

PROLONGED STANDING IN AN INDUSTRIAL WORKPLACE: A REVIEW ON HEALTH EFFECTS AND CONTROL

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Abstract— Industrialization has led to the development of various machines. Most of the industries have power press, hand press, lathe, drilling, polishing, milling machines etc. Although these machines save a lot of human effort and time, but they also affect workers health. Most of the processes performed during manufacturing of the product require standing position of the worker. Standing position provides more degree of freedom and frequent movement for immediate action not only for the productivity enhancement but also fast movement in case of any emergency. Beside this, standing for a prolonged period motivates occupational injuries such as muscle fatigue, pain and discomfort in leg, low back, shoulder, neck etc. This paper provides information regarding health effects and methods of alleviating occupational injuries due to prolonged standing. Engineering principles and ergonomic modifications in the workplace and job design are also reviewed to reduce adverse effect of prolonged standing on health of the worker.

Index Terms— Prolonged standing, ergonomically designed workplaces, Health hazards, Control methods

I. INTRODUCTION

Many industrial workers such as lathe operator, bench drilling machine operator, milling and grinder operator etc. require standing posture to perform industrial task [1]. Standing posture provides large degree of freedom for performing industrial tasks especially on large machines. These jobs may not be performed easily in the sitting position. If more than half of the total working duration is of standing nature then worker is said to be exposed to prolong standing [2]. Reduced productivity, occupational injuries, low performance, muscle fatigue, discomfort are not only the major effects of standing for a prolonged period but collectively they altogether increase medical cost and compensation etc. Krijnen et al., [3] found that impaired functioning of calf muscles takes place while worker is exposed to prolong standing. In a self reported work

related illness report of 2003-04, it was reported by Health and Safety Executive that 192000 people in the UK have occupational lower limb disorder because of their poor working environment [4]. According to American Podiatric Association, more than 80% of industrial workers in the United States reported foot or lower leg pain and discomfort due to prolonged standing [5]. Reduction of fatigue, pain, discomforts and disorders is important to improve the productivity. Activities in standing posture needs higher energy requirement hence, it is not suitable for higher age workers to carry out task in standing position. [6].

II. EFFECTS ON HEALTH

Occupational health statistics estimated that prolonged standing posture is responsible for more than 2 million days sick leave in a year [7]. Prolonged standing while performing a job is highly responsible for the low back pain, muscles fatigue and discomfort in legs, shoulders and neck. Beside this, chronic venous disorders, circulatory problems, compression and damage of the various joints such as spine, feet, knee etc. are also the major effects which occur due to the standing posture for a long period of time.

Day-by-day increasing levels of demand, force the workers to perform their jobs on non-ergonomically designed workstations leading to various disorders. High rate of Musculoskeletal disorders (MSDs) are the major problem in industries due to the poor working conditions and lack of application of work injury methods and programs [8]. Musculoskeletal disorder may be defined as the injury to the musculoskeletal system of the body. It might be due to strain and sprain of muscles, ligaments or tendons, soft tissue hernias, chronic pain etc. MSDs occurs by gradual wear and tear to joints, ligaments, muscles and inter-vertebral discs caused by repeated or continuous motion or by sudden damage caused by strenuous activity, or unexpected sudden movements. These conditions leads to pain, swelling, tingling and discomfort in various body regions such as neck,

shoulder, back, elbow, knee, leg. 'Duration of work' in standing posture was also found to be a significant factor contributing to MSDs. In an eight hour shift, workers performing jobs in standing position for 4 hours or more are exposed to MSDs [9]. Gregory and Callaghan [10] reported that even 2 hours of standing posture might be a contributory factor for lower back pain. Chandrasakaran et al. [11] reported that remaining in a posture or a movement for prolonged hours might be significant in relation with the prevalence of MSDs. In a study performed at small forging industry, it was reported that 20.33% of workers were at high risk of prevalence of MSDs due to the prolonged standing with awkward posture [12]. Singh et al., [13] also reported similar findings due to lack of implementation of ergonomic planning and methods in another forging industry. Sahu et al., [14] studied musculoskeletal problems related to occupational health of sweet makers in India and revealed that prolonged standing with awkward working posture elevates the prevalence of MSDs. Ansari et al., [15] in their study on body postures of the workers engaged in small scale industries found that prolonged standing and awkward posture were the key cause of MSDs propagation. Ahmad et al., [6] studied the influence of age over the MSDs and muscle fatigue, and reported that prolonged standing job demand more endurance of the muscles and energetic requirement. Therefore such jobs are not fit for old age workers because of adverse effects on their health and low performance [6]. Increase in rigidity of the body parts with age is responsible for early fatigue and discomfort [16].

Prolonged standing also lead to the Chronic Venous Insufficiency (CVI). CVI is a progressive medical condition in which the valves that carry blood from the legs toward the heart no longer function, causing blood to pool in the legs and the veins to swell. Leg heaviness, fatigue, pain, swelling, ulcers in the leg are some of the consequences of prolonged standing posture [17].

Atherosclerosis is a condition in which hardening and narrowing of the arteries takes place. This condition is the usual cause of heart attacks, strokes, and peripheral vascular disease. In a study conducted by Niklas et al. [18], it was found that prolonged standing might be harmful for the men suffering from heart diseases. Sartika and Dawal [19] measured activity of several muscles during standing condition and found that soleus muscle was the most active and tibialis anterior was the least active. The higher discomfort was found on lower back, and feet followed by ankles, lower leg and knees. It was also conclude reported that closer body part and muscles were to the ground, the more it be affected.

III. METHODS OF REDUCING PROLONGED STANDING

Buckle et al., [20] reported that to avoid health risk of prolonged standing worker should not be exposed to standing posture more than 30% of its working shift. Halim et al., [21] in one of the study evaluate the posture, muscle activity and

oxygen expenditure of the metal stamping operators and found that redesign of the workstations not only reduced muscle activity but also significant improvement in the overall physiological performance of the worker. Redesign of workstation was found to be the significant over reduction in MSDs [14].

Wickens et al., [22] reported that risk of occupational injuries might be reduced by various interventions in the industrial workplace. Ergonomically designed workstations, mats with anti-fatigue characteristics are some of the effective methods of reducing prolonged standing injuries. Ergonomically designed workstation consists of adjustable height of the work surface, enough space for worker to change its posture effectively with time, foot rest, elbow support space or attachments and sitting facility for resting purpose of the worker. Working height should be adjustable according to the worker's elbow height. Frequent rest breaks and job rotation might also be effective when concerned with prolong standing. Halim et al., [23] also reported that occupational injuries associated with prolonged standing may be reduced with interrupting continuous standing by providing micro-breaks, rotating jobs, changing posture from standing to sitting, using anti-fatigue mats on the floor and wearing soft shoe insoles.

Anti-fatigue mats are much softer than concrete or brick floor so it allows flow of blood through legs and hence avoid swelling etc. Proper clothes also have significant effects over worker. Sitting is also preferred posture than prolong standing posture as it requires less muscles contraction and uniform distribution of load over the upper limbs [24]. Sartika and Dawal [25] compared the percentage Maximum Voluntary Contraction (MVC) in sitting and standing position, and reported significant reduction in percent MVC during sitting. Prolonged and improper sitting was found to be the significant contributor to MSDs, reduced productivity [26, 27]. When engineering interventions are not possible to implement, then use of work rest schedule might be a solution for minimizing occupational injuries due to prolonged standing posture. Leg swelling can be avoided by using longer breaks [28]. Therefore for a working shift of standing nature, job rotation was found to be effective and if job rotation is not possible then sitting and standing may be effective than prolonged standing alone [29].

IV. DISCUSSION

Most of the industries demands standing position due to frequent movement and large degrees of freedom. Significant contribution of the standing duration, posture, muscles activity and working conditions over the worker discomfort, pain and muscle fatigue was found by different researchers [5, 9, 10, 28, & 30]. These effects can be minimized by using engineering principles and ergonomic design together. Deros et al., [31] studied the assembly line workstation design and reported that MSDs may be reduced if workstation is designed according to the anthropometric data of the workers

Therefore, task assigned to the worker should be according to individual capacity, anthropometry, age etc. Proper programs and training in the form of workshop practices might also be an effective way of reducing prolonged standing health hazards.

V. CONCLUSION

Based on present review, prolonged standing posture has various adverse effects on health of the worker. On the basis of review, it is suggested that the job rotation, proper work rest schedule and redesigning of the workstations to work in both conditions i.e. sitting and standing may be quite beneficial in reducing occupational injuries which occurs due to prolonged standing. It was also found that there is a strong need of literature regarding effects of workstation redesign to reduce prolonged standing and in turn various health effects.

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