A Critical Assessment of Posture-Related Musculoskeletal Injury on Welders

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Abstract- ***Musculoskeletal disorders cover a large percentage of occupational diseases; therefore, in order to protect welders from such disorders, there is need to evaluate their positions at work in different workplaces. The study assessed the state of ergonomics in all its ramifications of a welding workplace with focus on those musculoskeletal disorders that could be associated with working posture. Fifteen welding workplaces were investigated among which fifty (50) welders were examined. The questionnaire drawn from the checklist of suggested ergonomic questions was used for data collection and the posture analysis technique known as Exposure Assessment Method was equally employed to determine whether or not a welder uses postures likely to have adverse effects on health and productivity. Statistical tests were carried out using samples of workers and their facilities. The assessment shows that working posture is highly responsible for the onset of musculoskeletal disorders during welding. The result obtained in this study agrees with the already established fact (NIOSH, 1997), that interactions among other occupational risk factors such as workstation design, repetitive task, manual material handling, tool handle design and job/task design contribute to determining the type of posture adopted, which if maintained for a long period of time, lead to musculoskeletal injuries, poor quality of work and low productivity.***

Indexed Terms- ***WMSD, Work posture, Exposure Assessment Method, CTDs, Ergonomics, BMI.***

I. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are the major risk factors in the life of blue-collar workers. These disorders not only lead to ill-health but cause low productivity as well as poor quality of finished product. A large percentage of welders worldwide lack the knowledge, causes and prevention of work-rerated musculoskeletal injuries. In Nigeria for instance, there is a growing concern in recent times on the health and safety of a welder. Welding as a form of manufacturing process is observed to be fast gaining ground in developing countries. Its operations are majorly manual and labour intensive and these activities often involve risk factors of cumulative trauma disorder (CTDs). According to International Labour Office (ILO, 1960) welders have a high-risk prevalence of musculoskeletal complaints, including back injuries, shoulder pain, tendonitis, reduced muscle strength, carpel tunnel syndrome, white finger and knee joint diseases etc [1]. Work postures (especially during welding) can all contribute to these disorders. [2] These high forces coupled with the awkward postures increase the likelihood of an upper extremity Work-Related Musculoskeletal Disorder (WMSDs) [3]. This discomfort of working apart from being caused by musculoskeletal complaints, is also caused by natural work postures and thus ergonomic design is needed [4,5]. The musculoskeletal complaint of workers varies from low to high mostly in the upper body part [6].

Many researchers have concluded that welders comprise a large occupational group that works long hours in forced postures [7]. Maintaining forced postures have been proved to initiate early muscle fatigue [8] while it can eventually lead to work-related musculoskeletal disorders (WMSDs) in the long-run or in severe cases [9]. Moreover, prolonged forced postures can lead to occupational injuries to workers [10] which will cause long term physiological and psychological harm [11]. Furthermore, WMSDs are the most common occupational injury worldwide and most common cause of long-term pain and disabilities in workers [11]. It is undeniable that full mechanization would be the best approach towards minimizing worker fatigue and injury, but because of the high cost, ergonomic interventions for workers are

still necessary and effective for smaller scale businesses [12]. Some scholars have conducted a questionnaire survey on the health status of primary and secondary teachers in Hong Kong and found out that, in addition to mental stress, work-related musculoskeletal disorders should also be valued [13]. On the basis of the Nordic Musculoskeletal Disorders Questionnaire, the result of ergonomic related to nurses have shown that poor working postures tend to cause WMDSs and measures to prevent (WMSDs in nurses have been proposed [14]. Furthermore, stress on the upper limbs during the work of auto assembly welders, have been analysed and regular adjustment of welding work site was proposed which encouraged welder to frequently change posture and welding **torch**, for the purpose of reducing any occupational hazards [15]. This programme has had a positive effect on improving common occupational injuries. In 2017, Concn *et al.,* used computer software to conduct ergonomics studies on the working postures of wheeled mowers as well as evaluating the performance of the wheeled mowers [16]. It is not difficult to see that the study of ergonomics is roughly divided into two parts, the improvement of equipment and the improvement of working postures

Posture-related musculoskeletal disorders occur in common activities like lifting, pushing, pulling, gripping, forceful pinching, holding for a long period of time, intensive typing which are harmful but are hazardous when the movements are repeated for several time without providing recovery time, rest, or performed in a faster manner. These risk factors among workers can be classified as physical, Individual and psychological. Among these risk factors, working in proper body posture and doing repetitive tasks comes under the physical category. Occupational stress, low organization care, asking for more work and **dissatisfaction** are cases of individual and psychological issues [17]. WMDs can be assessed using self-report, observational and direct-measurement method [18,19]. Exposure to these workplace risk factors puts welders at a high level of risk which causes injuries and disorders that affect the human body's movement or musculoskeletal system (i.e., muscles, tendons, ligaments, nerves, discs, blood vessels etc.).

Ergonomic interventions for workers should consider gender and should focus on work sectors with high risk for MSDs with multiple ergonomic risk factors and with the largest number of workers [20].

The clinical study of welders' painful shoulders shows that the senior workers have shoulder discomfort with prolonged tendinitis on the rotator cuff [21]. The discomfort study of confined space in shipyard welding, proposed that localised muscles' fatigue may be condensed by changing the wire welding process [22].

Carson (1993) identified many costs associated injuries and illnesses as medical cast, compensation cost, loss of workdays and re-training of new employees' cost. He also identified indirect cost as high absenteeism, high labour turnover of staff, low employee morale and poor quality of work [23]. Posture is in fact, the most frequently cited risk factors for cumulative trauma disorders [24, 25]. To the greatest extent possible, jobs should be designed to accommodate a neutral posture [26].

It is against this background that critical assessment of posture-related musculoskeletal injuries is most appropriate in auditing and identifying ergonomic and or safety related problems that heavily impinges on the high level of profitability and productivity of the welding operation. Thus, to develop effective intervention for reducing postural stress on welders, it is necessary to understand how factors such as workers body size (BMI), Work station layout, Equipment, Tools and Work Methods interact to influence working posture.

To do this study, posture analysis technique known as Exposure Assessment Methods was employed to determine whether or not a welder uses postures likely to have adverse effects on health and productivity [27].

II. MATERIALS AND METHODS

Fifteen welding workplaces in Owerri and Umuahia were randomly selected as the study area. Due to the highly dynamic, mental and skillful nature of welding work, characterization of the ergonomic exposure profiles associated with various welding trades has been proven to be challenging. Because of this,

ergonomic exposure assessment protocols based on worker self-reports method was found to be well suited for accurately and conveniently capturing valid estimates of posture related musculoskeletal hazards associated with welding operations. [27]

Thus, to accomplish the study objectives, the following worker self- report techniques were used;

i. Deductive and inductive approach
ii. Use of questionnaire
iii. Oral Interview

The data collected through deductive and inductive approach showed the past records of activities impeding the progress and process of welding operation, the rate of injury, absenteeism and rate of visitation to clinic of each welder with respect to his work as shown in table 1 below.

Table 1: Annual Injury Rate, Absenteeism and Rate of Visitation to Clinic

	2010	2011	2012	2013	2014	Mean
Injury rate	76	108	92	55	89	84
Absenteeism	54	96	68	41	65	64.8
Visitation to clinic	30	57	21	33	44	37

The questionnaire was drawn up from the checklist of suggested ergonomic questions which have been found useful. [28]. The questionnaire served as audit tool to assist in identifying the problem areas that should be addressed in order to have an ergonomically safe welding workplace. The questions were classified in the following headings;

- Section A: Work organization and scheduling
- Section B: Work postures.
- Section C: Occupational health hazards
- Section D: Work station/Job and task design.

Furthermore, in order to elicit more information and possibly identify features of work not covered by the questionnaire but very important to the subject under study, oral interviews were conducted. The oral interview was structured to cover the following areas as show in table 2.

Table 2: Oral Interview Comment

FACTOR	FAVOURABLE		UNFAVOURABLE		TOTAL	
	NO	%	NO	%	NO	°/c
Repetitive Task	10	31	22	69	32	14.9
Workplace	6	25	18	75	24	11.2
Workers	4	14.3	34	85.7	38	17.7
Materials	7	39	11	61	18	8.4
Tool Handle	11	37	19	63	30	14.0
Environmental	5	19.2	21	80.8	26	12.1
Work Hazards	8	35	15	65	23	.10.7
General	7	29.2	17	70.8	24	11.2
	58	27.0	157	73.0	215	100

III. RESULTS AND DISCUSSION

From the study, it was discovered that work-related musculoskeletal injuries were associated with numerous occupational “risk factors” with working posture ranking extremely high. Almost all the welders claimed that most of the pains they suffer were as a result of awkward posture adopted during welding. Based on the records available, from table 1, the absenteeism is 65 days per year, visitation to clinic is 37 days per year and injury rate stood at 85 per year. These high results were due to the intensive physical exposures, stress, and strains on the muscles caused by adopting awkward working posture during welding.

The results presented in table 2 show the oral interview comments about repetitive tasks, workplace design, worker posture, work hazards among others. The result obtained show that awkward working posture is highly responsible for the frequent complain of discomfort, pain, fatigue, reduced concentration and sometimes lead to poor welds.

The result obtained in this study agrees with the already established fact that though, work posture contribute to the onset of work - related musculoskeletal disorders in some body regions, other occupational risk factors such as work station design, manual material handling, job/task design, tool handle design, vibrations as well as psychological and individual factors and the interaction/combination of these factors also contribute to the development of work-related musculoskeletal injuries. [29]

There were also significant correlations ($p < 0.05$) for the factors under investigation. The regression models for these factors established that there is a statistically significant relationship among the factors. For two factor models, comparing injury rate and absenteeism, the result indicated strong relationship between them ($r=0.959$) indicating that absenteeism is most probably due to injury. Similar results were observed between injury rate and visitation to clinic ($r=0.508$). Here the correlation is lower than former, indicating that people do not just visit clinic because of injury alone, but for other purposes. In the case of absenteeism and clinic visitation, it was ($r=0.658$) indicating a relationship between them. Here also their absenteeism is probably due to visitation to clinic. These factors adversely affect welders' health, productivity and quality of work.

CONCLUSION

Several attempts by work system designers have tended to place more emphasis on the mechanical functionality of tools and equipment and also the work content, thereby relegating ergonomic of workplace to the background. It is obvious that this practice is dangerous because it shifts emphasis from man, who is the main component of work system to machine. The resultant effect has always been; discomfort, pain or injury on the side of the worker and poor quality, low productivity and high labour turnover on the entire systems.

As can be seen from the study conducted among welders, working posture was found to be the main cause of musculoskeletal injuries. However, the findings also demonstrated that job/workstation design may determine the type of posture to be adopted during welding operations. The linear relationship show that job/workstation design and other occupational risk factors usually imposed undesirable posture on the welder which eventually lead to musculoskeletal injuries, lost workdays, low productivity and poor quality of work among others.

RECOMMENDATIONS

Based on the results of the study conducted, the following are recommended:

1. Welders should be made to avoid awkward and static body posture, which cause fatigue, reduced concentration which lead to poor welds by alternating between sitting and standing positions.
2. Ergonomic guidelines and principles must be' followed on the design' of workstation, work layouts, chairs, worktables and machines based on the anthropometries measurements of the users' operatives.
3. A periodic educational programme as well as training should be embarked upon so as to enable welding operation to be proactive in the systematic implementation of ergonomics.
4. Lifting tables, motorized positioning devices and scaffolding should be provided at a comfortable height to allow working in a seated position.
5. Daily body exercise such as stretching and strengthening active muscles, which promotes relaxation, should be encouraged. Relaxation is as important for prevention of work-related musculoskeletal disorders symptoms (WMSDs) as it is for general wellbeing. Always take a new, more active role in promoting your general fitness both at and away from work.

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