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ORIGINAL ARTICLE

Occupational Health Promotion throughout an Interventional Ergonomic Design (Case Study: An Ergonomic Cart Design at a Food Manufacturing Company in Iran)

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ABSTRACT

Health, safety, and environment management are dedicated a vast area in which ergonomics aspects known as one of the related aspects. In the following case study, the occupational hygiene by ergonomic intervention is focused. One of the prevalent activities among industrial sectors' workers in the developing countries is manual lifting tasks and other related physical activities, which are crucial tasks not only in terms of occupational health but also about safety. Such activities are known as one of the major risk factors of work related musculoskeletal disorders. In this case study, the mentioned tasks were focused in a food manufacturing company in Tehran-Iran where there are some kinds of plants. Some parts of workers' activities including lifting, lowering and carrying the boxes and bulky body packages. In the sesame seeds cleaning and peeling plant, some of the workers should transfer some amounts of sesames from centrifuge as an origin to kilns as a destination area by carrying the carts and lifting the tank to empty sesames into furnaces. Nordic Musculoskeletal Questionnaire (NMQ) assessed the psychophysical aspects of this activity, and anthropometry measurement was done among the 48 sampled workers. Ovako Working-posture Assessment method (OWAS) was also used to assess the body postures. The gathered data and in-depth observation showed the necessity of cart design to improve workers health in terms of ergonomic factors. A new cart was designed considering with economics limitations. This new cart would change lifting stress and pushing tasks to better condition.

KEYWORDS: *Manual lifting, WMSDs, Health, NMQ, Awkward posture*

INTRODUCTION

The term “food industry” covers various factories and industrial sectors including processing, conversion, preparation, preservation and packaging of foodstuffs. Food industries cover several kinds of manufacturing i.e., meat, fish, fruit, vegetable, baking, milling, chocolate making and confectionery, and biscuit making. In addition, these sorts of industry have a vast range of small sectors and SMEs to large scale ones. In Iran, there are several kinds of food industries especially in mega cities i.e., Tehran, Isfahan, Tabriz, Mashhad, Shiraz. One of the well-known food industries is Halva manufacturing factories. In this study one of them was chosen to assess in terms of ergonomics factors, as one of the main and critical concerns in these industries is health, not only in terms of nutrition health but also in occupational health and safety at work. One of the main goals of the healthy workplaces initiative is to reduce work-related injuries so MSDs prevention plays an important role in occupational health promotion [1]; in this regards, this case study is focusing on ergonomics in a chosen food industry. Ergonomics makes better conditions for both health and economics. In this case study, we conducted a study to assess occupational health conditions from ergonomics viewpoint through an ergonomics intervention by

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ergonomic design of some devices and tools. Ergonomic interventions are known as the best ways for the prevention of work related disorders [2].

Ergonomic interventions consist of three main areas of engineering, administrative and behavioral interventions [3]. We focused on the engineering side of intervention. Here, one of the well-known companies in Tehran was selected to study, which produces some sorts of Halva (or Halawa), and some products based on sesame. Halva is a kind of sweet confections made from sesame. In the Halva factories there are some different plants and activities i.e., cleaning as a first step of the process", "grading as a classifying process", "colour sorter", "soaking", "peeling", "separating", and "drying", also based on the manufacturing characteristics some other process such as oil extracting might be done. In most parts of these activities, workers have to do their jobs by physical activities in which some sorts of awkward postures will occur. In this regards, MSDs should be controlled in the mentioned industries, especially in developing countries. This study has focused on ergonomics improvement by equipment design to prevent MSDs among workers at the food industry.

Ergonomics: Ergonomics as a multidisciplinary science studies human abilities and limitation and also work conditions; the main objective of ergonomics is fitting the task to the man [1, 3-4]. Ergonomics has some relationship with some sciences such as medical and health science, management, engineering disciplines, psychology, art and design. Some different activities and performances are covered by ergonomics [5-6]. Undoubtedly, every promotion in ergonomics makes sustainable situations regarding human being and also economics aspects.

Considering the vast scope of ergonomics, there are some ergonomics sub-branches like Micro-ergonomics, Macro-ergonomics, Cognitive, Environmental and Cultural ergonomics (Fig.1). Each mentioned branch covers some parts of ergonomics issues, for instance human muscle and physical activities, fatigue and somatic performance, Workstation design, Hand tool design, anthropometry and Kinesiology are assessed in Micro-ergonomics; the aspects of industrial management and also relationship between technology and users are included as some of the issues under Macro-ergonomics. Interface design, displays and controls in terms of human interactions are some of the cognitive ergonomics aspects. Environmental agents such as illumination and noise are included in environmental ergonomics.

In Iran, ergonomics plays a major role in factories, especially regarding micro-ergonomics. Furthermore, ergonomic factors are also considered under HSE programs among industrial sectors, which follow by occupational health experts of the Iran ministry of health as the authority body, so most employers, attempt to make a better condition for workers, regarding ergonomic considerations.

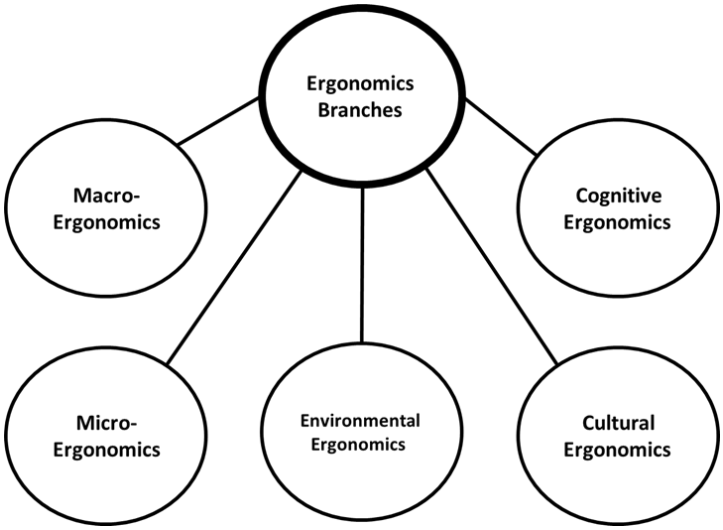

Fig.1. The branches of Ergonomics

MATERIALS AND METHODS

A Halva industrial group in Tehran-Iran was selected to assess industrial ergonomics to improve occupational health and safety. This factory produces some kinds of halva and clean, peeled sesame seeds. Around 150 workers are working in the factory where 48 out of 150 whose workers have included the samples in this case study. Fig.2 shows some of the mentioned tasks.

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However, the plant of cleaned and peeled sesame

Fig.2. Some samples of task

For task analysis and ergonomics evaluation, some methods were used such as anthropometry, layout assessment, Nordic Musculoskeletal Questionnaire (NMQ), Ovako Working-posture Assessment method (OWAS). We measured thirty workers' body to gather the anthropometric data. This group was selected randomly. By OWAS, the body postures were categorized, too. Psychophysical aspects of somatic problems were assessed by NMQ. Fig.3 shows some of the manual activities at the selected plant. Inasmuch as the main objective of this study was equipment design for working on carrying the seeds between centrifuges and furnaces, this area was given more concentration. Sketching and introducing some etudes were done to achieve a practical design. To introduce an appropriate design, all feasible preliminary etudes were finalized by Analytic Hierarchy Process (AHP) method, as well.

Fig.3. Some samples of tasks among the selected workstation (Author)

RESULTS

Workers' complaints about their muscle activity and fatigues, and the gathered data based on NMQ show the prevalence of WMSDs, especially in the trunk, knee and wrist (Fig.4).

was assessed in this study.

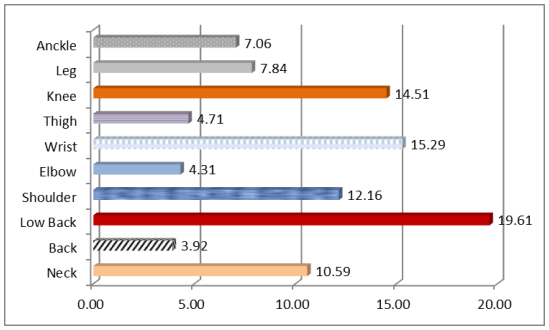

Fig.4. Limbs' disorders based on NMQ

Furthermore, OWAS data show that roughly 46% of body postures among the workers need modification in the near future, and in 40% of cases, the postures should be modified as soon as possible (Fig.5).

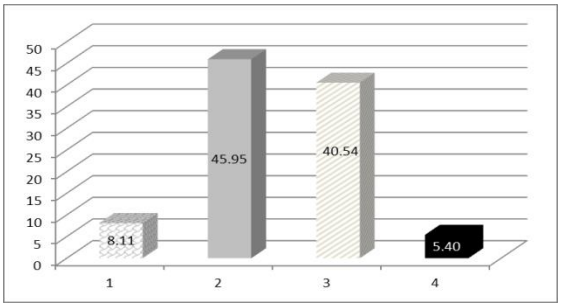

Fig.5. Action Category (AC) in OWAS

These data show the importance of ergonomics interventions. According to the mentioned data and in-depth observation, we decided to design a cart to help workers during carrying out the tasks to carry the seed tank from centrifuge to the furnace. In this regards, to begin with, some etudes were developed, then based on Analytic Hierarchy Process (AHP) method, one of the more appropriate and feasible designs was completed. According to the above mentioned results and considering depth observation and some limitations, we developed a new tool (Fig.6) in which not only might the manual lifting difficulties be removed but also some awkward postures will be revised and OWAS scores will change to better ones. Furthermore, suddenly drop of drain and materials will be removed so the recommended device has also safety benefits.

Fig.6. An ergonomic design of sesame seeds cart

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DISCUSSION

Considering the article's objectives, which focused on a practical ergonomics intervention throughout a design, the gathered data and ergonomic assessment present that in order to make a healthy and better condition for workers and occupational health improvement, the ergonomics design should be applied. Furthermore, in most workplaces in developing countries industrial sectors, work related musculoskeletal disorders are prevalent. Surely, ergonomics design changes the working characteristics to better condition and make fitting appropriate for workers tasks. The recommended design removes the major part of manual lifting among the worker's tasks. In addition, most of the work-related disorders are cumulative ones, which result from repeated loads over a long period of time [2].

"In most industrialized countries, the compensation costs for musculoskeletal disorders account for at least 50% of all workers' compensation costs" [7]; therefore, these costs make a huge burden effects in developing countries. Hence, through utilizing the mentioned ergonomic cart, awkward postures exposure will be also removed and it can be assumed that the above-mentioned negative effects would decrease. In this study, we recommend the mentioned ergonomic cart design, which seems to have effects on the tasks, which change them into better ones, as well. Of course, the recommended design was discussed with the supervisors and plant managers during 11 one-hour meetings with over a hundred participants, which proved to be so well received. Surely, awkward postures removal based on the recommendation design makes a better condition regarding MSDs prevention, also strong work-related component exists for many upper limbs and low back pain (LBP) cases [8-9]. Therefore, the mentioned gathered data confirm the rational of ergonomics changes in this factory.

Moreover, considering characteristics of our design, this cart might be used in other similar factories. This important point should be considered that the mentioned ergonomics changes will be ended to occupational health promotion under a participatory planning. Undoubtedly, interventional design based on ergonomics will be effective if ergonomics changes have a process based on a participatory ergonomics. According to Kourinka [10] this process is known as practical ergonomics in which all stockholders should corporate from employees to employer [11].

CONCLUSION

Manual lifting tasks are an inherent part of any manufacturing plant that causes MSDs [3]; also, MSDs are very common health problems all over the world, which has also some negative impacts regarding workplace disability [2]. MSDs, LBP and other health problems make increased absenteeism and higher insurance, increased probability of accidents and errors. Ergonomics changes in industrial sectors' work sites, especially in developing countries. In addition, it might make a better condition for employees' occupational health promotion. In this regards, ergonomics intervention activities in food manufacturing companies in Iran will be ended to healthy workplaces. This study illustrates significance of ergonomic interventions in the selected plant at this food industry. Undoubtedly, interventional design based on ergonomics will be effective if ergonomics changes have a process based on a participatory ergonomics.

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