Smyrna Tıp Dergisi ***Araştırma Makalesi***

Application of Ergonomic Risk Analysis Methods in a Mold Manufacturing Period and Regulatory Recommendations
Bir Kalıp İmalat Sürecinde Ergonomik Risk Analiz Yöntemlerinin Uygulanması ve Düzenleyici Tavsiyeler

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Summary
Objective: The rapid development of industry and the problem of industrialization, protection of workers against occupational accidents and occupational diseases have been raised. In this study, the employees of a mold manufacturing factory; synamic and static stances, and suggestions on necessary arrangements have been made.
Material and Methods: The study was carried out in March 2016, in a press shop section selected in a mold manufacturing operation. Worked in 17 different departments; video camera images were taken for about 10 minutes for a worker from each department. Captured videos were examined and according to these analyzes, the risky working postures of the workers were analyzed. The risk scores obtained as a result of the "Ergonomic Risk Analysis" study conducted by applying the Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) risk assessment methods for each job definition are shown and the risk levels corresponding to these risk scores are shown.
Results: In the Ergonomic Risk Analysis activities carried out, the lack of training of the working operators in terms of ergonomics is revealed. It is understood, however, that operators are obliged to work under ergonomic risk conditions, as most of them are seated, but using old and inadequate stools.
Conclusion: The ergonomically available high risk level can be reduced even further, especially if it is possible to replace the stools with appropriate designed chairs. In this way, both the employees will not be from their health and will work in a more moral way and the employer will benefit from it.
Key words: Ergonomics, risk, REBA, RULA

Özet
Amaç: Endüstrinin hızla gelişmesi ve sanayileşme sorunu, işçilerin iş kazalarına ve meslek hastalıklarına karşı korunması gündeme getirilmiştir. Bu çalışmada bir kalıp fabrikası çalışanları; sinamik ve statik tutumları ve gerekli düzenlemeler üzerine öneriler yapıldı.
Gereç ve Yöntem: Çalışma Mart 2016'da bir kalıp imalatı operasyonunda seçilen bir basın mağazası bölümünde gerçekleştirildi. 17 farklı bölümde çalışıldı; video kamera görüntüleri her bölümden bir çalışan için yaklaşık 10 dakika çekildi. Yakalanan videolar incelenmiş ve bu analizlere göre işçilerin riskli çalışma pozisyonları analiz edilmiştir. Her bir iş tanımı için Hızlı Tam Vücut Değerlendirmesi (REBA) ve Hızlı Üst Sınır Değerlendirme (RULA) risk değerlendirme yöntemlerini uygulayarak gerçekleştirilen "Ergonomik Risk Analizi" çalışması sonucunda, elde edilen risk puanları ve bunlara karşılık gelen risk seviyeleri ile risk puanları gösterildi.
Bulgular: Yapılan Ergonomik Risk Analizi faaliyetlerinde ergonomi açısından çalışan operatörlerin yetersizliği ortaya çıkmaktadır. Bununla birlikte, operatörlerin çoğu ergonomik risk koşulları altında çalışmakla yükümlüdürler, çünkü çoğu eski ve yetersiz alet kullanmaktadır.
Sonuç: Ergonomik olarak mevcut olan yüksek risk seviyesi, özellikle uygun şekilde tasarlanmış sandalyelerle mümkün olduğunda azaltılabilir. Bu şekilde, hem çalışanlar sağlıklarını kaybetmeyecek, hem de daha moralli bir şekilde çalışacak ve işveren de bundan fayda sağlayacaktır.
Anahtar kelimeler: Ergonomi, risk, REBA, RULA

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Introduction

Working individuals are in mutual influence with workplace conditions. The rapid development of industry has led to the problem of protecting workers against occupational accidents and occupational diseases. This is called ergonomics. Ergonomics is a branch of engineering which investigates the relationship between physical and psychological characteristics of individuals and business and environmental conditions. It follows the principles it has developed in the direction of the resulting data as well as the regulation of business and environmental conditions (1). The aim of ergonomics is to get the highest yield from the human posture by reducing the risk of injury (2).

Ergonomics are classified in three different types. First one is the cognitive ergonomics that deal with mental processes such as perception, logic, memory and motor response in terms of employee and working conditions interactions. Second brach is the physical ergonomics which deals with the anatomical, physiological and biomechanical characteristics of people. The third brach is the organizational ergonomics which aims at bringing the best position, including corporate policy (3).

Work related factors, mostly related to skeletal system diseases, are called ergonomic risk factors (4). These factors include; psychological factors (mental overload, psychosocial and organizational factors), environmental factors (temperature, noise, vibration, ventilation, illumination, chemicals) and physical factors (static posture, inappropriate postures, repetition, excessive force, compression) (5).

Ergonomic risk analysis means; examining the risks involved in the studied work environment, identifying the existing sources of hazards in manual work processes that do not comply with the ergonomic nature of the employees in the operations or processes being implemented in the workplaces and analyzing the detected and inappropriate ergonomic working conditions in a method such as spinal and skeletal inconveniences that may lead to unacceptable sources of risk in the workplace and removing risks.

In particular, ergonomic risk analysis has gained a much more important position in our country, especially in terms of employee health, along with work accidents, which have increased in numbers in recent years. Because of the ergonomic risk analysis methods, deficiencies and faults directly threatening employees' health can be detected much more easily. In this way, it can be shown more scientifically in the direction of these analyzes that employees can benefit from the science of ergonomics and how they can protect themselves - for example, which body posture is more appropriate when carrying weight. In fact, not only employees' mistakes or deficiencies are solved by risk analyse method, also the ergonomic industrial designs are derived from this method.

Nowadays, in order for people to do their jobs in a healthy way, it is important to make the necessary arrangements taking into account the triad of people, machinery and environment (6). Improvement which are done in this direction, has helped ergonomics to grow rapidly in recent times.

This paper presents an assessment of work tasks with an application with Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) methods. In this study, embarkation of the employees of a mold manufacturing factory were examined and suggestions were made on necessary regulations. It was aimed to compare both of the methods.

Materials and Method

This study was carried out in March 2016, in a press section selected in a mold manufacturing operation. 17 researches from different departments were taken into account. Their video camera records were taken for about 10 minutes for each worker in each department. The 10-minute observation period was considered adequate due to the similarity of the work the employee did all day. Observed employees were randomly selected at this workplace among workers in the relevant department. The recorded videos were examined. According to these observations, an analysis of the workers' risky working stances were determined.

There are many methods developed for ergonomic risk assessment. In this study, two methods offering comprehensive evaluation were selected and evaluation was made with these two methods.

The Rapid Entire Body Assessment (REBA) method evaluates the postural risk of the whole body of a worker taking into consideration the loading and the human-load interaction, which is the case in dynamic and static postures. It is also used to assess, whether the risk of discomfort is reduced before and after the improvement. According to the REBA scoring system; score 1: negligible risk level and no improvement needed, score 2-3: low risk level, improvements needed, score 4-7: more observation and near-time improvement, score 8-10: high risk level, emergency improvement require, score 11 and above: very high risk level, very urgent improvements should be made (7,8).

RULA was developed to evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity musculoskeletal disorders. It is an ergonomic evaluation tool that takes into account the biomechanical and postural load requirements of the neck, trunk, upper arm and hand work tasks. According to the RULE scoring system; Score 1-2: negligible risk level, no immediate improvement needed, score 3-4: low risk level, improvements needed if needed, score 5-6: medium risk level, more observation and improvement in the near future, score 6 and: very high risk level, urgent improvements without loss of time should be made (9,10).

REBA analysis is scored by Ergofellow program and RULO analysis is scored by RULO's ready excel program. The risk levels corresponding to the REBA and RULA scores were statistically compared with each other by the chi-square test in the Statistical Package for the Social Sciences (SPSS version 11.0) program. Obtained scores were interpreted.

Findings

The risk scores obtained as a result of the "Ergonomic Risk Analysis" study conducted by applying REBA and RULA risk assessment methods for each job definition in a mold manufacturing company and the risk levels corresponding to these risk scores are shown in the following table (table 1).

When the risk levels corresponding to REBA and RULA scores are compared with each other in terms of statistical significance; statistical significance (p:0.003, d:0.720) was found for all four groups (low risk, moderate risk, high risk, very high risk).

The presented methods assess one posture, not a full sequence of postures that occur during work. The paper does not explain if the assessed postures refer to one or many workstations. This is the weakness of the study and planned to be investigated with different studies to be carried out in the future

Table 1. *The risk scores obtained and the risk levels corresponding to the risk scores*

Worker	Job description	REBA score	REBA risk level	RULA score	RULA risk level
1	Loading parts during plastering	8	High risk	5	Medium risk
2	Plastering parts	9	High risk	6	Medium risk
3	Taking pieces of material during drilling	9	High risk	6	Medium risk
4	Drilling a pieces of material	8	High risk	5	Medium risk
5	Sheet strip punching	7	Medium risk	6	Medium risk
6	Bending part in the bending process of perforated sheet	10	High risk	6	Medium risk
7	Pressing process button in bending of drilled sheet	8	High risk	5	Medium risk
8	Take-up and drop-off in bending process of perforated sheet	9	High risk	4	Low risk
9	Taking pieces while sheet metal drilling	7	Medium risk	4	Low risk
10	Drilling holes to the sheet of iron during drilling process	5	Medium risk	4	Low risk
11	Part punching in mounting clamp work	5	Medium risk	4	Low risk
12	Drilling holes in the hole	11	Very high risk	7	Very high risk
13	Placing parts in hole drilling	10	High risk	7	Very high risk
14	Transport of the cut-off piece during tape cutting	10	High risk	6	Medium risk
15	Transport of the cutter segment during edge cutting	12	Very high risk	7	Very high risk
16	Moving the machined part during transport	7	Medium risk	6	Medium risk
17	Loading of the processed part in the installation process	11	Very high risk	7	Very high risk

Discussion

For parting and loading during the plastering process; the operator's seat is appropriate. As the operator turns around in the neck and in the waist during the rutine work, it causes the worker to have a hunchback. So giving the rotating chair with a revolving wheel that can raise and lower the operator can prevent difficult stances.

For the operator who is working in the plastering process, the operator will be able to improve his/her neck, trunk arm and wrist posture when he/she has a chair with following properties: wheeled, turnable to right-left, moveable to up and down, and designed to grip the back and the waist region.

The operator who works in the part taking job for drilling, will develop hunching as it is the turning of the neck and the waist due to the work he has done. Thus, giving the rotating chair with wheels which can raise and lower the operator can prevent the difficult stance of the worker. In addition, it is possible to prevent the operator from leaning unnecessarily in order to get parts by raising the support beneath the chassis next to the operator.

It is suggested that the operator drilling the hole in the drilling process should use a chair that can be raised and lowered in an ergonomic manner rather than a present distressed stool. When this adjustment is done, improvements in neck and trunk posture will be observed.

In the process of drilling hair stripper, operator can be prevented from leaning by giving a him/her a rotating chair with wheels which can raise and lower the operator. The operator should be trained to keep his body upright, to keep his wrists straight without twisting.

In the bending process of the pierced iron sheet, the neck and the body of the bending operator are incorrectly shaped according to the posture. It can be improved by the operator being able to withstand his back in a healthy way by giving the operator a chair with a proper back support and ability to descend and ascend.

In the process of bending the punctured iron sheet, instead of the ergonomically unsuitable stool, the worker should have a chair with wheels and the ability to move up and down.

It seems that the operator can not stand his back because of the stool he is currently using for the parting and dropping of the pierced hair in the bending process. The neck and body, however, turn in different directions than the whole of the body. This is not an ergonomically correct position.

It seems that the operator does not hold the body and size in the correct posture position when he/she working to drill the sheet metal.Instead of the stool used in the present situation; the operator's neck, body part, the spinal cord and the movement system will suffer less damage with the chair with whells and the ability to turn right and left.

In the case of the operator opening the hole in the drilling of the sheet of metal, there is no problem in terms of ergonomics other than shape of the wrists when holding a device. The wrists should be kept flat. Besides this, the arms should not be above the heart level.

During the drilling of the parts of the clamping operation, it is necessary to train the operator for him/her to keep the body and the neck straight. If they take this training and adopt ergonomically appropriate movements, the spine and motion system will be less affected than the current situation.

In the hole drilling to sheet of metal process, the operator working in the hole drilling; sespite being seated, his back is not in a correct posture.The reason for this is that the stool he is sitting on is too high for the counter.Providing a chair than can be lowered and elevated, will resolve these problems.

During the work of putting the part while the drilling of the hole of metal sheet and taking the empty sliver, the worker's shape of the neck, the body, the back and the ankles is ergonomically disadvantageous. All this can be explained by the fact that the stool on which he is sitting is high for the bench he is working with.In other words, if the seat is height adjustable instead of a stool, the better ergonomic position ,can lead to more healthy results.

Suitable and unsuitable load lifting and transporting positions have been elaborated in the work of Hasdemir AG. Transporting the part to be cut during lumber cutting requires that the operator be trained to transport and remove heavy loads in particular. When the load is lifted and transported, it is absolutely necessary that the spine or the neck should not be rotated. At the same time the wrists should be flat (11).

For the job of moving the part to be cut during edge cutting; the operator tilts forward to almost 90 degrees for such a heavy piece, which is lower than it should be in a standing environment. In order to correct this situation, the operator should be taught how to lift his body, his body, his legs by.

As regards the transportation of the processed part in the transportation process; the operator should take power from both feet, not just one as he is doing in the present seen by our observation. In order to avoid having to lean forward, he can get more comfortable strength from his legs by bending his knees.

Finally, for the task of box loading of the part in the loading process, the operator has to take the heavy piece at the low level while also standing on his single leg. To correct this situation, either the part should be placed high, or the operator should be held on a pallet on

the ground and should take the load by squatting.

Likewise, in the article "Ergonomics and Stress in the Workplace", which Ayanoğlu has written, it has been suggested that there should be a compatibility between the work expected at the workplace and the main characteristics of the employees and "program management" has been proposed against the ergonomic disturbances at the workplace (12).

Conclusion

Examinations made in the press room of a factory where the sheet metal processing is predominantly carried out; in Ergonomic Risk Analysis activities carried out with the help of REBA and RULA applications, the lack of education in terms of ergonomics of working operators is revealed. It is understood, however, that operators are forced to work under conditions of ergonomic risk, as most of them are seated, but using old and inadequate stools. The ergonomically available high risk level can be reduced even further, especially if it is possible to replace the stools with appropriate designed chairs. In this way, both the employees' health will not get worse and they will work highly motivated and because of that the employer will benefit from it.

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