



Evaluation of Musculoskeletal Disorders Risk Factors in Panting: A Case Study of Akaki Basic Metal Industry Painters

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Abstract

The purpose of this study is to investigate and propose of ergonomic conditions of manual spray painting in the manufacturing industry have been studied. Manual spray painting is despite rationalizations quite common in the Akiaki basic metal industry. Observation and medical record with spray painters showed that they had higher prevalence of musculoskeletal symptoms in their right shoulder compared with other workers with manual work. A majority of the spray painters painted work-pieces lying on a work-table. A majority of these painters abduct the right upper-arm so much when painting the horizontal surface of the work-piece that they risk supraspinatus tendinitis. The upper-arm abduction when painting horizontal surfaces could be decreased without introducing new ergonomic disadvantages by installing work-tables with powered height control or possibly also by changing the geometry of the spray gun. Gripping the spray gun trigger was for some of the painters identified as causing a high risk for WMSD in the wrist. Lower spray gun trigger force would improve the situation. This could be done by the users in several ways, such as greasing the trigger mechanism and/or decreasing the spring pressure on the fluid needle.

Keywords: Work-Related Muscular-Skeletal Disorders; PMSDs

Introduction

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Proper ergonomic design is necessary to prevent repetitive strain injuries and other musculoskeletal disorders, which can develop over time and can lead to long-term disability [1]. The improvement of musculoskeletal health at work is one of the most important objectives of ergonomics. According to the International Ergonomics Association (IEA, 2003) Physical ergonomics issues include working postures, materials handling, repetitive movements, Work-related musculoskeletal disorders, workplace layout, safety and health. Musculoskeletal health can be maintained by controlling for risk factors. Biomechanical Hazards, genetic predisposition, morphological disadvantages, all interact in the precipitation of work-related musculoskeletal injuries, but it is only Feasible to control for the biomechanical and psychosocial factors. Physical exertion in the workplace can result in the precipitation of work-related musculoskeletal Injuries. Studies have shown that posture, range of motion, force repetition (OML, 2011). The goal of ergonomics is to maximize the productivity and effi-

ciency and minimize human suffering due to accidents or chronic excessive stress. An ergonomics program can be as complex as the design of an entire manufacturing plant, or as simple as the "quick-fix" adjustment of a chair height [1]. In the processes involved in paint manufacture (such as mixing, milling, and shearing) workers are exposed to organic solvents that may cause a variety of symptoms, including transient symptoms of the central nervous system such as euphoria, headache, and dizziness at low or moderate concentrations and serious symptoms such as fainting and respiratory and circulatory failure at high concentrations [2]. The main objective of this study is to assess the exposure level to PMSDs risks and to determine the MSDs occurrence among painters. Through this the specific objectives are Analyzing the existing situation of painter's section that exposes the painters to WMSDs risks; Ensuring worker safety, worker health and worker productivity by Reduce absenteeism; causes of MSDs; Improve worker safety and Participate in your employer's ergonomics program. Industries increasingly require higher production rates and advances in technology to remain competitive and stay in business. As a result, jobs today can involve. Frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices; Increasing specialization that requires the worker to perform only one function or

movement for a long period of time or day after day, working more than 8 hours a day, working at a quicker pace of work, such as faster assembly line speeds and Having tighter grips when using tools (Sanchez, 2015). The scope of ergonomics in manufacturing industries include but not limited to pushing and drawing of loads, physical work load, staff posture at work, man-machine interaction, noise, visibility, environmental stress, analysis of human capabilities and weaknesses, fatigue, dynamic forces acting on the human body while at work, the tools used by workers to perform various tasks, etc. Godwin and observed that work-related health problems are experienced by workers across all types of jobs and work sectors, and to many, it has become a fact of life.” However, they explained that some types of work groups seem to be particularly at higher risk Identifying the risk factors in a manufacturing company is fundamental in eliminating (Okpala, 2013). The ability of manufacturing companies to ergonomically design conducive shop floors and plants that enhance good health by allowing reduced motions, better posture and less exertion will lead to more effective and productive work force, as well as the production of high quality products with reduced defects. According to Middles worth another importance of ergonomics is production cost reduction; this is because a properly designed ergonomics friendly workstation will drastically reduce all risk factors that may lead to fatigue, strain, injuries, musculoskeletal disorders, as well as other exorbitant indirect costs (Marilyn and Andrew, 2014). When a worker is exposed to MSD risk factors, they begin to fatigue. When fatigue outruns their body’s recovery system, they develop a musculoskeletal imbalance. Over time, as fatigue continues to outrun recovery and the musculoskeletal imbalance persists, a musculoskeletal disorder develops. These risk factors can be broken up into two categories and individual-related risk factors. Repetition is excessive repetition of movements can imitate tendons and increase pressure on nerves Aback ward postures is position that stretch physical limits can compress nerves and imitate tendons Static postures is positions that a worker must hold for long periods of time can restrict blood flow and damage muscles Quick motions is increased speed or acceleration when bending and twitting can increase the amount of force exerted on body. Compression or contact stress is Grasping edges like tool handles can concentrate force on small areas of the body reduce blood flow and nerve transmission and damage tendons and tendon sheaths Vibration is excessive vibration from tools can decrease blood flow damage nerves and contribute to muscle fatigue whole body vibration can affect skeletal muscles and cause low-back pain Cold temperatures is working in cold temperatures can adversely affect a workers coordination and manual dexterity and cause a worker to use more force than necessary to perform a task force is exerting excessive force can cause a variety of injuries MSD hazards are general classified into three categories; biomechanical hazards, additional hazards, and individual hazards (Middlesworth, 2015). Paint products are widely used in industry to provide surface coating for protection against corrosion, for appearance as electrical insulation, for fire retarda-

tion and for other special purposes. Paints can be applied by a variety of processes including brush, roller, dip, flow, conventional air spray, airless spray, disk spraying and powder coating fainting and respiratory and circulatory failure at high concentrations in the processes involved in paint manufacture (such as mixing, milling, and shearing) workers are exposed to organic solvents that may cause a variety of symptoms, including transient symptoms of the central nervous system such as euphoria, headache, and dizziness at low or moderate concentrations Long-term exposure may cause damage to the Central Nervous System (CNS), such as cognitive and emotional deficits. In particular, solvent related chronic encephalopathy (SRCE) has been described in several studies. Toxic effects of organic solvents were reported to harm liver, kidney and skin. Occupational exposure to mixtures of organic solvents has been evaluated in many activities, such as pain- ting, paint spraying, floor-laying, shoe making, laundries, graffiti removers, etc. (Aida Abd, Hamid Hassan, 2013). Organic solvents application grew to be wide and diverse in both developed and developing countries. The health effects of organic solvents have been known for more than a century. The introduction of chlorinated solvents in the led to reports of toxicity. Although solvents number in the thousands, only a few have been tested for neurotoxicity. The advent of industry has increased the need for different solvents. While only a few organic solvents were used at the turn of the last century, their number has today increased to several hundreds. Although the primary concern about their usage used to be related to their causing fire and explosion, their toxicological properties have to be considered as well. The most important toxicological properties of organic solvents are their ability to evaporate and to dissolve fats. By dissolving fats, organic solvents can damage hematopoietic tissue [3-10].

Methods and Material

To accomplish the objective of the research, the researcher has used different methods while gathering information. The data of the study relies both from primary and secondary sources of data, believed to be the major sources of collecting information. The primary data are collected through direct observation and from the medical data of the industry that found from the medical report of the company in addition to this, direct observation is held on foundry of ABMI (Akaki Basic Metal Industry) to critically observe and analyze the cause of the musculoskeletal disorder among each worker of the industry.

The secondary sources of data that the researcher used are internets, journals, senior thesis work and other relevant books. Complete literature reviews or survey have been conducted regarding the concept of musculoskeletal disorder among welder. After gathering the required data, the data is analyzed by comparing with different research books and literature that wrote in musculoskeletal disorder that happen in the panting area of workers. Reviews or survey have been conducted regarding the concept of musculoskeletal disorder among painter and spray painter.

Tools and Equipment	Operations	Possible MSDs
Spray painting	Is a process that utilizes a continuously fed solid electrode, shielding gas from an externally supplied source, and electrical power to melt the electrode and deposit this molten material in the weld joint. The welder for semi-automatic operation is travel speed, travel direction and gun (torch) positioning. MIG Welding can be used on a wide variety of metals and in a number of different base metal thicknesses.	Welders often position their torch and work piece Repeated frequently over a long period of time, this motion can lead to repetitive motion injuries in welders. In addition, work pieces that are not optimally positioned or job tasks that require welders to contort their bodies can contribute to muscular disorder injuries.
Panting brushes	Grind the welded material for small particulate release as well as fumes and gasses that typically have small particulate size and a metal-cutting process that is a large and diverse area of manufacturing. It produces fine finishes and accurate dimensions;	Position their grinder during grind work and Repeated frequently over a long period of time, this motion can lead to repetitive motion injuries too. Optimally positioned or job tasks that require a grinder person to contort their bodies can contribute to muscular disorder injuries.
Sand paper and scrapers	The preparation isn't complete without a sanding or scraping. this could be alight sanding only meant to even out the portion of the substrate that have been repaired. Other time the entire surface must be sanded down for the paint to adhere know what material you intend to paint and whether a full sanding is necessary to make your paint jobs successful	contains numerous sharp edges that cut away at wood or metal. The abrasive edges are glued onto backing material such as Kraft paper with a bonding agent. Different grades of sandpaper represent the difference in quality of the abrasives, the backing material and the bonding agents.
Pressure washer	Any painter worth his salt will tell you that the most important step to any painting jobs is the surface prep properly Prepping the substrate your wall or floor whatever it is that needs paint	Paint free of dirt and dust ,chipping these items the surface, which might cause it to ripple or chip industrial painters require a good pressure washer or blaster to get all the gunk off ensuring the painting surface is in the ideal condition for painting .

Table 1: Literature review summery.

Data collection and analysis

This data are collected based on medical record and ways doings at Akaki kaliti Basic Metal Industry workers. It is collected to assess the effects of work related musculoskeletal disorders. To evaluate this different data are collected from different perspectives by interviews and observations.

Existing workstations

There are four main production rooms in the factory. Their corresponding operations are stated as follows. There are four main production rooms in the factory. Their corresponding operations are stated as follows.

Standard product and engineering production room: In this production room there are different types of operations to accomplish the factory's overall production achievement. Some of them are

Operation for the department	Department
Casting	Freres casting factory
Cutting, darling, milling	Machin part production factory Department
Forging	Machin Chin part production factory's
Bending and rolling	Machin part fabrication factory's
Mechanical test, Tan sale test	Laboratory taste
Panting	Grinding and Assembling

Table a

Other production room are Machin part fabrication factory

- Cutting
- Welding
- Grinding
- Rolling and banding
- Heat treatment Department
- Painting production room.

From the above production room most of the welding production process is in the production of track and trailer and we can find medical records b/c of muscular disorder from medical recorded data of the company.

Medical record of the company				
Year	Total no of medical recorded	Percentage of recorded medical report of common accident		
		Common diesis	Different Injuries	Muscular disorder
2005	90	35	38	27
2006	88	45	25	30
2007	96	37	41	22
2008	86	40	40	24
2009	70	37	50	35
2010	90	35	38	20

Table b

Medical record of the company

From the above table we can understand muscular disorder problem is one of the major risen but it has less medical recurred rather than the others b/c effects of muscular disorder are seen mostly when the age of the person increase but for this study purpose we try to divide muscular disorder problem in production room.

Production room	Year and % of muscular disorder recorded					
	2005	2006	2007	2008	2009	2010
1. Standard product and engineering production room:	28	20	15	26	30	22
2. Machin part fabrication fabric	32	28	30	22	40	20
3. Heat trite meant production room:	18	38	27	34	30	35
4. Painting production room	22	14	28	18	30	17

Table 2: Medical records.

Observations of painting work position that are related to the cause of MSD in ABMI

Picher 1: Working in front and Working above the shoulders at standing position. Most injures caused by this position is hand muscle disorder during holding the painting material.

Task requirement

- Holding time = 10 min,
- Frequency = 30-35, Time per one shift.



Figure 1

Picher 2: Working at ground level at different work shop during painting.

Task requirement

- Holding time = 8 min
- Frequency = 55-60 time per one shift.

Picher 3: Panting and spry painting under the work piece working cycle is basically slight bending for positioning the welding. From the observation when axel is produced painting under the axel is necessary like shown in the figure it has been noted that this work- ing position is one of the risky tasks.



Figure 2



Figure 3

Task requirement

- Holding time = 5 min
- Frequency = 20-30 Time per one shift.

Picher 4: Is the reaching and forward bending pose common in the gear box housing and spry painting trade. Painter often grabs painting guns and target to hit inclined work pieces by bending and reaching their back. This posture is mostly repetitive in daily routines.

Task requirement

- Holding time = 15 min
- Frequency = 10-15 Time per one shift.

Picher 5: Portrays the common kneeling position of a painter. This posture is required in certain painting circumstances when are large and complex or difficult to lift up. This position is very common in most of the painting works. The painters may rely on knee support on the floor and yet the back and neck are in awkward positions. Also extended durations or repetitions might add additional MSD risks to knee and joints as well

Task requirement

- Holding time = 10 min
- Frequency = 25-30 Time per one shift.

Picher 6: Working at ground level at different work shop during painting

Task requirement

- Holding time = 7 min
- Frequency = 30-35 Time per one shift.



Figure 4: Spray painting and painting in different position.

Result and Discussion

Postures in spray painting and painting	Musculoskeletal Hazards						
	Biomechanical Hazards			Additional Hazards			
	High Force	Awkward Posture	Repetition	Vibration	Temperature	Contact Stress	Work Methods
Picher 1	High impact of gripping	Medium impact on static loading in arm and shoulder	High impact	Low impact	High impact on hot	Medium impact	Technique
Piche2	High impact of gripping	High impact on folding knee and extension of neck	High impact	Medium impact	High impact on hot	Medium impact	Technique
Picher 3	High impact of lowering, pushing carrying	High impact on back bend forward, static load on arm and solder folding knee, and extension of neck	High impact	Medium impact	High impact	High impact	Technique
Picher 4	High impact of gripping	High impact on back bend forward, static load on arm and solder and extension of neck	Medium impact	Medium impact	Medium impact	Medium impact	Technique
Picher 5	High impact of gripping	High impact on back bend forward, folding knee and extension of neck	High impact	Medium impact	High impact on hot	Medium impact	Technique
Picher 6	High impact of lifting, pushing, carrying and gripping	High impact on back bend forward and static load on arm and solder	High impact	High impact	Medium impact	High impact	Technique

Table 3: Evaluation of Musculoskeletal Disorder Hazards.

- Improve worker safety
- Controlling ergonomic risk
- Training and education.
- Position yourself in a stable, comfortable posture
- Use motorized positioning devices
- Learn to recognize symptoms of work-related musculoskeletal disorders (WMSDs; also called repetitive strain injuries or RSIs). Repeated uncomfortable postures and tasks can cause injury
- A good ergonomics training program will teach employees how to properly use equipment, tools, and machine controls as well as the correct way to perform job tasks.
- Use a foot rest if standing for long periods.
- Change of type of spray gun used, that is, compressed air type to other types such as high volume low pressure (HVLP) or electro-deposition spray gun which have less overspray.

Ergonomic solutions for painting and musculoskeletal disorder hazards

- Increase productivity by making jobs easier and more comfortable for workers
- Improve product quality because fewer errors will be made when using automated processes that demand less physical effort
- Reduce absences because workers will be less likely to take time off to recover from MSD related problems
- Avoid working in one position for long periods of time
- Lower costs as workers' compensation and other payments for illness and replacement workers go down

Conclusion

Musculoskeletal disorders in welding tasks at Akaki kaliti Basic Metal Industry are serious concerns. Ergonomic risk evaluation of panting tasks is crucial as these have strong connectivity with PMSDs. As it observed from study; Poor workstation design and layout; Lack of awareness of ergonomic principles and standard Long exposure of work and Lack of skilled operator are the responsible factors for the cause of WMSDs in Akaki Basic Metal Industry painting area worker.

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