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Ergonomic intervention, workplace exercises and musculoskeletal complaints: a comparative study

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Abstract

Background: Musculoskeletal disorders are among the most prevalent occupational disorders in different jobs such as office work. Some interventions such as ergonomic modifications and workplace exercises are introduced as the methods for alleviating these disorders. In this study we compared the effect of ergonomic modifications and workplace exercises on musculoskeletal pain and discomfort in a group of office workers.

Methods: In an interventional study on office workers, the effect of two interventions was compared. Ergonomic modification consisted of correcting the arrangement of workstation and changing some equipment; workplace exercises included stretching exercises focusing on neck, shoulders, low back, and hand and wrist. Musculoskeletal complaints were assessed and compared before and after 1 month interventions.

Results: The frequency of musculoskeletal complaints was high before the study. Both interventions significantly reduced complaints in a similar manner except for low back pain which was reduced in exercise group more than the other group.

Conclusion: In this study we found a beneficial short-term effect for both ergonomic modifications and stretching work-place exercises on reducing musculoskeletal pain in office workers.

Keywords: Musculoskeletal diseases, Ergonomic modification, Stretching exercises, Office worker.

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Introduction

Musculoskeletal disorders are among the most prevalent occupational disorders in different jobs. There is substantial evidence that such ergonomic risk factors as repetition, awkward posture, contact stress and force if overcome worker's biomechanical capabilities may lead to work-related musculoskeletal disorders (WMSDs) (1). It is said that WMSDs are leading causes of absenteeism and disability (2, 3).

Office work due to computer use is now a job with a high prevalence of WMSDs (4). Most office workers now routinely use a computer and its accessories as a part of their equipment in the workplace and this equipment creates many ergonomic risk factors, especially awkward postures (5). Therefore, musculoskeletal complaints in different parts of the body, especially, neck, shoulder, wrist and hand are common in this occupational group (6, 7). Some studies have shown an incidence of about 50% for WMSDs among video display terminal (VDT) users in different parts of the body (5, 8).

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In order to overcome musculoskeletal disorders or symptoms, some interventions are used such as training, ergonomic modifications, rest breaks, and workplace exercises with various effects (9-16).

It is obviously proved in several studies that ergonomic modifications can decrease the frequency of musculoskeletal pain or discomfort among office workers. Amick et al. assessed this effect after changing the chairs in an office environment and found considerable results (9), they also found that training alone can also reduce the frequency of MSDs although to a level lower than ergonomic change; this result was also observed in the authors' previous study on office workers (14). Arnetz et al. found that workplace ergonomic intervention can decrease absenteeism among office workers (17).

Although it has been shown in some studies that ergonomic modifications are significantly effective for alleviating MSDs, they are costly, which is an important issue especially in developing countries. Thus considering other interventions such as training, rest breaks, or workplace exercises are probably more practical in these countries.

Some studies have shown that installing ergonomic programs based on training, or workplace exercises are also effective in reducing of WMSDs. Authors in their previous study found a beneficial effect for training in reduction of awkward postures (14). Tsauo et al. found a beneficial effect for an intensive team-exercise program in reducing neck and shoulder symptoms in sedentary workers (18). Coury et al. in a systematic review found that workplace exercises can significantly reduce neck pain among office workers, although this effect was not significant for other parts of the body (19).

Although studies have shown a beneficial effect for ergonomic modifications and exercise, compliance especially over time is a concern (20). In another hand, some studies have failed to show a significant effect for ergonomic modifications or exercise. (13). A systematic review conducted by Verhagen et al. failed to show a clear effect of some ergonomic modifications and exercises on work-related complaints of the arm, neck and shoulder (16).

In this study, we aimed to evaluate and compare the effect of ergonomic modifications and workplace exercises on musculoskeletal pain and discomfort in a group of office workers.

Methods

This was an interventional study conducted on 184 office workers. According to previous studies sample size was calculated to be at least 80 subjects for each group (13).

Subjects

Two departments in the central office of the university were selected to join the study and subjects in each department were assigned in the same intervention program to avoid contamination between groups. Two groups were working in different buildings of an office with similar jobs and similar environmental conditions (lighting, temperature and dampness). All subjects in both departments were office workers who worked on a VDT most of their working time. Their job was sedentary in a 7-hour morning shift (from 8 AM to 3 PM). They had half an hour rest period at 1:30 PM for praying. They worked at least 3 hours on a computer workstation and were sitting on a chair more than 5 hours during their work shift.

The intervention in two groups included the following activities: One group received ergonomic modifications in their workstation and equipment and the other received training to exercise regularly in the workplace. Those with previous known musculoskeletal diseases and those with second jobs containing ergonomic hazards were excluded from the study. Eight subjects in the first group (3 due to job change, 3 due to previous diseases and 2 due to second job) and 12 subjects in the second group (1 due to job change, 4 due to previous diseases and 7 due to second job) were

excluded from the study at the beginning or during the study.

Musculoskeletal complaints were assessed by Nordic questionnaire (25) before and after intervention and the change after intervention was compared between two groups. An informed consent was obtained from each participant.

Intervention

All workstations in the first group (ergonomic modification), were surveyed by two occupational medicine specialists and one industrial hygienist in order to find non-ergonomic conditions and equipment. Then the arrangement of the equipment was corrected according to ergonomic rules (change in desk placement, seat height, position of keyboard, mouse and monitor) using OSHA VDT workstation checklist (21, 22), and non-ergonomic equipment (including mouse, keyboard, and mouse pad) were changed and copy holder and foot rest were added to the workstation when needed. No change was performed in the chair and desk due to monetary limitations of the study.

In the second group (exercise) a workplace exercise program was planned for all participants. The program consisted of two 1-quarter periods of office exercises including stretching exercises focusing on neck, shoulder, wrist, back and low back at 10 AM and 12. After assessment of musculoskeletal complaints, all participants in the second group participated in a training session (1 hour in 20-person groups) about exercises and all planned exercises were explained to them by an occupational medicine specialist through an oral lecture. In these training sessions, exercises were presented using pictures. After the training session a poster containing the picture of

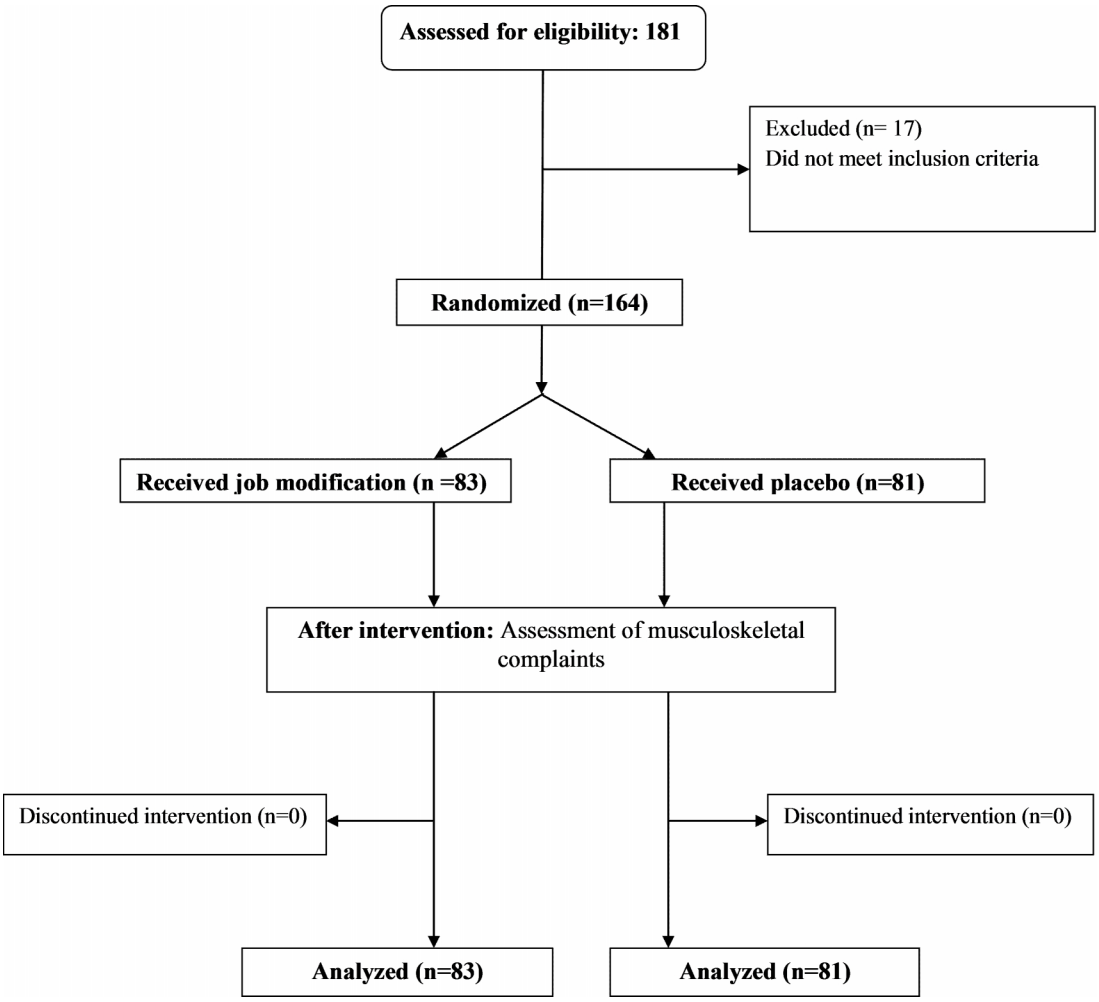

Diagram 1. The allocation of two groups

exercises and a brief explanation sent to their e-mail and they were asked to do exercises regularly at the planned times. An occupational medicine resident supervised the exercises every other day.

One month after the interventions, participants were assessed again by the same questionnaire.

The study was sponsored by Shahid Sadoughi University of Medical Sciences and approved by ethics committee of the university. Data was analyzed by SPSS software (ver. 19) using independent samples or paired samples T-test and chi square or Mc Nemar test.

Results

In total 181 subjects were selected, and after considering exclusion criteria, 164 individuals enrolled the study (83 subjects in the ergonomic modification and 81 in the exercise group). Diagram 1 shows subjects' allocation in two groups. Gender distribution was similar in both groups (49% males and 51% females).

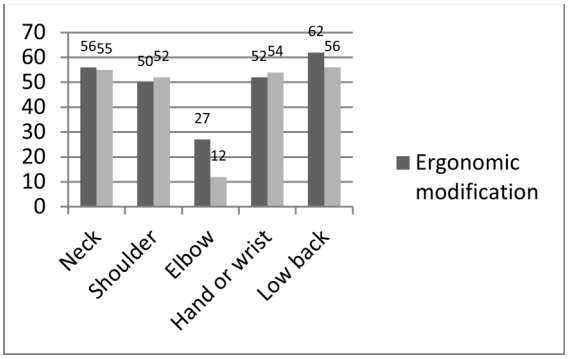

Fig. 1. Frequency of musculoskeletal complaints in two groups before intervention.

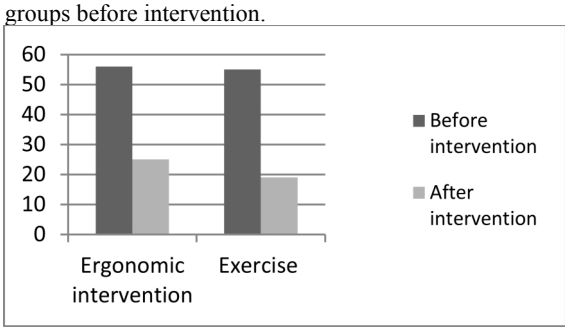

Fig.2. Reduction of the musculoskeletal complaints in neck.

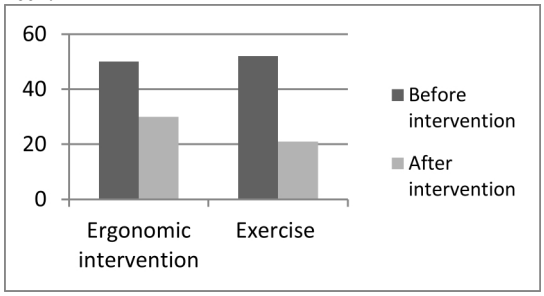

Fig. 3. Reduction of the musculoskeletal complaints in shoulder.

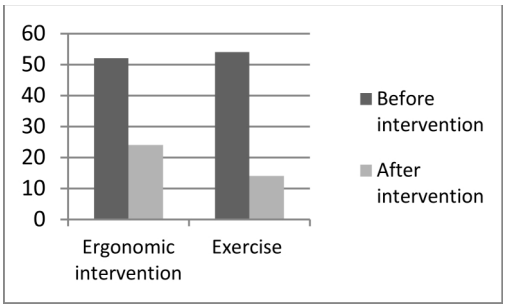

Fig. 4. Reduction of the musculoskeletal complaints in wrist/hand.

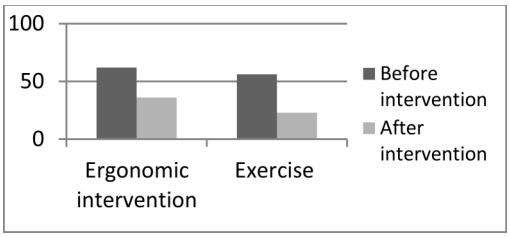

Fig. 5. Reduction of the musculoskeletal complaints in low back area.

Body part with the most frequent complaints was low back. There was no difference between two groups regarding the frequency of musculoskeletal complaints in different parts of the body before intervention except for elbow. The ergonomic modification group complained of more symptoms in the elbow than exercise group. Figure 1 shows this comparison.

There was a significant reduction (partial or complete improvement) in musculoskeletal complaints after intervention in both groups. We could not find any significant difference between two groups in neck, shoulder, hand and wrist after the interventions (p= 0.508, 0.243, and 0.575, respectively for each area). Although change in the frequency of musculoskeletal symptoms in low back area was significantly higher in the exercise group (p= 0.03). Figures 2 through 5 show the changes in the frequency of musculoskeletal complaints in different parts of the body.

Table 1. Demographic variables in the study groups (ergonomic modification and exercise).

Variables	Study groups**	Mean	SD*	P value
Age	1	38.95	7.48	.650
	2	38.40	8.00	
Work experience	1	15.09	7.30	.077
	2	14.07	7.14	
BMI	1	24.86	3.30	.29
	2	26.04	3.48	

* SD: standard deviation, ** 1: Ergonomic modification group, 2: Exercise group

Table 2. Characteristics of musculoskeletal complaints in different parts of body in both groups before intervention.

Complaints		Frequency in different parts of body, N (%)							
		Group							
		Job modification				Exercise			
		Neck	Shoulder	Low back	Wrist and hand	Neck	Shoulder	Low back	Wrist and hand
Pain severity	Mild	12 (14.45)	20 (24.09)	13 (15.66)	12 (14.45)	14 (17.28)	18 (22.22)	19 (23.46)	16 (19.75)
	Moderate	38 (45.78)	27 (32.53)	33 (39.75)	26 (31.32)	35 (43.21)	27 (32.23)	26 (32.09)	35 (43.21)
	Severe	8 (9.64)	2 (2.41)	18 (21.68)	14 (16.86)	11 (13.58)	10 (12.34)	15 (18.52)	17 (20.98)
Pain frequency	Only once	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.23)	1 (1.23)	2 (2.47)	2 (2.47)
	More than once, not every day	36 (43.37)	34 (40.97)	41 (49.38)	29 (34.93)	50 (61.5)	43 (53.07)	44 (56.78)	51 (62.95)
	Every day	21 (25.30)	14 (16.87)	22 (26.50)	23 (27.71)	9 (11.11)	10 (12.34)	12 (14.81)	4 (4.94)
Pain duration	Less than 1 day	19 (22.89)	25 (30.12)	14 (16.86)	22 (26.51)	25 (30.84)	25 (30.86)	28 (34.57)	26 (32.09)
	1-7 days	23 (27.71)	23 (27.71)	28 (33.73)	19 (22.89)	39 (48.15)	35 (43.21)	34 (41.97)	36 (44.44)
	> 7 days	32 (38.55)	21 (25.3)	34 (40.95)	30 (36.13)	14 (17.28)	18 (22.22)	18 (22.22)	16 (19.75)
Absenteeism due to pain		13 (15.66)	4 (4.82)	17 (20.38)	7 (8.43)	7 (8.43)	11 (13.58)	22 (27.16)	8 (9.87)

Discussion

Computer work is one of the main jobs which may lead to several kinds of musculoskeletal symptoms and discomfort. Ergonomic interventions by modifications in the equipment or arrangement of the workstation, training, rest breaks and workplace exercises have been proved to reduce musculoskeletal symptoms in many workplaces, especially office work. The strongest improvements have been observed by ergonomic modifications, but some of these modifications are costly and difficult to recommend in many workplaces especially in developing countries.

In this study, we compared the effect of workplace exercises, as a more practical intervention, and ergonomic modifications in reducing the frequency of musculoskeletal complaints among office workers.

The frequency of musculoskeletal complaints was high in this study. We found a significant reduction in musculoskeletal complaints one month after both interventions which was consistent with some previous studies, the efficacy of both ergonomic modifications and workplace exercises (9, 17, 23-25). This change was observed in the most important at risk areas of body (i.e. neck, shoulder, hand and wrist and low back).

Regarding ergonomic modifications, we could change the arrangement of workstation and some non-ergonomic equipment. We were unable to modify non-ergonomic chairs or desks due to monetary limitations, thus our focus was on neck and hand/wrist more than other parts of the

body. We found a significant reduction of musculoskeletal complaints in neck, shoulder, hand/wrist and low back. This result was also observed in the exercise group. The improvement in musculoskeletal complaints was similar in both groups except for low back region in which the effect of workplace exercises was more than ergonomic interventions. This was probably due to our limitation for changing chair or desk, but our exercise program included exercises for back and low back regions as well. In this study we assessed only short-term effects of the interventions after one month. More studies are required to assess long-term effect and durability of the interventions.

Anderson et al., consistent with the results of the current study, showed the positive effect of exercise on neck, although they used specific strengthening but we used some stretching exercises. They also assessed the effect of general fitness training which showed a small acute pain reduction (23). Alexandre et al. found a positive effect of exercise on low back pain among nursing personnel, although their exercise program was different from ours (24).

Amick et al. found a clear effect after using ergonomic chair with training (9). Sjogren et al. in a cluster randomized controlled trial evaluated the effects of a workplace physical exercise intervention on the intensity of symptoms in the neck and shoulders and found that physical exercise intervention resulted in a slight, but statistically significant decrease in the intensity of neck symptoms. The intervention had no effect on the intensity of shoulder symptoms (25).

Sihawong et al. in a literature review assessed the effectiveness of various types of exercise for prevention and treatment of nonspecific neck pain in office workers and found a positive effect for muscle strengthening or endurance exercises (26).

Boocock et al. in a systematic review found that the use of some mechanical and modifier

interventions were effective in preventing and managing neck/upper extremity musculoskeletal conditions and fibromyalgia (27). Tsaou et al. found that an intensive team-exercise program was beneficial for alleviating neck and shoulder symptoms in sedentary workers which is in agreement with the results of the current study (18).

Maher et al. in a systematic review of randomized controlled trials showed that workplace exercise was effective, but education ineffective, and workplace modification plus education was of unknown value in preventing low back pain (13) which is in contrast to the results we found in this study, although ergonomic modifications and workplace exercise programs were various in different studies.

Maul et al. found that supervised physical training could effectively improve functional capacity and reduced low back pain. This study showed a long-term benefit for training as well (28). In the current study we assessed only the short-term effect of exercise.

Van Poppel et al. could not find a beneficial effect for lumbar supports, education, or exercise in the primary prevention of low back pain at the workplace which was contrary to the results of the current study (29).

This study had some limitations: Our study suffered from monetary deficiencies, hence our ergonomic modification was not complete and we could not change non-ergonomic chairs or desks.

Conclusion

There is inconsistency between the results of different studies about the effect of exercise or ergonomic modifications on alleviating musculoskeletal complaints or disorders. One of the principal explanations for this inconsistency could be different methods of the interventions. In this study we found a beneficial short-term effect for both ergonomic modifications and stretching work-place exercises on reducing musculoskeletal complaints in office workers.

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