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Ergonomic Evaluation of Occupational Tasks in a Sofa Making Workshop Based on KIM and Presentation of Corrective Actions

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Abstract

Aims: Manual tasks and load carrying and handling are the most important tasks in a sofa making workshop. Evaluation of these types of tasks is very important for identifying the health risks to which workers are exposed. The aim of this study was the ergonomic evaluation of occupational tasks in a sofa making workshop based on KIM and presentation of corrective actions.

Instruments & Methods: The present descriptive cross-sectional study was conducted in a sofa making workshop in Ardabil in 2017. All tasks of the sofa making workers (n=22) were examined, among which 7 main tasks were identified. The identified tasks were analyzed, using KLM-MHO and KLM-LHC methods. Manual tasks and load lifting and carrying tasks were evaluated, scored, and checked out, using EXCELL 2010.

Findings: Among the tasks examined, the tasks of woodcarving, preparation for coloring, and sofa dressing showed the highest final score (Risk Grade 4), followed by jointing wood parts with glue and coloring (Risk Grade 3). Most items with high workload were related to grips status, repetitive movement in the hand-finger area, position and repetitive movements of the joints at the end of motion range, and curved forward trunk posture.

Conclusion: In carving, preparation for coloring, and dressing tasks, the amount of workload is high. In jointing wood parts with glue and coloring tasks, the amount of workload increases dramatically. And, in designing layout on wood and cutting tasks, the amount of load increases.

Keywords
Ergonomic Assessment [https://www.ncbi.nlm.nih.gov/mesh/68006804];
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Introduction

Musculoskeletal disorders are one of the common occupational diseases in industrial environments, which are caused by various factors. Musculoskeletal complications related to occupational tasks are considered as the main cause of losing work time, increased costs, and damage to human workforce and one of the major problems in developed and developing countries [1].

The highest rates of musculoskeletal disorders are observed in 5 main subcategories: furniture workshops and wholesalers; food products and related products; metal, mineral, and motor vehicles industries [2].

The sofa making industry in the country is in the form of small workshop units, in which many tasks are done manually. Exerting pressure on the arms, hands, and fingers while carrying hand-held objects and loads are the most demanding tasks in a sofa making workshop; therefore, the evaluation of these types of tasks is very important for identifying the health risks, to which workers are exposed [3].

One of the methods for evaluating the work environment conditions is physical evaluation. It is essential for many researchers to use physical methods to evaluate the ways, in which tasks are performed in any industrial facility [4]. Workers' body posture and ergonomic conditions during work time can be evaluated in a variety of ways, including Quick Exposure Check (QEC), Rapid Upper Limb Assessments (RULA)، and Ovako Working Posture Analysis System (OWAS).

In order to evaluate the work conditions associated with occupational tasks of sofa making workers, a method called Key Indicator Method (KIM) was presented by the Federal Institute for Occupational Safety and Health (BAUA) in Germany during 2001 to 2007. The KIM is one of the most complete and valid methods of evaluating manual and load carrying tasks. KIM–LHC (Lifting, Holding, and Carrying) method can be used to evaluate lifting, holding, and carrying tasks. The KIM-MHO (Manual Handling Operations) method is used to evaluate the activities, in which the pressure and force is exerted on arms, hands, and fingers while carrying objects manually. KIM-PP (Puling and pushing) method can be used to evaluate the tasks of pulling and pushing. The use of KIM evaluation technique is easy, by which comparative and quantitative results are presented, and the degree of intervention (redesigning work environment or health care) is determined [5].

The aim of this study was the ergonomic evaluation of occupational tasks in a sofa making workshop based on KIM and presentation of corrective actions.

Instrument and Methods

The present descriptive cross-sectional study was conducted in a sofa making workshop in Ardabil in 2017.

All tasks of the sofa making workers (n=22) were examined, among which 7 main tasks were identified, in which the workers were busy with the greatest amount of work time during a work shift, and the probability of musculoskeletal disorders was high. Then, information about the posture status was collected by observation, interview, photo, and video. The tasks of designing layout on wood, woodcutting, and carving, joining parts with wood glue, preparation for coloring, coloring, dressing, and carrying loads were selected for evaluation. The KIM-MHO and KIM-LHC worksheets were completed for the selected tasks in accordance with the following steps:

In order to implement KIM-LHC technique, points were assigned to the time, load, posture, and work conditions and, ultimately, the final score was calculated, and corrective actions were determined [5].

Final Score = Time score × (work conditions points + posture points + load points)

Equation 1: Calculate the KIM-LHC final score

In order to implement the KIM-MHO technique, the points were assigned to the time, hand and finger, grip, hand and arm, work organization, work conditions, and posture, and at the end, the final score was calculated, and corrective actions were determined [6].

Final Score = Time score × (work conditions points + posture points + work Organization points + position and movement of hand and arm + transfer of force and grip + the use of hand and finger force)

Equation 2: Calculate the KIM-MHO final score

The final scores obtained in these 2 techniques were categorized as follows:

Final scores below 10 (Risk Domain 1): The amount of load is low, and the occurrence of additional physical load is unlikely.

Final scores of 10 to 25 (Risk Domain 2): The amount of load has increased, and additional physical load may occur for people over 40 and under 21 years; therefore, redesigning the work environment would be helpful for this group of people.

Final scores of 25 to 50 (Risk Domain 3): The amount of load has increased dramatically, and additional physical load may occur for ordinary

people; therefore, redesigning the work environment is recommended [7].

Final scores over 50 (Risk Domain 4): The amount of load is high, and additional physical load is likely to occur; therefore, redesigning the work environment is essential [8].

Findings

The useful work time of each person per work shift was 6 hours. In the task of carving, the grips did work hardly, and because of the sharp edges of objects, a lot of force was applied to the hands and fingers, and posture position was inappropriate while working. In the task of joining parts with wood glue, grips also did work hardly because of the sharp edges of objects, and the worker was placed in an inappropriate physical conditions. In the task of preparation for coloring, physical conditions was inappropriate (position and repetitive movements of joints at the end of motion range, and holding arms statically without hand and arm support), and exercising force on hands, fingers, and grips was inappropriate. In coloring task, mostly due to standing without any step, the curved forward trunk led to an inappropriate posture in the person. Sofa dressing with inappropriate physical condition caused force to be applied on hands, fingers, and grips inappropriately. In load carrying tasks, there was forward bending and twisting with heavy load.

Among the tasks examined, the tasks of woodcarving, preparation for coloring, and sofa dressing showed the highest final score (Risk Grade 4), followed by jointing wood parts with glue and coloring (Risk Grade 3). Most items with high workload were related to the grips statues, repetitive movement in the hand-finger area, the position and repetitive movements of joints at the end of motion range, and the curved forward trunk posture (Tables 1 and 2).

Table 1) Evaluation and final score of manual handling operations (KIM-MHO)

Tasks	Time	Hand/Finger	Grip	Hand/Arm	Work Organization	Work Conditions	Posture	Final Score
Designing layout on wood, cutting	3.5	2	2	2	0	0	1	24.5
Carving	3.5	4	4	2	2	0	3	52.5
Jointing parts with wood glue	3.5	1	4	2	2	0	4	45.5
Preparation for coloring	3.5	4	4	2	2	0	3	52.5
Coloring	3.5	1	2	1	0	1	3	28
Dressing	3.5	4	4	2	2	0	4	52.5

Table 2) Evaluation and final score of Lifting, Holding and Carrying (KIM-LHC)

Tasks	Time	Load	Posture	Work Conditions	Final Score
Load carrying	2	4	4	1	18

Discussion

In a study conducted by Rahimifard *et al*. [1], ergonomic problems in furniture workshops were due to the unfavorable general conditions, incorrect work organization, and inappropriate workstation.

In another study, it was shown that the prevalence rate of musculoskeletal disorders was high in the lower back, knees, legs, hands, and wrist, and the workers' body conditions needed to be corrected. These findings were consistent with the results of the current study.

In another study conducted by Moghadam *et al*. [9], in an assembly factory, due to the high prevalence rate of musculoskeletal disorders among the workers with low work experience, the workers expected to suffer from more disorders in the coming years. Therefore, it is necessary to prevent the occurrence of more musculoskeletal disorders in the future by appropriate training and management.

In a study carried out by Hokmabadi and Fallah, the training of proper load lifting techniques to workers reduced the amount of musculoskeletal disorders in building workers, which is also considered necessary for sofa making workers [10].

Similar to the present study, in a study performed by Habibi *et al*., the implementation of ergonomic (technical and managerial) interventions, preventive measures and educational programs were announced to be essential for workers in industries [11]. Lemasters *et al*. [12], in their study conducted on carpentry-related tasks, declared that training to workers had an important role in preventing the occurrence of musculoskeletal disorders. Reducing the risk of musculoskeletal disorders would lead to increased productivity [13]. Gauthier *et al*.'s study showed that 65% of the musculoskeletal disorders were related to the furniture industry [14].

Nicoletti *et al*.'s study conducted on musculoskeletal disorders related to the 3 major

furniture industries showed that among all factors affecting the risk of musculoskeletal disorders (frequency, force, condition, additional risk factors, pauses), posture seems to play a significant role [15].

To reduce the physical load to an acceptable risk domain, the following steps should be taken: training to workers in order to correct their postures and physical conditions, carrying load correctly, the use of proper gloves when taking sharp edges, the use of overhead lifters to shift heavy loads, replacing the tools (hammer, pen and blade) with ergonomic design, and doing work on wood parts using a work surface with a suitable height.

The study limits the lack of study of musculoskeletal discomfort among workers and its relation with the results of KIM's technique.

It is suggested that in subsequent studies, musculoskeletal disorders should be investigated with technique results.

Conclusion

In carving, preparation for coloring, and dressing tasks, the amount of workload is high, and it is likely to endanger the workers' health, and additional physical load is likely to occur; therefore, redesigning the work environment is essential. In jointing wood parts with glue and coloring tasks, the amount of workload increases dramatically, and the physical load may occur for ordinary people. Therefore, redesigning the work environment is recommended. In designing layout on wood and cutting tasks, the amount of load increases, and additional physical load may occur for people over 40 and under 21 years; therefore, for this group of people, redesigning the work environment would be useful.

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