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Musculo-Skeletal Disorders (MSDs) Risk Assessment among Goldsmiths by Using RULA (Rapid Upper Limb Assessment) Method

Ms. Tanuja Jukariya[1], Dr. Suman Singh[2]
[1]Ph. D. Scholar, Department of Family Resource Management
Email: tnjjkr45@gmail.com (Corresponding Author)
[2]Professor, Department of Family Resource Management
Email: sumanfrm@rediffmail.com
College of Home Science, Udaipur, Rajasthan, 313001

Abstract
The Gems and Jewellery sector plays a significant role in the Indian economy, contributing around 6-7 per cent of the country's GDP. It also employs over 2.5 million workers. One of the fastest growing sectors, it is extremely export oriented and labour intensive. Based on its potential for growth and value addition, the Government of India has declared the Gems and Jewellery sector as a focus area for export promotion. The Government has recently undertaken various measures to promote investments and to upgrade technology and skills to promote 'Brand India' in the international market. India is the largest player in diamond cutting and polishing and also the largest consumer of gold. A goldsmith is a metalworker who specializes in working with gold and other precious metals. Their work only seen as a cost, not as an investment and focused on 'menu' driven training. The work is unsystematic and marginal required high skill but pays very less to the workers. Apart from that the worker perform task in a very awkward postures which gives invitation to many occupational disease. RUBA (Rapid Upper Body Assessment) is ergonomic assessment tool useful for manual task risk assessment. The purpose of the study is to find out the risk of MSDs and classify the risk in goldsmiths in Lohaghat city. To achieve the purpose 50 healthy male goldsmiths were randomly selected from Lohaghat city in Champawat district of Uttarakhand. RULA was used to assess the stress of workers for all predominant postures by scoring them according to their severity of stress. The average working postures of the goldsmiths at their working condition (cross-legged) were analyzed by the RULA method. This was carried out with the aid of digital photography. Video were recorded with artisan performing various task related to their work which was eventually subjected to analysis. The analysis revealed that the posture requires investigation and changes immediately. This indicates that the workers adopt awkward posture at their daily work process.

Keywords: RULA, Goldsmiths, MSDs, Workstation, Workposture

Introduction

According to India Brand Equity Foundation (2017), India is one of the largest exporter of gems and jewellery, jewellery industry is considered to play a vital role in the Indian economy as it contributes a major chunk to the total foreign reserves of the country. Net exports of gems and jewellery from India rose at a compound annual growth rate (CAGR) of 7.01 per cent between FY05 and FY17.The net exports rose from US$ 15.66 billion in FY 2004-05 to US$ 35.59 billion in FY 2016-17.

Jewelleries have always been part of Indian culture since the pre-historic era of the Indus-Valley civilization. Even after thousands of years, the tradition of wearing metal-furnished ornaments has been part of Indian and largely Asian customs and cultures. Jewellery products are largely made of gold, silver and other precious metals and colourful and costly gems. Although, India has advanced through all the socio-economic angles, the mechanism of crafting of jewellery products has remained almost same over hundreds of years without any significant change of its procedure or its technology. Although, now some advanced machinery are being used in these sectors, but these are very few in numbers and not practised routinely by the workers.

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In India Gold ornament making industries are one of the widespread small-scale industries. Gold jewellery has been part of Indian tradition and is considered as an integral part of Indian culture. Since gold is highly portable in nature and acts as a hedge against inflation in India, gold is valued as an important saving and investment vehicle. It is the second most preferred investment after bank deposits (EXIM Bank, 2010). In the last decade 75 per cent of the gold demand in India has taken the form of gold jewellery. Kerala, Maharashtra, Gujarat and Uttar Pradesh are some of major demand centres for gold in India. The southern states of India (Kerala, Tamil Nadu, Karnataka and Andhra Pradesh) accounts for over 40% of the country's gold demand (World Gold Council, 2011). Jewellery making is spread throughout the country with every village having a family of goldsmiths. The diamond processing industry has spread from the State of Gujarat, which accounts for almost 85 per cent of the diamonds processed in India. The success story of Indian gold ornaments manufacturing Industry is unique. India's strength lies in the 2 million highly skilled workforces dedicated to the cause of this sector of which 1 million are exclusively engaged in production of export oriented Jewellery items. The artisan workforce is most economical and is competitive possessing the latest state-of-the-art skills compared to any cutting centres in the world. India is the largest consumer and fabricator of gold in the world and the estimated annual demand for gold in the country is over 800 tones. Indian Designers have won recognition and awards at international competitions for their innovative designs and have also made a mark in the world's Jewellery scenario thus catering to the varied tastes and changing market needs at par with international standards. It is only a matter of time for India to become the most sought after jewellery destination and is poised to occupy a pivotal position in the global market particularly for diamonds and coloured gemstones.

According to the Work Place Safety and Health Council (WSHC, 2011), Occupational disease is defined as any disease contracted as a result of an exposure to the risk factors arising from work activity. The symptom ranges from aches and pains to numbness and limitation of movements in the musculoskeletal system. Musculoskeletal Disorder (MSD) is an umbrella term for various physical injuries and disorders in the musculoskeletal system. MSD can happen suddenly or develop over time. Several factors like awkward posture, repetitive actions, heavy lifting, vibration, fatigue, working for long hours without rest can lead to Work Related Musculoskeletal Disorders (WMSD). WMSD leads to frequent absenteeism among workers, compensation claims and loss of production to the management (Armstrong, 2000) (Wallace and Armstrong, 1998). The loss due to such problems not only affects the individual, but also the organization and society as well.

Further acute or chronic musculoskeletal problems among industry workers are generally either the outcomes of improper design of the workstations or long work hours in awkward postures. It has long back been reported by the National Institute of Occupational Safety and Health (NIOSH) that the prevalence of low back pain is mainly due to inappropriate workplace (NIOSH, 1978) and there are innumerable studies, which have also demonstrated that the rates of low back disorders vary greatly by industry, occupation and job type within a given industry or facility.

In recent years some workers, trade unions, employers, manufacturers, and researchers have begun to give attention to how workplace design that can improve the health of workers. Ijadunola *et al.* observed that poorly designed workstation promote unnecessary physical efforts, which reduce efficiency and productivity also. Thompson *et al.* (2003) show that high percentages were suffered from MSDs commonly associated with poor ergonomic design in the workplace. Without the application of ergonomic principles, tools, machines, equipment, and workstations are often designed without much consideration of the fact that people are of all different heights, shapes, and sizes and have different levels of strength. It is important to consider these differences in order to protect worker′s health and comfort. Huang and Feuerstein (2004) suggested that job redesign and interventions that address a worker′s work style when faced with increased work demands may help reduce the likelihood of musculoskeletal symptoms and/or their intensity.

Hence the present study was undertaken to assess the risk of MSDs and classify the risk in goldsmiths in Lohaghat city.

Review of Literature

In India, the unorganized sectors are generally sole proprietorship ventures. According to the census report of the year 2001, there are 40 million workers involved in the informal sectors including agriculture. Health related issues are of prime concern among the unorganized workers in India (Sahu and Sett, 2010). Due to lack of awareness of the workers on the safe material handling and no governance or systematic legislation of work safety, these sectors are largely undermined although there is a huge turnover every year from these sectors. With the economic growth of this country, jewellery business is rapidly growing and globalization and easy

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policies of open trade have allowed these industries to spread across the globe. Indian jewellery houses largely manufacture gold and silver jewelleries although many other metals and diamond are frequently used but the net amount are much lesser than the total amount of gold and silver used. Henceforth, Indian jewellery workers are largely named 'goldsmiths' and in this thesis, the terms 'goldsmiths' and 'jewellery workers' were used interchangeably with the same intention of meaning. However, Indian gold and jewellery industries are highly unorganized and fragmented. It is very hard to determine the exact numbers of jewellery workers of this country because of several reasons. First, till date, there is no official record about the numbers of jewellery shops in India and the reason being the jewellery industries are largely household ventures. Secondly, there is no record of labour management and policy in these sectors that could have provided idea about the numbers of workers. Thirdly, these small-scale enterprises are rarely registered with any government agency, therefore, the structure of these industries have remained unclear. However, according to a bulletin published by Indian Law Office (2008), India harbours approximately 450,000 goldsmiths in different jewellery manufacturing units along with 100,000 gold jewellers. They also estimated 6,000 diamond processing players and 8,000 diamond jewellers although this report might not be very much appropriate since jewellery industries are even present in remote villages and might not have been accounted so precisely. Yet, this is the only available source that has estimated the numbers of the Indian goldsmiths.

In a developing country like India, Work Related Musculoskeletal Disorders (WMSD) has become a major problem and is widespread in many countries (Hagberg *et al.* 1995). Several international studies have also shown that there is a high incidence of Musculoskeletal Disorders and work related physical problems in the textile and garment manufacturing industries [(Blader *et al.*, 1991), (Dillard and Schwager, 1997), (Halpern and Dawson, 1997). (Delleman and Dul, 2002)]. As per the report of United States Department of Labour (2000), in a private sector in the United States, nearly six million workers experience nonfatal injuries or illness. In Britain, MSDs are believed to represent the largest category of work related illness (Palmer and Cooper, 2000). WMSDs affect one million people each year and the most common problems are back pain, work related neck and upper limb disorders, repetitive strain injuries and lower limb disorders (Takala and Martimo, 2007). These disorders are preventable or at least can be delayed (Detels *et al.* , 2002). The risk of WMSDs can increase with an increase in workloads, low work satisfaction, high work demands and work related stress. Therefore immediate attention must be provided to those individuals. Any delay in such cases might result in very lengthy treatment with a long rest period and also results in other sufferings with financial losses to the individual, his / her family, surroundings and the community in turn (Wadsworth and Walters, 2005).

A large number of goldsmiths are working there for prolonged period in a semi-confined workstation. It was found in one study (Ghosh *et al.* , 2010 and Ijadunola et al, 2003) that goldsmiths were highly affected by improper body posture and workload. Twisting, bending, and over-reaching are the resultant of poorly designed workstation. Moreover, lack of proper illumination at work site also exerts an additional adverse effect on the health of the goldsmiths. These all only contribute toward development of different kind of musculoskeletal disorders. It has been proved in many scientific studies (Gangopadhyay *et a.l*, 2003) that poorly designed workstation promote unnecessary physical efforts, which reduce efficiency and productivity also. Sustaining any static posture, such as sitting, increases the demand on the muscles, ligaments, and other soft tissues of the musculoskeletal system. It is not surprising then that overall discomfort and pain in the back, neck, and shoulders are common symptoms reported by workers who sit for most of their workday. Sitting alters the normal curvature of the spine and puts pressure on the discs. With prolonged sitting this pressure can cause compression of the discs. These resulting chronic back pain and possible nerve damage can impact on workers ability. It was shown that high percentages were suffered from MSDs commonly associated with poor ergonomic design in the workplace. Apart from these factors Temperature and humidity play very crucial role on the health of the workers. Many researchers are now emphasizing heat stress as one of the important factors that can have deleterious health effects. There are substantial evidences that have clearly identified heat stress, especially environmental heat stress as a prime factor for the reduction of productivity (Kjellstrom *et al*. 2009a; 2009b) (Parsons, 2009; Sett and Sahu, 2014). Unlike outdoor environment, indoor environment is also very important for the health and productivity of the workers. Temperature and humidity in the indoor environment also are very crucial for health and optimum productivity. There are many studies that have assessed direct association between productivity and quality of life of the workers with quality of indoor environment of the workplaces (Fisk and Rosenfield, 1997; Fisk, 2000; Wyon, 2004).

Insistence on occupational health is not a barrier for industrial growth rather a must for providing adequate health coverage to the workers of different industrial sectors. Neglecting this may put substantial burden on the economy of the country as ill health will reduce the productivity. There should be some state or nation-driven

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ventures to do more prospective and retrospective surveillance studies for taking necessary action to reduce the burden of occupation-associated health hazards of the workers, especially for those who remain in the marginal sectors of the community. If any interventional policy is undertaken to minimize any occupational health related issue of the goldsmiths under this present study, it may, in future, provide substantial benefit to a large community.

Methodology

Selection of subjects

In this study, the experiment was performed on 50 male goldsmiths. To avoid selection bias, all the workers were selected randomly from the Lohaghat, district Champawat, Uttrakhand.
Participants were included in the study if they meet following criteria:

(1) Only those workers were selected those are indulge in this work at-least since last five years.
(2) Normal Healthy worker not on any kind of medication
(3) Workers who are working more than 12 hours/day.
(4) Worker's willingness to participate in study

In this section the demographic characteristics of the sample such as age, gender, educational qualification, family type, marital status and family income was collected.

Analysis of Working Posture

Standard methodology, rapid upper limb assessment (RULA) was used to assess the stress of workers for all predominant postures by scoring them according to their severity of stress. Since, the goldsmiths belonged to sedentary class of workers and their tasks needed more usage of upper limbs (neck, shoulders, arms) compared to the lower limbs (legs), a more proficient posture assessment tool, rapid upper limb assessment (RULA) was used to stratify the postural patterns of the upper limbs only. RULA first described by McAtamney and Corlett (1993) is also a score-based information tool containing items of upper and lower arm position, wrist twist and position and neck and trunk position. Like REBA, this also evaluates the scores systematically for a particular job task. This is basically to assess the exposure of people to postures, forces and muscle activities known to contribute to Upper Limb Disorders (ULD). This Rapid Upper Limb Assessment (RULA) technique was used here to assess the postural discomfort of the goldsmith at their average working posture.

Procedure

A single page worksheet is used to evaluate required body posture, force, and repetition. Based on the evaluations, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.

Table 1: RULA Scoring System

Score	Level of risk assessment
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

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Results and Discussion

Demographic factors of goldsmiths, relating to the study population, including age, height, weight etc are presented in the Table 2 below.

Table 2 General information of the workers

n=50

Variables	Mean	SD
Age (years)	36.04	±7.8
Height (cm)	167	±11
Weight (kg)	73.03	±1.67
BMI	25.83	±5.67
Years of experience	16.24	±7.4
Duration of work per day (in hour)	15.7	±2.1
Duration of rest per day (in hour)	1.6	±0.49
Number of working days in a week	6.36	±0.63
Salary (per month)	Rs 13040	±7623.7

The mean age of the workers being 36.04 (±7.8) years have average 167cm (±11) height and 73.03 (±1.67) kg weight. Taking into account the height and weight the BMI was calculated which was average 25.83, which is concluded as workers being overweight, which varies from ±5.67 means obese to normal BMI. The years of experience of the workers were calculated from questionnaire and on average goldsmiths have 16.24 (±7.6) years of experience. The daily work schedule including the average duration of work was 15.7 hrs (± 2.1) that varies on the demand of work and rest 1.6 hr (± 0.49). The number of working days in a week is 6.36 days.
As the work of these workers s very intricate and requires all time special attention. The skills are acquired by the workers through their work only no exclusive training is given to them at any stage of making gold items. The salary of goldsmiths' starts from Rs 2000 pm and the highest salary range goes up to Rs 25,000 pm only. The average salary of goldsmths in Lohaghat district is Rs 15326 pm (±7557.45).

Rula Scoring

The assessment using RULA worksheet is presented in appendix. Table 1 presents the different categories of the risk levels as obtained after analyzing the posture.

Table 3 Categorization under RULA level

n=50

RULA Level	0	1	2	3
RULA score	1-2	3-4	5-6	7
Risk Level	Negligible	Low	Medium	High
Reqd. Action	Acceptable	Investigate further	Investigate further and change soon	Investigate and change immediately
f/% of workers	-	-	28	72

Figure 1 showed that 72 per cent of the workers are at high risk level and needs an Investigate and change immediately, whereas 28 per cent workers were found at medium risk levels and needs a Investigate further and change soon. The results of the posture analysis using RULA are shown in Table 3. These results reveal that only two categories of the risk levels exist in this work postures. The table showed that posture of 72 per cent workers who used in performing the activities is at high risk levels. A further investigation with an immediate change was recommended to these workers. The table also shows that none of the worker is at negligible risk level and in low risk level. The study was done on workers working in different sections of work related to gold and their activities were divided in different categories.

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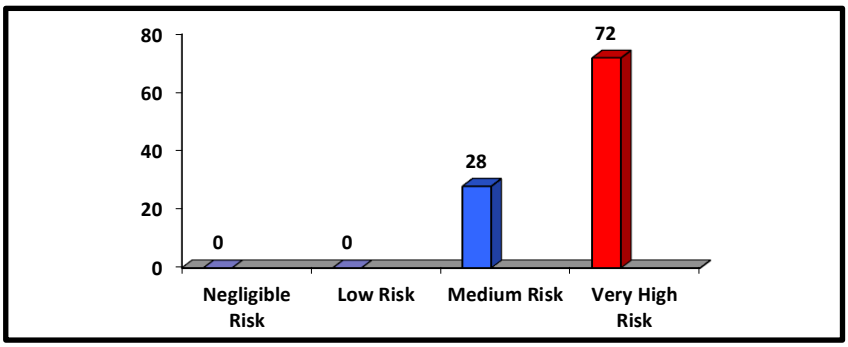

Figure 1: Percentage of worker under RULA level

Conclusion

The evaluation of body posture has been carried out for this particular manufacturing unit by RULA tool, it can be concluded that; significant proportion of the workers are working in uncomfortable and painful postures as found by analysis. This is due to lack of ergonomics knowledge and awareness in small scale industry. Thus the workers are under moderate to high risk of musculoskeletal disorders as determined from REBA risk level. This study recommends the immediate implementation of ergonomics interventions with proper knowledge among workers and health education on common postural change, implementation and monitoring of laws among industries are recommended to take down morbidity due to musculoskeletal disorders.

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