MUSCULOSKELETAL SYMPTOMS AMONG CLEANERS IN HEALTH CAMPUS, USM

by

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A dissertation submitted in partial fulfillment of the requirements for the Degree of Bachelor of Health Sciences (Hons) (Environmental and Occupational Health)

JUNE 2014

APPROVAL PAGE

This is to certify that I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation submitted in partial fulfillment for the degree of Bachelor of Health Sciences (Hons) (Environmental and Occupational Health).

DECLARATION PAGE

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees
at Universiti Sains Malaysia or other institutions.

ACKNOWLEDGEMENTS

First and foremost, thanks to Allah the Al-Mighty for His grace that gives me the ability to complete final year project for my Degree of Bachelor of Health Sciences (Hons) of Environmental and Occupational Health, School of Health Sciences, USM.

I would like to express my deepest gratitude and thanks to my supervisor Miss Faridah Binti Naim, lecturer of Environmental and Occupational Health for her wonderful supervision, guidance, assistance and motivation during my research project. I would also like to express my gratitude to all lecturers of Environmental and Occupational Health, PPSK lectures, and all USM staffs who contributed directly or indirectly for the completion of this research project.

Last but not least, I would like to express my utmost appreciation to my beloved parents, Mr. Mohamed Noor Abdullah and Mdm. Noorhamidah Abdullah, my dear aunt, Amy and my siblings, Joe, Arie, Bot, Nen, Apik, Mila, Noi and Abbas for their tremendous support, encouragement, blessing and understanding. To my friends, especially Nurul Aliyana, Nurul Syahiirah and Siti Norarfah, thank you very much for your sincere help, concern and moral support.

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LIST OF ABBREVIATIONS AND SYMBOLS

NIOSH	National Institute of Occupational Safety and Health
WMSDS	Work-related Musculoskeletal Disorders
DOSH	Department of Occupational Safety and Health
HSE	Health and Safety Executive
IDEAS	Institute for Democracy and Economic Affairs
ILO	International Labour Organization's
MSDs	Musculoskeletal Disorders
MSS	Musculoskeletal symptoms
NSW	New South Wales
OSHA	Occupational Safety and Health Administration (United States)
SPSS	Statistical Package for Social Science
USM	UniversitiSains Malaysia
BMI	Body Mass Index
OA	Osteoarthritis
UK	United Kingdom
MSS	Musculoskeletal Symptoms
P	*p value*
et al.	*Et alia* (and others)
%	Percentage
<	Less than
>	More than

SIMPTOM MUSKULOSKELETAL PEKERJAAN DALAM KALANGAN PENCUCI DI USM, KAMPUS KESIHATAN

ABSTRAK

Kajian ini dijalankan untuk mengkaji simptom muskuloskeletal pekerjaan dalam kalangan tukang cuci di USM, Kampus Kesihatan. Kesakitan dan ketidak selesaan pada bahagian anggota badan dapat memberi kesan dan mengganggu prestasi kerja. Faktor fizikal, personal dan psikososial turut dikaitkan dengan MSDs dalam kalangan pekerja pencucian. Hubungan dengan faktor-faktor ini telah dikenal pasti dengan menggunakan ujian khi-kuasa dua. Maklumat mengenai kajian ini dikumpul melalui pengedaran borang soal selidik kepada 112 orang responden dengan bantuan penyelidik. Pemantauan terhadap kerja pencucian turut dilakukan. Hasil kajian menunjukkan pekerja wanita mendominasi pekerjaan sebagai pencuci di Kampus Kesihatan. Hasil kajian turut mendapati bahagian badan yang sering mengalami kesakitan dan ketidak selesaan dalam tempoh 12 bulan yang lepas adalah pada bahagian lutut (69%), pergelangan tangan kanan/ tangan (65%), belakang atas (68%), belakang bawah (58%), kaki (67%), dan kedua-dua bahu kanan dan kiri (66% dan 64%). Kelaziman bahagian yang mengalami masalah kesakitan dan ketidak selesaan adalah sama dengan kajian sebelum ini kecuali pada bahagian lutut dan kaki. Kesakitan pada lutut dan kaki ini dapat dikaitkan dengan factor risiko lain iaitu fisiologikal (umur) dan psikososial (gaya hidup dan pemakanan). Selain itu, hubungan antara simptom muskuloskeletal dengan faktor fizikal, personal dan psikososial telah dikaji. Bagi faktor fizikal, jenis kerja yang menyumbang kepada risiko MSDs ialah mengemop dan mengalihkan perabot manakala faktor personal ialah jantina dan umur. Selain itu, factor psikososial iaitu organisasi kerja (bantuan daripada orang lain, intensiti kerja, masa untuk menyiapkan semua kerja dan membuat keputusan untuk masa rehat) dan lokasi kerja turut menyumbang kepada risiko MSDs dalam kalangan pekerja pencucian di Kampus Kesihatan. Kesimpulannya, kewujudan simptom muskuloskeletal dalam kalangan pekerja pencucian di Kampus kesihatan wajar diambil perhatian oleh pihak pengurusan dan juga individu itu sendiri kerana ianya melibatkan kualiti hidup pekerja itu sendiri dan juga prestasi syarikat tersebut.

MUSCULOSKELETAL SYMPTOMS AMONG CLEANERS AT HEALTH CAMPUS, USM

ABSTRACT

This study was conducted to investigate the musculoskeletal symptoms among cleaners at Health Campus, USM. The muscular aches, pain and discomfort on part of the body can affect and disrupt the job performance. Physical, physiological and psychosocial factors areassociated with MSDs among cleaners. The associations were identified by using chi-square test. The information about this study was collected through distribution of questionnaires to 112 respondents with guidance from the researcher. Observation of cleaning job was alsoconducted. Results from this study show female workers were dominated the cleaning job at Health Campus. The study also found that the body part that often experience muscular aches, pain and discomfort in the last 12 months were at the knee (69%), right wrist/hand (65%), upper back (68%), lower back (58%), legs (67%), and both the right and left shoulders (66% and 64%). The prevalence of location of muscular aches, pain and discomfort was similar with previous studies except for knees and foot. Pain in knees and foot can be associated with other risk factors of MSDs which is physiological (age) and psychosocial (lifestyle and diet). Relationship between musculoskeletal symptom with physical, personaland psychosocial risk factors were identified. For physical factors, work task that associated with risk of MSDs was mopping and moving furniture whereas personal factor were gender and age. Psychosocial factor which is work organisation (helps from others, work intensity, time to complete all works and controls on deciding own break) and job location also have association with the risk of MSDs among cleaners at Health Campus.As a conclusion, the presence of musculoskeletal symptoms among cleaning workers in Health Campus should be considered by the management as well as the individual because it involves quality of life of the workers and the companies'reputations.

CHAPTER 1

INTRODUCTION

1.1 Research Background

Cleaning can be defined as the removal of undesired dirt, dust, marks, stains and other unneeded materials from locations where they serve no useful purpose (Cambridge, 2014). This activity is required for every place either factory, educational institutions, health institutions or home. The risks that cleaners may be exposed to Musculoskeletal Disorder (MSDs) not only depend on the tasks they perform, but also on the premises they work in (Roskams*et al.*, 2009). Based on Oxford dictionary, cleaners are the person employed to clean something, particularly to clean the interior of a building. The cleaning work plays an important role in general work and public environments as it improves the worker and public feeling of health and well-being. Clean work areas also promote productivity and quality of output (Kumar, 2006). Unclean environments can lead to accidents, and without cleaning, there is a greater risk of exposure to irritants which can lead to problems such as allergic reactions and respiratory problem especially for people that is vulnerable to this problem.

Cleaning is an occupation with a high level of physical activity (Søgaard*et al.*, 2006 and Korshøj, 2013). There are studies of Scandinavian reported that cleaning activities cause high physical strain and there are other studies that describe cleaning as a strenuous activity (Kumar *et al.*, 2005(a), (b) and Kumar& Kumar, 2008). Cleaners tend to do the repetitive movement and work in awkward postures for long periods of time

throughout their work. According to Walker-Bone & Cooper (2005); and Nordander (2009), these types of actions can cause muscle fatigue and may lead to musculoskeletal disorders. MSDs are impairments of bodily structures such as ligaments, nerves, joints, tendons, muscles, bones and the localized blood circulation system, that are caused or trigger primarily by work and by the effects of the immediate environment in which work is carried out (Punnett & Wegman, 2004). The main body parts that particularly risky are at the back, neck, shoulders and upper limbs (Krause, 2005; Unge, 2007; and Chang, 2012).

MSDs occur when acute episodes of pain or impairment may arise from one single excessive or repetitive work task (Bell, 2012).For example, the direct impact of heavy mechanical loads can rupture soft tissues or break bones. MSDs can also result from the effects of many repeated, apparently moderate loads that are endured over an extended period. These loads may not appear to cause immediate injury, but if they are imposed regularly over many months or years, they can cause deterioration of muscles and other bodily structures that lead to microscopic injuries in the tissues (Kumar& Kumar, 2008). This will be explained further in Chapter 2 based on Conceptual Model of Potential Factors for Musculoskeletal Disorder. According to European Agency for Safety and Health at Work (2013), the body will grow stronger when there is a sufficient time for the muscle to rest while doing the physical work. Anyway, MSDs can result when there is insufficient time for the muscle to recover from the consequences of fatigue or if the loading is sustained for too long.

Therefore, there are two primary risk factors at work:

1. **The magnitude of the loading**: The amount of physical effort applied including the weights that are handled or the forces to be opposed (Søgaard*et al.*, 2006; and Korshøj, 2013).

2. **The exposure period**: The length and frequency of the physical activity leading to the fatigue and the need for recovery (Kumar& Kumar, 2008).

Cleaners are best defined by task rather than as a sector or group. They usually have more than one job task and their common tasks are surface cleaning such as sweeping, mopping, clean the cobwebs, vacuuming, polishing floors and routine housekeeping (Zock, 2005). Numerous investigations have shown that cleaners are at risk of developing MSDs of the back, neck, shoulders, elbows, hands and lower limbs as a result of their work (Woods & Buckle, 2005). Chung *et al.* (2005) said that, industrial repetitive tasks have been associated with musculoskeletal disorders of the upper extremity and this is also applied to the cleaners.

In addition to the use of cleaning machines, there is a lot of hard manual work including mopping, cleaning cobwebs at high areas, swiping surfaces, polishing, moving rubbish bags, furniture and equipment (Pekkarinen, 2009) that contribute to the risks of accidental injury or work-related ill health (Bell, 2012). Work and activity-related musculoskeletal disorders have a complex multifactorial etiology including not only the physical aspects of the activities that people perform, but also with the contribution from other aspects (Engholm&Holmström, 2005; Zock, 2005 and Nielsen *et al.*, 2009). Several

studies have shown relationships between physical and psychosocial riskfactors at work and such musculoskeletal disorders (Östergren*et al.* 2005 and Nordander, 2009).

Musculoskeletal problems among cleaners may arise from:

- **Physical factors** for example heavy, static or monotonous work, extreme or constrained postures, repetitive movements, unsuitable workplaces and equipment, forces, exposure to vibration (Andersen*et al.*, 2007).

- **Personal factors** for example gender, age, seniority, exercise habits, lifestyle, psychological characteristics and capacities (Smith, *et al.*, 2013 and EU-OSHA, 2013).

- **Psychosocial factors** for example work organisation, interpersonal relationships, short cycle tasks, poor work control, piece-rate payment system, poor management, unsatisfactory training, lack of breaks (Karina Nielsen, 2009; and Zock, 2005).

A number of researchers have studied cleaning methods and working postures along with the physiological, biomechanical and psychosocial aspects of cleaning (Kumar *et al.*, 2005b and Chung*et al.*, 2005). The findings of these studies also describe work activities were inappropriate and poor working postures are common during cleaning activities for example, reaching and stooping to access out of the way places. Work areas are not designed to be easily cleaned and cleaning tools that require unnecessary levels of force(Kumar and Kumar, 2008). Organizational factors such as long working hours, low salaries and inconvenient working times were also described by Fredrikssonet *al.*, (2001). All these factors contributed to the increasing the risk of musculoskeletal injuries among the cleaners.

The aim of the study is to evaluate the physical, psychosocial and personal factors in cleaning work and their relationship with MSDs. Concentrating only on physical factors may not be as effective in reducing sickness absence, pain and discomfort as an approach that also takes into account psychosocial and personal factors. This is because, not all musculoskeletal problems are caused by work, and musculoskeletal risks in cleaning arise from various activities (Health and Safety Executive, 2003 and Chang *et al.*, 2012). In this study, risk factors that the cleaners at Health Campus, USM face regarding to their work can be identified and can provide advice on the practical steps that can be taken to prevent or reduce the risks of musculoskeletal disorder. With that, work-related ill health and injuries suffered by cleaners can be significantly reduced.

1.2 Problem Statement

Since the Minimum Wages Order 2012 was commenced on 1 January 2013 for employers with more than five employees and on 1 July 2013 for employers with five or fewer employees, all workers, including contract workers, security guard, and cleaners in Malaysia are eligible to receive minimum wage (Ministry of Human Resources Malaysia 2013). Chief Executive Institute for Democracy and Economic Affairs (IDEAS) said that the increasing of minimum wage cause the reduction of the workers because the employers could no longer afford to pay the workers. This problem also happened to the cleaners at Health Campus, USM as approximately half of the cleaners have been laid off from the work. They complained that the reduction of the number of cleaners increased their work task as they have to cover the larger work areas every day. A condition in which the prolonged performance of repetitive actions from the cleaning activities can

cause pain or impairment of function in the tendons and muscles involved may lead to the musculoskeletal disorders. Thus, this study will determine the extent of MSDs among cleaners at Health Campus, USM.

Besides, there are study were conducted on 180 cleaners on 2012 in Taiwan show that nearly 90% of the cleaners reported musculoskeletal discomfort in at least one body part due to work (Chang*et al.*, 2012). This shows that the cleaners have been a high-risk group for developing MSDs. Time pressure as a psychosocial risk factor was found to be associated with discomfort in several body parts (Nielsen*et al.*, 2009 and Zock, 2005). These show that there are other factors that contribute to MSDs instead of physical factor alone. Thus, this study will be able identify the extent of MSDs among cleaners based on the equipment used during the cleaning activity, the working environment and other associated factors. Thus, the relationship between musculoskeletal disorders among cleaners at Health Campus, USM with the physical, psychosocial, and personal factors can be identified.

1.3 Research Objectives

There are two types of objectives in this research project.

1.3.1 General Objective

To investigate the symptoms of musculoskeletal disorders among cleaners at Health Campus, USM and its associated factors.

1.3.2 Specific Objectives

1. To identify the extent of musculoskeletal work-related problems and discomfort among cleaners at Health Campus, USM.
2. To determine the main work-related factors associated with the MSDs among cleaners at Health Campus, USM.
3. To find the relationship between musculoskeletal disorders among cleaners at Health Campus, USM with the physical, psychosocial, and personal factors.

1.4 Alternative Hypothesis

1. Cleaners at Health Campus, USMhave musculoskeletal symptoms.
2. The main work-related factor of MSDs is physical including awkward postures, manual handling and repetitive movement.
3. Physical, psychosocial, and personal factors have influence to the occurrence of MSDs among cleaners at Health Campus, USM.

1.5 Significance of Study

This study should be carried out because it gives benefits to both employers and workers. Smith *et al.* (2013) stated that the health problems related to MSDs are likely to have an effect on job performance with implication for both job efficiency and morale of the workers. From MSDs, both workers and employers will face indirect financial issues. Resultant sickness absence and staff turnover are costly to the employers as they have to

consider the treatment and rehabilitation of the workers and also to hire new workers while for the workers, it may cause the loss of job and income (EU-OSHA(b), 2013).

Although the musculoskeletal problems of cleaners have already beeninvestigated worldwide, cleaners in different parts of the world may suffer from different levels of MSDs due to the diverse working environments and/or the kind of work tasks performed (Chang *et al.*, 2012). There is a study said that reported data on MSDs in the work task or exposure have its own definition for every case determination, thus the estimated risks within and among different occupational settings and condition cannot be adequately compared using current evidence (Andersen *et al.*, 2007, Kuorinka*etal.*, 1987, Palmer *et al.*, 2000, Nordander, 2009; and Sluiter*et al.*, 2001).

Therefore the previous study of musculoskeletal among cleaners may not represent the extent of MSDs among cleaners at Health Campus, USM. The main risk factors for MSDs for example repetition, awkward position, and inadequate rest are likely to be present in the cleaning activities (Robens Centre for Health Ergonomics, 1999). Besides, psychosocial risk factors may also be playing a part such as work organization, management, and duration of breaks hours to the workers (Gamperiene*et al.*, 2003; and EU-OSHA(b), 2013). Personal factors such as gender, age, exercise habits, and lifestyle also take into the considerations while performing this study. Therefore, the assessment of musculoskeletal symptom was conducted to better understand the extent of physical, psychosocial and personal factor that contribute to MSDs that cleaners in Health Campus, USM endure. In view of limited studies on cleaning work and the usage of cleaning equipment in USMKK, it was considered necessary to conduct a study to investigate and known the extend of work-related ill health and injuries among cleaners at USMKK.

CHAPTER 2

LITERATURE REVIEW

2.1 Musculoskeletal Disorder (MSDs)

The term 'musculoskeletal disorder' describes a variety of strain, sprain, and overuse problems affecting the body's muscles, joints and nerves. The back, neck, shoulders and upper limbs are particularly at risk. According to Health and Safety Executive (2003), problems include everything from backache and slipped discs, to upper limb disorders, tenosynovitis, pain, numbness, swelling and tingling in the hands and wrists.These conditions are often caused or made worse by work activities. MSDs is an occupational disease that become a major concern because it is the single largest category of work-related illness, which representing a third or more of all registered occupational diseases in the United States, the Nordic countries, and Japan (Bernard, 1997 and Punnett, 2004).

MSDs are common among the general and working population and can result in serious social and economic impacts on individuals and communities(Hanson *et al.*, 2006 and Widanarko, 2011). This is also stated byWalker-Bone *et al.* (2004) as MSDs constitute a major problem in society as these disorders often lead to long-term sick leave, early retirement, and effect the persons economic status (Norlund*et al.*, 2000 and Unge, 2007). Punnet (2004) stated MSDs occur in certain industries and occupations with rates up to three or four times higher than the overall frequency.Symptoms of MSDs may occur suddenly, or there may be a more gradual onset of symptoms with initial tingling, then slight swelling or soreness, which may persist and gradually worsen (Kumar& Kumar, 2008). In most cases, sufferers should stay active, avoid putting undue pressure or stress

on the damaged area, try simple pain relief and if discomfort persists, seek medical advice (Tschudi-Madsen *et al.*, 2011). According to Health and Safety Executive (2003), when symptoms are not addressed sufferers may adopt new ways of performing tasks, or adapt tools to reduce discomfort, perhaps avoiding use of the affected limb and so putting strain on other joints. Therefore, if there are no actions taken, it can cause serious effect to the cleaner such as permanent disablement of any part of the body or job change.

Based on the study of musculoskeletal risk factors in cleaning occupation by Kumar& Kumar on (2008), MSDs occur when acute episodes of pain and/or impairment may arise from one single excessive overload or assault. MSDs result from the effects of many repeated, apparently moderate loads that are endured over an extended period. These loads may not appear to cause immediate injury but, if they are imposed regularly over many months or years, they can cause deterioration of muscles and other bodily structures that lead to microscopic injuries in the tissues (Health and Safety Executive, 2003). According to Punnet (2004), upper extremity musculoskeletal disorders are highly prevalent in manual-intensive occupations, such as clerical work, postal service, cleaning, industrial inspection and packaging.

2.2 Musculoskeletal Symptoms

Violante*et al.*, (2000) and Widanarko *et al.*, (2011) discussed the importance of case definition and the necessity to clearly distinguish between the terms musculoskeletal disorders (MSDs) and musculoskeletal symptoms (MSS). Buckle and Devereux (2002) suggested that 'musculoskeletal disorders' should be a term reserved for describing common inflammatory and degenerative disease and disorders. The term 'disorder' is

defined as a condition that includes both symptoms which is subjective evidence perceived by patient and signs which is objective evidence from physical examination as well as any positive result arising from a diagnostic procedure to identify musculoskeletal pathology (Violanteet *al.*, 2000). Meanwhile, 'symptoms' including discomfort, complaint and pain represent subjective feelings (Burton *et al.*, 2008) and are often self-reported. Base on the range of case definitions, it is not surprising that prevalence estimates for musculoskeletal 'problems' vary so widely (Widanarkoet *al.*, 2011).

Based on European Agency for Safety and Health in Work for Cleaners and Musculoskeletal Disorders(EU-OSHA(a) 2013) and Nordander (2009), some MSDs exhibit well-defined signs and symptoms as shown in **Table 2.1**:

Table 2.1: Signs and Symptoms of MSDS

Diagnosis	Criteria/ Symptom
Tendonitis	Inflammation and soreness of a tendon resulting from repeated movement of a joint
Carpal tunnel syndrome	Damage to a nerve through the wrist and into the hand from repeated bending of the wrist while holding tools tightly or by constantly pressing wrist against hard object
Vibration white finger	Numbness and tingling of the fingers, especially in cold weather, resulting from changes to the nerves and blood vessels of the hand caused by use of vibrating hand tools;
Thoracic outlet syndrome	Reduced blood flow in the shoulder and arm caused by working above head height or by carrying heavy loads in the hands with the arms hanging straight down.
Tension neck syndrome	Neck pain, sense of fatigue or stiffness in the neck, pain radiating from the neck to the back of the head; tightness of muscles, and tender spots in the muscles.
Frozen shoulder	Shoulder pain; progressive stiffness ofshoulder during the last 3-4 months; limitedoutward rotation and abduction
Radial tunnel syndrome	Pain in the elbow during rest; pain of the proximal, lateral part of the forearm; tendemess about 5–8 cmdistally of the lateral epicondyle and pain at resisted isometric supination

In a study by Yu *et al.*, (2012), they identified the musculoskeletal symptoms through the survey and the symptoms in the study included the pain and discomfort. Discomfort was explained to participants as being any unpleasant subjective sensation including numbness, soreness, and/or any limitation of physical activity. Participants who responded to pain in the survey were considered to have a musculoskeletal symptom in a specific body region.

2.3 Cleaners

According to EU-OSHA (2013a), cleaning is a generic job carried out in all sectors and workplaces, outdoors and indoors, in private companies as well as in public areas. Cleaning services include a broad range of activities and were performed in different work environments, such as homes, offices, industries, schools, shops, aircrafts and hospitals.Cleaners usually work in facilities designed for other activities or work processes (Zock, 2005) and the factor of how to clean an area is not the major consideration rather than part of design planning. Research by Woods & Buckle (2005b) has found that fixtures, furniture and other design elements often require cleaners to adopt difficult working postures which cause pain and discomfort while Kumar *et al.* (2005a) found that cables on floors and behind desks forced cleaners to squat and crawl to lift the cables when mopping.

The workforce in the cleaning activities is mainly unskilled or low-skilled (Kantowitz*et al.*, 2009) and not very selective in terms of education and experience. It means that cleaning sector may offer employment opportunities to people who have difficulties in finding employment in other sectors which more demanding in terms of

that both skills. Women are the majority of the workforce in the sector (Kumar*et al.*, 2008; and Woods & Buckle, 2005a). According to the research by Roskams*et al.* (2009), women represented about 77% of the totalworkforce in the cleaning industry in 2006. Cleaners have unfavorable working hours as they often work before or after the regular working hours (Pekkarinen, 2009). Kumar & Kumar (2008) stated that work hours of the cleaners are often early in the morning, during lunch periods and late in the evening.Lee & Krause (2002) and Seifert & Messing (2006) stated that cleaners have little control over their work and their employment can be contract-based and precarious thus signify the factors of unstable employment among cleaners. Most cleaners learn skills on the job which beginners are often paired with an experienced worker and carry out the most routine tasks (UDSL, 2011).

About 80% of cleaning work is manual and performed by using non-powered tools, and about 30% of that consists of mopping (Kantowitz, 2009) while poor posture and awkward movements like bent and working with hands over shoulder level or by squatting down, cannot be totally avoided in cleaning work (Woods & Buckle, 2009). Cleaning is sometimes done in groups or teams but, their often work alone (Pekkarinen, 2009). The wages of cleaners vary widely between labor markets (Kumar& Kumar, 2008). A report by the International Labour Organization's (ILO) shows that wages for work such as performed by cleaners is low in comparison to most other occupations. The cleaning sector is mainly composed of small and very small companies.

According to Roskams*et al.* (2009), most of the cleaning work is performed as contract cleaning where the cleaners are employed by a cleaning company, but work within the premises of one or more "host companies". It also stated that, health and safety

matters are not always being the priority instead of become an integral part of the negotiations beforehand, this matter was discussed after the contract is signed (EU-OSHA 2013a). This situation leaves very little room for the cleaning company to be able to negotiate about safe and healthy working conditions for their cleaning workers within the host company. Therefore, the employers which are the cleaning companies have difficulties in controlling the environment in which the cleaners work, although they are responsible for their health and safety. This combination of factors puts them at high risk of developing MSDs.

2.4 Musculoskeletal Disorder (MSDs) among cleaners

Cleaning tasks are generally characterized by a high level of physical demand; high aerobic strain, static muscular loads and repetitive movement (Johansson &Ljunggren 1989 andBuckle & Devereux, 2002). These types of prolonged static and repetitive muscle activities cause muscle fatigue and may lead to musculoskeletal disorders (Unge *et al.*, 2007 and Jørgensen *et al.*, 2011a). Cleaners often work in awkward postures, bent forward and with twisted backs (Lee *et al.*, 2013) and working with poor ergonomic characteristics of the cleaning equipment or in the incondusive work environment. They sometimes have to lift heavy pieces of furniture or work equipment(EU-OSHA 2013a and Robens Centre for Health Ergonomics 1999).As a consequence of this, cleaning workers are at a high risk of incurring injury (Bell, 2012).

Musculoskeletal disorder is a common problem among cleaners all over the world. There are previous studies in Europe, Australia and Portugal indicated that the cleaners have a high risk of developing musculoskeletal problems, affecting the back, neck,

shoulders, elbows and hands (Cabecas, 2007; Unge *et al.*, 2007; and Johansson &Ljunggren, 1989) that may lead to frequent absenteeism (Nielsen *etal.*, 2009). The tools and equipment used in cleaning require users to engage in both dynamic and static muscular activity(Kumar, 2006). The hazards linked to the poor ergonomics of work equipment, such as buffers, mops or vacuums, are strongly related to the particular tool used and also to whether it is adapted to the characteristics and specific needs of the worker taking into account their anthropometry, physical strength, age, psychosocial etc. (Treaster& Burr 2004 and Garden *et al.*, 2005).

Based on Australian Bureau of Statistics on 1999, injury rates for cleaning workers in New South Wales (NSW), Australia, are as high as those in the more obviously 'risky' industries of forestry and mining. In particular, the NSW Government identified that cleaning workers in experienced high rates of work-related upper limb musculoskeletal disorders (Work Cover NSW, 2002).Several studies about cleaning jobs describe typical physical demands of this work (Søgaard*et al.*, 1996) meanwhile Kumar*et al.*, (2005a) and Woods & Buckle, (2005b) describes about the frequent use of awkward posturesduring performing cleaning work.

In questionnaire surveys by Woods (2005b),74% of the cleaners in the UK reported experiencing muscular aches, pain and discomfort whereasreported a high occurrence of carpal tunnel syndrome (CTS) in floor cleaners and repetitive forced flexion/extension and radial/ulnar deviation of the wrist, often associated with a power grip or pinch of the hand and the use of vibrating tools and machinery, is considered a risk factor for CTS (Mondeli*et al.*, 2006). Data from a representative sample of the Danish workforce reveal that cleaners have an elevated amount of work involving

pushing and pulling tasks and twisted postures with bent neck and twisted back or squatting (Jørgensen*et al.*, 2011a), and cleaners characteristic their job as physically strenuous (Burr, 2002 and Johansson &Ljunggren, 1989). Thus, although cleaning work is not heavy as in construction work or repetitive as in assembly line work, the cleaning tasks involve day-long raised physical exposure therefore is characterised as a job with high physical work demands (Unge, 2007).

2.5 Factors for musculoskeletal disorders among cleaners

As with most chronic diseases, MSDs have multiple risk factors, both occupational and non-occupational. A number of researchers have studied cleaning methods and working postures along with the physiological, biomechanical and psychosocial aspects of cleaning (Savinainen*et al.*, 2004; Treaster& Burr, 2004 and Jespersen *et al.*, 2012). The findings of these studies describe work activities during cleaning were inappropriate and have poor working postures, for example reaching and stooping to access out of the way places (Kumar *et al.*, 2005b). Besides, there are several studies have also shown relationships between physical and psychosocial risk factors at work with the occurrence of MSDS (Östergren*et al.*, 2005 and Öztürk & Esin 2011).

Woods & Buckle's (2005a) stated that commonly used cleaning tools were not designed using ergonomic principles, repetitive movements, heavy workloads and high force requirements are some of the resulting problems. In addition to the physical factors associated with musculoskeletal complaints, psychosocial factors such as job dissatisfaction, lack of control over work and breaks, and limited job control are

thecommon key features of cleaning work (Zock, 2005 and Nielsen *et al.*, 2009) and all these factors have interactive effects on MSDs (Fredrikssonet *al.*, 2001).

Risk varies by age, gender, socioeconomic status, and ethnicity can influence to the occurrence of MSDs. Punnett (2004) stated that other suspected risk factors include obesity, muscle strength and other aspects of work capacity. The links between the psychosocial work environment and poor health are well-established (Lange *et al.*, 2004) thus contribute to the presence of MSDs. According to Fredrikssonet *al.*, (2000), the moderate effect of certain single factors on one body part may become remarkable when physical and psychosocial factors at both work and home were taken into account.

To better understand the association factors of MSDs among cleaners, a conceptual model of factors that can contribute to musculoskeletal disorders in cleaners kwjon a worker's musculoskeletal system (Load), the responses of tissues to the loading (Tissue response) and any subsequent adaptation of the worker (positive or negative) from the loading (Outcome). The model is shown in **Figure 2.1.**

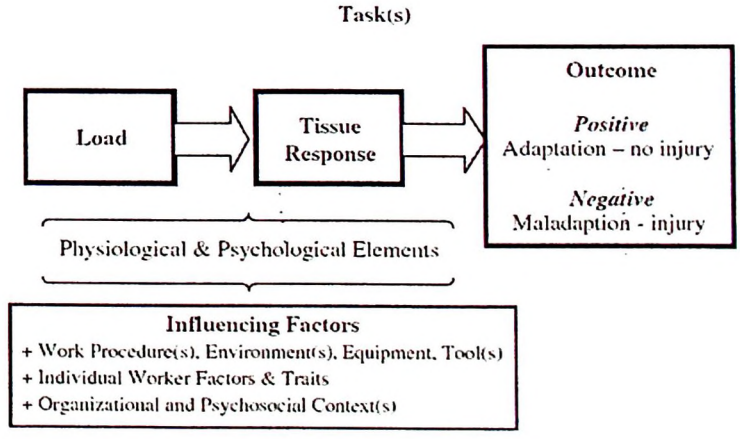

Figure 2.1: Conceptual model of risk factors of musculoskeletal disorders

(Source: Kumar, 2001)

This is a model that incorporates commonly recognized responses to physical demands upon the body such as described by Kumar (2001). On top of that, the model identify that there can be a range of influence from Physiological and Psychological Elements that may affect the physiological response to the same load. The origins of these can vary and irregardless of origin, they cause a body's physiological response to vary from one time to another. The variation may be small or it can be large and countable that the physical capacity of musculoskeletal tissue is exceeded. This model recognizes that a worker may adapt to workloads such as increases in strength, fitness, or experience harmful outcomes that may result in permanent or long-term impairment to a level that prevents performance of essential job functions.

Risk factors for musculoskeletal disorders have been grouped into the three main categories: (i) physical factors for example work procedure, work environment, equipment, tools and methods such as repetitive movement, awkward posture and vibration (Buckle & Devereux, 2002); (ii) psychosocial factors: job demands, work organisation, job control and social relations at work (Smith *et al.*, 2013 and Nielsen *et al.*, 2009) and (iii) personal factors: gender, age, socioeconomic status and pre-existing musculoskeletal disorders (Roskams*et al.*, 2009). From this model, it is show that there is a significant relationship between work procedure, work environment, equipment, tools or methods, individual factors, organizational and psychosocial factors with the load,tissue response and outcome. In the other words, any or all of these factors can contribute to the causation of musculoskeletal disorders (Engholm&Holmström, 2005).

According to Kumar& Kumar (2008) based on the model, intervention through alteration of any of the influencing factors will reduce the risk of musculoskeletal injury.

The third influencing factor which is organizational and psychosocial can have different meanings for different occupations. For cleaners, the relevant research for example by Krause *et al.*, 2005points towards two key problem areas which are monotony and intensity. For cleaners, this means that they must work faster and that there is less of an opportunity to vary task pace to reduce physical stress and monotony. Work such as that reported by Nordander*et al.*, (2009) and has found that the combination of the factors create conditions where workers are more likely to have MSDs, consistent with the model as shown in **Figure 2.1**. In this instance, negative organization and psychosocial factors contribute to musculoskeletal injury through the excessive usage of load.

i) Physical work factor

Bongers*et al.* (1993) stated that load and physical capability can contribute to the causation of musculoskeletal disorders and physical work demands are significant among cleaners (Unge, 2007). High aerobic strain, heavy static muscular loads, awkward postures,working with a in a forward, bent position, forceful arm and hand movement, overexertion and the fast-pace work (Kantowitz*et al.*, 2009 and Lee *et al.*, 2013) are required to meet cleaners daily work requirement and put them at high risk for physical injury that may lead to MSDs.Besides, cleaners are also more likely than other workers to suffer repetitive motion injuries (Kumar, 2001). In other studies the relationships between poorly designed workplaces resulting in poor posture and MSDs have also been described (Zock, 2005).Based on Holtermann*et al.* (2010), although many physically heavy jobs have been taken over by machines, cleaning is a permanent job segment in all countries, with on-going challenges in coping with the physical demands of the work.

ii) Personal Factor

Age, gender, anthropometery, and general health/physical condition have been described as contributing factors to MSDs (Gamperiene*et al.*, 2003; Smith, *et al.*, 2013 and EU-OSHA, 2013b). In a study of energetic requirement, muscle fatigue, and musculoskeletal risk on Malaysian operators by Ahmad *et al.* (2006), younger subjects suffer significantly less pain than the older ones which showed that personal factor such as age associated with MSDs. Physical capacity and the ability to recover from physically demanding tasks deteriorates with age while the physical demands of jobs do not decrease(Kumar & Kumar, 2008). This cause older cleaners are generally sick more often and more likely to retire early (Jørgensen*et al.*, 2011a).

Some studies have investigated the prevalence of MSDs in relation to gender. There are gender differences in prevalence of MSDs for males and females. Females have been shown to have a significantly higher prevalence of symptoms in the neck, shoulders, wrist/hands, upper back, low back, hip, and ' at any body region' than males (Widanarko*et al.*, 2011). In contrast, previous studies reported that males had higher prevalence of symptoms in low back and knees (Aasa*et al.*, 2005)compared with females. On top of that, anthropometery is also a personal factor that relates to MSDs.Karwowski (2005)stated that body, tool and equipment dimensions must be compatible for optimal productivity and occupational safety to workers. General health is also a consideration when body weight is an anthropometric measurement; well established is the relationship between health and body mass index (BMI) (Vister et al., 2013). For example, Hopsu*et al.* (2005) found that obese Finnish cleaners were more likely to retire early.

iii) Psychosocial factors

Interactive effects of physical and psychosocial exposures upon musculoskeletal disorders have been observed by Fredrikssonet *al.* (2001) and Smith *et al.* (2013). Factors such as job dissatisfaction, monotony of work, limited job control, and lack of social support contribute to the causation of MSDS (Yu *et al.*, 2012). A recent study has suggested that the type of leadership, the way that cleaners are managed, and the collaboration with co-workers have an effect on their mental health (Gamperieneet *al.*, 2006).

Other factors that relate to psychosocial of the cleaners are lack of control over work conditions (Zock, 2005) and limited possibilities to develop professionally. Most of the time, organisations and workers are flexible and creative enough to deal with these demands or possible hazards successfully. However, the resources to balance these demands are lacking. In situations where hazards are not managed successfully or where individuals do not have the resources to deal with these issues, these demands or hazards can pose risks to the health, well-being and safety of workers and the workplaces or organizations(EU-OSHA 2013b).

2.6 Type of Tool/Machine Used with Possible Risk Factors

i) Mop

Hopsuet *al.*, (2000) stated that about 80% of the cleaning work is manual, using nonpowered tools, and about 30% of this is spent on mopping. Heavy awkward lifting of a pail, bending, squatting to lift the pail from floor level to waist-level sink, wringing, lifting and carrying wet mop, repetitive motions, slippery floors, unsuitable mop heights (Roskams *et al.*, 2009) can cause risk factors of MSDs among cleaners during mop

activity.Louhevaara*et al.* (2000) found that wet mopping causes greater cardiorespiratory and muscular loading. Cleaners use either one of two mopping techniques which is push and pull which moves the mop back and forward or figure of eight which is move the mop in an arc. Hagner&Hagberg (1989) reported that the "figure eight" mopping which is moving the mop in a figure eight pattern across the floor leads to a higher oxygen consumption level compared to back and forth mopping.

Movements in the lower arms, elbows and wrist can lead to structural changes in carpal tunnel region (Pierre-Jerome *et al.*, 1996) which can cause CTS whereas frequent floor mopping seems to lead to a high static load on the upper arm and back muscles (Hagner&Hagberg, 1989).Besides that, study from EU-OSHA (2013a)show that uncomfortable grip design, high pressures needed to squeeze mops, heavy, unstable buckets will contribute to MSDs. A study by Kumar *et al.* (2005b) reported that a redesigned mop to a bent shaft can reduce loading and help to avoid awkward postures.

ii) Broom

Sweeping have less of muscular load than mopping which sweeping requires no water, less weight than mop and have friction between the broom and floor. Sweeping can be applied when floors are light to moderately dirty (Hopsu*et al.*, 2000). However, sweeping and mopping have likely the same risk factors location of pain as both activities use the using the same body parts and muscle. According toChang*et al.* (2012), both wrists were observed to perform flexion and ulnar deviation during cleaning when the cleaners were provided with longer-handled equipment and was found to reduce back strain during sweeping. This is because, a short-handled broom require greater force than

a long-handled broom as being less likely to cause musculoskeletal discomfort/injury (Stubbs and Guan, 1996).

iii) Vacuum cleaners

According to the study by Woods & Buckle (2005a) in the design and use of workplace cleaning equipment, the main design criticisms of the vacuum cleaners were inappropriate grip which is too short or too thin, unintentional operation of the mechanical suction power regulation, difficulty changing the brush control and adjusting the power suction. Besides, there are study by Bell (2012) said that in cleaning work in Australia, vacuuming is a task that places cleaners at risk of incurring work-related upper-limb musculoskeletal disorders, particularly as the mean score was 6.54, where the highest possible risk score was 7. Repetitive motions especially at hand and arm, grip force, pushing and pulling, lifting and lowering, bending wrist and back, noise which increasing stress and muscle tension, poor grip design, lack of safety and power indication displays, and flex management difficulties contribute to risk factors of MSDs to the cleaners (Roskams*et al.*, 2009; and (EU-OSHA 2013a). Difficulty in understanding how to change the brush control also were the most common problems experienced by the cleaning workers (Kumar& Kumar, 2008).

iv) Buffing machines

Buffing machines also known as polishers, floor cleaning or scrubbing machines, generally electrically powered and are used to clean and polish floors. A number of studies have identified musculoskeletal problems resulting from buffing machine use.As explained by Woods & Buckle (2005a), buffing machines are operated by continuous

depression of a trigger switch, one on either side, just below the machine handle. The cleaner walks along, holding the machine handle with both hands, moving the machine from side to side. A bottle is sometimes held in one hand to spray chemicals on the floor prior to cleaning. Kumar & Kumar (2008) found the main problems with buffing machine design were heavy weight and lack of maneuverability, high initial reaction torque on starting, poor trigger switch design,awkward position due to the design of the machines, power cable handling and storage, brush/disc replacement and transfers of vibration to the arms of the operator. Besides, the machine is heavy to lift and it makes the floors slippery with risk of slips and falls (Roskams *et al.*, 2009).

Studies have reported musculoskeletal problems from the use of some models of buffing machines. A study of single disc machines by Hide *et al.* (2000) reported that high force was required for control whereas height and design of the handle also created control problems of the machine. Woods & Buckle (2005a) have described buffing machine switch and control design deficiencies such as location and the amount of force needed for operation. The force needed to operate a buffing machine can be very high when the machine is defectuous and not maintained (Woods & Buckle, 2005b). Besides, poor grip, trigger and lever design and awkward location of controls, combined with high activation pressures can also cause risk to the cleaners.