AN ERGONOMIC ASSESSMENT AMONG ADMINISTRAITVE WORKERS IN HIGHER LEARNING INSTITUTION

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ABSTRAK

Kerja yang berkaitan dengan ganguan musculoskeletal (WRMSD) adalah salah satu pekerjaan yang paling banyak di kalangan pekerja pentadbiran. Ia sering menyebabkan pelbagai faktor fzikal dan fisiologi pekerja pentadbiran. Di samping itu, WRMSD adalah penyebab beban kewangan untuk sistem penjagaan kesihatan dan prestasi pekerja. Oleh itu, tujuan kajian ini dijalankan untuk menentukan kelaziman ganguan berkaitan muskuloskeletal. Selain itu, kajian ini bertujuan untuk mengenal pasti faktor fizikal, menganalisis faktor ergonomik dan juga menentukan hubungan antara kelaziman aduan WRMSD dan juga faktor risiko ergonomik. Seramai 135 responden dari pelbagai jabatan di Universiti Malaysia Pahang (UMP) telah terlibat dalam kajian ini. Kajian ini dijalankan di kalangan pekerja pentadbiran. Pengumpulan data dilakukan dengan mengunakan dua instrumen iaitu Penilaian Sendiri Sakit Otot/Ketidakselesaan Muskuloskeletal dan Penilaian Risiko Ergonomik Permulaan (ERA). Penilaian Sendiri Sakit Otot/Ketidakselesaan Muskuloskeletal telah digunakan untuk mengumpul data mengenai kelaziman aduan WRMSD. Sementara itu, Penilaian Risiko Ergonomik Permulaan (ERA) untuk mengukur dan menentukan faktor risiko ergonomik di kalangan pekerja pentadbiran. Berdasarkan keputusan menunjukkan bahagian bawah badan adalah kelaziman WRMSD yang paling dikenalpasti di kalangan responden. Selain itu, keadaan yang janggal adalah faktor risiko tertinggi pada peratusan skor awal ERA. Tambahan pula, ianya setuju bahawa kelaziman WRMSD mempengaruhi faktor risiko ergonomik. Keputusan ini juga mendapati terdapat hubungan antara kedua-dua pembolehubah yang merupakan kelaziman WRMSD dan faktor risiko ergonomik apabila dibandingkan Penilaian Sendiri Sakit Otot/Ketidakselesaan Muskuloskeletal dan Penilaian Risiko Ergonomik Permulaan (ERA).

ABSTRACT

Work-related musculoskeletal disorder (WRMSD) are one of the most occupational among administrative workers. It was often causes many physical and physiological factors of administrative workers. In addition, WRMSD were causes of financial burden for health-care system and performance of worker. Hence, the aim of this study was conduct to determine the prevalence of work related musculoskeletal disorder. Moreover, this study was to identify physical factor, analyze ergonomic risk factor and also determine the association between prevalence of WRMSD complaint and ergonomic risk factors. In this study, 135 respondents from many departments in Universiti Malaysia Pahang (UMP) had been involved. The study was carried out among administrative workers. Data collection was done using two instruments, namely Self-Assessment Musculoskeletal Pain/Discomfort Survey Form and Initial Ergonomic Risk Assessment (ERA). Self-Assessment Musculoskeletal Pain/Discomfort Survey Form was used to collect data on the prevalence of WRMSD complaints. Meanwhile, Initial Ergonomic Risk Assessment (ERA) to measure and determine ergonomic risk factors among administrative workers. The results showed the lower back was the most identified prevalence of WRMSD among the respondents. Moreover, awkward posture is the highest ergonomic risk factor on percentage of Initial ERA score. In addition, it was agreeing that prevalence of WRMSD was influenced the ergonomic risk factors. The result also found that there was an association between the two variable which was prevalence of WRMSD and ergonomic risk factors when comparing Self-Assessment and Initial ERA.

TABLE OF CONTENT

LIST OF TABLES

Pages

LIST OF FIGURES

Pages

LIST OF ABBREVIATIONS

CTS	Carpal Turner Syndrome
DOSH	Department of Occupational Safety and Health
ERA	Ergonomic Risk Assessment
FMA	Factory and Machinery Act
MSD	Musculoskeletal Disorder
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act
SOCSO	Social Security Organization
SPSS	Statistical Package for Social Sciences
SHO	Safety and Health Officer
SHC	Safety and Health Committee
UMP	Universiti Malaysia Pahang
VDU	Visual Display Unit
WRMSD	Work Related Musculoskeletal Disorder

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter covers the background of study, problem statements, research objectives, research questions, research hypothesis, and significance of study, scope of study, limitations of study, operational definition and conceptual framework.

1.2 Background Study

Educational sectors especially university have been emerged rapidly in terms of technology, research and innovation. This is due to achieve or standing equally with the developed country. Plus, it is to strike for digital era 4.0. 'Industry 4.0' was first coined at the Hannover Fair in 2011, and the term has drawn great attention from academics, practitioners, governmental officials, and politicians all over the world Kagermann et al. (2013). Ergonomics-related disorders have recently emerged as near epidemic trend in the workplace. Based on Figure 1.1 Social Security Organization (SOCSO) has reported an exponential increasing trend of Occupational Disease reported cases (per 10,000 employees). It is shows that was commuting accident increasing by year.

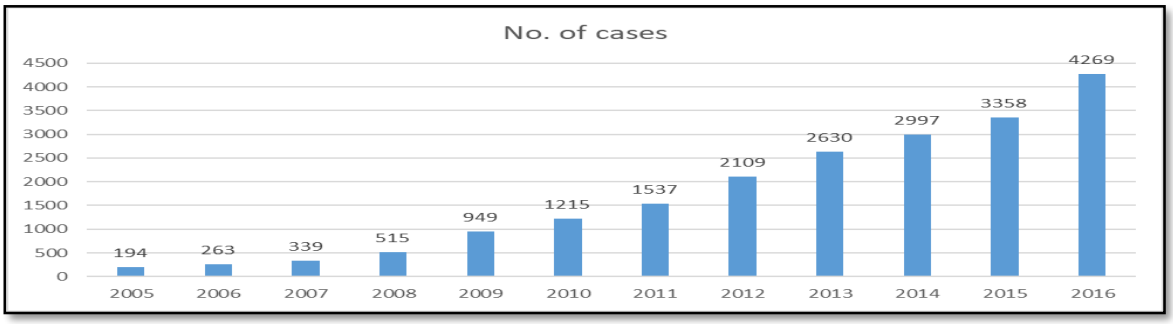

Figure 1.1: Trend of reported Occupational Disease Cases from 2005-2016

Source: Social Security Organization (SOCSO) (2017)

Administrative workers mostly a visual display unit (VDU) workers and cannot avoid to deal with computer. The prevalence of Work Related Musculoskeletal disorder (WRMSD) is found to be higher in VDU work compared with non-VDU work (Punnet and Bergquist, 1997). The administrative workers need to key in data students in the computer. Unfortunately, prolonged computer use will lead to many potential health effect. WRMSD have been common complaints among workers involved in static work or tasks requiring the repetitive motion of the upper limbs and prolonged computer work (Poochada & Chaiklieng, 2015).

Moreover, according to the statistic report about the numbers of occupational disease cases 2015 reported by SOCSO, 728 of cases were reported in administration. Based on figure 1.2, Social Security Organization (SOCSO) also has reported increasing trend of occupational musculoskeletal disorder cases. It is clearly shown rapidly increasing trend from 2008 until 2015. From 77 disorder cases at 2008 to 708 disorder cases at 2015. Even though ergonomic is not hot issues in Malaysia but it is keep rising and cannot taken easy.

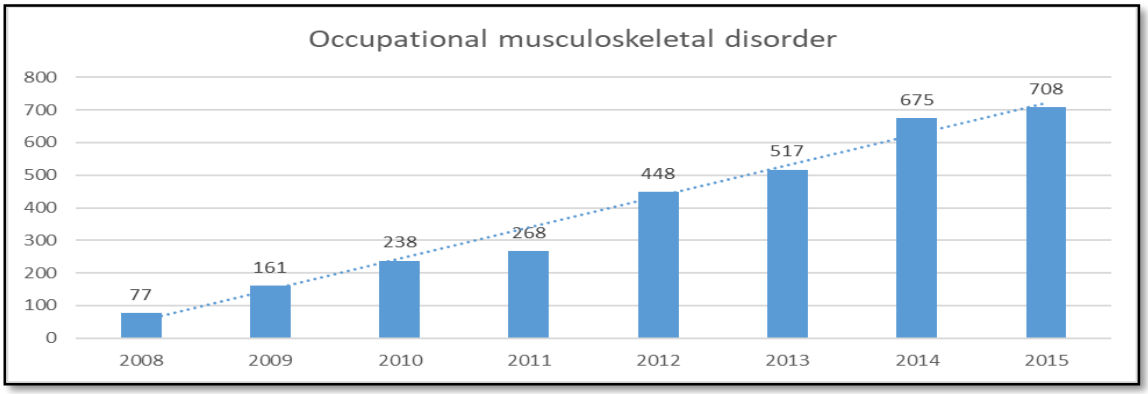

Figure 1.2: Trend of reported Occupational Musculoskeletal Disorder Cases from 2008-2015

Source: Social Security Organization (SOCSO) (2017)

With the statistics result, it shows that the lack of awareness on musculoskeletal disorders has brought the increasing reported cases over the last eight years. Due to this, an understanding on the risk factors of musculoskeletal disorders should be applied so that people will aware on the disease. The aim of the study is to identify the work related musculoskeletal disorder and ergonomic risk factor involved

1.3 Problem Statement

According to the Social Security Organization (SOCSO), number of cases of occupational musculoskeletal disorders (MSD) accounted for 708 cases in 2015 and 675 cases in 2014. These statistics represent increase rapidly of cases that related to work related musculoskeletal disorders (WRMSD). Educational sectors suffer from tangible and intangible losses because of increased medication costs, decreased productivity, work quality and decreased worker morale. Most of the administrative worker are visual display unit (VDU) and handling with computer. WRMSD are the main problem by VDU workers. According to Punnett and Bergqvist (1997), in their review of epidemiological studies of VDU work, it was found that VDU work indicated higher risk of neck, shoulder, arm, wrist and hand musculoskeletal problem compared with non-VDU work. It is well documented in other parts of the world that industries that implement ergonomics program report significant decreases in accidents, injuries, illnesses and healthcare costs over time, along with increase in productivity, work efficiency, product quality and worker morale. The discipline of ergonomics is nothing peculiar to safety and health practitioners in this country but for the administrative workers, it is still difficult to do. This might be the reason why ergonomics is still cannot be implemented in university. But due to the widespread use of computers at university, there is a need to educate the administrative workers on the importance of ergonomics. Administrative core work is sitting for long hours and deal with computer that lead to potentially deleterious health effects. James et al. (2018) stated that, prolonged computer use is recognized as an ergonomic risk factor for work related musculoskeletal disorders.

1.4 Research Objective

1.4.1 To investigate the prevalence of work related musculoskeletal disorder among administrative workers;

1.4.2 To identify the ergonomics risk factors of work related musculoskeletal disorder among administrative workers; and

1.4.3 To determine the relationship between ergonomics risk factors and work related musculoskeletal disorder among administrative workers.

1.5 Research Question

1.5.1 Is the prevalence of work related musculoskeletal disorder high or low among administrative workers?

1.5.2 What is the ergonomics risk factors of work related musculoskeletal disorder among administrative workers?

1.5.3 Is there any relationship between ergonomics risk factors and work related musculoskeletal disorder among the administrative workers?

1.6 Research Hypotheses

1.6.1 There is an association between ergonomics risk factors with prevalence of work related musculoskeletal disorder among the administrative workers.

1.7 Significance of Study

Administrative workers are exposed to ergonomic risk factor. This study is important to be conduct because ergonomic risk factors can cause many disorders and injuries. This study could be the baseline data for ergonomic problem and associated risk factors among administrative workers in Malaysia. In addition, it will enhance the awareness towards ergonomics risk factor and reduce the severity of work related musculoskeletal disorder. For future, this study provides an approach for the accessing of ergonomic knowledge among the administrative workers. Hence, a better ergonomic programed can be practiced to achieve a sustainable development in education sector.

1.8 Scope of Study

A cross sectional study has carried carry out to access the ergonomic problems and its associated risk factors among administrative workers in University Malaysia Pahang, Gambang and Pekan, Pahang. This studies strongly focused on the ergonomic causes and associate factors such as awkward posture, static and sustained work posture, repetitive motion, vibration and environmental factors that arising from their work activities.

1.9 Operational Definitions

1.9.1 Ergonomics

Ergonomics is the applied science of designing workplace demands and environment to accommodate human capabilities and limitation for well-being and optimum performance. Workplace ergonomic hazards can contribute to a number of negative effects.

1.9.2 Ergonomics Risk Factors

An ergonomics risk factor is any attribute, characteristic or exposure that may cause or contribute to a musculoskeletal injury; the mere presence of a risk factor may not in itself result in an injury. In general, two or more risk factors may be present at one time, thereby increasing the risk of injury.

1.9.3 Level of ERA (Guidelines on Ergonomics Risk Assessment at Workplace 2017)

There are two levels of ERA:

A) Level 1- Initial ERA

B) Level 2- Advance ERA

A trained person should start the assessment using an Initial ERA checklist. The outcome will determine if there is a need to carry out an advance ERA

1.9.4 Work-Related Musculoskeletal Disorders

Musculoskeletal Disorder or MSD are injuries or disorders that affects the human body's movement or musculoskeletal system (i.e. muscles, tendon, ligaments, nerves, discs, blood vessel, etc.

1.10 Conceptual Framework

Figure 1.1 shows the illustrations of conceptual framework of this study regarding the ergonomic risk assessment and prevalence of WRMSD. This conceptual framework might help in giving the idea on how to conduct the study based on the objective of the study.

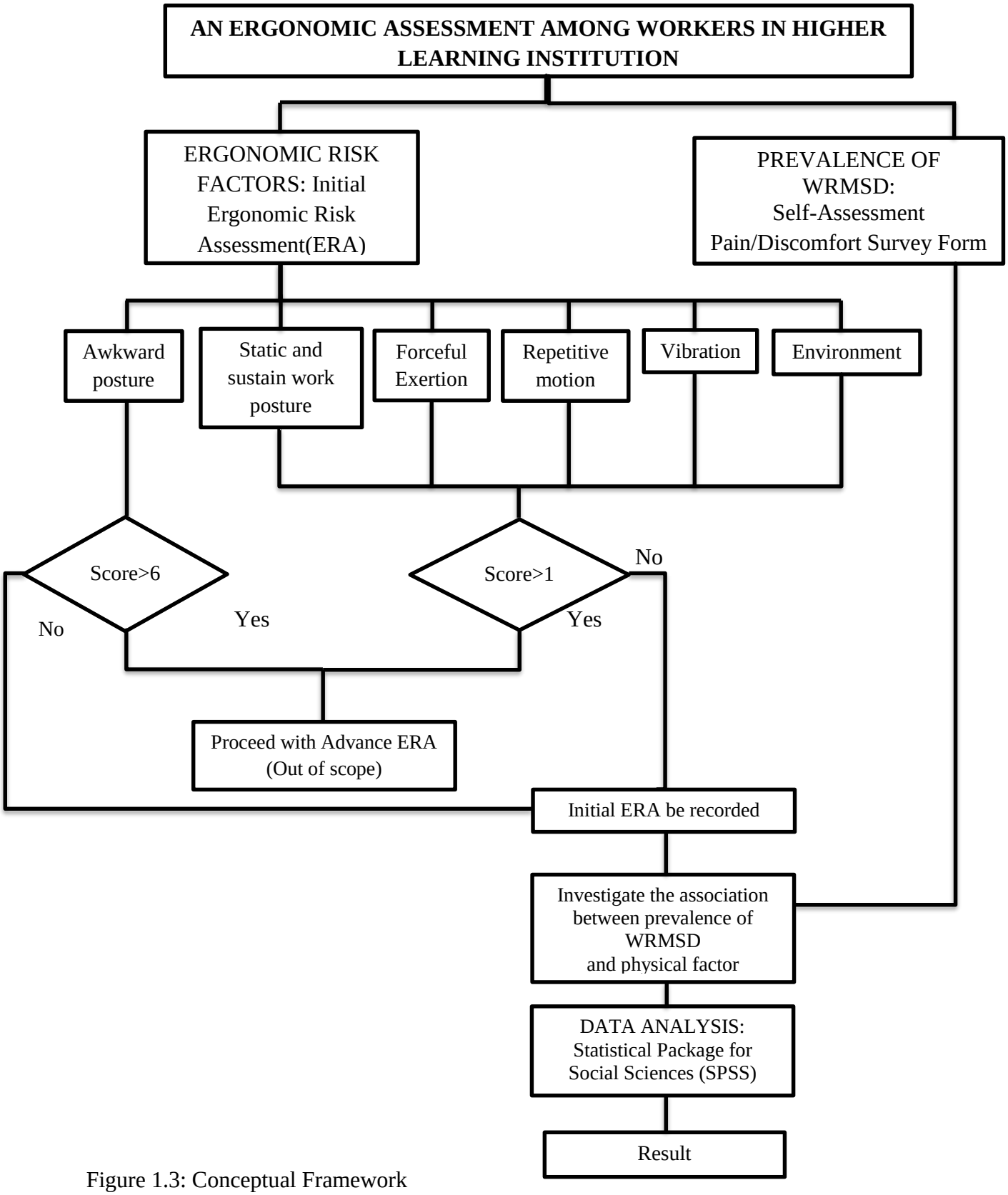

Figure 1.3: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the past research's literature related to ergonomics risk factors has be discussed in order to gain more knowledge and information. This chapter emphasized of the definition of ergonomic assessment, risk factors of ergonomic, the prevalence of ergonomic problem, hierarchy of control and the previous researcher's finding related to ergonomic and associated factors among lecturer and assistant.

2.2 Ergonomic Assessment

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that apply theory, principle, data and method to design in order to optimize human well-being and overall system performance (Guideline on Ergonomics Risk Assessment at Workplace, 2017).

Ergonomic is a study of work to prevent injuries, ensure comfortable and improve effectiveness. According to Jaffar & Lop (2011), Ergonomics normally are known to be related to human and their job. In larger scope of ergonomics, it examines human behavioral, psychological, and physiological capabilities and limitations. Based on Guideline on Ergonomics Risk Assessment at Workplace (2017) stated that ergonomics consists of three main domains as shown in Figure 2.1. Physical ergonomics is about the human body's responses to physical and physiological work demands. The most common types of issues are cumulative trauma disorders from repetitive, vibration, force and posture, and thus have design implications.

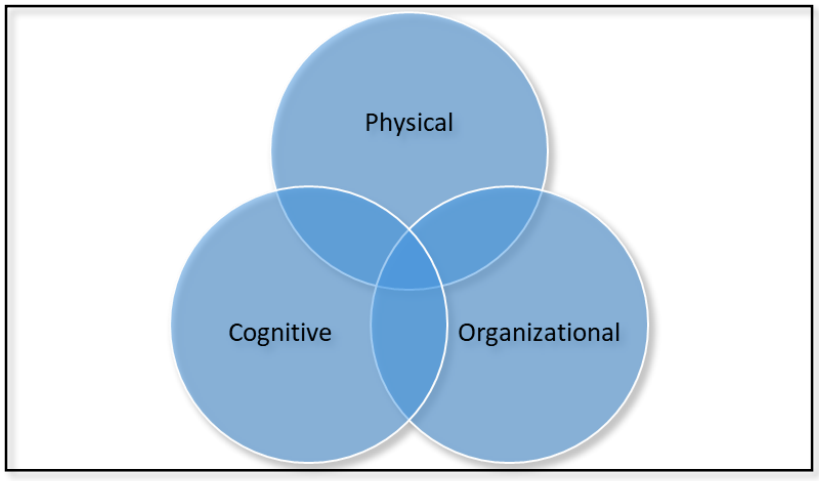

Figure 2.1: Domain in Ergonomics

Source: Guidelines on Ergonomics Risk Assessment (2017)

The focus of ergonomics implementation should remove barriers to quality, productivity and safe human performance by fitting products, tasks, and environments to people instead of forcing the person to adapt to the work. In order to assess the fit between a person and their work, ergonomists will consider the worker, the workplace and the job design. Moreover, to promote an occupational environment which is adapted to the physiological and psychological needs of workers (OSHA 1994).

2.3 Ergonomics in Malaysia

In the ongoing trend of reducing fatal accident, injuries and illnesses, it is needed to comply with all legislation related to occupational safety and health. There are two Acts bonding all organization in Malaysia in order to ensure the workers are being protected from all risks coming from the workplace hazards: Factory and Machinery 1967 (FMA 1967) and Occupational Safety and Health Act 1994 (OSHA 1994). Regulations, guidelines and codes of practice have been drawn up to support both Acts such as Guidelines On Ergonomics Rick Assessment at Workplace 2017.

Ergonomics is one of the safety and health important elements covered. Without ergonomics concern, the effectiveness of safety and health legislation cannot be attained. Hence, the emphasis is not yet placed within the core of the legislation (Sirat, Shaharoun, Abdul, & Syed, 2011).

The general awareness and level of ergonomics application are low in many countries including Malaysia according to Mustafa et al. (2009). Moreover, Department of Occupational Safety and Health (DOSH) not shown specific statistic on ergonomic risk such as Musculoskeletal Disorder (MSD) and Carpal Tunnel Syndrome (CTS), specifically show on severity of ergonomics injury in Malaysia. In 2010, Niu stated existing national and international ergonomics standards and guidance have some deficiencies including narrow focus on some physical hazards, inadequate coverage of issues related to effective program implementation and inadequate attention given by document designers to document usability.

In Malaysia, OSH Act must be approved by Parliament while the OSH regulation must be endorsed by the Human Resource Ministry. Guidelines should be endorsed by the General Director of DOSH. Acts and regulations are seen as a method of solutions for the time being for the implementation of ergonomics in Malaysia. It is capable of being a push factor to companies which comply with it. There are two types of issue brought up in this legislation: technical issues and management issues. Normally OSHA focuses on management issues while FMA 1967 tackled on technical issues Previous study has study the extend of ergonomics issues in OSH legislation and the outcome that going to highlight (Sirat et al., 2011).

Table 2.1: Ergonomics mentioned in Act and regulation

No	Issue	Detail in the category(OSHA)	Act or regulations relevant to ergonomics (summary)	Comments
1	Objective of OSHA	Sec. 4 OSH Act 1994	To promote an occupational environment for persons at work	Direct and strong relation between ergonomics and the OSH objectives.
2	Safety and health (S&H) policy	Sec. 16 OSH Act 1994	To prepare a written statement of general policy with respect to the safety and health at work.	Indirect but strong relation between ergonomics and safety and health policy.
3	Medical Surveillance	Sec. 28 OSH Act 1994	The changes in any process, there may be risk of injury to the health of persons employed in the process.	Indirect and strong relation. Ergonomics falls within one of the safety and health scope.
4	Functions of SHO	Sec. 15 OSH Act Reg. (18) Safety and Health Officer under OSHA 1994	Making arrangement, to investigate new miss and to collect, analyze and maintain statistics on any accident.	the ergonomics has too much uncertainty. Thus, SHO difficult to collect, analyze data and to measure the risk without any strong knowledge and expertise.
5	Functions of safety and health committee (SHC)	Sec. 31 OSH Act 1994 Reg (11d) SHC Regulation 1996 under OSHA 1994	Review safety and health policies at the workplace and make recommendations to the employer for any revision of such policies.	Indirect but strong relation between ergonomics and function of safety health committee.
6	Responsibility of notification	Reg. (7) NADOPOD 2004 under OSHA 1994	An employer shall send a report in an approved form to DOSH within 7 days	Indirect but strong relation between ergonomics and notification.

Source: Sirat et al. (2011)

Table 2.1 shows ergonomics under OSHA in term of direct and indirect statements and the point was in the main, more directed toward management issues. For example, in objective (sec. 4(c) OSHA 1994) such as, “to promote an occupational environment for persons at work which is adapted to their physiological and psychological needs”. Even though the statement does not mention ergonomics directly, “physiological and psychological” refers to ergonomics. Safety policy was required as mentioned in OSH (employers’ Safety and Health General Policy Statements) (Exception) Regulation 1995.

Nevertheless, it depends on employers to develop the policy and put the emphasis on safety, health or ergonomics. Here the significant role of employers was to put an effort of ergonomics as a priority, where by the content of policy should strongly emphasize ergonomics in practice. In Sec. 28 (Medical Surveillance), sec. 31 (Function of Safety and Health Committee), sec. 32 (Notification of Accidents, Dangerous Occurrence, Occupational Disease and Inquiry) and sec. 66 (Minister Power to Regulate or Prohibit), the detail explanations should be done to ensure the company understand the essence concerning ergonomics.

Under the regulation category, employers are bond with NADOPOD (Reg. 7 under OSH 2004) which explained the requirements of reports of occupational poisoning and occupational disease. A well-conceived explanation is required as there are hidden statements whereby companies should refer under 3rd schedule with ergonomics problem such as heat cramp/ heat stroke, hearing impairment and noise (which is listed in eight (8) pages of occupational poisoning and occupational disease category).

There is considerable evidence of significant ergonomics influences in OSHA but its role has either been ill defined, understood and perhaps confused. There is no specific act, regulation, or guideline available to explain ergonomics implementation in general much like what Safety issues have done for the Act (OSHA emphasized on the safety management at the workplace such as self-regulation, consultation and cooperation). Some parts of the Act refer to ergonomics and are detailed enough to merit taking action. Others are more indirect and fuzzy (Sirat et al., 2011).

2.4 Ergonomics Risk Factors

Risk factors are defined as actions or conditions that increase the likelihood of injury to the musculoskeletal system (Jaffar & Lop, 2011). Lecturers and office workers are exposed to ergonomics issues in their standard works. There are many ergonomics issues, which are unavoidable, such as: awkward posture, repetitive movement, and force risk factors. Without proper handling of the issues, every worker has a high propensity to experience the ill effects of musculoskeletal issues.

Risk and risk factors are common concepts used in safety and applied ergonomics literature. Risk includes a component of how likely or what the probability of an event is and the seriousness of the consequence or what the severity is if something does occur. Risk is often defined on how many injuries or accidents resulted for a given exposure. At the extremes, injury risk can be viewed as very low probability but extremely high consequence for example multiple fatalities or higher probability but less severe consequence such as slipping and tripping (Jaffar & Lop, 2011).

Risk factors also the main relationship with musculoskeletal disorder (MSDs). MSDs, also are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back. Body areas of interest incorporated the neck, shoulder, back (upper and lower), arm (upper and lower), elbow, wrist and fingers (Mahmud, Kenny, & Heard, January, 2011).

One of the risk factor is awkward postures. Awkward posture was postures that when used repetitively or for prolonged periods result in increased risk of fatigue, pain or injury. These postures are sustained either actively by muscle contractions or passively by compressive or tensile loads on bones, muscles, tendons, ligaments (Chaffin et al., 1984).

Jaffar and Lop (2011) stated that posture refers to the position of different parts of your body. Muscles, tendons, and ligaments must work harder and can be stressed when you are in an awkward posture. Awkward posture occurs when any joint of your body bends or twists excessively, outside a comfortable range of motion Various work activities can result in awkward postures:

1. Leaning sideways, such as when reaching into a low drawer to one side (awkward back posture).
2. Bending down to work at a low level (awkward back posture).
3. Reaching overhead (awkward shoulder posture).
4. The elbows out to the side (awkward shoulder posture).
5. Bending the wrist when moving objects or keyboarding (awkward wrist posture).
6. Bending the neck down, such as looking at small components in poor lighting conditions (awkward neck posture).
7. Twisting part of the body, such as twisting the neck to view documents while keyboarding for a long time (awkward neck posture).

Moreover, repetition was defined as the average number of movements or exertions performed by a joint or a body link within a unit of time or performing similar motions with the same body part with little rest or recovery. Repetition could also be defined as performing the same motion or group of motions excessively. Repetition involves doing a task that uses the same muscles over and over with little chance for rest or recovery. This applies to both large muscles and small muscles. Repetition put workers at a higher risk of injury when other risk factors are also present (such as an awkward posture or heavy force). Repeated identical or similar motions performed over a period of time could cause over-extension and overuse of certain muscle groups, which could lead to muscular fatigue. However, by varying tasks, muscle groups have periods of activity alternated with periods of rest, which may be beneficial in reducing the possibility of injury (Jaffar and Lop, 2011).

Furthermore, force is the mechanical or physical effort to accomplish a specific movement or exertion. Force can be defined as the amount of physical effort required to perform a task (such as lifting) or to maintain control of equipment or tools. Exerting a force on a person or object may overload our muscles and tendons. The force may come from gripping, lifting, pushing or pulling. The force that a worker exerts on an object is a primary risk factor. Muscles and tendons can be overloaded when you apply a strong force against an object. Holding a lighter object (such as a mouse) for long periods can also expose workers to a risk of WRMSD (Jaffar & Lop, 2011).

2.5 Ergonomic in Higher Learning Institutions

Matos and Arezes (2015) claimed the appearance of WRMSD at the offices as rise over the last years, mainly because of the regular use of computers at the workstations increased the occurrence of WRMSD reported mostly on neck and upper limbs. Musculoskeletal disorders (MSD) have been common complaints among workers involved in static work or tasks requiring the repetitive motion of the upper limbs and prolonged computer work (Poochada & Chaiklieng, 2015).

Chaiklieng and Krusun (2015) found that the prevalence of reported discomfort in the neck and upper extremities is high among computer workers. A previous study suggested that using a computer for more than 4 hours a day greatly increases the risk of WRMSD. It is found a positive association between the duration of mouse use and hand-arm symptoms. In the contrast, no association was found between the software-recorded duration of computer use and musculoskeletal symptoms.

Prolonged computer use is recognized as an occupational risk factor for musculoskeletal disorders. Whilst the association between musculoskeletal symptoms and increased hours of computer use, including mouse use has been previously studied within the general office environment, there is very limited research specifically related to musculoskeletal symptoms associated with computer based tasks undertaken by academics in context with an extended range of operational environments(James et al., 2018).

Academicians are more likely to work in diverse operational environments, and therefore the relationships between their musculoskeletal symptoms and computer use may be different to what is observed in standard office environments (Gornall and Salisbury, 2012). Prolonged sitting at computers has also raised concerns about the impact of a lack of variation in working postures and activity on worker health and wellbeing (Straker and Mathiassen, 2009).

The rapid development in communication technologies, including the availability of smart phones, tablets and laptop computers, has provided opportunities for working away from the office workstation. This is increasingly commonplace among office workers

(Ciccarelli et al., 2011). Academicians have very variable work environments and use computers within offices, laboratories, at home and when travelling. They are expected to be 'mobile' and available to respond to queries, regardless of location. The expectation of availability outside of office hours has been identified as a concern for many professionals and a range of reasons for completing work at home has been identified, including working unpaid overtime to complete the demands of the job (Ciccarelli et al., 2011).

James et al. (2018) claim that in many instances academicians therefore may not be working at designated workstations purposely set up for them. Potentially they are less likely than university administrative staff to use single fixed workstations designed to minimize ergonomic risks and the extent to which academics apply design recommendations to alternate workstation and equipment configurations is also unknown.

Previous research has been conducted on the prevalence and physical risk factors of work-related musculoskeletal disorders (WMSD) among occupations such as agriculture workers, office workers, school teachers, and health care professionals. However, a paucity of research exists on the patterns and physical risk factors of WMSDs among the academicians in a higher learning institution (Mohan, Justine, Jagannathan, Aminudin, & Johari, 2015).

2.6 Conclusion

WRMSD risk factors clarified in all the above researches suggests that ergonomics risk factors play vital roles in causing WRMSD among administrative workers. From the previous studies had found that neck and shoulder pain is the most prevalent symptoms and common type of WRMSD faced by administrative workers. This may have occurred when administrative worker faces risk factors like poor seated posture, prolonged seated and repetitive movement. Thus, by knowing the condition faced by administrative worker, the University administration can work onto taking actions and to equip the work area with all the measures needed to maintained and improve the level of safety in their workplace.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discuss about the research procedure that is carried out throughout the study. This chapter consist of the explanation on research design, study samples, sample size, study area, process and procedure, research instruments and data analysis.

3.2 Research Design

This study is a cross-sectional study. Researchers recorded data and information on the subject without manipulating the study environment.

3.2.1 Cross-sectional study

Cross sectional study is a research tool used to capture information based on data gathered for a specific point in time. The data gathered is from a pool of participants with varied characteristics and demographics known as variables. Age, gender, education, geographical locations, and department are all examples of variables. The variables, or demographics, used in a single study are based on the type of research being conducted and on what the study aims to prove or validate. The research findings help remove assumptions and replace them with actual data on the specific variables studied during the time period accounted for in the cross-sectional study.

3.3 Study Sample

There are two types of sampling strategies in a study which are probability sampling and non-probability sampling. A probability sample is selected in such way as to be represented of the population, where there are three types of this sampling strategies that are random sampling, stratified sampling and cluster sampling. Furthermore, non-probability sampling does not involve random sampling.

There are three types of non-probability sampling which are judgement sampling, voluntary sampling and convenience sampling. This study was used random sampling since the subjects are randomly chosen as the study population. The purpose of this studied is to obtain the highest effect of ergonomics problems among administrative workers that did the same job but in difference work area. The sample population come from administrative workers.

3.3.1 Sampling Strategies

This study has used random sampling as sampling strategy to collect data. Random samples are used when the population members are similar to one another on important variables. The key to random sampling is that each unit in the population has an equal chance of being selected in the sample. Using random sampling protects against bias being introduced in the sampling process and hence it helps to ensure a high degree of representative sample.

In general, random samples are taken by assigned a number to each unit in the population and using a random number table to generate the sample list. Absent knowledge about the factors for stratification for a population, a random sample is useful first step in gained samples. The advantages of random sample are the sample represent the target population and eliminate sampling bias. Meanwhile, the disadvantage is that it is very difficult to achieve in term of time, effort and money.

3.3.2 Sample Size

There are increasing demand for research has created a need for an efficient method of determining the sample size needed to be representative of a given population. This studied will determine the sample size based on Krejcie and Morgan's (1970) table. The number of population was 230 and the sample size representative of this studied was 144. Table 3.1 is applicable to any defined population. It should be noted that as the population increases the sample size increases.

Table for Determining Sample Size from a Given Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

Figure 3.1: Table sample size from a given population

Source: Krejcie and Morgan's (1970)

3.4 Study Area

For the purpose of sampling, institute of higher education, Universiti Malaysia Pahang(UMP) was chosen for this study. This institute located at Gambang and Pekan, Pahang. Figure 3.1 and 3.2 shows the location of Universiti Malaysia Pahang at Gambang and Pekan, Pahang. There are many departments in this university that involve in administration work. The reason this study area was chosen are because the administrative workers are full time workers at this university. In addition, many complain had been made to Occupational Safety & Health Management Office (OSHMO) Universiti Malaysia Pahang related to back pain and work related musculoskeletal disorder.

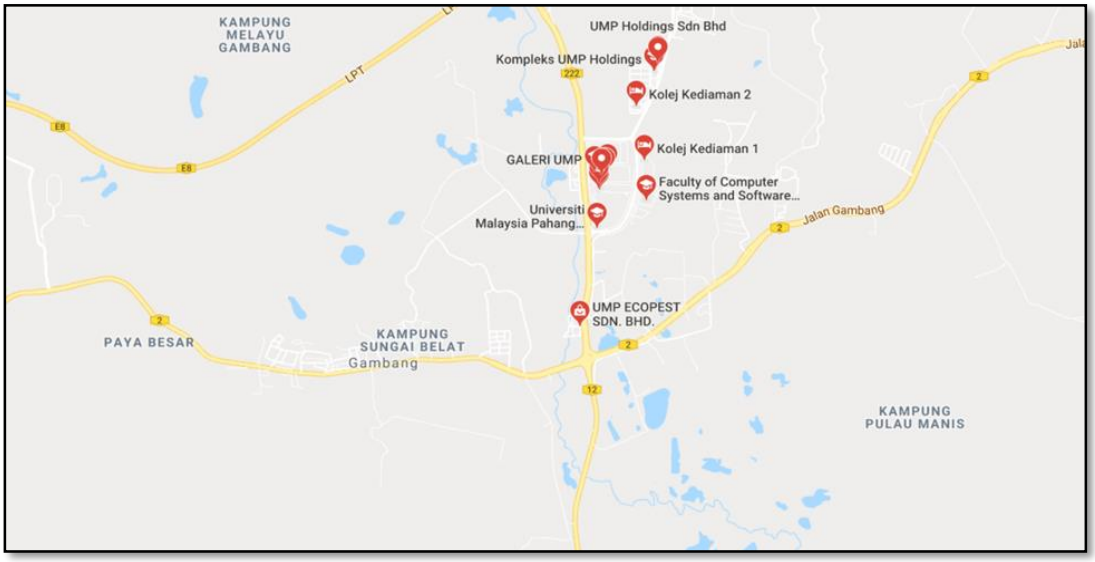

Figure 3.2: The Map location of Universiti Malaysia Pahang, Gambang, Kuantan

Source: Adapted from Google Map

Figure 3.3: The Map location of Universiti Malaysia Pahang, 26600 Pekan, Pahang

Source: Adapted from Google Map

3.5 Research Process and Procedure

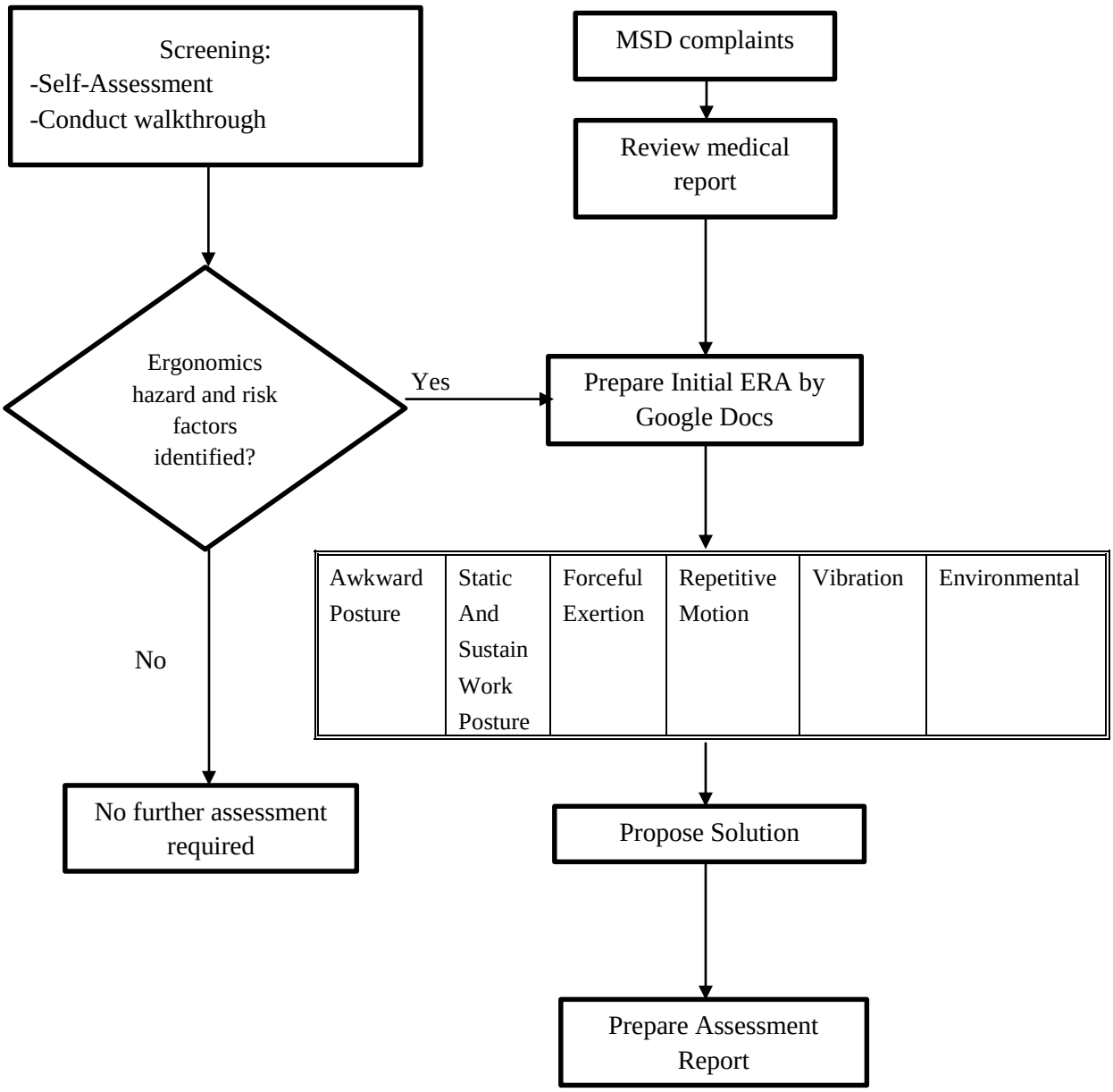

Figure 3.4: Research Process and Procedure

3.6 Research Instruments

Two instrument was used in this research in order to obtain data which are Self-Assessment Musculoskeletal Pain/Discomfort Survey Form (Self-Assessment Form) and Initial Ergonomic Risk Assessment (ERA).

3.6.1 Self-Assessment Musculoskeletal Pain/Discomfort Survey Form (Self-Assessment Form)

Self-Assessment Form is used in this study to collect data in order to address the stated of objectives. Self-Assessment Form is based on the guidelines on ergonomic risk assessment at workplace 2017. It was used as a survey instrument to identify musculoskeletal disorder and discomfort among administrative workers. The discomfort form may provide ways to measure the outcome of epidemiological studies on musculoskeletal disorders. The demographical data of workers such as age, gender, body mass index and work experience of workers were obtained in this study.

The aim of Self-Assessment Form is to determine the prevalence of musculoskeletal symptoms. The Self-Assessment Form consisted of questions referring to nine body areas. There were three upper limb segments which are shoulder, upper arm and lower arm, three lower limb segments which are hips/thighs, knees, ankles/feet, and three trunk segments which are neck, upper back and lower back. Thus, nine body parts was evaluated to determine which body part experienced pain or discomfort within last 12 months. Figure 3.5 shows the body map diagram that consisted in Self-Assessment Form.

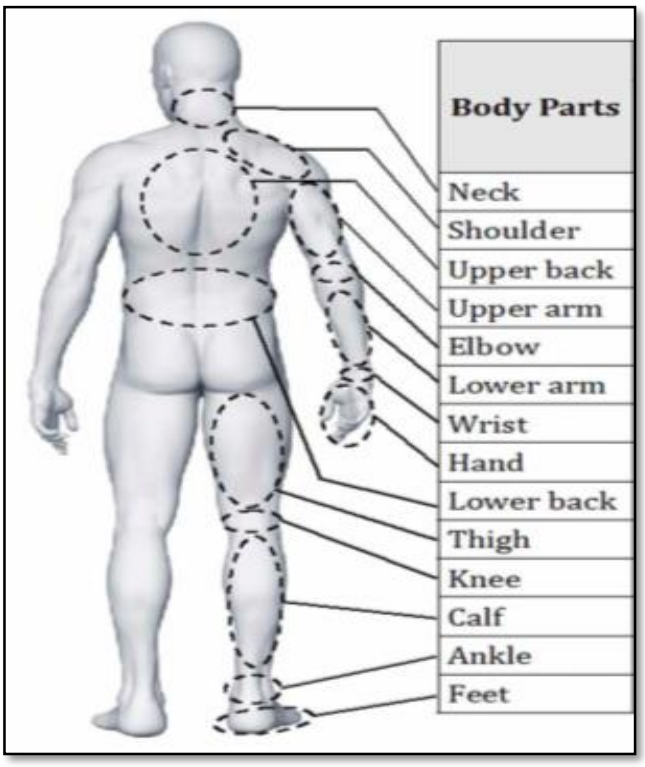

Figure 3.5: The body map diagram that consisted in Self-Assessment Musculoskeletal Pain/Discomfort Survey Form

Source: (Guidelines on Ergonomics Risk Assessment 2017)

3.6.2 Initial Ergonomics Risk Assessment (ERA)

Initial Ergonomic Risk Assessment(ERA) is used in this study due to pain or discomfort from the self- assessment form or based on the walkthrough and complain related to MSD record. The assessment depends on the types of ergonomics risk factors identified. There are many ergonomics risk factors such as awkward posture, static and sustained work posture, forceful exertion, repetitive motion, vibration and environmental risk factors. This assessment required various considerations such as; team formation, instruments, materials and facilities, communication and coordination. The outcome of initial ergonomic risk assessment will determine if there is a need to carry further investigation. Recommendations on ergonomic should be suggest to the problem towards improving the work conditions. Table 3.1 shows the number of question that need to answer for each risk factor.

Table 3.1: Number of question that need to answer for each risk factor

Risk Factor	Number of Questions	Requirement
Awkward Posture	13	More than 6 is conclude having awkward posture
Static and Sustain Work Posture	3	More than 1 is conclude having static and sustain work posture
Forceful Exertion	1	More than 1 is conclude having forceful exertion
Repetitive Motion	5	More than 1 is conclude having repetitive motion
Vibration	4	More than 1 is conclude having vibration
Environmental	5	More than 1 is conclude having environmental

3.7 Data Analysis

Data analysis is the process of systematically applying statistical and logical techniques to describes, illustrate and evaluate data. The data for this study that had been collected were be analysed using a suitable method. In addition, to identify the risk factors, administrative workers were asked on risk factors at their workplace. Administrative worker's responses were documented according to similarities and categorized by percentages.

3.7.1 Statistical Package for Social Sciences (SPSS) Version 25

SPSS is widely used software for statistical analysis in social science. SPSS could analyse data in three basic ways which were describe data using descriptive statistics such as frequency, mean, minimum and maximum, examine association between variables example correlation, regression, factor analysis and compare groups to determine if there were significant difference between these groups example t-test, ANOVA and nonparametric test and many more. In this study, SPSS were used to compare the data obtained from the analysis of the Self-Assessment Form and Initial ERA in order to analyse the association between these two variables.

3.8 Conclusion

As conclusion, this chapter discussing about the research procedure and process that is carried out throughout the study. Moreover, this chapter also consist of the explanation on research design, study samples, sample size, study area, process and procedure, research instruments and data analysis. There are two methods that used in this study namely Self-Assessment Form and Initial ERA.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter discussed the major findings on the study of ergonomic risk assessment among administrative workers in Universiti Malaysia Pahang. This study is set out to identify prevalence of work related musculoskeletal disorder, identify ergonomic risk factors, to investigate association between symptoms pain and discomfort and ergonomic risk factors. This study focuses on the data analysis of the collected Self-Assessment Musculoskeletal pain/discomfort Form and Initial Ergonomic Risk Assessment (ERA). For Self-Assessment Musculoskeletal pain /discomfort Form, each element, comprising of neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles, will be discussed individually. The association between symptoms of pain/discomfort of body regions and physical factors have been analyzed using Chi-square test and then further discussed in this chapter.

4.2 Ergonomic Risk Assessment (ERA) By Google Docs

4.2.1 Interface of ERA by Google Docs

An ergonomic risk assessment was developing by google docs for researcher to reduce the time and energy during data collection. Google Docs is use to help in conducting the ergonomic risk assessment among the administrative workers. This ergonomic risk assessment was in google form and the respondents can enter the google doc and fill in the ergonomic risk assessment. In this google form there were many form that need to fill in by respondent such as demographic form, self-assessment musculoskeletal pain/discomfort survey form, awkward posture form, static and sustain

work posture form, forceful exertion form, repetitive motion form, vibration form and environmental form.

4.2.2 Validation by Ergonomic Expert

This Ergonomic Risk Assessment (ERA) by Google Docs had been validated by ergonomic expert from UMP. The Occupational Safety and Health Office (OSHMO) also used this to collect, identify and analyze the discomfort and ergonomic risk factors among their staff during data collection. It was proven that ergonomic risk assessment (ERA) by Google Docs can use for data collection.

4.3 Normality Test

Normality tests are used to determine if a data set is well-modelled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. In other words, a normality test is carried out to check whether the collected data are normally distributed or not. The Shapiro-Wilk Test is more appropriate for small sample sizes more than 50 samples but can also handle sample sizes as large as 2000. The Shapiro-Wilk test is used to check normality of the data (Razali et el., 2011). The alpha level is the probability of rejecting the null hypothesis when the null hypothesis is correct. The null hypothesis (H_0) states that the data is normally distributed whereas the alternate hypothesis (H_1) states that the data is not normally distributed. The alpha level is used to compare with the p-value from the Shapiro-Wilk test in order to check for data normality. The null-hypothesis of this test is that the population is normally distributed. Thus, if the p-value is less than the chosen alpha level ($\alpha < 0.05$), then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population, in other words, the data are not normal. On the contrary, if the p-value is greater than the chosen alpha level ($\alpha>0.05$), then the null hypothesis that the data came from a normally distributed population cannot be rejected. However, since the test is biased by sample size, the test may be statistically significant from a normal distribution in any large samples. Thus, a Q–Q plot is required for verification in addition to the test.

4.3.1 Normality Test of Self-Assessment and Initial ERA

Table 4.1 shows average of mean, median and standard deviation analysis for two methods which are Self-Assessment Form and Initial ERA. From the normality test, all the p-value for these two methods is 0.000. This shows that the P-value is smaller than the alpha level of 0.05 ($p < \alpha$). Therefore, the data obtained from the Self-Assessment and Initial ERA is not normally distributed and rejecting the null hypothesis. This means that non- parametric tests should be used for all shifts to analyze the data. As can be seen in table above, the average of mean for Self-Assessment Form method were 1.96. Then for average of median, were obtained 2.0. For average of standard deviation were 0.52. Meanwhile, for average of standard deviation of Initial ERA method, the average mean was 1.87. Whereas, the score for average median was 2.0 and followed for average standard deviation were 0.21.

Table 4.1: Descriptive analysis of normality test

	Mean	Median	Std. Dev.	P-value
Self-Assessment Form	1.96	2.0	0.52	0.000
Initial ERA	1.87	2.0	0.21	0.000

4.4 Demographic Information

This study is involved 136 respondents among administrative workers from University Malaysia Pahang. The respondents were randomly chosen for this study. The administrative workers were of different age, gender, body mass index (BMI) range, year of job, highest education level and department. Table 4.2 shows the details analysis of respondent's characteristics.

Table 4.2: Demographic data of 135 respondents in UMP

	Frequency (n)	**Percentage (%)**
Age		
20-30	48	35.56
31-40	74	55.56
41-50	7	5.19
Gender		
Male	39	28.9
Female	96	71.1
BMI Range		
Underweight (<18.5)	4	2.96
Healthy (18.5-24.9)	85	64.39
Overweight (25.0-29.9)	34	25.19
Obese (30.0-39.9)	12	8.9
Years of Job with UMP		
1-5	49	36.3
6-10	54	40.0
11-15	23	17.0
16-20	9	6.7

Highest Educational Level		
SPM/Certificate	18	13.3
STPM/Diploma/Matriculation	88	65.2
Degree	29	21.5
Department		
Vice Chancellor's Office	9	6.7
Research & Innovation	11	8.1
Academic & International Affairs (JHEAA)	11	8.1
Student Affairs & Alumni	27	20.0
Registry	25	18.5
Bursary	24	17.8
Department of Corporate & Quality Affairs (JHKK)	5	3.7
International Office (IO)	4	3.0
ICT Centre	11	8.1
Career Placement & Development Centre (CPDC)	2	1.5
Library	3	2.2
Railway Industry Academic	3	2.2

4.4.1 Age

The age of the respondents was divided into 3 ranges which are 20-30 years old, 31-40 years old, and 41-50 years old. Based on the Figure 4.1, the highest percentage based on age range is 31-40 years old, which is 55.56% of respondents. The second highest is 20-30 years old, comprising of 35.56% respondents. The lowest frequency was in the range of 41-50 years old, comprising of 5.19% respondents. In this study, more than half of the respondents are in the range of ages between of 30-50 years old. Age plays a role in musculoskeletal complaints frequency in people (Zwart et al., 1997).

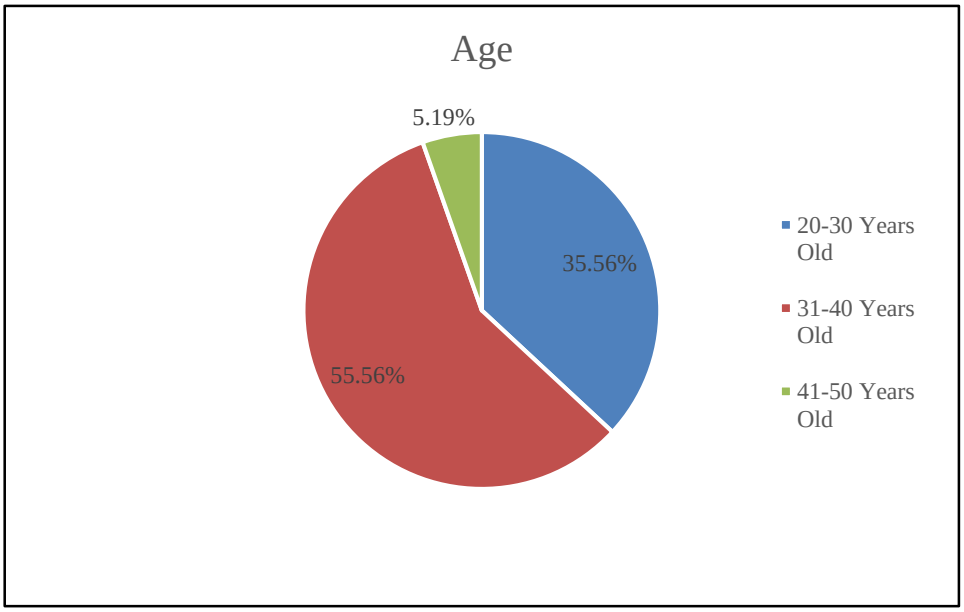

Figure 4.1: Percentages of respondents according to age range

4.4.2 Gender

Based on the Figure 4.2, the frequency of female respondents is significantly higher than that of male respondents. This study was involving an amount of 135 respondents which is majority are females which is 96 respondents and males are the minority with only 39 respondents. The female respondents have a percentage of 71.10% whereas the male respondents have a percentage only 28.90%. According to Zwart et al, (1997) gender plays a role in causing musculoskeletal disorders.

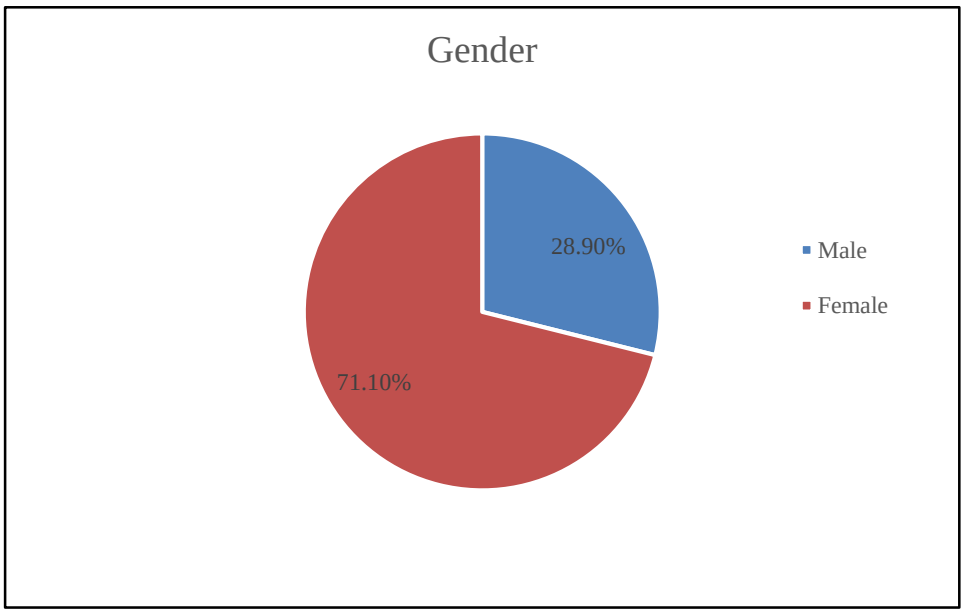

Figure 4.2: Percentages of respondents according to gender

4.4.3 Body Mass Index (BMI)

BMI range were divided into four categories which are Underweight (<18.5), Healthy (18.5-24.9), overweight (25.0-29.9), and Obese (30.0-39.9). According to Figure 4.3, the highest percentage based on BMI range is healthy, which comprises of 64.39% respondents. The second highest of BMI range of respondents is overweight, which is 25.19%. This followed by obese range, comprising of 8.90% respondents. The lowest of BMI range of respondent is underweight, which is 2.96%. Thus, this will be one of the factors that induce WRMSD among respondents.

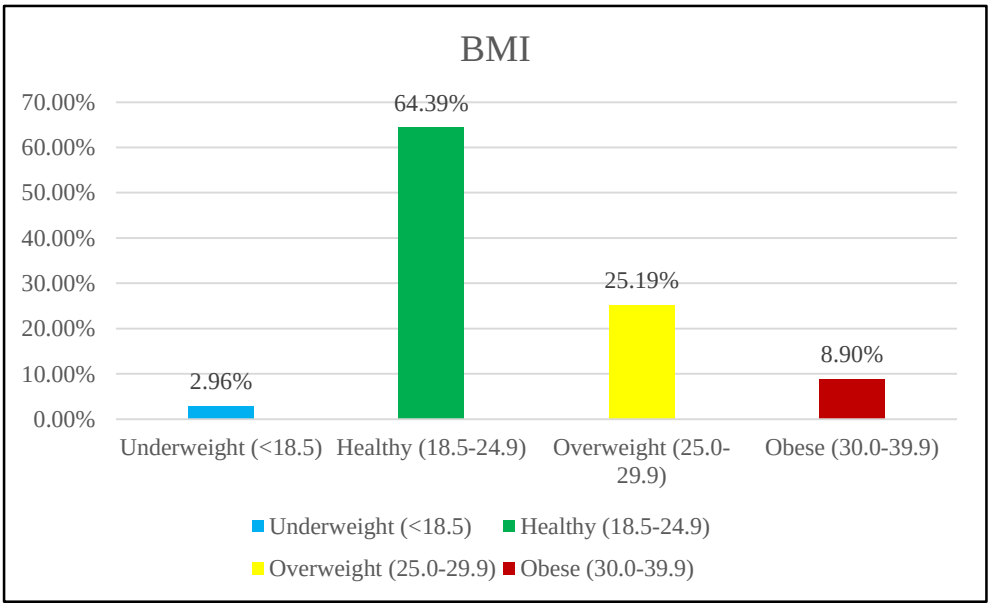

Figure 4.3: Percentages of respondents according to BMI Range

4.4.4 Years of Job with UMP

The years of job among administrative worker were divided into 4 ranges which are 1-5, 6-10, 11-15 and 16-20 year. Based on Figure 4.4, the highest percentage based on year of job is 6-10 year, comprising of 40.0% respondents, followed by year of job of 1-5 years, which is 36.63% respondents. The lowest percentage was in range of 16-20 year, which is only 6.7% respondents whereas, the second lowest percentage in range of 11-15 years, which comprise of 17.0% respondents.

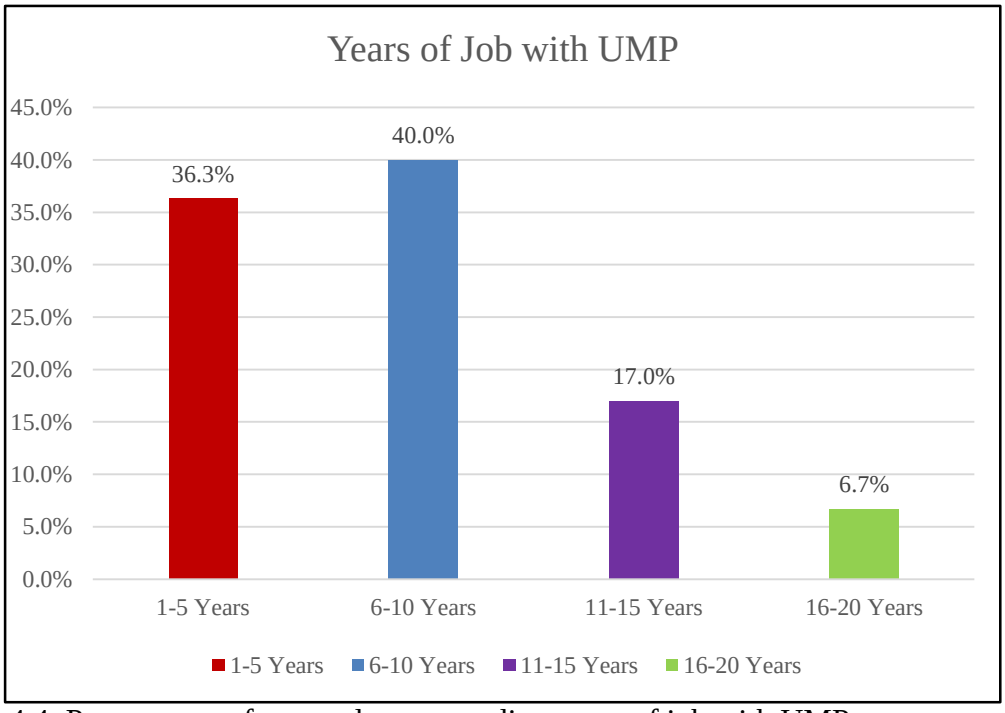

Figure 4.4: Percentages of respondents according years of job with UMP

4.4.5 Educational Level

There are 3 categories of education level among respondents which are SPM/Certificate, STPM/ Diploma/ Matriculation, and Degree. Figure 4.6 shows that majority of administrative workers was in STPM/ Diploma/ Matriculation level, comprising of 65.20%. This followed by Degree level with 21.50% of respondents. The lowest percentage of respondents was SPM/Certificate level, which is 13.30%.

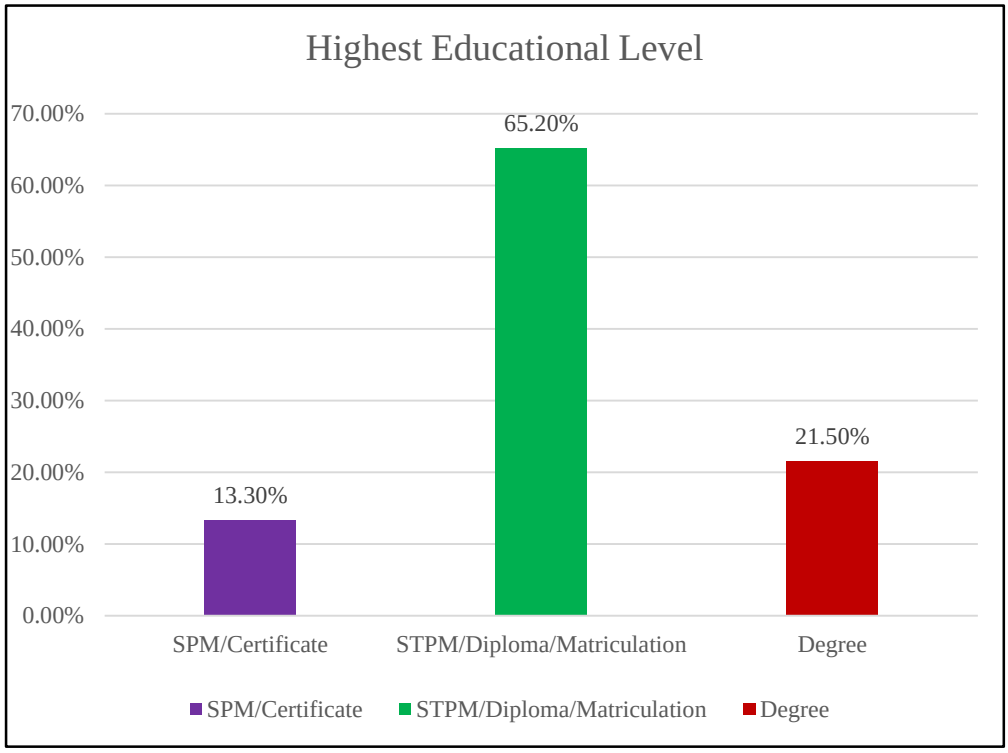

Figure 4.5: Percentages of respondents according educational level

4.4.6 Department

This study was conducted at Universiti Malaysia Pahang (UMP). Figure 4.8 shows that all respondents from each department with 135 respondents according to their department. UMP has many department, however only administrative workers from department Vice Chancellor's Office (D1), Research & Innovation (D2), Academic & International Affairs (JHEAA) (D3), Student Affairs & Alumni (D4), Registry (D5), Bursary (D6), Department of Corporate & Quality Affairs (JHKK) (D7), International Office (IO) (D8), ICT Centre (D9), Career Placement & Development Centre (CPDC) (D10), Library (D11) and Railway Industry Academic (D12) allow to do collecting data process. Other department not gives permission to do the assessment.

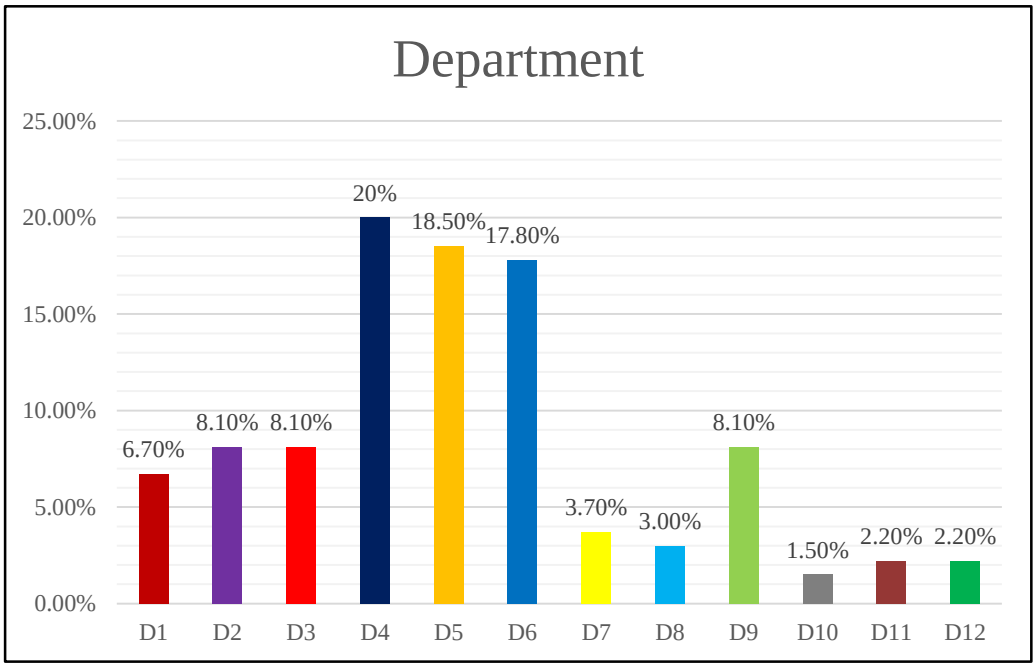

Figure 4.6: Percentages of total respondents according department

4.5 Self-Assessment Musculoskeletal Pain/Discomfort Survey Form Analysis

4.5.1 Descriptive Analysis for Self-Assessment Form

In this study, a total number of 135 respondents from administrative workers were asked that whether they have troubles with body regions during last 12 months. The table 4.3 shows the summary of the general overview of the frequency and percentage of musculoskeletal complaints among respondent that work as administrative workers. Meanwhile, table 4.4 shows more specific numbers in the upper arm, elbow, lower arm, wrist, hand, thigh, knee, calf, ankle and feet among the respondents. In addition, table 4.5 portray specific number on the pain/discomfort that respondent had comes from work during last 12 months. According the analysed 135 Discomfort Form from all respondents, 43.7% administrative workers had neck pain/discomfort during the last 12 months whereas 56.3% have not trouble. From the analysed on neck pain, there are 34.1% state that the pain comes from work during the last 12 months meanwhile 65.9% state the pain not comes from the work. In the shoulder regions, 42.2% respondents had shoulder pain trouble in the last 12 months whereas 57.8% have not trouble. There are 31.1% respondents claim that the pain at shoulder comes from work while 68.9% claim not.

In addition, 38.5% of the respondents had trouble in upper back region in the past 12 months whereas 61.5% of them have not trouble. 26.7% state that the pain at upper back region comes from work whereas 73.3% state not comes from work. In upper arm region 14.1% of the respondents had pain while 85.9% of them not pain. Out of 14.1% that had pain, 3.7% both, 3.7% in the left side and 6.7% in the right side. 7.4% of respondents said that pain comes from work during the last 12 months and 92.6% said not. Out of 7.4% that said pain comes from work, 1.5% both, 0.7% left, and 5.2% right.

In elbow region,14.1% of the respondents have felt some kind of pain, discomfort, or problem whereas 90.4% are not pain. Those who answer “Yes”, 3.0% of them had pain both, 3.7% in the left elbow and 3.0% in the right elbow. 5.9% of respondents said that pain comes from work during the last 12 months and 94.1% said not. Out of 5.9% that said pain of elbow comes from work, 1.5% is both, 2.2% in the left elbow and right elbow.

For lower arm regions, 13.3% of the respondents have felt some kind of pain, discomfort, or problem in this area in the past 12 months whereas 86.7% have not trouble. Out of the 13.3% respondents that had trouble, 5.9% in the right side, 3.7% in the left side and 3.7% in both lower arm. There are also 11.1% of respondent claim that the discomfort comes from work whereas 88.9% are not. Out of the 11.1% of claim, 5.2% in the right side, 2.2% in the left side and 3.7% in both lower arm. Furthermore, 27.4% respondents stated had pain at wrist region whereas 72.6% state not pain. Out of the 27.4% respondents that had trouble, 14.8% in the right side, 4.4% in the left side and 8.1% in both wrists. There are also 18.5% of respondent claim that the discomfort comes from work whereas 81.5% are not. Out of the 18.5% of claim, 9.6% in the right side, 3.0% in the left side and 5.9% in both wrists. Plus, 20.7% respondents had trouble at hand region whereas 79.3% are not trouble. Out of 20.7% respondents, 7.4% had discomfort for both hand, 3.0% had discomfort on left hand and 10.4% had discomfort on right hand. There are also 18.5% respondents state that the discomfort at hand come from the work during last 12 months while 81.5% stated not comes from work. Out of 18.5% respondents, 5.9% are both hand, 1.5% are left hand and 8.1% are right hand.

Other than that, 47.4% of the respondents had discomfort in lower back region in the past 12 months whereas 52.6% of them have no discomfort. There also 32.6% claimed that the discomfort comes from the work during the last 12 months while 67.4% are claimed not comes from work. For the thigh region 10.4% of the respondents have felt some kind of pain, discomfort, or problem in this area in the past 12 months whereas 89.6% have not trouble. Out of the 10.4% respondents that had trouble, 1.5% in the right side, 0.7% trouble in the left side and 8.1% in both thighs. There are also 6.7% of respondent claim that the discomfort comes from work whereas 93.3% are not. Out of the 6.7% of claim, 1.5% in the right side, no trouble in the left side and 5.2% in both thighs. From the finding, it was found that it was also found that 14.8% had pain in the knee region and the other 85.2% had no pain during last 12 months. Out of the 14.8% respondents that had pain, there was 3.0% had pain on right knee, 2.2% had pain on left knee and 9.6% had both knee. There also found that 7.4% respondents said the pain on knee comes from work during 12 months whereas 92.6% found not from work. Out of

7.4% respondents, 5.2% respondents found pain both knee, 0.7% respondents found left knee and 1.5% respondents found right knee.

Meanwhile, for calf region it was stated 12.6% had discomfort in the past one year whereas the other 87.4% had no discomfort. From those 12.6% that had discomfort, 3.0% had discomfort on right calf, 2.2% had discomfort on left calf and 7.4% had discomfort both calf. There also stated that 5.9% respondent had discomfort comes from work in the past one year whereas the others 94.1% had no discomfort comes from work. From those 5.9% that had discomfort comes from work, 3.7% had discomfort on both calf, 1.5% had discomfort on left calf and 0.7% had discomfort on right calf. From the finding, it was also stated that 11.9% had trouble in the ankle region and the others 88.1% had no trouble during the last 12 months. Out of the 11.9% respondents that trouble, 6.7% had trouble both ankle, 3.0% had trouble left ankle and 2.2% had trouble right ankle. Then, from the analyzed data for ankles it shows that 5.2% respondents had ankle pain comes from work during last 12 months while 94.8% state no comes from work. Out of 5.2% respondents, 2.2% respondents had pain both ankle, 1.5% respondents had pain on left and right ankle.

Lastly, for the feet region, 14.8% respondent had feet pain in the past year whereas 85.2% had no pain. Out of those 14.8% that had pain, 7.4% respondents had pain on both feet, 4.4% respondents had pain on left feet and 3.0% respondents had pain on right feet. There also show 6.7% respondents had pain on feet comes from the work whereas 93.3% was not comes from work. Out 6.7% respondent had pain comes from work, 3.0% respondents had pain on both feet, 1.5% respondents had pain on left feet and 2.2% had pain on right feet.

Table 4.3: Frequency and percentage of pain/discomfort among respondents (General)

Answer by Everyone				
Percentage of pain by period and Body Regions N=135	**Had pain/discomfort during the last 12 months n (%)**		**The pain/discomfort comes from work during the last 12 months n (%)**	
	Yes	**No**	**Yes**	**No**
Neck	59 (43.7)	76 (56.3)	46 (34.1)	89 (65.9)
Shoulder	57 (42.2)	78 (57.8)	42 (31.1)	93 (68.9)
Upper Back	52 (38.5)	83 (61.5)	36 (26.7)	99 (73.3)
Upper Arm	19 (14.1)	116 (85.9)	10 (7.4)	125 (92.6)
Elbow	14 (9.6)	122 (90.4)	8 (5.9)	127 (94.1)
Lower Arm	18 (13.3)	117 (86.7)	15 (11.1)	120 (88.9)
Wrist	37 (27.4)	98 (72.6)	25 (18.5)	110 (81.5)
Hand	28 (20.7)	107 (79.3)	21 (15.6)	114 (84.4)
Lower Back	64 (47.4)	71 (52.6)	44 (32.6)	91 (67.4)
Thigh	14 (10.4)	121 (89.6)	9 (6.7)	126 (93.3)
Knee	20 (14.8)	115 (85.2)	10 (7.4)	125 (92.6)
Calf	17 (12.6)	118 (87.4)	8 (5.9)	127 (94.1)
Ankle	16 (11.9)	119 (88.1)	7 (5.2)	128 (94.8)
Feet	20 (14.8)	115 (85.2)	9 (6.7)	126 (93.3)

Table 4.4: Frequency and percentage prevalence of WRMSDs among respondent (Upper Arm, Elbow, Lower Arm, Wrist, Hand, Thigh, Knee, Calf, Ankle, Feet)

Percentage of pain by period and Body Regions N=135	**Had pain/discomfort during the last 12 months n (%)**			
	Both	**No**	**Left**	**Right**
Upper Arm	5	116	5	9
	(3.7)	(85.9)	(3.7)	(6.7)
Elbow	4	122	5	4
	(3.0)	(90.4)	(3.7)	(3.0)
Lower Arm	5	117	5	8
	(3.7)	(86.7)	(3.7)	(5.9)
Wrist	11	98	6	20
	(8.1)	(72.6)	(4.4)	(14.8)
Hand	10	107	4	14
	(7.4)	(79.3)	(3.0)	(10.4)
Thigh	11	121	1	2
	(8.1)	(89.6)	(0.7)	(1.5)
Knee	13	115	3	4
	(9.6)	(85.2)	(2.2)	(3.0)
Calf	10	118	3	4
	(7.4)	(87.4)	(2.2)	(3.0)
Ankle	9	119	4	3
	(6.7)	(88.1)	(3.0)	(2.2)
Feet	10	115	6	4
	(7.4)	(85.2)	(4.4)	(3.0)

Table 4.5: Frequency and percentage prevalence of WRMSDs comes from work among respondents (Upper Arm, Elbow, Lower Arm, Wrist, Hand, Thigh, Knee, Calf, Ankle, Feet)

Percentage of pain by period and Body Regions N=135	**The pain/discomfort comes from work during the last 12 months n (%)**			
	Both	**No**	**Left**	**Right**
Upper Arm	2	125	1	7
	(1.5)	(92.6)	(0.7)	(5.2)
Elbow	2	127	3	3(
	(1.5)	(94.1)	(2.2)	2.2)
Lower Arm	5	120	3	7
	(3.7)	(88.9)	(2.2)	(5.2)
Wrist	8	110	4	13
	(5.9)	(81.5)	(3.0)	(9.6)
Hand	8	114	2	11
	(5.9)	(84.4)	(1.5)	(8.1)
Thigh	7	126	0	2
	(5.2)	(93.3)	(0)	(1.5)
Knee	7	125	1	2
	(5.2)	(92.6)	(0.7)	(1.5)
Calf	5	127	2	1
	(3.7)	(94.1)	(1.5)	(0.7)
Ankle	3	128	2	2
	(2.2)	(94.8)	(1.5)	(1.5)
Feet	4	126	2	3
	(3.0)	(93.3)	(1.5)	(2.2)

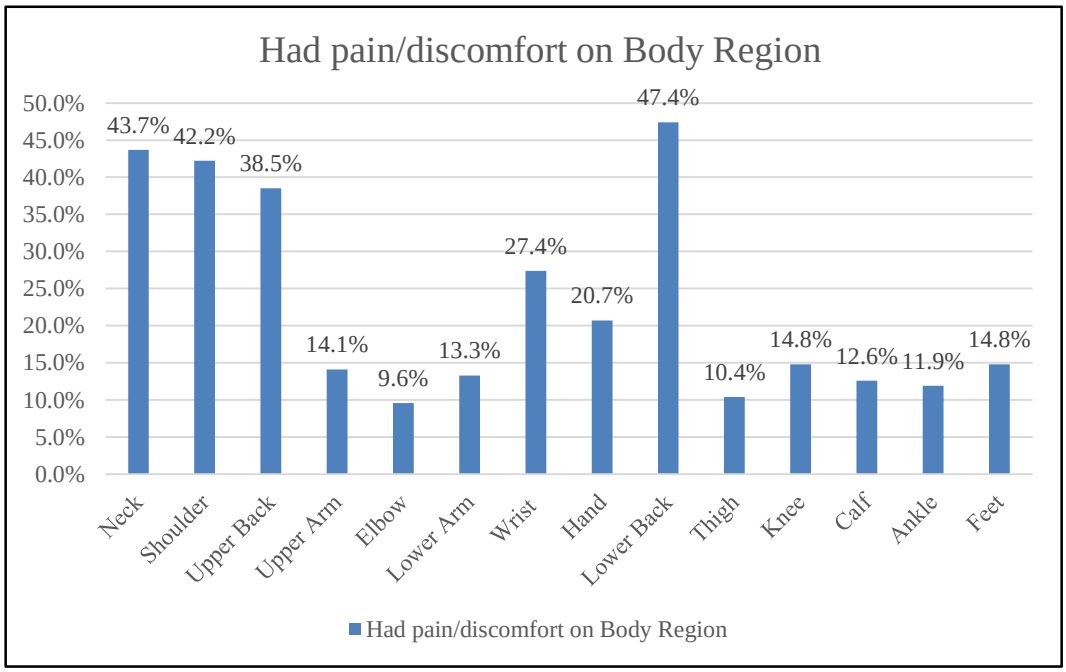

Figure 4.7: Percentage of pain/discomfort on body region among the respondents

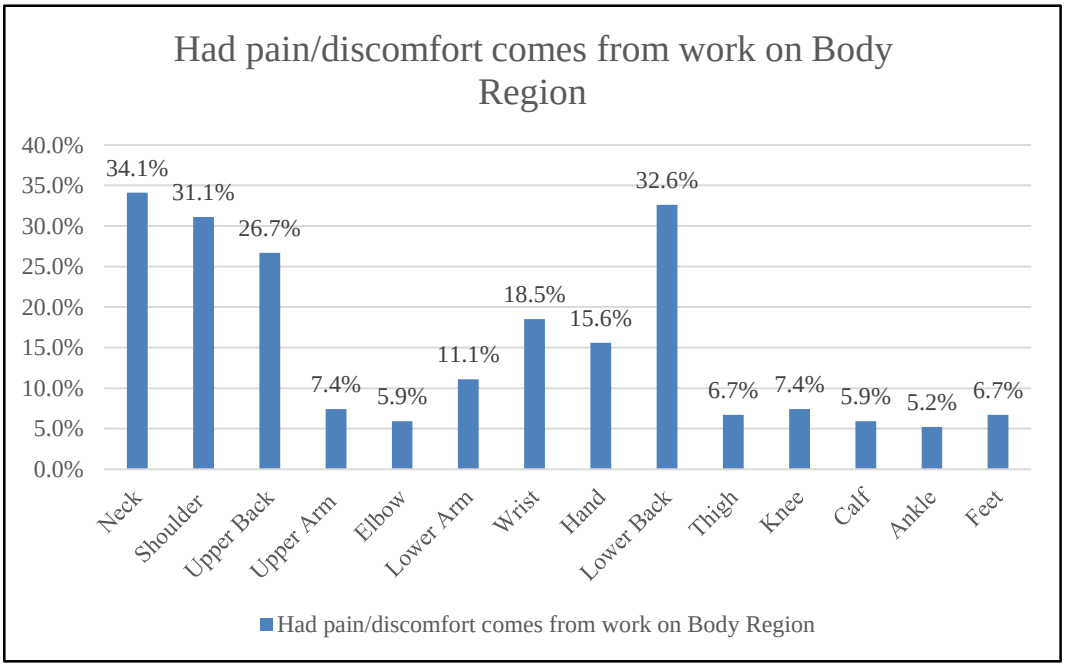

Figure 4.8: Percentage of pain/discomfort from work on body region among the respondents

4.6 Initial Ergonomic Assessment (ERA) Analysis

Nowadays, the prevalence of musculoskeletal disorders (MSD) in workplaces is a major problem (Stock et al., 2011). According to Guidelines on Ergonomics Risk Assessment (2017) defines ergonomic risk factor is an attribute, characteristic or exposure that may cause to a musculoskeletal injury. In general, there was one or more risk factors may be present at one time at once increasing the risk of the injury. In this study, the Initial Ergonomic Risk Assessment (ERA) was used to measure the physical factor which is the outcome is initial ergonomic risk factors score.

Initial ERA score is categorized into 5 risk factors namely awkward posture, static and sustained work posture, forceful exertion, repetitive motion, vibration and environmental. Initial ERA should be scored based on each factor observed and analysed. The score was obtained through summation of questions in each part of risk factors. After the total score have been determined, the score will be compared by the minimum requirement for advance assessment. Each risk factors have their own minimum requirement based on the Guidelines on Ergonomic Risk Assessment (2017) and the classified risk level suggest the recommendation action to be take in order to decrease the risk of developing prevalence of musculoskeletal disorder. In other words, a score below the minimum requirement means the task is acceptable and no changes need to be applied upon the way the task is carried out meanwhile a score that above the minimum requirement means that task is not acceptable and immediate change to the way the task is carried out is necessary in order to prevent injury on the worker doing the task (Rahman et al., 2011)

4.6.1 Initial Ergonomic Risk Assessment (ERA) among administrative worker at UMP.

Table 4.6 shows the frequency and percentage of Initial ERA scores for the administrative worker at UMP. The highest percentage of risk factor was awkward posture. The percentage of respondents above the minimum requirement for awkward posture was 37.0% whereas 63.0% respondents were below the minimum requirements. Other than that, for static and sustain work posture there were 31.9% of respondents exceed the minimum requirement whereas 68.1% of respondents lower the limit. Next, repetitive motion shows 11.1% of respondents score "Yes" and beyond the limit whereas 88.9% of respondents score "No" and under the limit. Plus, for the forceful exertion, vibration and environmental there are no respondents due to non-applicable risk factors among administrative workers. Table 4.7 shows the frequency and percentage of respondents that need to advance ERA. Among 135 respondents, a total of 45.9% respondents are need for advance ERA whereas 54.1% respondents not have to proceed to advance ERA

Table 4.6: Frequency and percentage of the initial ERA score among administrative worker at UMP

Risk Factor	**Frequency (n)**		**Percentage (%)**	
	Yes	**No**	**Yes**	**No**
Awkward Posture	50	85	37.0	63.0
Static & Sustain Work Posture	43	92	31.9	68.1
Forceful Exertion	0	135	0	100
Repetitive Motion	15	120	11.1	88.9
Vibration	0	135	0	100
Environmental	0	135	0	100

Table 4.7: Frequency and percentage of the administrative worker at UMP need Advance ERA

Need Advance ERA	Frequency (n)	Percentage (%)
Yes	62	45.9
No	73	54.1

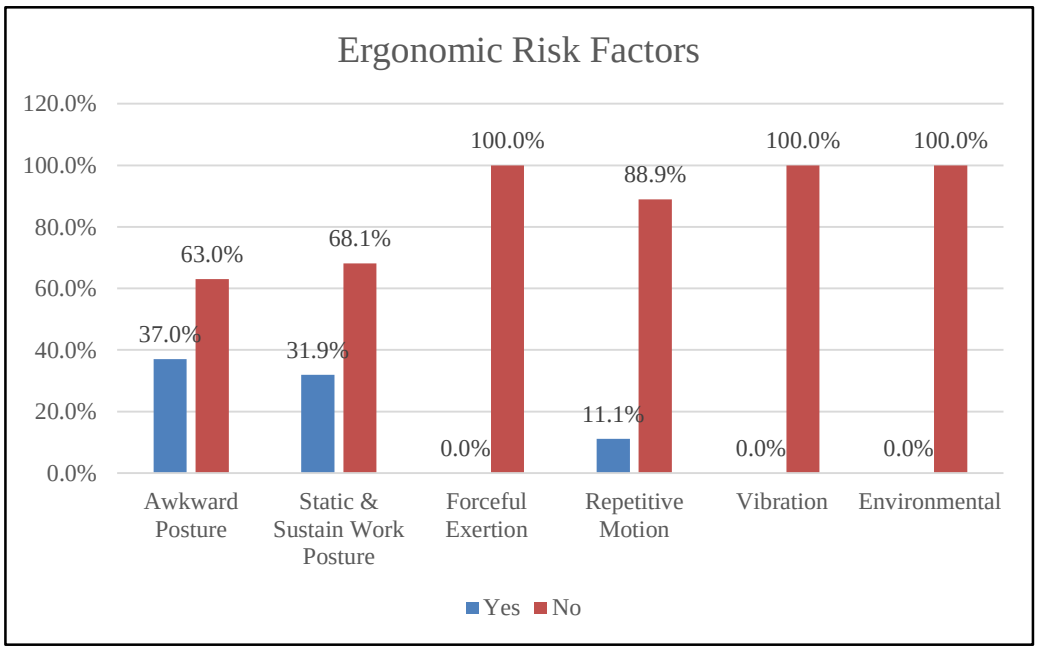

Figure 4.9: Percentage on Ergonomic Risk Factors among the respondents

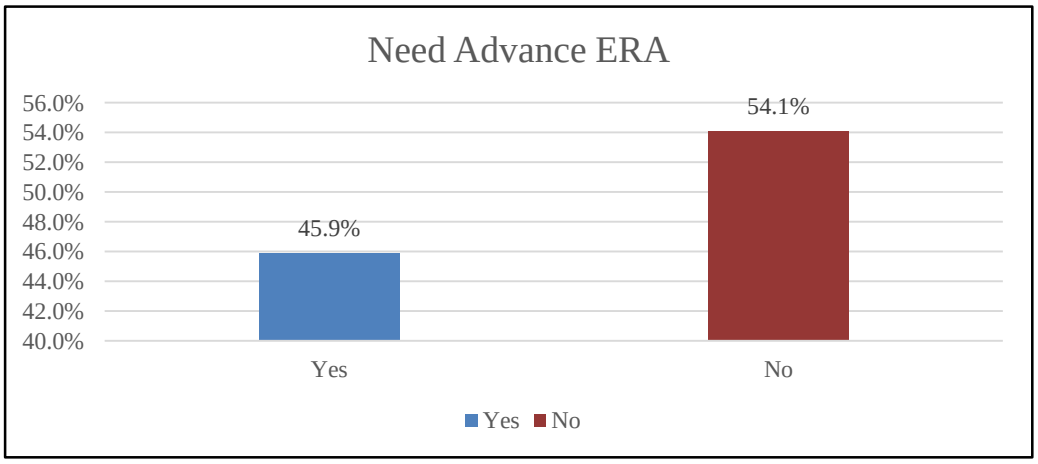

Figure 4.10: Percentage among the respondents need Advance ERA

4.7 Association Between Prevalence of Work Related Musculoskeletal Disorder with Ergonomic Risk Factors Administrative Workers.

There are many risk factors associated with MSD in different workplaces. These factors are categorized into two major groups which is psychosocial factors such job satisfaction. Another one are physical factors such poor posture, lifting and carrying heavy loads and repetitive motion tasks. Physical ergonomics is about the human body's responses to physical work demands. The most common types of issues are cumulative trauma disorders from awkward posture, repetitive, vibration, and force, and thus have design implications (Guideline on Ergonomics Risk Assessment at Workplace, 2017). The most common occupational MSD are incorporated the neck, shoulder, back (upper and lower), arm (upper and lower), elbow, wrist and fingers (Mahmud, Kenny, & Heard, January, 2011). These disorders are especially due to rapid and repetitive movement of the muscles and extremities that occur over weeks, months, and years. Muscles and tendons also can be overloaded when you apply a strong force against an object. Holding a lighter object (such as a mouse) for long periods can also expose workers to a risk of WRMSDs (Jaffar & Lop, 2011).

WRMSD and physical factor had been studied in many other past researches and a positive association is known to be present. Ergonomic risk factor and WRMSD both show that awkward posture is a risk factor of ergonomic risk factor and WRMSD among administrative workers in high learning institution. In this study, Pearson's chi-square analysis has been used to prove whether there is indeed an association between WRMSD and physical factor among administrative worker by comparing Self-Assessment Form results with Initial ERA scores.

The null hypothesis (H_0) states that there is no association between prevalence of WRMSD and physical factor. The alpha level is set at 0.05 in order to compare with the p-values obtained. If the p-value obtained is bigger than 0.05 ($p > \alpha$), the null hypothesis is accepted, which alternatively means that there is no association between WRMSD and psychosocial factor. If the p-value is smaller than 0.05 ($p < \alpha$), null hypothesis is rejected, which means that there is association between WRMSD and psychosocial factor.

4.7.1 Chi-Square Test (χ^2) Between Self-Assessment Form and Initial ERA among administrative workers

Table 4.8 shows the chi-square analysis (χ^2) between Self-Assessment and Initial ERA for awkward posture. Based on this table, all the body region between Self-Assessment and Initial ERA for awkward posture showed a significant which is p-value lower than the alpha level ($p < \alpha$). This means, the null hypothesis is rejected and there is association between prevalence of WRMSDs complaints and physical factor. This finding was support by Waersted and Westgaard (1997) stated that, it is significant stressful work posture are the factors associate with WRMSD.

Table 4.8: Chi-square analysis (χ^2) between Self-Assessment and Initial ERA for awkward posture

Body Region	χ^2	Df	P-value
Neck	22.319	1	0.000
Shoulder	32.872	1	0.000
Upper Back	21.773	1	0.000
Upper Arm	13.096	3	0.004
Elbow	14.572	3	0.002
Lower Arm	11.502	3	0.009
Wrist	28.948	3	0.000
Hand	23.946	3	0.000
Lower Back	5.051	1	0.025
Thigh	17.180	3	0.001
Knee	15.777	3	0.001
Calf	14.446	3	0.002
Ankle	15.781	3	0.001
Feet	14.796	3	0.002

* Significant (P< 0.05)

Table 4.9 shows the chi-square analysis (χ^2) between Self-Assessment and Initial ERA for static work and sustain work posture. Based on this table, it can be seen majority the body region between Self-Assessment and Initial ERA for static and sustain work posture showed a significant which is p-value lower than the alpha level ($p < \alpha$). This means, the null hypothesis is rejected and there is association between prevalence of WRMSDs complaints and physical factor. However, only Neck, Upper Back and Lower Back region ($p > \alpha$), which is the null hypothesis is accepted and that means there is no association between prevalence of WRMSCs and physical factor among administrative workers.

Table 4.9: Chi-square analysis (χ^2) between Self-Assessment and Initial ERA for static and sustain work posture

Body Region	χ^2	Df	P-value
Neck	0.202	1	0.653
Shoulder	4.778	1	0.029
Upper Back	1.702	1	0.192
Upper Arm	8.795	3	0.032
Elbow	11.882	3	0.008
Lower Arm	9.471	3	0.024
Wrist	30.536	3	0.000
Hand	41.623	3	0.000
Lower Back	0.263	1	0.608
Thigh	16.724	3	0.001
Knee	14.897	3	0.002
Calf	19.032	3	0.000
Ankle	11.481	3	0.009
Feet	12.192	3	0.007

*Significant ($P < 0.05$)

Table 4.10 shows the chi-square analysis (χ^2) between Self-Assessment and Initial ERA for repetitive motion. Based on this table, it can be seen majority the body region between Self-Assessment and Initial ERA for repetitive motion showed a significant which is p-value lower than the alpha level ($p < \alpha$). This means, the null hypothesis is rejected and there is association between prevalence of WRMSDs complaints and physical factor.

Table 4.10: Chi-square analysis (χ^2) between Self-Assessment and Initial ERA for repetitive motion

Body Region	χ^2	Df	P-value
Neck	12.660	1	0.000
Shoulder	4.133	1	0.042
Upper Back	12.261	1	0.000
Upper Arm	23.852	3	0.000
Elbow	29.443	3	0.000
Lower Arm	20.051	3	0.000
Wrist	19.556	3	0.000
Hand	18.787	3	0.000
Lower Back	1.073	1	0.300
Thigh	31.742	3	0.000
Knee	13.103	3	0.004
Calf	40.317	3	0.000
Ankle	11.883	3	0.008
Feet	8.650	3	0.034

*Significant ($P < 0.05$)

4.8 Limitation of Study

Some limitation need to be faced during the completion of this study. The limitation of the assessment was inadequate sample due to the respondent not at the workstation during data collection.

4.9 Conclusion

As conclusion, this chapter discussed the major findings on the study of WRMSD and ergonomic risk assessment among administrative workers in Universiti Malaysia Pahang. This study is set out to identify prevalence of work related musculoskeletal disorder, identify ergonomic risk factors, to investigate association between symptoms pain and discomfort and ergonomic risk factors. This study focuses on the data analysis of the collected Self-Assessment Form and Initial ERA. For Self-Assessment Form, lower back is the highest body region that had pain among administrative workers. While, the Initial ERA show awkward posture is the most risk factor involve among administrative workers. The association between two variables have been analyzed using Chi-square test and there is significant on association with the prevalence of pain/discomfort of body regions and ergonomic risk factors.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the conclusion and recommendation are concluded based on the data obtained and analyzed. The recommendations were made to improve their safety and health in order to improve better quality of performance of administrative workers.

5.2 Conclusion

Administration is the service profession that involves with many job tasks and responsibilities in order to handle client. This study is conducted to identify the prevalence of WRMSD complaint among administrative workers, identify the ergonomic risk factor among administrative workers, analyze ergonomics risk among administrative workers and to investigate the association between prevalence of WRMSDs and physical factor. From all the findings that discussed in Chapter 4, the most prevalence of WRMSD among respondents that work in UMP arranged in descending order is lower back, neck, shoulder, upper back, wrist, hand, knee, feet, upper arm, calf, ankle, thigh and lastly elbow. In addition, based on the observation during data collection administrative workers always working in awkward posture during they handle the task given. This may be one of the factors that contributes to the lower back pain among them. The findings conclude that the lower back is indeed the most prevalence of WRMSD among administrative workers.

Besides, the prevalence of WRMDs influence of ergonomic risk factor. Based on this study, it found that the highest ergonomic risk factor in Initial ERA score was awkward posture. Based on the observation during data collection, Forceful Exertion, Vibration were not applicable due to the job tasks among administrative workers.

From the analyzed data in Chapter 4, the association between prevalence of WRMSD and physical factor among administrative workers for awkward posture it showed a significant which is p-value lower than the alpha level ($p < \alpha$). This means, the null hypothesis is rejected and there is an association between prevalence of WRMSD complaints and ergonomic risk factor.

However, only neck, upper back and lower back region ($p > \alpha$), which is the null hypothesis is accepted and that means there is no association between prevalence of WRMSD and physical factor among administrative workers. Meanwhile, all body region in association between Self-Assessment form and Initial ERA for repetitive motion showed a significant which is p-value lower than the alpha ($p < \alpha$) and that means that the null hypothesis is rejected and there is an association between prevalence of WRMSDs and physical factor among administrative workers. As a conclusion, because of only neck, upper back and lower back region is not proven, therefore this finding can assume as there is an association between Self-Assessment Form and Initial ERA.

5.3 Recommendations

From this study, some recommendations can be implement for future research to improve the safety, health and performance quality among the administrative workers while working and handling tasks. The following approach can be implementing at the healthcare settings.

5.3.1 Future Research

For future researchers, it is recommended to conduct the studies in other sectors might give clearer view in comparing the job performance among administrative workers in Universiti Malaysia Pahang. Besides administrative at high learning education, academician also exposed to high frequency of risk due to workstation and job task almost similar to the administrative workers.

Besides, the future study is recommended to conduct a comparative study of ergonomic risk factor in private high learning institution. By comparing with other institution, ergonomic risk factor scores among administrative could be identified. It is

because of occupation as administration is one of the of most exposed to high ergonomic risk factor.

Moreover, the respondent need to proceed in Advance ERA for further assessment. There are many type of Advance ERA such as Rapid Upper Limb Assessment (RULA), OCRA Checklist and Rapid Office Strain Assessment (ROSA). It is to ensure more specific assessment need to be conduct among the respondents.

Lastly, it is recommended to conduct the future study with the large sample size. It is also can include whole Department, Centre and Faculty in higher learning institution. Large sample size is important to make the result more representative of an entire population.

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APPENDIX A GANTT CHART

PROJECT TASK	SEMESTER 1														SEMESTER 2												
	WEEK																										
Purpose of title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Understand a scope of study and propose a problem statement, research objective and research question																											
Literature Review																											
Develop methodology																											
Submission of proposal																											
Slide preparation for presentation																											
Data collections																											
Data analysis																											
Final report writing																											
Submission of final report																											

APPENDIX B

SELF-ASSESSMENT MUSCULOSKELETAL PAIN/DISCOMFORT SURVEY FORM

Name: _____ Staff ID No: _____

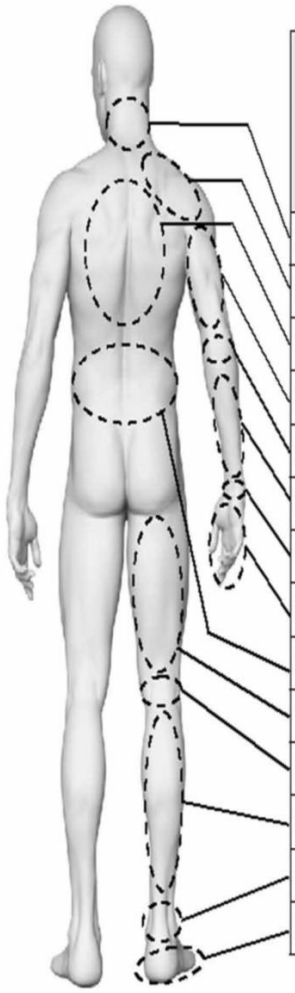
Age: _____ Gender: Male / Female Height: ____cm Weight: ___kg

Academic Qualification: _____ How long work with UMP: _____

Department: _____ Jobs tasks/title: _____

Instruction:

1. Tick (√) on any body parts (Column A) if you feel discomfort/pain during your work in the last 12 months
2. For those body parts you were feeling pain/discomfort, tick (√) (Column B) if in your opinion, the pain is due to your work.



Body Parts	A		B	
	I have pain/ discomfort in the following body parts.		I think the pain/ discomfort comes from work.	
Neck				
Shoulder				
Upper back				
Upper arm	L	R	L	R
Elbow	L	R	L	R
Lower arm	L	R	L	R
Wrist	L	R	L	R
Hand	L	R	L	R
Lower back				
Thigh	L	R	L	R
Knee	L	R	L	R
Calf	L	R	L	R
Ankle	L	R	L	R
Feet	L	R	L	R

APPENDIX C INITIAL ERGONOMIC RISK ASSESSMENT

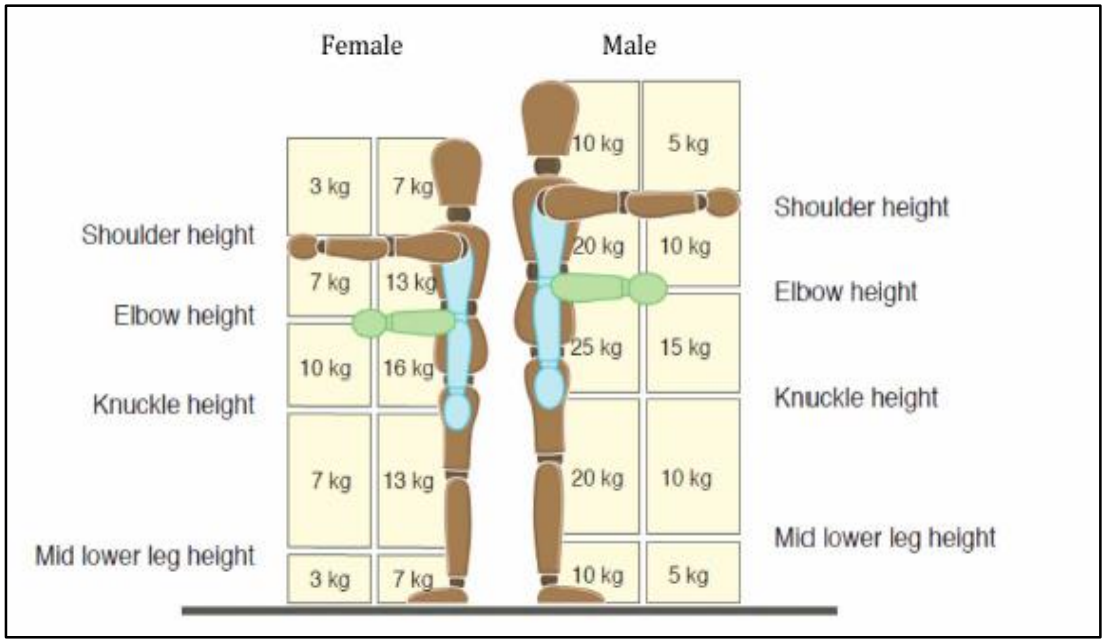
Ergonomic risk factors: awkward posture

Body Part	**Physical Risk Factor**	**Max. Exposure Duration**	**Please tick(/)**	
			Yes	**No**
Shoulder	Working with hand above the head OR the elbow above the shoulder	More than 2 hours per day		
	Working with shoulder raised	More than 2 hours per day		
	Work repetitively by raising the hand above the head OR the elbow above the shoulder more than once per minute	More than 2 hours per day		
Head	Working with head bent downwards more than 45 degrees	More than 2 hours per day		
	Working with head bent backwards	More than 2 hours per day		
	Working with head bent sideways	More than 2 hours per day		
Back	Working with back bent forward more than 30 degrees OR bent sideways	More than 2 hours per day		
	Working with body twisted	More than 2 hours per day		
Hand/ Elbow/ Wrist	Working with wrist flexion OR extension OR radial deviation more than 15 degrees	More than 2 hours per day		
	Working with arm abduction sideways	More than 4 hours per day		
	Working with arm extended forward more than 45 degrees OR arm extended backward more than 20 degrees.	More than 2 hours per day		
Leg/ Knees	Work in squat position.	More than 2 hours per day		
	Work in a kneeling position	More than 2 hours per day		
Sub Total (Number of ticks (s))				

Ergonomic risk factors: static and sustained work posture

Body Part	Physical Risk Factor	Max. Exposure Duration	Please tick (/)	
			Yes	No
Trunk/ Head/ Neck/ Arm/ Wrist	Work in a static awkward position as in Table 3.1	Duration as per Table 3.1		
Leg/ Knees	Work in standing position with minimal leg movement	More than 2 hours continuously		
	Work in seated position with minimal movement.	More than 30 minutes continuously		
Sub Total (Number of ticks (s))				

Ergonomic risk factors: forceful exertion (manual handling)



Ergonomic risk factors: forceful exertion

(Manual Handling – Lifting and/ or lowering)

Working height (where force is applied)	**Recommended weight limit (male or female)**	**Current weight handled**	**Exceed limit?**	
			Yes	**No**
Between floor to mid-lower leg				
Between mid- lower to knuckle				
Between knuckle height and elbow				
Between elbow and shoulder				
Above the shoulder				

Ergonomics risk factors: forceful exertion

(Manual handling – Lifting and /or lowering with repetitive operation)

If employee repeats operations	**Weight* should be reduced by**
Once or twice per minutes	30%
Five to eight times per minute	50%
More than 12 times per minute	80%

Ergonomics risk factors: forceful exertion

(Manual handling – Lifting and /or lowering with twisted body posture)

If employee twists body from forward facing to the side	**Weight* should be reduced by**
45 degrees	10%
90 degrees	20%

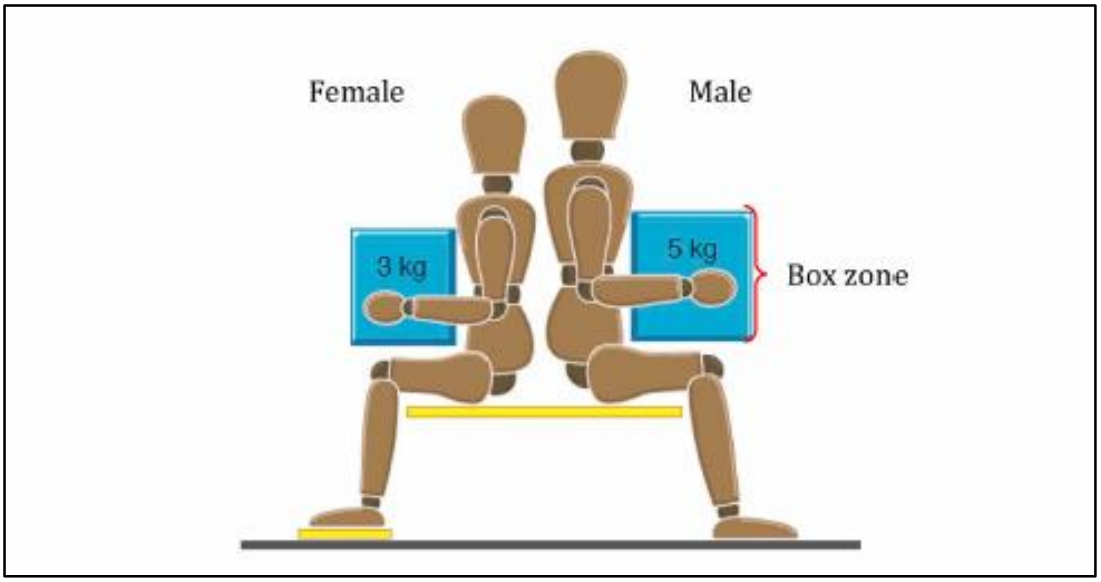
Ergonomics risk factors: forceful exertion

(Pushing and/ or pulling)

Activity	**Recommended weight**	
	Male	**Female**
Stopping or starting a load	Approximately 1000kg load (equivalent to 200N pushing or pulling force) on smooth level surface using well maintained handling aid	Approximately 750kg load (equivalent to 150N pushing or pulling force) on smooth level surface using well maintained handling aid
Keeping the load in motion	Approximately 100kg load (equivalent to 100N pushing or pulling force) on uneven level surface using well-maintained handling aid	Approximately 70kg load (equivalent to 70N pushing or pulling force) on uneven level surface using well-maintained handling aid

Ergonomics risk factors: forceful exertion

(Handling in seated position)



Summary for carrying activity

Factor	Condition	Outcome
Floor surface	Dry and clean floor in good condition	Acceptable
	Dry floor but in poor condition, worn or uneven	Conduct advanced ERA
	Contaminated/ wet or steep sloping floor or unstable surface or unsuitable footwear	
Other environmental factors	No factors present	Acceptable
	One or more factor present (i.e. poor lighting condition, extreme temperature)	Conduct advanced ERA
Carry distance	2 m – 10 m	Acceptable
	More than 10 m	Conduct advanced ERA
Obstacles en route	No obstacles and carry route is flat	Acceptable
	Steep slope or up steps or through closed doors or trip hazards or using ladders	Conduct advanced ERA

Summary of Single Manual Handling activities (forceful exertion)

Activity (where applicable)	Recommended weight limit	Exceed limit?	
		Yes	No
Lifting and lowering only; or	based on Figure 3.1 and Table 3.3		
Repetitive lifting and lowering; or	based on Figure 3.1 and Table 3.4		
Twisted body posture while lifting and lowering; or	based on Figure 3.1 and Table 3.5		
Repetitive lifting and lowering with twisted body posture; or	based on Figure 3.1, Table 3.4 and Table 3.5		
Pushing and pulling; or	based on Table 3.6		
Handling in seated position; or	based on Figure 3.2		
Carrying	based on Table 3.7		

Ergonomic Risk Factor: Repetitive Motion

Body Part	Physical Risk Factor	Max. Exposure Duration	Please tick (/)	
			Yes	No
Neck, shoulders, elbows, wrists, hands, knee	Work involving repetitive sequence of movement more than twice per minute	More than 3 hours on a "normal" workday OR More than 1 hour continuously without a break		
	Work involving intensive use of the fingers, hands or wrist or work involving intensive data entry (key-in)			
	Work involving repetitive shoulder/arm movement with some pauses OR continuous shoulder/arm movement			
	Work using the heel/base of palm as a "hammer" more than once per minute	More than 2 hours per day		
	Work using the knee as a "hammer" more than once per minute.	More than 2 hours per day		
Sub Total (Number of tick(s))				

Ergonomics Risk Factor: Vibration

Body parts	Physical Risk Factor	Max. Exposure Duration	Please tick (/)	
			Yes	No
Hand-Arm (segmental vibration)	Work using power tools (e.g. battery powered/ electrical pneumatic/hydraulic) without PPE	More than 50 minutes in an hour		
	Work using power tools (ie: battery powered/electrical pneumatic/hydraulic) with PPE	More than 5 hours in 8 hours shift work		
Whole body vibration	Work involving exposure to whole body vibration	More than 5 hours in 8 hours shift work		
	Work involving exposure to whole body vibration combined employee complaint of excessive body shaking	More than 3 hours in 8 hours shift work		
		Sub Total (Number of tick(s))		

Ergonomic Risk Factor: Environmental Factor

Physical Risk Factor	Please tick (/)	
	Yes	No
Inadequate lighting		
Extreme temperature (hot/cold)		
Inadequate air ventilation		
Noise exposure above PEL (based on previous reports or measurement)		
Exposed to annoying noise more than 8 hours		
Sub Total (Number of tick(s))		

Initial Era Summary

<table>
<tr><th>Risk factors</th><th>Total Score</th><th>Minimum requirement for advanced assessment</th><th>Result of Initial ERA</th><th>Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (refer Part 3.1) (Yes/No)</th><th>Need Advanced ERA? (Yes/No)</th></tr>
<tr><td>Awkward Postures</td><td>13</td><td>≥ 6</td><td></td><td rowspan="10">YES / NO

If YES, please tick (√) which part of the body
<table><tr><td>Neck</td><td></td></tr><tr><td>Shoulder</td><td></td></tr><tr><td>Upper back</td><td></td></tr><tr><td>Upper arm</td><td></td></tr><tr><td>Lower back</td><td></td></tr><tr><td>Forearm</td><td></td></tr><tr><td>Wrist</td><td></td></tr><tr><td>Hand</td><td></td></tr><tr><td>Hip/buttocks</td><td></td></tr><tr><td>Thigh</td><td></td></tr><tr><td>Knee</td><td></td></tr><tr><td>Lower leg</td><td></td></tr><tr><td>Feet</td><td></td></tr></table></td><td></td></tr>
<tr><td>Static and Sustained Work Posture</td><td>3</td><td>≥ 1</td><td></td><td></td></tr>
<tr><td>Forceful Exertion</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td>Repetitive Motion</td><td>5</td><td>≥ 1</td><td></td><td></td></tr>
<tr><td>Vibration</td><td>4</td><td>≥ 1</td><td></td><td></td></tr>
<tr><td>Lighting</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td>Temperature</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td>Ventilation</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td>Noise</td><td>2</td><td>≥ 1</td><td></td><td></td></tr>
</table>

APPENDIX D TABLE OF LR

No	Title	Author	Objective	Sampling	Method	Finding
1	A Literature Review of Ergonomics Risk Factors in Construction Industry	Jaffar & Lop (2011) Malaysia	- Give a basic introduction and clear definition of ergonomic. - Ergonomics risk factors in relation of human and their nature of work. -To enhance the awareness of the risk factors which may occur in the construction industry.	-	Reviews of numerous researches of ergonomics	The most significant ergonomics risk factors are a) awkward posture in handling job task. b) force and repetition of specific movement including vibration. c) uncomfortable static position d) contact stress of muscles and tendon e) extreme temperature condition.
2	The effects of breaks on low back pain, discomfort, and work productivity in office workers: A systematic review of randomized and non-randomized controlled trials	Waongen ngarm, Areerak, & Janwanta nakul (2018) Thailand	- evaluate the effectiveness of breaks on low back pain, discomfort, and work productivity in office workers.	-	-Two re- viewers (PW and KA). -Cochrane Back and Neck Review Group expanded 13-item criteria a third reviewer (PJ) was consulted to achieve a final judgment.	Low-quality evidence for the conflicting effect of breaks on pain and low-quality evidence for the positive effect of breaks on discomfort. When stratified by type of breaks, moderate-quality evidence was found for the positive effect of active breaks with postural change for pain and discomfort. Moderate-quality evidence indicated that the use of breaks had no detrimental effect on work productivity.
3	Effects of stretching exercise training and ergonomic modifications on musculoskeletal discomforts of office workers	Shariat et al. (2017) Malaysia	-To evaluate the effectiveness of exercise, ergonomic modification, and a combination of training exercise and ergonomic modification on the scores of pain in office workers with neck, shoulders, and lower back pain.	142	Cornell Musculoskeletal Disorders Questionnaire.	Long term effective on MSDs, physical therapists and occupational therapists should use stretching exercises in their treatment programs rather than solely rely on ergonomic modification.

No	Title	Author	Objective	Sampling	Method	Finding
4	Health risk assessment and incidence of shoulder pain among office workers	Chaiklieng & Krusun (2015) Thailand	Assess the incidence of shoulder pain following a survey study on baseline of health risk of shoulder pain (SP) among University office workers	149	-Rapid Office Strain Assessment (ROSA) -Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)	- For the majority of office workers (66.2%) the ergonomic risk was at a high level, for 19.5% the risk was moderate, for 13.8% the risk was very high, and for 0.4% of the staff the risk was low. 43.7% of office staff had no shoulder discomfort. For 22.9% of the office staff the level of shoulder discomfort was low, and 18.2% of workers had moderate discomfort.
5	Ergonomic risk assessment among call center workers	Poochada & Chaiklieng (2015) Thailand	Assess ergonomics risk for MSDs in work environment among call center workers.	216	Rapid Office Strain Assessment (ROSA)	-Most of the call center workers were exposed to a high ergonomics risk for MSDs development. -There should be ergonomics training for workers to be aware of ergonomics factors in the office workplace. -The personal working behaviors and the design of the workstations should be improved based on the ergonomics principles. -Call center workers were under conditions only at 2 risk levels that were high level (52.3%) and medium level (47.7%).
6	Ergonomic evaluation of office workplaces with Rapid Office Strain Assessment (ROSA)	Matos & Arezes (2015)	-Evaluate the presence of risk factors for WRMSD in an office	38	Rapid Assessment Office Strain method (ROSA)	ROSA final score was 3.61 ± 0.64, for Chair section was 3.45 ± 0.55, to Monitor and Telephone section was 3.11 ± 0.61, and to Mouse and Keyboard section was 2.11 ± 0.3. Further research and modifications of the workplace may be necessary.

No	Title	Author	Objective	Sampling	Method	Finding
7	A checklist for evaluating ergonomic risk factors resulting from awkward postures of the legs, trunk and neck	Keyserling, B, & Silverstein (1992) USA	Determining the presence of ergonomic risk factors associated with awkward postures of the lower extremities, trunk and neck was developed and evaluated as part of a joint labor-management ergonomics intervention program	335	Ergonomic Risk Factor Checklist	-The was found to be an effective instrument for identifying potentially harmful exposures such as awkward posture.
8	Causal assessment of awkward occupational postures and low back pain: results of a systematic review	Roffey, Wai, Bishop, Kwon, & Dagenais (2010) Canada	-To conduct a systematic review of the scientific literature focused on establishing a causal relationship between awkward occupational postures and LBP	-	Systematic review of the literature using MEDLINE, EMBASE, CINAHL, Cochrane Library, and Occupational Safety and Health database.	-This search yielded 2,766 citations. -Eight high-quality studies reported on awkward occupational postures and LBP. -Three were case-control studies, one was cross-sectional, and four were prospective cohort studies. -There was strong evidence for consistency of no association between awkward occupational postures and LBP.
9	Musculoskeletal discomfort and use of computers in the university environment	James et al. (2018) Australia	-Investigated musculoskeletal discomfort and computer use in university staff	302	-Online questionnaires -Cross-sectional study design	-The most commonly reported symptomatic areas were the neck and shoulder, followed by lower and upper back - Poor seated postures (e.g. leaning forward, or sitting on the front edge of the chair) had increased odds of experiencing discomfort in the upper back. - Few administrative staff and even fewer academics had attended Workstation Ergonomics Training or had requested individualized ergonomic assessments.

No	Title	Author	Objective	Sampling	Method	Finding
10	Assessing ergonomic risks of software: Development of the SEAT	(Peres, Mehta, & Ritchey, 2017) USA	Develop a Self-report Ergonomic Assessment Tool (SEAT)	166	Self-report Ergonomic Assessment Tool (SEAT)	-The SEAT is a viable method of assessing ergonomics risks presented by software design.
11	An ergonomic expert system for risk assessment of work-related musculoskeletal disorders	Pavlovic-veselinovic, Hedge, & Veselinovic (2016) Serbia	Identify ergonomic risks for work-related musculoskeletal disorders (WRMSDs) in a wide variety of jobs and provide expert prevention advice	-	computer-based expert system (SONEX)	-SONEX can correctly diagnose possible WRMSDs in different work places and also identify ergonomic deficiencies present in the workplace. -SONEX can be used as both a diagnostic tool and an advisory tool for ergonomic analysis of the workplace.
12	Ergonomic and psychosocial factors and musculoskeletal complaints in public sector administration	Lima & Coelho (2018) Portugal	-Demonstrates an approach to jointly monitor multiple factors to support controlling work system efficiency and mitigate negative outcomes	96	-Observations and interviews -Nordic Musculoskeletal Questionnaire (NMQ) -Copenhagen Psychosocial Questionnaire (COPSOQ).	-Risk factors of a diverse nature were present in the workplace studied that required acting upon, in order to promote actual sustained improvements in working conditions, worker's health, well-being and productivity.
13	Work-related musculoskeletal disorders and ergonomic risk factors in early intervention educators	Cheng, Cheng, & Ju (2013) Taiwan	-Investigate the prevalence of work-related musculoskeletal disorders in this population, and to evaluate the relationship between work-related musculoskeletal disorders and personal/ergonomic risk factors.	417	Questionnaire (demographics/prevalence of work-related musculoskeletal disorders/ergonomic risk factors)	-High prevalence of work-related musculoskeletal disorders impacts this occupation negatively. -Further regulations to the institutions regarding workplace health promotion and environment modification,

No	Title	Author	Objective	Sampling	Method	Finding
14	Vibration and Ergonomic Exposures Associated With Musculoskeletal Disorders of the Shoulder and Neck	Charles, Ma, Burch, & Dong (2017) USA	-To review and summarize the evidence linking occupational exposures to vibration and awkward posture with MSDs of the shoulder and neck. Methods:	-	A literature search published during 1998-2015 were included. Databases searched were MEDLINE (Ovid), Embase (Ovid), Scopus, Ergonomic Abstracts, NIOSHTIC-2, and Health and Safety Science Abstracts	-Occupational exposure to vibration and awkward posture are associated with shoulder and neck MSDs. Longitudinal studies are required to elucidate the mechanisms responsible for these associations, and intervention studies are warranted.
15	Lumbar posture and muscular activity while sitting during office work	Mörl & Bradl (2013) Germany	-To measure the posture and sEMG of the lumbar spine during office work for a better understanding of the lumbar spine within such conditions.	13	-Typical tasks were documented and synchronized to a portable long term measuring device for sEMG and posture examination.	- The majority of time spent in office work was sedentary (82%). Only 5% of the measured time was undertaken in erect body position (standing or walking). -The sEMG of the lumbar muscles under investigation was task dependent. -A strong relation to lumbar spine posture was found within each task. The more the lumbar spine was flexed, the less there was activation of lumbar muscles ($P < .01$). -Periods of very low or no activation of lumbar muscles accounted for about 30% of relaxed sitting postures.

No	Title	Author	Objective	Sampling	Method	Finding
16	Influence of musculoskeletal pain on workers' ergonomic risk-factor assessments	Imbeau, Major, Aubry, Delisle, & Eve (2015) Canada	-Compares the ergonomic risk factor assessments of workers with and without musculoskeletal pain	473	-Pain Questionnaire -Ergonomic Workplace Analysis method -Visual analog scales (VAS)	-Respondent were exposed to significant musculoskeletal disorder (MSD) risk factors, according to the Finnish Institute of Occupational Health (FIOH) assessment and the high percentages of reported pain. -Those who reported pain in the seven days prior to the assessment evaluated their workstations more negatively than subjects who reported no pain, while the expert found no difference between the two groups' exposure to MSD risk factor.
17	Development and evaluation of an office ergonomic risk checklist: ROSA e Rapid office strain assessment	Sonne, Villalta, & Andrews (2012) Canada	-To develop quickly quantify risks associated with computer work and to establish an action level for change based on reports of worker discomfort.	72	Rapid Office Strain Assessment (ROSA)	-ROSA proved to be an effective and reliable method for identifying computer use risk factors related to discomfort.
18	Modifiable individual and work-related factors associated with neck pain in 740 office workers	Chen, Leary, & Johnston (2018) Australia	-To examine the relationship between self-reported neck pain with a comprehensive range of individual and work-related risk factors.	763	-Survey Pain Numerical Rating Scale (dependent variable) -Nordic Musculoskeletal Questionnaire	-Neck pain was significantly associated with more senior occupational categories, working > 6 hours per day on the computer. The low severity of neck pain of the participants in this study may limit a robust determination of their association with the risk factor variables.

No	Title	Author	Objective	Sampling	Method	Finding
19	Ergonomic Design of Computer Workstation	Moeed (2016) India	-To study the effects of surroundings and workstation on human working efficiencies in computer workstation.	-	Literature review	-Ergonomics should be used while designing any work place. Computer system as well as its peripheral devices must be ergonomically designed. -The rest pauses must be adequate while operating in computer workstation. Use of ergonomics in workstation increases efficiency of the worker or operator.
20	The effect of ergonomic intervention on discomfort in computer users with tension neck syndrome	Mekhora, Liston, Nanthavanij, & Cole (2000) Thailand	-To investigate the long-term effects of ergonomic intervention on neck and shoulder discomfort among computer users	470	-Nordic questionnaire -Visual analogue discomfort scale	This study has introduced a means of using inexpensive interventions (A computer software application, IntelAd version 1.2) for the workplace and a clear and readily understandable method for using ergonomic suggestions to alter individual workstations.
21	Computer use and musculoskeletal symptoms among undergraduate university students	Dockrell, Bennett, & Culleton-quinn (2015) Ireland	-To determine the prevalence of computer-related MSS in a cohort of undergraduate university students in Ireland	241	Questionnaire Nordic Musculoskeletal Questionnaire	-All students used a computer, with 95.4% using a laptop. Although the reported duration of computer use was quite low, the prevalence of computer-related MSS was high (52.8%). Increased prevalence of MSS was significantly associated with year of college, average daily laptop use and right hand dominance.
22	WRMSD and associated risk factors among office workers with high workload computer use	Pt, Hwang, & Cherng (2009) Taiwan	-To investigate the prevalence of musculoskeletal symptoms for office workers with high computer workload. The association between risk factors and musculoskeletal symptoms was also assessed.	254	-Chinese Health Questionnaire -Musculoskeletal Symptom Questionnaire	-High psychologic distress was significantly associated with shoulder and upper back pain, whereas high workload was associated with lower back pain. Women tended to have a greater risk of shoulder.

No	Title	Author	Objective	Sampling	Method	Finding
23	Analysis of the role of job stress in the presence of musculoskeletal symptoms, related with ergonomic factors	González -muñoz & Chaurand (2015)	present a comparative analysis of four studies, in which the presence of job stress with reports of musculoskeletal discomfort was related	649	Standardized Nordic Questionnaire The short version of the Job Content Questionnaire List of ergonomic evaluation	• the design of jobs in industries not only generates musculoskeletal injury due to inadequate ergonomic conditions, but also influences the presence of stress among workers, which increases the presence of musculoskeletal symptoms.