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Original Article

Ergonomic Interventions in Workstations of an Assembly Company

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Abstract

Background & Aims: Currently, work-related musculoskeletal disorders (MSDs) are one of the main occupational health concerns. These disorders are particularly observed in the upper limbs in the assembly lines of production units. The aim of this study was to perform ergonomic interventions in the workstations of the assemblers of a manufacturing company in 2016.

Materials and Methods: In this cross-sectional study, 60 workers who were active in the production of auto equipment and gas control with at least 3 years of experience were randomly selected for evaluation. To evaluate the ergonomics activities, data were collected using a researcher-made demographic questionnaire and the Assessment Repetitive Tasks method, and the interventions were performed in this production unit. The statistical analysis of data was performed using SPSS software (Version 22) by comparing the mean of the assessment of repetitive task (ART) scores of a paired t-test.

Results: In an initial assessment of 60 people, 18% and 29% were at high and medium risk, respectively. To investigate the effect of the interventions, 39 people were selected from those who had moderate (64.10%) and high (5.2%) exposure risk and had similar workstations and equipment. The levels of exposure changed after performing engineering and management interventions in the workstations of these people. The number of people at the level of safe exposure was 30.70% before the intervention and increased to 53.85% after the intervention. The frequency of people at the moderate risk level decreased from 64% before intervention to 43% after the intervention, and the frequency of people at the high-risk level decreased from 5% to 2.5% ($P<0.05$).

Conclusion: Interventions in this industry confirmed the effectiveness of these methods in reducing MSDs, and it can be concluded that a variety of ergonomic interventions have been effective in decreasing disorders.

Keywords: Musculoskeletal disorders, Ergonomics, Methods, ART technique

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1. Introduction

Manpower is regarded as the largest capital of a country; the role of manpower in the economic and social development of societies should be considered more than any other major factor, and supporting it should be one of the main concerns of the owners of industries. It is also the most important force for the increase or decrease in productivity [1].

Musculoskeletal disorders (MSDs) affect muscles, nerves, blood vessels, ligaments, and tendons in all parts of the body. Workers in different industries and occupations can be exposed to risk factors such as lifting heavy objects, bending, reaching, pushing and pulling heavy loads, working in awkward body postures, and performing repetition tasks repetitively. Exposure to these known risk factors for MSDs increases the risk of injury to workers [2].

Work-related MSDs are the most common occupational problems worldwide worsened by physical and psychological factors in different occupations. Further, they are the most economically costly diseases, and the individual has to carry the cost, resulting in income loss and increasing poverty. The global burden of MSDs constitutes the second most common cause of disability that most frequently appears in the form of back pain, measured by years lived with disability [3].

These disorders occur in the upper and lower extremities of the body. Upper limb disorders (ULDs) are aches, pains, tension, and disorders involving any part of the arm from fingers to the shoulder or neck; they include problems with the soft tissues, muscles, tendons, and ligaments, along with the circulatory and nerve supply to the limb, and are often caused or made worse by work [4-6]. Studies have reported that poor posture, repetitive work, high force (e.g., exposed to higher loads), vibration, manual material handling, bending and twisting, and extreme temperatures are associated with work-related MSDs in the upper limbs of people working in manufacturing units. In addition, causal relationships have been found between some physical risk factors (e.g., poor posture and repetitive tasks) and neck, knee, or wrist pain among workers in various industries [6].

Pain in the neck and lower back is the most prevalent MSD, often leading to disability and sick leave. It has

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been reported as one of the most costly health problems in Western society. Previously, MSDs were defined as all complaints related to muscles, joints, tendons, ligaments, and bones [5].

The risk factors for MSDs are highly diverse, but awkward posture is one of their most important causes. These disorders will be reduced and eliminated by improving the awkward posture [7,8].

The assembly industry is one of the occupations that has risk factors such as frequent movements or workstation design and awkward postures for a long time, and workers' exposure to these factors causes high pressure on various organs and the possibility of MSDs between them [5].

Examining the ergonomic risks of repetitive movements in assemblers, Habibi et al reported high pain in the wrist and fingers with frequencies of > 86% and > 62%, respectively [9]. In another study performed by Choobineh et al on assemblers, the frequency of pain in the shoulder, knee, and back areas was 73%, 67%, and 66% [10]. Furthermore, the Malaysian Department of Occupational Safety and Health conducted an ergonomic risk assessment in the workplace of 86 medical equipment assembly workers in a multinational company in Malaysia. The results revealed that the lower back and shoulders were the most commonly injured parts of the body with the highest MSD severity. Also, the thumb, ring finger and middle finger had the highest MSD severity score in the right hand.

Management control, along with engineering control can play an important role in reducing MSDs. Among the management control methods are employee training, job rotation, and management of work and rest time, which is one of the most important intervention approaches for reducing the exposure of people to MSDs [11].

Some studies have evaluated the positive effect of educational interventions and proper adjustment of work equipment and workstation of workers on alleviating MSDs [12,13].

Several methods have been developed for the exposure assessment of MSD risk factors, mainly for the assessment of the upper limbs of the body, including the back, neck, shoulder, arms, and wrists. The assessment of repetitive tasks (ARTs) is one of the methods for investigating MSDs. This method was presented by the UK Health and Safety Committee. According to the above description and considering the wide range of disorders in most occupations, the use of appropriate methods and their analyses, the identification of MSDs risk factors, as well as the presentation and implementation of ergonomic intervention strategies to reduce the risk factors of MSDs are necessary [14-16].

The workstation has the most important role in increasing productivity in various industries. However, limited ergonomic studies have been performed in relation to the repetition of tasks in the workplace using the ART technique. Given the above-mentioned explanations, the importance of the subject, and upper extremity disorders, it is essential to study the risk factors affecting MSDs related to repetitive activities and to achieve corrective methods in this regard.

1. 1. Aims of the study

This study was performed to investigate the risk factors of MSDs using the ART technique in 2016 and ergonomic interventions, as well as the effect of ergonomic interventions in a gas production company.

2. Materials and Methods

This study was an interventional and cross-sectional study. Data were collected by simple random sampling of active workers in the production hall. It is noteworthy that workers in workstations performed their tasks standing and mostly sitting. It should be noted that more sitting positions were considered in this study. Data on MSDs were collected from 60 workers, including 15 (25%) females and 45 (75%) males (considering SD of 2, d of 0.7, the first type error of 5%, and the test power of 80%, and the number of samples was set to 60 people) at workstations, using the ART method [14]. The entry criteria were having permanent employment or at least 3 years of experience in the company and residing in Hamadan; because people at the beginning of work experience are probably less exposed to factors affecting MSDs (e.g., psychosocial factors and workload, and the like). Further, the results demonstrate fewer points, and the number of people at exposure levels will be less at risk. On the other hand, people with a history of trauma or fractures to the neck, elbows, back, and arms, a history of rheumatoid arthritis, arthritis, diabetes, or thyroid disease were excluded from the study because of the effects of these diseases on the musculoskeletal system. After coordination with the director of the occupational health and safety department, a list of basic tasks and absences from the musculoskeletal diseases of extremities limbs was prepared according to the number and type of work. The job assessment was concerned with the ergonomic risk factors related to head/neck, back, shoulder/arm, and wrist and hand/finger grip. The mentioned tasks were filmed in each unit, and the time required to photograph each task was at least 3 minutes. The captured videos for each task were used by the evaluators for the qualification and documentation of the tasks. The workers of the production line with ergonomic risk factors such as manual handling, pushing/pulling of the loads, force, awkward, finger grip and repetitive movements of upper limbs, and additional factors, including breaks, work speed, vibration, need for the accurate movements of the hand and feet, working time, and psychological factors were observed carefully [17]. Before the assessment, related licenses were received from the company's manager. The consent form was distributed among the workers, and they filled out the forms. Workers who were unwilling to cooperate were excluded from the study. Then, the samples were determined, and the study was conducted in three phases as follows:

Stage I. Initial Assessment of the Environment and Working Conditions:

1) Data collection using a demographic questionnaire (including variables of occupation, age, gender, height, weight, and work experience).

2) Assessment of the risk factors of MSDs:

The ART tool is used to identify, design, evaluate, manage, and monitor common risk factors and those that cause MSDs in the upper limbs [14,16].

After initially reviewing the documents of periodic examinations, observing different workstations, and interviewing workers and the person in charge of safety and health, it was found that employees perform additional tasks such as vibration exposure and use of gloves while working, along with inappropriate postures. MSDs in the upper limbs were assessed by the ART method.

The investigation represented that the ART tool has a substantial agreement of the inter-rater reliability (Cohen's kappa) value of 0.725-1.000 (left side) and 0.649-1.000 (right side), as well as the re-evaluation of the reliability of approved (Intra-class correlation coefficient) values of 0.741-1.000 (left side) and 0.651-1.000 (right side). The ART tool meets the requirements of reliability [18].

2. 1. Required equipment

The ART instrument is designed to help assess tasks that require the repetitive movement of the upper limbs (arms and hands). It further helps in assessing some of the common risk factors in repetitive work contributing to the development of ULDs.

The ART targets those responsible for designing, assessing, managing, and inspecting repetitive works. It can help identify tasks that involve significant risks and focus on risk-reduction measures.

Repetitive tasks are made up of a sequence of upper limb actions, which have a fairly short duration, are repeated many times and are almost always the same (e.g., stitching a piece of cloth, manufacturing one part, and packaging one item).

The ART is mostly suited for tasks that involve the actions of the upper limbs, are repeated every few minutes or even more frequently, and occur for at least 1-2 hours per day or shift.

The tasks are typically found in assembly, production, processing, packaging, packing, and sorting works, as well as works involving the regular use of hand tools.

The ART method and a pen were required for recording scores, observations, and employees' descriptions or opinions about their works, along with a watch or stopwatch and a video camera. One of the strengths of the ART method is that it provides a separate assessment for each risk factor, a risk level that is defined by three colors of green, yellow, and red for each score [14].

Stage I. Initial Assessment

The assessment ART is split into four stages as follows:

Stage A: Frequency and repetition of movements;

Stage B: Force;

Stage C: Awkward postures;

Stage D: Additional factors.

For each stage, the level of risk for each risk factor can be determined by following the flow chart and/or the assessment guide (Figure 1).

The task and exposure scores help prioritize the tasks that need the most urgent attention and help check the effect of any improvements. The colors assigned to the risk factors will help identify where to focus on risk-reduction measures. A system for interpreting the exposure score is proposed in Table 1.

For each stage, the flow chart and/or assessment guide should be followed for determining the level of risk for each risk factor. Table 1 classifies the levels of risk.

Stage II. Implementation of Interventions:

The draft HFES 100 standard provides specifications for the design of workstations. Previous research (Honan, 2015) suggests that desktop workstations remain a critical component of the workplace [11]. Due to the risk factors of MSDs, engineering and managerial interventions were performed in the workstations.

Stage III. Educational Interventions:

Training classes were held for the workers before the interventions and during the work for three months. The following items were taught to the participants.

Considering short-term and continuous break times during work, stretching exercises and work-related tasks were performed during long rest and even at home. Workers became aware of work-related MSDs, correct carrying and manual handling in the workplace, ergonomic seat workstation adjustment before working for proportion to the percentile of each person, how to sit on the chair properly, and how to walk and stand in accordance with ergonomic principles in the workplace, and were introduced with the ergonomic risk factors of the work environment [19].

Stage IV. Evaluating the Effectiveness of Interventions

To determine the effectiveness of the interventions, the ART evaluation score before the interventions was compared with the ART score after 3 months after the interventions (July-October).

Despite the permission of the company management and coordination with the head of the unit, more ergonomic interventions were not acceptable in the workstations, and it took a long time to perform each intervention. On the other hand, there was not enough

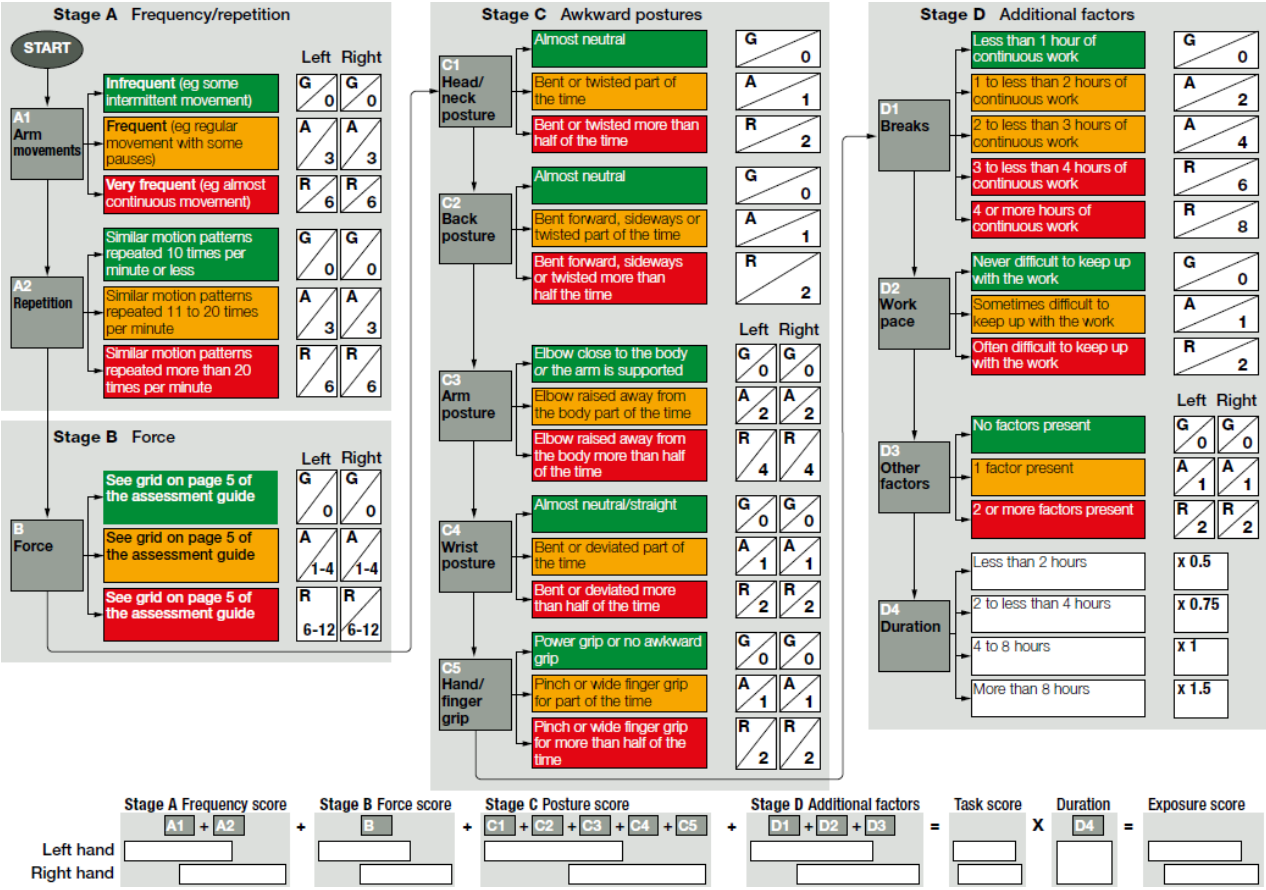

Figure 1. Overview of the ART rapid assessment process flow chart. *Note*. ART: Assessment of repetitive task.

Table 1. Risk level boundaries used for the benchmarking of risk assessment methods

Risk levels	Risk interpretation	ART
1	Low	0-11
2	Medium	12-21
3	High	+22

Note. ART: Assessment of repetitive task.

time for long-term interventions, and these factors limited the work.

3. Results

The demographic characteristics of the 60 workers who completed the consent form to collaborate with the research were the: mean and standard deviation (SD) of work experience, height, weight, and age were 7.26 ± 5 years, 172 ± 0.086 cm, 67.13 ± 8.91 kg, and 31.37 ± 7.73 years, respectively. Additionally, 22, 34, and 4 workers worked in the machine-building, assembly, and painting sectors, respectively.

In terms of education, there were 11 undergraduates, and 45, 4, and 4 diploma, post-diploma, and higher education, cases, respectively. In addition, 56 workers (93.3%) worked with both hands, and the final score was equal for both hands.

This method includes tasks that are suitable for carrying light loads less than 8 kg, thus the mean (SD) of the weight of the obtained objects was 3.6 (± 4.07) kg, respectively.

The results of the initial assessment among 60 workers from different stations revealed that the exposure of 13 (21.7%) workers was at low risk. The frequency of people was at the average risk level of 29 people (3.48%), which is the highest number of exposed people at this level, and 18 people were at the high level of exposure (30%). Given that the majority of workers evaluated in the first stage were in the assembly department (39 people), the second stage of assessment and interventions was also performed in this unit. Some of interventions were removed from the initial interventions due to the difference between the workstations of the machining and painting units, the large workload of workers in different stations, the types of tools in the halls, and the seasonality of some tasks and workers. Furthermore, most interventions were performed on 39 people who mostly worked in the assembly unit. Five of these workers in the machining unit had joint tasks with the assembly unit, and their initial assessment score was at the medium (3 people) and high (2 people) risk levels. Thus, they only entered the next stages of evaluation and intervention. The ART scores of workers before intervention are presented in Table 2.

In the initial assessment of 60 people, 18% and 29% were at high and moderate risk levels, respectively. To determine the impact of the interventions, 34 people at moderate to high (64.10%) and high (5.2%) risk levels with similar workstations and equipment assembled the gas regulators, along with 5 other individuals. Those who had rotational work with the machining unit but mostly worked shifts in the assembly unit were selected for this purpose. The exposure levels of these people changed after performing engineering and management interventions in their workstations (Table 3).

The highest frequency after interventions is assigned to risk level one, which includes 21 people (53.85%).

Due to the same ergonomic conditions of the workstation, 12 out of 39 workers were at a low-risk level before the evaluation; it is predicted that they would be exposed to skeletal disorders in the future if not correcting the ergonomics of the workstation (e.g., using inappropriate chairs and footrests, and the like). In addition, they are likely to be exposed to MSDs in the future; therefore, reforms affect all workers at risk.

3. 1. Engineering interventions in the workstation

3. 1. 1. Making a chair according to anthropometric participants

This study evaluated anthropometric characteristics related to the chair of 39 working men and women who were to undergo ergonomic interventions. Then, the chair was designed according to the standard ANSI/HFES100-2007 [20] and workers' anthropometry and ergonomic criteria (i.e., armrest, lumbar support with detachable seat, and adjustable seat height, design and construction of adjustable footrest with each percentage used, and design of desktop toolbox with workers' access range). Further, the ergonomic chair was made considering the technical limitations. Next, this chair was compared with the old chairs used in the workstation. The comparison of the final assessment score of this chair using paired t-test showed that there is a significant difference between the new chair and the previous chair of the workers ($P < 0.001$, Figure 2).

The ART technique assesses a variety of risk factors, the majority of which are related to the workstation; the risk factor exposure would be eliminated or reduced to a minimum if correcting these risk factors. Considering that most of our risk factors were present in workstations, engineering interventions (e.g., design and construction of workstation equipment such as chairs, footrests, toolboxes, and the like) were performed by the research team in the workstation.

Table 2. Exposure risk level in workers before ergonomic interventions

Risk levels	Assembly	Machining	Frequently	Percentage
Low	13	10	13	21.7
Moderate	27	12	29	48.3
High	15	4	18	30
Total	34	26	60	100

Table 3. Results of the interventions performed and their comparison using the ART technique among assembly workers

Risk Interpretation		ART: Before interventions No. (%)	ART: After interventions No. (%)	*P* value
Low	0-11	12 (30.70)	21 (53.85)	0.003
Moderate	12-21	25 (64.10)	17 (43.59)	
High	+22	2 (5.2)	1 (2.56)	
Training score		1.33	5.79	<0.001
Total		39 (100)	39 (100)	

Note. ART: Assessment of repetitive task. Paired t-test showed that there was a significant difference in the risk score before and after ergonomic interventions ($P = 0.003$). The average risk score decreased from 1.74 to 1.48.

3. 1. 2. Footrest

The footrest was adjustable for short persons, who could not fully fit their legs on the floor if they wanted to place their legs on this footrest. Moreover, tall persons could fully close it if they did not want to use the footrest.

This adjustable footrest helps increase your comfort and productivity and keeps you in an ergonomic position throughout the day. This is an affordable way to change your workstation. By adjusting the height and angle at any time, you can adjust your foot position in the most comfortable position [21].

To build an ergonomically suitable footrest, several items were considered by the workers and the research team. They included product aesthetics (adaptation to the background color of the work environment), physical conditions of the work environment (possible contamination), resistance to moisture in the work environment (can be washed if the outer surface can be washed), and the necessary strength against various pressures on the workers' feet (Figure 3).

3. 1. 3. Toolbox

The reach limit is the range determined from the tip of the thumb during the circular motion of the arm on the work surface (the table). During this movement, the arm is in a relaxed and downward position. The maximum access limit is linear in front of the work surface, and the operator can access without bending the trunk. For

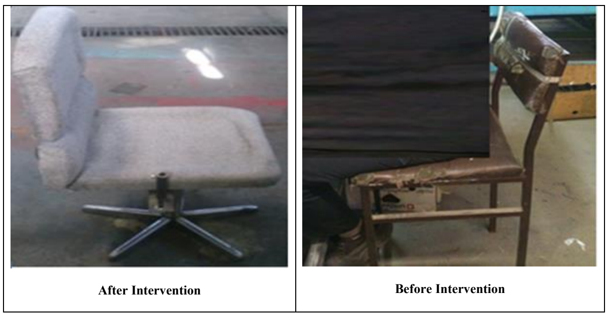

Figure 2. Interventions for chair design and construction.

repetitive tasks, hand movements should be in the normal workspace. Although controls and less commonly used devices can be located outside this space, they must be within maximum accessibility.

The concept of a natural work area is the maximum space in front of the worker at a horizontal level below elbow height. This space is often the most used area of the workstation, which must be within the normal reach of the operator. Access requirements should not exceed the maximum access to avoid bending forward and improper posture. Anthropometric measurements for arm length, shoulder height, and elbow height are employed to calculate the arm radius in the 95th, 50th, and 5th percentiles of women (Table 4).

Practical access restrictions determine the range of motion of individuals so that the primary components and parts are in the primary motion zone, and the secondary components and components are in the secondary motion zone. The location of the tools in the workstation is chosen so that it can be used for all tasks. A proper workstation design saves time and increases productivity. In making this device, the proper location of the hand tools, controls, and parts was considered based on their degree of importance and priority according to Figures 4a and b [21].

The standard height for this type of work is for the 5th, 84th, 89th, 50th, 90th, and 95th percentiles. The height of the station desk for all percentiles set in the assembly unit was 81 cm and 95 cm [21].

3. 2. Management interventions

3. 2. 1. Educational interventions

Educational interventions can help people gain knowledge of lumbar anatomy, how to lift and carry objects effectively, and potential risk factors for low back pain [19, 22].

It is predicted that after designing engineering interventions and implementing them in workstations, workers with different percentages will benefit from these interventions. The training program to work with this equipment will require a variety of training topics. Additionally, the results of the evaluation with the ART technique demonstrated that the risk factors for upper extremity disorders (i.e., posture, psychosocial factors, load weight, sitting on a chair and access to equipment at the workstation, and the like) created the need for ergonomic training sessions.

During this study, the researcher and two occupational health undergraduate students provided ergonomic training to the participants, and the assessment results with a paired t-test revealed that the comparison of the ergonomics training scores of the participants before the intervention and after the educational intervention (a score of 20) was significant between the mean score of pre- and post-test participants ($P < 0.001$, Table 3).

In this study, engineering controls reduced workers' exposure levels (Table 3) because they eliminated harmful factors at the source of production; however, they cannot eliminate harmful factors alone, and management interventions can complement them in recognizing risk factors by workers and reduce their exposure. The construction of an ergonomic chair and a tool holder and the adjustment of the height of the work surface according to the anthropometric work of the workers reduced the risk score of posture factors (neck/head, back, arms, and wrists), work speed, arm movements, and repetition. In addition, adjusting the height of the local lighting of the

Figure 3. Interventions for footrest design and construction.

Table 4. Women's anthropometric sizes and maximum access (cm)

Percentile	Arm length	Shoulder height	Elbow height	Maximum access
5th percentiles	60	128	99	53
50th percentiles	66	138	105	58
95th percentiles	72	147	111	63

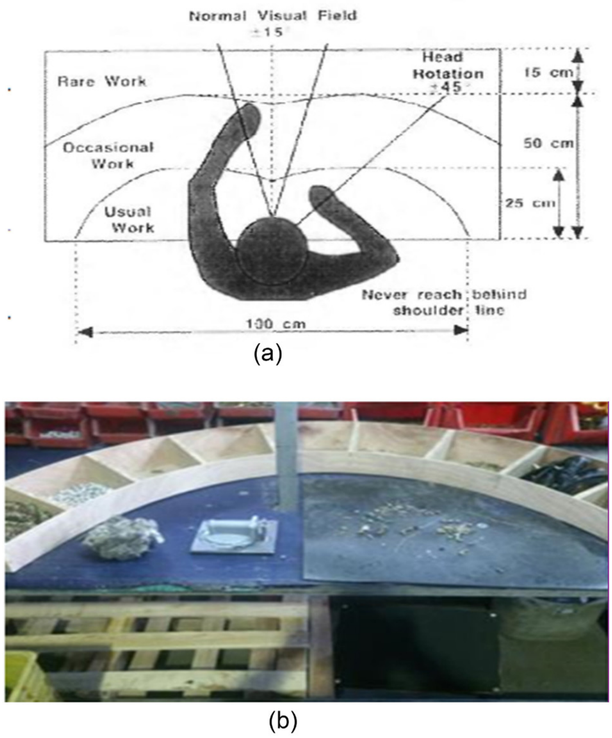

Figure 4. (a) Schematic view of hand tools within the reach of workers. *Source*. [21]. **(b)** Interventions for toolbox construction .

workstation was effective in reducing the score of postures and installing a pneumatic wrench at a standard height, and hanging in a way that was effective in reducing the force score and repetition of arm movements. Therefore, the evaluation score after the intervention with the ART technique showed that the engineering interventions performed in the workstation were effective in reducing the final ART score and thus reducing exposure levels (Table 3). Thus, none of the mentioned interventions alone can effectively reduce the risk of exposure to the risk factor, and the role of each of these modifications in reducing the risk is unknown. Furthermore, a separate evaluation of training represented that training alone has a slight effect on reducing exposure to all risk factors. Performing other management interventions (e.g., job rotation and work-rest program) and using personal protective equipment (work gloves) to reduce fatigue, psychological factors, or according to the workers, the reduction of pressure on the evaluated organs were effective, but the contribution of each of them to the risk factor score is not certain.

4. Discussion

The results of the assessment of workers in the production unit by the ART method before the intervention indicated that the levels of the risk of exposure in workers are medium and high. To reduce the high level of risk in workers' workstations, engineering and management reforms were carried out in workstations. Engineering and management interventions including prolonged poor posture and discomfort combined with the improper design of chairs and tables used in the workstation are important factors that may affect a person's physical performance and ability. Therefore, chairs should be designed based on the anthropometric dimensions of the users. Matching between the dimensions of the seats and the anthropometric dimensions of the user and the ergonomic indicators makes the consumers more comfortable. The standard design of the chairs can enhance various anatomical and comfortable positions, leading to the prevention of inappropriate postures. It can also reduce the risk of MSDs and increase the efficiency of the individual and the system [23, 24].

The footrest of the designed chair was adjustable for short persons, who cannot fully fit their legs on the floor if they want to place their legs on this footrest. In addition, tall persons can fully get it aside if they do not want to use the footrest.

Toolbox design according to workers' access and its use on the workstation table, placement of the pneumatic wrench hanging and accessible so as not to hinder the work of workers, placement of the appropriate light source at the right height at the workstation, rotation of work shifts among workers, and stretching exercises were performed during fatigue at the workstation and at break times to reduce static posture. Results related to the elimination of inappropriate postures caused by fatigue and the overall assessment result after the intervention showed that workers at moderate and high-risk levels were exposed to low risk levels. The results of the present study revealed that various factors cause assembly workers in workstations to be at medium- and high-risk levels. Some of the risk factors that cause inappropriate posture and play a role in accelerating MSDs include frequent activities and light problems [25], vibrating and inactive devices [26], high workload [27], psychosocial factors such as stress and job dissatisfaction [28], tools and equipment [29], and proper ventilation and temperature [30]. If any of the non-standard work environment factors are designed, they will cause physical discomfort to the workstation operator, as well as psychological stress and MSDs [31].

After designing all the interventions of the workstation, they were placed in the workstation to observe the results of the study. After 3 months of intervention (July-October), the results of the risk assessment (Table 3) demonstrated that the level of exposure risk after ergonomic interventions decreased from level 2 (a medium risk level) to level 1 (a safe risk level). Accordingly, the main strategies for performing engineering and managerial interventions in assemblers' workstations are effective in reducing MSDs or eliminating the risk [32]. In the study conducted in a car assembly hall that used RULA and MFA methods for risk assessment, Motamedzade et al found that many factors might cause musculoskeletal injuries, and a significant portion of these disorders can be reduced to an acceptable level by proper ergonomic interventions [33].

Numerous studies have been conducted on engineering interventions in the workstation. In the study of Azizi et al, the mirror control workstation was performed on a glass production company. The RULA technique was used to assess the physical condition of workers before and after the intervention. The data analysis after the intervention showed that 20% and 80% of the workstations were at action levels 3 and 2, respectively, and the risk level was reduced efficiently [34]. A similar perception was also discussed in the interventions implemented by Khan Mohammadi et al [35].

Ergonomics workshops were held to prevent musculoskeletal injuries, and there was a significant difference between the mean scores of pre- and post-test participants. In a study by Choobineh et al, educational action was effective as part of ergonomic interventions [22].

This indicated that making a device is divided into partitions according to the access of workers in the sitting position. Commonly tools and controls should be placed in the first access area and at elbow height, the construction of ergonomic footrests should be based on the anthropometric characteristics of users at workstations, and install the (hydraulic) wrench from the center of gravity in place. Workers workstations will increase ease of use and efficiency of users.

Despite the permission of the company management and coordination with the head of the unit, more ergonomic interventions in the workstations were not acceptable, and it took a long time to perform each intervention. On the other hand, there was insufficient time for long-term interventions, limiting the work.

This study showed that the use of ART technique is a suitable method to identify and evaluate the risk factors of repetitive tasks in the upper limbs.

5. Conclusion

Previous studies revealed that the implementation of various ergonomic interventions in the workplace has reduced exposure to ergonomic risk factors and MSDs, and ergonomic standards in the workplace have improved accordingly [11, 36]. However, current risk management strategies to reduce MSDs alone do not function properly. It has been proven that the focus is not only on interventions such as exercise, work station, and training of optimal methods to reduce ergonomic risk, but also attention to all risks, especially psychosocial factors and other factors that cause disorders such as air pollution, lighting, weather conditions, vibration, organizational, cognitive, psychological, and individual factors are essential. Moreover, it is necessary to use a comprehensive assessment technique that can assess each of the risk factors for the role of organizational ergonomics involved in the development of MSDs.

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Authors' contributions

All stages of writing the article have been done by the author.

Conflict of Interests

The authors declare no conflict of interests.

Ethical Considerations

In this research, all ethical principles were approved by the Ethics Committee of Hamadan University of Medical Sciences (IR. UMSHA.REC.1396.399), and participants were satisfied with the study and signed the consent form before starting the study.

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