Assessment of Manual Material Lifting and Comparison of Oral and Booklet Training Intervention for Improvement of Working Conditions in a Porcelain Production Industry: A Randomized Controlled Trial

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Abstract

Background: Proper training on how to correctly handle loads is one key point for prevention of low back disorders. This study was conducted with the objectives of assessing manual material lifting activities and comparing two methods of training intervention in a porcelain company.

Methods: In this randomized controlled trial which was conducted in a porcelain company, all male employees with lifting activities (n=204) participated. The data were collected using Nordic Musculoskeletal Disorders Questionnaire and Lift/Lower Force Risk Assessment software for assessing manual material lifting. Intervention methods included booklet and oral training. Data were analyzed using Mann-Whitney U and Chi-square tests using SPSS software (Version 17.0).

Results: The most prevalent musculoskeletal disorders symptoms were reported in the knee (52.5%), feet (45.1%), and lower back (43.6%). Risk assessment before intervention showed that in 62.7% of the workers studied, the level of exposure to musculoskeletal risks was in Action Level (AL) 1, 31.9% in AL 2 and 5.4% in AL 3. The risk assessment after intervention showed that in 77.5% of the workers studied, the level of exposure to musculoskeletal risks was in Action Level (AL) 1, 20.6% in AL 2 and 2% in AL 3 (P<0.001). Also, statistical analysis revealed that oral training (24.5%) was more effective than the booklet training (11.8%) (P=0.018).

Conclusion: This study showed that training intervention could be effective in correction of methods of manual material lifting of workers. It seems oral training for workers of porcelain industry is more effective than the booklet training.

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Introduction

Despite the current knowledge on work-related musculoskeletal disorders (WMSDs), many occupations are still associated with strenuous working postures and movements combined with a heavy physical work load.[1]

Manual material handling is one of the major causes of severe industrial injury.[2] Some authors[3,4] have affirmed that musculoskeletal disorders and occupational injuries are a major occupational problem even in the highly industrialized countries. Back pain is very common among adults, especially engaged in manual material handling tasks. Also, in these workers the risk of developing lower back pain is high.[5] Optimal working techniques to prevent back pain and injuries when lifting heavy loads should be considered. Employers must ensure that workers receive proper training and information on how to handle loads correctly. Specific techniques have been advocated to reduce the load on the back.[6] The primary method for reducing the risk of musculoskeletal disorders among materials handlers is to provide engineering solutions. Another method for this purpose is providing training program. Training is an important complement to engineering intervention, but it is not a replacement for it.[7] Generally, four methods of training (including self-training, peer, e-learning and instructor-led (such as oral or booklet training) are used for behavior change of the personnel in the workplace. These methods are affected differently by characteristics of the organization, the worker's socio-technical environment, and the individual characteristics of the worker. Oral training is a proper way for training individuals with low level of education.[8]

In porcelain industry, employees are encountered with diverse musculoskeletal disorder risk factors. For instance, long hours of activities such as handling heavy loads are observed among workers. The average weight of loads handled in this industry is about 20 kg and the minimum and maximum of load weight are 10 and 40 kg, respectively. The frequency of lifting loads is high in this industry (e.g. 250 times per day). In such situations, the high rate of musculoskeletal symptoms particularly in the lower back is expected in employees.

To the best of our knowledge, no ergonomics study has been conducted on musculoskeletal symptoms in porcelain industry. The present study was, therefore, undertaken in this industry with the following aims:

1- Assessment of lifting loads among workers

2- Determination and compression of effectiveness of two intervention methods (booklet and oral training) in correction of behavior patterns in the study population

It is believed that the results of this study can be an appropriate basis for planning and implementing interventional ergonomics programs in the workplace and improving the workers' health in this industry. Although some studies have separately been conducted on the effectiveness of oral[9] and booklet[10] training in Iran, there is no information regarding the difference between the two intervention methods of oral and booklet training on reduction of risk of musculoskeletal problems among workers in different industries.

Methods

In this randomized controlled trial study which was conducted in a porcelain factory in Shiraz (Iran) in 2013, all male employees engaged in lifting activities (341) were invited and/or their eligibility for entering the study were assessed. 204 eligible individual volunteered to take part in the study with at least one year of job tenure. All the subjects voluntarily participated in the study after being informed about the aims of the study. Also, the participants signed an informed consent form before commencement of the study. Employees with a history of any diseases or accidents (such as occupational and road accidents) affecting the musculoskeletal system and/or methods of manual material lifting were excluded from the study. In order to determine the effectiveness of the intervention methods (booklet and oral training), the participants were randomly divided into two groups.

Data Gathering Tools and Study Procedure

An anonymous self-administered questionnaire was used to collect the required data from each subject. The questionnaire consisted of 2 parts:

(a) Personal details (including age, weight, height, job tenure, daily working time, marital status, education, type of employment and working schedule).

(b) The general Nordic Questionnaire of musculoskeletal (NMQ) symptoms to examine reported cases of musculoskeletal disorders in different body regions among the study population.[11] Reported musculoskeletal symptoms were limited to the previous 12 months. The validity and reliability of the Persian version of NMQ had been perused in Choobineh and colleagues' study.[12] Each participant received the questionnaire in person in his workplace. The questionnaire was completed by workers during the shift while performing their jobs in presence of an ergonomist. Manual material lifting is one of risk factors that can be effective on the occurance of MSDs (especially low back pain).[13,14]

In order to assess lifting load activities, Lift/Lower Force Risk Assessment software was used.[15] In this software, items including weight (kg or lbs), distance of object from the body (closest distance, to 18 cm and to 30 cm from body), lifting zone (floor to knee, knee to knuckle, knuckle to shoulder, shoulder to arm reach), lower back twist (≤45° and 45°<), lifting frequency (1 to 10 lift per minute) and number of hours of lifting per day (≤1 hr, 1-2 hr and 2hr≤) are considered. After assessing by this software, each case was interpreted in accordance to the Action Levels (AL) described below:

Action Level 1= The person is lifting the load in the best condition with no risk of injury of the spine.

Action Level 2= The person is lifting the load that could present some risk of injury of the spine, so this should be investigated and corrected.

Action Level 3= The person is lifting the load in the worst condition with an immediate risk of injury of the spine, and the reasons for this need to be investigated and changed immediately to prevent an injury.

After assessment of manual lifting activities, the intervention program including two methods of training (i.e. booklet and oral training) was implemented. Subjects were randomly divided into two groups using a blocked randomization method. Half of the individuals (102 subjects) were put in the booklet training group and the others (102 subjects) in the oral training group.

In the oral training method, the workers received 1.5 hours of practical training related to proper load lifting techniques maximum acceptable weight of load and proper body posture. In the booklet training method, the same items were presented to the workers. It should be noted that the booklet and oral training were prepared by the researchers. Figure 1 presents the flow diagram of CONSORT (Consolidated Standards of Reporting Trials).

After one month[16] of implementing the interventional training, the subjects were assessed again using Lift/Lower Force Risk Assessment software.

Data Analysis

Statistical analyses were performed using SPSS (version 17). The normal distribution of data was assessed using Kolmogorov-Smirnov test. Mann-Whitney U test was used to examine the differences of demographic and occupational characteristics (age, weight, height, and job tenure) of the workers of the two groups. Chi-square test was used to compare the two methods of intervention (booklet and oral training). The level of significant was set on 0.05.

Results

Table 1 summarizes personal details of the workers participating in the study. Statistical analysis using Mann-Whitney U test showed that the two groups were not significantly different ($P<0.05$) in terms of demographic and occupational characteristics (age, weight, height, job tenure, and educational level).

The results of NMQ showed that the knee (52.5%), feet (45.1%) and lower back (43.6%) symptoms were the most prevalent problems among the studied workers. Table 2 presents the prevalence of MSDs symptoms in different body regions of the workers during the last 12 months before implementation of intervention.

The results of the risk assessment by Lift/Lower Force Risk Assessment software in all workers (n=204) showed that in 62.7% of the workers studied, the level of exposure to musculoskeletal risks was in Action Level (AL) 1, 31.9% in AL 2 and 5.4% in

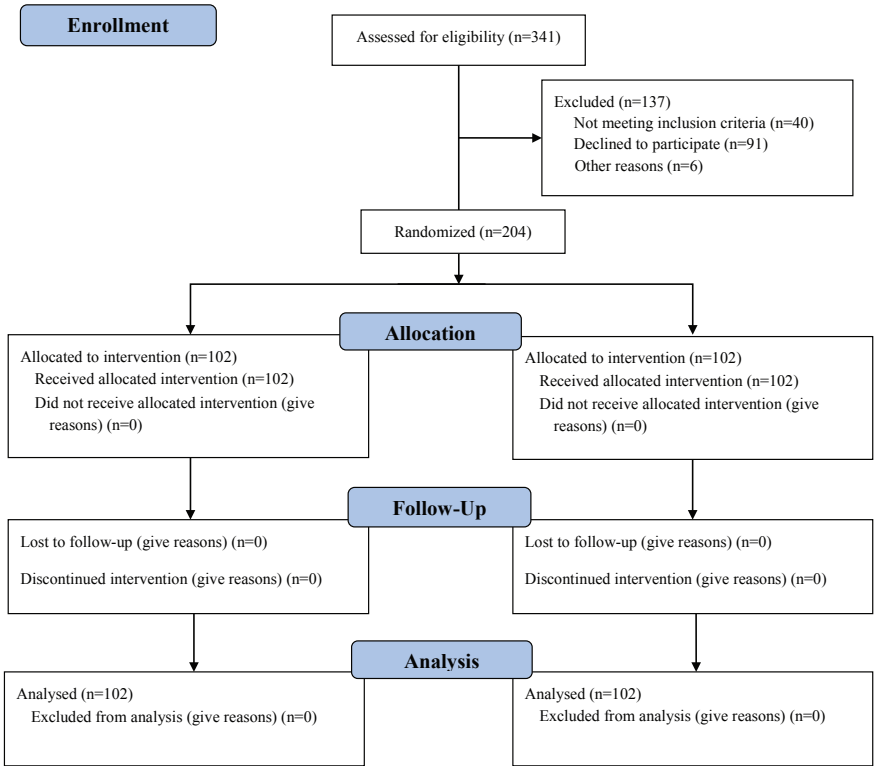

Figure 1: The flow diagram of CONSORT

Table 1: Some personal details of the workers participating in the study

Variable		Group 1* (n=102)	Group 2** (n=102)	P value
Age (yrs)	Mean (SD)	35.41 (6.48)	33.61 (6.94)	0.058†
	Min – Max	21-48	23-51	
Weight (kg)	Mean (SD)	75.23 (9.78)	74.32 (10.92)	0.535†
	Min – Max	50-115	52-104	
Height (cm)	Mean (SD)	174.29 (6.48)	174.02 (7.45)	0.792†
	Min – Max	140-181	158-190	
Job tenure (yrs)	Mean (SD)	11.57 (5.72)	10.02 (6.05)	0.075†
	Min – Max	1-21	3-19	
Educational level	Without academic degree	99 (50.26)	98 (49.74%)	0.201††
	With academic degree	3 (42.85%)	4 (57.15)	

*Workers with booklet training; **workers with oral training; †Mann-Whitney U test; ††Chi-Square test

Table 2: Frequency of reported musculoskeletal symptoms in different body regions among the studied workers during the last 12 months (n=204)

Body region	Yes	
	No.	%
Neck	66	32.4
Shoulders	84	41.2
Elbows	47	23
Wrists/Hands	73	35.8
Upper back	70	34.3
Lower back	89	43.6
Thighs	46	22.5
Knees	107	52.5
Feet and Ankles	92	45.1

AL 3. In Table 3, frequency of subjects in different risk levels in the two methods of intervention groups (booklet training (group 1) and oral training (group 2) before and after the intervention is presented and compared. This results showed that there was a significant difference between the risk level before and after the intervention (P<0.001) in both groups. This means that the risk level decreased after the intervention in the two training methods.

In Table 4, the effectiveness of each intervention method by examining the changes in risk levels with the type of intervention is presented. First, the subjects were divided into two groups including one subject with no change in the level of risk.

As demonstrated in Table 4, the level of risk did not increase in either case. Association between changes in risk levels and type of intervention was examined and compared. In the intervention group of booklet training, 88.2% of workers had remained at the same level and in 11.8% of the subjects the risk level reduced. In the intervention group of oral training, 77.5% of workers remained unchanged and in 24.5% of the individuals the risk level reduced. Statistical analysis using Chi-square test showed that the oral training method was more effective than booklet training (P=0.018).

Discussion

The results of NMQ showed that the knee, feet and lower back symptoms were the most prevalent problem among

Table 3: Distribution of subjects with different levels of risk in groups 1 and 2 before and after the intervention

Level of risk	Booklet training (n=102)		P value†	Oral training (n=102)		P value*
	Before No. (%)	After No. (%)		Before No. (%)	After No. (%)	
Low	63 (61.8%)	73 (71.5%)	<0.001	65 (63.7%)	85 (83.3%)	<0.001
Moderate	35 (34.4%)	27 (26.5%)		30 (29.4%)	15 (14.7%)	
High	4 (3.8%)	2 (2.0%)		7 (6.9%)	2 (2،0%)	

*Chi square test

Table 4: Changes in the level of risk between the two groups

Change in level of risk	Booklet training	Oral training	P value*
	No. (%)	No. (%)	
No change	90 (88.2%)	77 (77.5%)	0.018
Reduced	12 (11.8%)	25 (24.5%)	

*Chi square test

the studied workers, respectively. In employees with manual material handling, the lower back symptoms have been reported to be the most prevalent problems.[17] These findings are different from the results of Habibi and colleagues[18] and Nasle Seraji and colleagues'[19] studies. In the porcelain factory, the workers worked in standing posture for a long time. This situation induced pressure on the lower extremities, especially the knees.

The results of the risk assessment by Lift/Lower Force Risk Assessment software showed that a high percentage of workers were encountered with MSDs risk factors and corrective actions and ergonomics intervention had to be taken into account with high priority.

The results revealed that ergonomics intervention (booklet and oral training) was effective in correction of behavior patterns. This finding was in line with the result of Snook and colleagues' study, indicating that manual material lifting training could be effective in control of low back disorders.[20] Also, the result of this study confirmed the findings of Marras and colleagues[21] and Mullen and colleagues'[22] studies that showed ergonomics intervention was effective on methods of lifting of loads in manual material handling activities. The results of this study was in line with the results of Saremi's[23] study, showing that after the ergonomics intervention of training, the working posture was improved.

These results showed that the training intervention through booklet was effective but as demonstrated in Table 4 the effect of this intervention method was less than oral training. The results are in line with those of Zeidi and colleagues'[9] study that showed effectiveness of oral training intervention in correction of body postures in video display terminal users. In oral training, the proper perspective and orientation of a subject can be presented. Also, in this method, greater attention could be secured and maintained, as interest leads to attention and spoken word has greater weight than mute appeal by books.[10]

Also, the results of this study were in line with the findings of Zeidi and colleagues,[24] indicating that oral training might improve the behavior, knowledge and attitude of people during the work.

The comparison of two methods of training (oral and booklet training) among workers involved in manual material lifting activities is the strong point of this study. Since the subjects participating in the present study were all male and from a porcelain factory, so the results of this study should be used with caution for female workers and other industries. Also, to obtain accurate results about the effectiveness of training intervention there is a need to long term (at least 12 months) studies on the two assessments of manual material handling activities (initial and later assessment).

Conclusion

The results of this study showed that the knee, feet and lower back symptoms were the most prevalent problems among the studied workers. The results of the low back disorders risk assessment showed that in a high proportion of workers studied, the level of exposure to musculoskeletal risks was in the high or very high action level. The results showed that training intervention can be effective in correction of behavior patterns of workers. Oral training was more effective than the booklet training. This method of intervention (oral training) is recommended for prevention of back disorders caused by manual material lifting in this industry and other similar industries.

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