difference between the groups in our study regarding the ergonomics training can be attributed to those results parallel to previous studies in the literature. However, our study found a statistically significant difference in the mean scores of the spine and upper extremity, which are affected by MSDs, among the employees in the experimental group. This result confirms, with certainty and clarity in our study, the effectiveness of the ergonomics training provided to the experimental group, even though the evidence in the literature is not definitive. Additionally, preventing MSDs reduces lumbar flexion, work-time loss, occupational injuries and overall economic costs, including workers' compensation claims for employers.

5. Limitations

One of the main limitations of the study is its relatively short duration of 12 weeks. Additionally, the study was conducted only on administrative personnel from a single university, limiting the generalizability of the results to this specific group. In our study, another limitation is that during the interim and final tests, the employees in the experimental group had the opportunity to see the researcher and correct their working postures, which could influence the results. Additionally, since RULA and ROSA are qualitative risk analysis methods, different researchers may yield different results when conducting analyses.

6. Conclusion

The study found that ergonomics training was effective in office workers' correct use of office equipment and improvement of working postures. Particularly, the rapid improvement in working postures immediately after ergonomics training demonstrates the effectiveness of the training in a short period of time. While the RULA score remained significant over the 12-week period, the ROSA score did not maintain its significance. Consequently, while the ROSA score was statistically significant in repeated measurements, it did not show statistical significance in the comparison between pre-training and 12 weeks after training. On the other hand, the RULA score was found to be statistically significant in both repeated measurements and pairwise comparisons between pre-training and 12 weeks after training. Additionally, the ergonomic intervention was found to be effective in reducing spine, upper extremity and lower extremity discomfort, but it was determined that a sufficient level of reduction was not achieved.

The ergonomics training provided to the employees did not have the desired level of impact on all variables used in the study. Therefore, the researchers recommend that in addition to ergonomics training, it is necessary to implement workplace modifications, employee motivation and control policies in order to protect the health of employees, especially focusing on the most common extremity that affects the body, and providing short and continuous ergonomics training programs. These efforts will continuously improve employee health and contribute to organizational improvement.

Acknowledgements

This study was produced from the PhD dissertation prepared by the first author and supervised by the second author.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Ali Ağar http://orcid.org/0000-0003-2771-9587
Gülay Yeginoğlu http://orcid.org/0000-0003-0944-1585
Belkız Kızıltan http://orcid.org/0000-0003-2044-623X

References

[1] Besharati A, Daneshmandi H, Zareh K, et al. Work-related musculoskeletal problems and associated factors among office workers. Int J Occup Saf Ergon. 2018;26(3):632–638. doi:10.1080/10803548.2018.1501238
[2] Sohrabi MS, Babamiri M. Effectiveness of an ergonomics training program on musculoskeletal disorders: job stress, quality of work-life and productivity in office workers: a quasi-randomized control trial study. Int J Occup Saf Ergon. 2022;28(3):1664–1671. doi:10.1080/10803548.2021.1918930
[3] AlOmar RS, AlShamlan NA, Alawashiz S, et al. Musculoskeletal symptoms and their associated risk factors among Saudi office workers: a cross-sectional study. BMC Musculoskelet Disord. 2021;22:763. doi:10.1186/s12891-021-04652-4
[4] Argus M, Paasuke M. Musculoskeletal disorders and associated factors among office workers in an activity-based work environment. Int J Occup Saf Ergon. 2022;28(4):2419–2425. doi:10.1080/10803548.2021.1999616
[5] Mirmohammadi T, Gook O, Mousavinasab N, et al. Investigating the prevalence of musculoskeletal disorders in Melli bank staff and determining ıts relationship with office tension in North Khorasan province in 2019. J Ergon. 2020;7(4):31–39. doi:10.30699/jergon.7.4.31
[6] Mohammadipour F, Pourranjbar M, Naderi S, et al. Work-related musculoskeletal disorders in Iranian office workers: prevalence and risk factors. J Med Life. 2018;11(4):328–333. doi:10.25122/jml-2018-0054
[7] Norval M, Zare M, Brunet R, et al. Operational leeway in work situations: do ergonomic risk assessment tools consider operational leeway for job analysis? Int J Occup Saf Ergon. 2019;25(3):429–442. doi:10.1080/10803548.2017.1387392
[8] Rodrigues MSA, Leite RDV, Lelis CM, et al. Differences in ergonomic and workstation factors between computer office workers with and without reported musculoskeletal pain. Work. 2017;57(4):563–572. doi:10.3233/WOR-172582
[9] Abdollahi T, Razi SP, Pahlevan D, et al. Effect of an ergonomics educational program on musculoskeletal disorders in nursing staff working in the operating room: a quasi-randomized controlled clinical trial. Int J Environ Res Public Health. 2020;17(19):7333. doi:10.3390/ijerph17197333
[10] Arman SE. Are ergonomic interventions effective for prevention of upper extremity work-related musculoskeletal disorders among office workers? A Cochrane review summary with commentary. Musculoskelet Sci Pract. 2020;45:102062. doi:10.1016/j.msksp.2019.102062
[11] Hoe VCW, Urquhart DM, Kelsall HL, et al. Ergonomic interventions for preventing work-related musculoskeletal disorders of the upper limb and neck among office workers. Cochrane Database Syst Rev. 2018;10:16–17. doi:10.1002/14651858.CD008570.pub3
[12] Guduru RKR, Domeika A, Obcarskas L, et al. The ergonomic association between shoulder, neck/head disorders and sedentary

activity: a systematic review. J Healthc Eng. 2022;2022:5178333. doi:10.1155/2022/5178333
[13] Frutiger M, Borotkanics R. Systematic review and meta-analysis suggest strength training and workplace modifications may reduce neck pain in office workers. Pain Practice. 2021;21(1):100–131. doi:10.1111/papr.12940
[14] Jun D, Zoe M, Johnston V, et al. Physical risk factors for developing non-specific neck pain in office workers: a systematic review and meta-analysis. Int Arch Occup Environ Health. 2017;90:373–410. doi:10.1007/s00420-017-1205-3
[15] Gedik T, Batu C, Yıldırım F, et al. Analysis of work-related illnesses in office workers: Duzce University example. Düzce Üniversitesi Bilim ve Teknol Derg. 2017;5(2):370–381. Turkish.
[16] Özkan NF, Kahya E. Assessment of ergonomic risks in administrative offices of a university. J Fac Eng Archit Gazi Univ. 2017;32(1):149–158. Turkish. doi:10.17341/gazimmfd.300603
[17] Morkoç DK, Okcu O. A research on the ergonomic evaluation of work spaces and office furniture: The Çanakkale Onsekiz Mart University Example. İleri Teknol Bilim Derg. 2017;6(3):422–434. Turkish.
[18] Amit LM, Song YW. Effectiveness of ergonomic intervention in work-related postures and musculoskeletal disorders of call center workers: a case–control study. Ind Eng Manag Syst. 2021;20(2):109–118. doi:10.7232/iems.2021.20.2.109
[19] Motamedzadeh M, Jalali M, Golmohammadi R, et al. Ergonomic risk factors and musculoskeletal disorders in bank staff: an interventional follow-up study in Iran. J Egypt Public Health Assoc. 2021;96(34):1–10. doi:10.1186/s42506-021-00097-8
[20] Faul F, Erdfelder E, Lang AG, et al. G∗ Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175–191. doi:10.3758/BF03193146
[21] Sümbüloğlu K, Sümbüloğlu V. Biostatistics. 20th Edition. Hatiboglu Publishing; 2021. p. 48–57.
[22] Sethi J, Sandhu JS, Imbanathan V. Effect of body mass index on work related musculoskeletal discomfort and occupational stress of computer workers in a developed ergonomic setup. Sport Med Arthrosc Rehabil Ther Technol. 2011;3(1):1–7. doi:10.1186/1758-2555-3-22
[23] Celik S, Celik K, Dirimeşe E, et al. Determination of pain in musculoskeletal system reported by office workers and the pain risk factors. Int J Occup Med Environ Health. 2018;31(1):91–111. doi:10.13075/ijomeh.1896.00901
[24] Sonne M, Villalta DL, Andrews DM. Development and evaluation of an office ergonomic risk checklist: ROSA – rapid office strain assessment. Appl Ergon. 2012;43(1):98–108. doi:10.1016/J.APERGO.2011.03.008
[25] Sanaeinasab H, Saffari M, Valipour F, et al. The effectiveness of a model-based health education intervention to improve ergonomic posture in office computer workers: a randomized controlled trial. Int Arch Occup Environ Health. 2018;91(8):951–962. doi:10.1007/s00420-018-1336-1
[26] Shariat A, Cleland J, Danaee M, et al. Relationships between Cornell musculoskeletal discomfort questionnaire and online rapid office strain assessment questionnaire. Iran J Public Health. 2018;47(11):1756–1762.
[27] McAtamney L, Nigel Corlett E. RULA: a survey method for the investigation of work-related upper limb disorders. Appl Ergon. 1993;24(2):91–99. doi:10.1016/0003-6870(93)90080-S
[28] Namwongsa S, Puntumetakul R, Neubert MS, et al. Ergonomic risk assessment of smartphone users using the rapid upper limb assessment (RULA) tool. PLoS One. 2018;13(8):e0203394. doi:10.1371/journal.pone.0203394
[29] Gómez-Galán M, Callejón-Ferre ÁJ, Pérez-Alonso J, et al. Musculoskeletal risks: RULA bibliometric review. Int J Environ Res Public Health. 2020;17(12):4354. doi:10.3390/ijerph17124354
[30] Kakaraparthi VN, Vishwanathan K, Gadhavi B, et al. Clinical application of rapid upper limb assessment and Nordic musculoskeletal questionnaire in work-related musculoskeletal disorders: a bibliometric study. Int J Environ Res Public Health. 2023;20(3):1932. doi:10.3390/ijerph20031932
[31] Hedge A, Morimoto S, Mccrobie D. Effects of keyboard tray geometry on upper body posture and comfort. Ergonomics. 1999;42(10):1333–1349. doi:10.1080/001401399184983
[32] Erdinç O, Hot K, Ozkaya M. Turkish version of the Cornell musculoskeletal discomfort questionnaire: cross-cultural adaptation and validation. Work. 2011;39(3):251–260. doi:10.3233/WOR-2011-1173
[33] Acquah AA, D'souza C, Martin BJ, et al. Musculoskeletal disorder symptoms among workers at an informal electronic-waste recycling site in Agbogbloshie, Ghana. Int J Environ Res Public Health. 2021;18(4):2055. doi:10.3390/ijerph18042055
[34] Regulation on Health and Safety Measures in Working with Display Devices [Internet]. T.C. Official Gazette, 28620 16 April 2013; 2013 [cited 2022 Jun 18]. Turkish. Available from: https://www.mevzuat.gov.tr/mevzuat?MevzuatNo = 17288&MevzuatTur = 7&MevzuatTertip = 5
[35] Health and Safety Guide for Working with Screen-Based Devices [Internet]; 2019 [cited 2022 Jun 18]. Turkish. Available from: http://isg.ankara.edu.tr/wp-content/uploads/sites/160/2020/01/Ekranli-Araçlarla-Çalisma-Rehberi.pdf
[36] Occupational Safety and Health Administration. Computer workstations [Internet]; [cited 2022 Jun 18]. Available from: https://www.osha.gov/etools/computer-workstations
[37] Office ergonomics: OSH answers [Internet]; 2022 [cited 2022 Jun 18]. Available from: https://www.ccohs.ca/oshanswers/ergonomics/office/
[38] Iram H, Kashif M, Sattar M, et al. Ergonomic risk factors among computer office workers for complaints of arm, neck and shoulder and workstation evaluation. Work. 2022;73(1):321–326. doi:10.3233/WOR-211029
[39] Taieb-Maimon M, Cwikel J, Shapira B, et al. The effectiveness of a training method using self-modeling webcam photos for reducing musculoskeletal risk among office workers using computers. Appl Ergon. 2012;43(2):376–385. doi:10.1016/j.apergo.2011.05.015
[40] Ekinci Y, Atasavun Uysal S, Kabak VY, et al. Does ergonomics training have an effect on body posture during computer usage? J Back Musculoskelet Rehabil. 2019;32(2):191–195. doi:10.3233/BMR-181196
[41] Poochada W, Chaiklieng S. Ergonomic risk assessment among call center workers. Procedia Manuf. 2015;3:4613–4620. doi:10.1016/j.promfg.2015.07.543
[42] Dusefante A, Flego A, Dallan G, et al. Tailored physiotherapeutic intervention for musculoskeletal disorders among video display terminal users: a case–control study. Med del Lav. 2022;113(2):e2022012. doi:10.23749/mdl.v113i2.12498
[43] Mirmohammadi SJ, Mehrparvar AH, Olia MB, et al. Effects of training intervention on non-ergonomic positions among video display terminals (VDT) users. Work. 2012;42(3):429–433. doi:10.3233/WOR-2012-1400
[44] Arabian FA, Motamedzade M, Golmohammadi R, et al. The impact of ergonomics intervention on musculoskeletal disorders among Nahavand Alimoradian hospital staff. Iran J Ergon. 2013;1(1):23–32.
[45] Shariat A, Cleland JA, Danaee M, et al. Effects of stretching exercise training and ergonomic modifications on musculoskeletal discomforts of office workers: a randomized controlled trial. Brazil J Phys Therapy. 2018;22(2):144–153. doi:10.1016/j.bjpt.2017.09.003
[46] Robertson MM, Huang Y-H, Larson N. The relationship among computer work, environmental design, and musculoskeletal and visual discomfort: examining the moderating role of supervisory relations and co-worker support. Int Arch Occup Environ Health. 2016;89:7–22. doi:10.1007/s00420-015-1046-x
[47] Brakenridge CL, Chong YY, Winkler EAH, et al. Evaluating short-term musculoskeletal pain changes in desk-based workers receiving a workplace sitting-reduction intervention. Int J Environ Res Public Health. 2018;15(9):1975. doi:10.3390/ijerph15091975
[48] Agarwal S, Steinmaus C, Harris-Adamson C. Sit–stand workstations and impact on low back discomfort: a systematic review and meta-analysis. Ergonomics. 2018;61(4):538–552. doi:10.1080/00140139.2017.1402960
[49] Park JH, Srinivasan D. The effects of prolonged sitting: standing, and an alternating sit–stand pattern on trunk mechanical stiffness, trunk muscle activation and low back discomfort. Ergonomics. 2021;64(8):983–994. doi:10.1080/00140139.2021.1886333
[50] Hoe VCW, Urquhart DM, Kelsall HL, et al. Ergonomic design and training for preventing work-related musculoskeletal disorders of the upper limb and neck in adults. Cochrane Database Syst Rev. 2012;8:CD008570. doi:10.1002/14651858.CD008570
[51] Luger T, Maher CG, Rieger MA, et al. Work-break schedules for preventing musculoskeletal symptoms and disorders in healthy workers. Cochrane Database Syst Rev. 2019;7:CD012886. doi:10.1002/14651858.CD012886
[52] Parry SP, Coenen P, Shrestha N, et al. Workplace interventions for increasing standing or walking for decreasing musculoskeletal symptoms in sedentary workers. Cochrane Database Syst Rev. 2019;11:CD012487. doi:10.1002/14651858.CD012487