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Ergonomic Evaluation of Industrial Tasks in Indian Electronics Industries

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Abstract: ***Work related musculoskeletal disorders (MSDs), low back injuries and bad body postures are the most common problems occurring in the electronic industries. The aim of this study was to estimate the risks of work related MSDs. In this paper, the impact of bad body postures on MSDs was found out using postural analysis tools. The RULA & REBA methods were used to find out the scores of working postures.***

Keywords: Ergonomic Evaluation of Industrial tasks, Postural analysis, RULA, REBA, DELMIA

1. Introduction

Ergonomics can be defined as the study of work. Ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Global market competition has placed manufacturing companies under pressure to improve their working environment. Industries require higher production rates to remain competitive. As a result jobs today are involved working in awkward postures, lifting awkward items, repeating the same motion throughout workday and working at a quicker pace of work. This factor creates physical stresses on worker's body which leads to MSDs. MSDs occur when physical capabilities of the worker do not match the physical requirements of the job. Excessive exposure of risk factors can cause the damage of the worker's body and lead to MSDs. In this paper, the impact of bad body postures on MSDs was found out using postural analysis tools. The RULA & REBA methods were used to find out the scores of working postures.

1.1 RULA (Rapid Upper Limb Assessment)

Rapid Upper Limb Assessment (RULA) is used for ergonomic investigations of workplaces where work related injuries are reported. RULA is a simple diagnostic tool that allows surveying various tasks involving the upper limbs at workplace with focuses on use of arms, wrists, position of the head and the posture of the upper body. McAtamney and Corlett (1993) introduce RULA, or Rapid Upper Limb Assessment [1]. It is developed to observe the operators who suffered upper limb disorders due to the musculoskeletal loading. The RULA is used without need for advanced and expensive equipment that's why it is one of the most popular ergonomic investigation tools in industry. It proved a tool which is reliable for use by those whose job it is to undertake workplace investigations.

1.2 REBA (Rapid Entire Body Assessment)

The RULA and REBA both are similar tools for evaluate the musculoskeletal disorders. REBA is an ergonomic assessment tool uses an orderly process to evaluate whole body postural MSD and risk associated with Workplaces. Hignett and McAtamney (2000) introduce REBA and stated that it is used to investigate posture for risk of work related musculoskeletal disorders (WRMSDs) [2]. REBA is a better tool for whole body parts (wrist, upper arm, lower arm, neck, trunk and legs,) REBA is user friendly and useful for manual task risk assessment. But here some drawback of REBA is: REBA does not give the combine assessment of biomechanical risk factors.

2. Literature Survey

Lynn McAanncy and E. Nigel Corlett (1993) proposed a method called RULA [1]. RULA is designed to assess operators who may be exposed to musculoskeletal loading. Hignett and Lynn McAtanncy (2000) proposed a method REBA. REBA is another postural analysis tool [2]. This tool is found to be sensitive to the type of unpredictable working posture in health care and other service industries. Ira L. Janowitz et.al (2006) measures the physical demands of work in hospital setting [3]. For this they use Rapid Entire Body Assessment (REBA). T. Jones and S. Kumar (2007) compare ergonomic risk assessment in a repetitive high risk sawmill occupation Saw-filler [4]. Kee D. and Karwowski W. (2007) made a comparison of three observational techniques for assessing postural loads in industry [5]. For this study OWAS, RULA and REBA are taken as observational techniques. Tan (1996) studied the analyses of tasks carried out in an electronics factory [6]. The ergonomic and biomechanical hazards of problem work tasks are identified. Yeow and Sen (2003) studied an ergonomic study that was conducted to improve the workstations for electrical tests in a printed circuit assembly (PCA) factory [7]. Yeow and Sen (2003) aimed at reducing the occupational health and safety problems faced by the manual component insertion operators [8]. Subjective, objective assessments and direct observations were made in the printed circuit assembly factory. Yeow and Sen (2004) studied an ergonomics improvement that was conducted on the visual inspection process of a printed circuit assembly (PCA) factory [9]. Three problems identified were operator's eye

problems, insufficient time for inspection and ineffective visual inspection. Ergonomics interventions were made to rectify the problems. A visual inspection sequence was introduced to rectify it. Abdullah et al. (2009) studied to identify and quantify ergonomics working postures that contributed to the serious development of musculoskeletal injuries and thus investigated possible contributory their related causes [10]. Rapid Entire Body Assessment (REBA) methods were used to estimate the final score of working posture. Grzybowski (2001) discussed new trends in developing and implementing methods of workplace analysis [11]. A sample method for the workplace ergonomics evaluation was developed. Mirka et al. (2002) studied to develop and evaluate engineering controls for the reduction of low back injury risk in workers in the furniture manufacturing industry [12]. Keyserling et al. (1992) developed a one-page checklist for determining the presence of ergonomic risk factors associated with awkward postures of the lower extremities, trunk and neck [13]. Vignais N et al. (2013) studied a system that permits a real-time ergonomic assessment of manual tasks in an industrial environment [14]. A computerized RULA ergonomic assessment was implemented to permit a global risk assessment of musculoskeletal disorders in real-time. Chang et al. (2007) proposed a method of conducting workplace evaluations in the digital environment for the prevention of work-related musculoskeletal disorders and apply a digital human modelling system to the workplace virtual dynamic simulation [15].

3. Methodology

A survey of electronics industries was done to find out the causes of MSDs resulted due to adoption of wrong postures or lifting techniques, by worker during manual lifting tasks. Posture analysis techniques were used to find out the same. First the most difficult and frequently used task was found out. For this it was observed and asked from the workers, for difficult to do manual lifting task in his daily routine. The most difficult tasks felt by workers were videotaped from different angles. Picture frames were taken from these videos. Each frame of a task was further analyzed by using RULA and REBA techniques. The angles of each body postures were found out for each picture frame. Delmia software was used for finding angles. The RULA score were found out in Delmia software and for finding REBA score, standard REBA score sheet was used.

For RULA Score that represents the level of MSD risk is listed below:

Table 1: RULA Score

Score	*Level of MSD Risk*
1-2	Negligible risk, no action required
3-4	Low risk, change may be needed
5-6	Medium risk, further investigation change soon
7+	Very high risk, implement change now.
Source: www.ergo-plus.com	

For REBA score that represent the level of MSD risk is listed below:

Table 2: REBA score

Score	*level of MSD Risk*
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation change Soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change now.
Source: www.ergo-plus.com	

4. Result and Discussion

Three electronic industries in an around Chandigarh were surveyed. It was observed that the manual lifting tasks were the most critical task, resulted in MSDs amongst workers. These tasks were analyzed by using RULA and REBA techniques. Manual lifting task which were carried for more than five minutes were analyzed using RULA & REBA techniques. Video of each task were taken. Picture frames were captured from these videos. For each picture frame, angles of entire body joints were measured.

The RULA score is find out by using Delmia software. This software consists of human manikins which can be changed as per the anthropometric dimensions of workers. Using direct kinematic techniques, angle of each body joint was changed according to the particular posture of the worker.
The REBA score is finding out by using REBA sheet. Measured angles of the body joints were put into the sheet and total REBA score for particular posture were find out.
Thus the RULA & REBA score of different postures were calculated and are discussed below.

Figure 1: shows joint angles of task 1 for posture 1

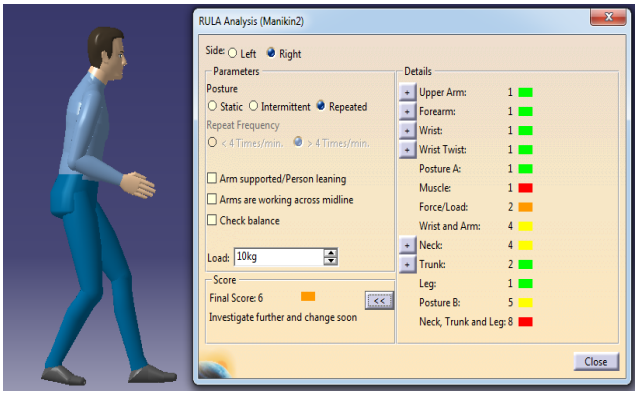

Figure 2: RULA score found in DLMIA for posture 1 at figure 1

Table 3: RULA and REBA scores for posture at figure 1

RULA SCORE	6	Medium risk, further investigating change soon
REBA SCORE	11	Very high risk, implement change

Figure 3: Shows Joint Angles of Task 1 For Posture 2

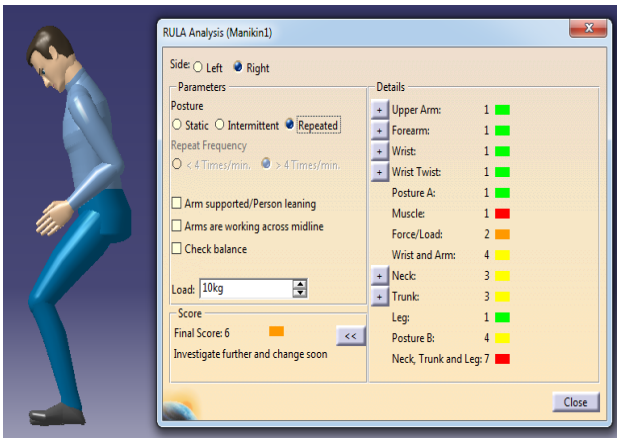

Figure 4: RULA score found in DLMIA for posture 2 at figure 3

Table 4: RULA and REBA scores for posture at figure 3

RULA SCORE	6	Medium risk, further investigation change soon
REBA SCORE	11	Very high risk, implement change

From the above results it was concluded that changes are required in the worker postures or lifting techniques to avoid MSDs. The RULA score for the posture given in Fig.1 is 6. It shows that the Medium risk, further investigating change soon is required for same posture; REBA score for this 11 which show very high risk, and implement change. Thus implementation of change is required. Now for Fig.3, RULA score is 6. It means further investigation and immediate change is required. REBA score for this posture is 11 which show high risk and further investigation. Thus implementation of change is required for this posture, immediate change. Form the above score it can be concluded that the all these postures are not safe for the workers. These postures if continue for a long duration can cause MSDs among the industrial workers.

5. Conclusion

From the above discussion the study reveals that the activities found in electronic industries may result in high risks and potential injuries to the workers. Thus further investigations are needed to avoid MSDs. The bad postures of the workers were observed by applying RULA & REBA technique. Recommendations for change in postures were given where RULA & REBA scores were higher. Thus it was concluded that the well organize posture of the worker can reduce the score of the activity which leads to the safer working environment.

References

[1] McAtamney L., and E Nigel Corlett E. N., (1993) “RULA: a survey method for the investigation of world-related upper limb disorders”, Applied Ergonomics, Vol. 24(2) pp. 91-99.
[2] Hignett S., and McAtamney L., (2000) “Rapid Entire Body Assessment (REBA)”, Applied Ergonomics, Vol. 31 (2) pp. 201-205.
[3] Ira L. Janowitz, Marion Gillen, Greg Ryan, David Rempel, Laura Trupin, Louise Swig, Kathleen Mullen, Reiner Rugulies, Paul D. Blanc., (2006) “Measuring the physical demands of work in hospital settings: Design and implementation of an ergonomics assessment”, Applied Ergonomics, Vol. 37(5) pp. 641-658.
[4] Jones T., and Kumar S., (2007) “Comparison of ergonomic risk assessments in a repetitive high-risk sawmill occupation: Saw-filer”, International Journal of Industrial Ergonomics, Vol. 37 (9–10), pp. 744-753.
[5] Kee D., and Karwowski W., (2007) “A comparison of three observational techniques for assessing postural loads in industry”, Int J Occup Saf Ergon, Vol. 13(1), pp. 3-14.
[6] Tan G.L., (1996) “Ergonomic task analysis in electronics industries: some case studies”, J Hum Ergol (Tokyo), Vol. 25(1), pp. 49-62.
[7] Yeow P.H.P., and Sen R.N., (2003) “Quality, productivity, occupational health and safety and cost effectiveness of ergonomic improvements in the test workstations of an electronic factory”, International Journal of Industrial Ergonomics, Vol. 32, pp. 147–163.
[8] Sen R.N., and Yeow H.P., (2003) “Ergonomic study on the manual component insertion lines for occupational health and safety improvements,” International journal of occupational safety and ergonomics (JOSE), Vol. 9, (1), pp. 57-74.
[9] Yeow P.H.P., and Sen R.N., (2004) “Ergonomics Improvements of the Visual Inspection Process in a Printed Circuit Assembly Factory”, International Journal of Occupational Safety and Ergonomics (JOSE), Vol. 10 (4), pp. 369-385.
[10] Abdullah A.S., and Rahman M. N. A., (2009) “Ergonomic assessment of working postures in semiconductor manufacturing processes,” National Symposium on Advancements in Ergonomics and Safety (ERGOSYM2009), pp. 111-114.

[11] Grzybowski W., (2001) "A Method of Ergonomic Workplace Evaluation for Assessing Occupational Risks at Workplaces," International Journal Of Occupational Safety And Ergonomics 2001, Vol. 7, (2), pp. 223–237.
[12] Mirka G.A., Smith C., Shivers C., and Taylor J., (2002) "Ergonomic interventions for the furniture manufacturing industry. Part I - lift assist devices", International Journal of Industrial Ergonomics, Vol. 29 pp. 263–273.
[13] Keyserling W.M., Brouwer M., and Silverstein B. A., (1992) "A checklist for evaluating ergonomic risk factors resulting from awkward postures of the legs, trunk and neck ", International Journal of Industrial Ergonomics, Vol. 9(4), pp. 283-301.
[14] Vignais N., Miezal M., Bleser G., Mura K., Gorecky D., and Marin F., (2013) "Innovative system for real-time ergonomic feedback in industrial manufacturing", Applied Ergonomics, Vol. 44(4), pp. 566–574.
[15] Chang S.W., and Wang M. J., (2007) "Digital human modeling and workplace evaluation: Using an automobile assembly task as an example", Human Factors and Ergonomics in Manufacturing & Service Industries, Vol. 17(5), pp. 445-455.

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Annexure - I